

A Comparative Study of Owner, Contractor, and Consultant Perspective on the Selection Criteria for Subcontractors

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UPTILLNOW, MOSTRESEARCH ON THE SELECTION OF SUBCONTRACTORS IN CONSTRUCTION PROJECTS HAS FOCUSED ON THE FACTORS CONSIDERED BY THE MAIN (GENERAL) CONTRACTORS. The goal of this study is to identify the factors that other main stakeholders, namely clients and consultants, believe should be taken into account when selecting subcontractors. The paper presents the results of a survey of experts from various backgrounds in the construction industry and conducts a comparative study of their perspectives in factors that should be considered in selecting subcontractors. The results of the survey show that there are similarities and dissimilarities between perceptions of respondents with different background. For example, nearly all the respondents identified subcontractor's past experience in similar projects and subcontractor's available resources, as the most important factors that should be considered in selecting subcontractors. However, while respondents from contractor organizations identified the lowest bid as one of the most important factors, those from consultant and client organizations identified subcontractor's safety record, compliance with project schedule, and safety programs and past safety record as their top considerations in selecting subcontractors. The paper provides an extensive statistical analysis to identify the impact of stakeholder's background on their perspective in the importance of factors that should be considered in selecting subcontractors and discusses the similarities and dissimilarities in their perspectives.

INTRODUCTION

A considerable portion of the work in construction projects is carried out by subcontractors, due to the need for specialized skills and the fluctuations in demand that occur in the construction industry. According to one study, between 60-70% of the value of a project may typically be subcontracted (Maturana et al. 2007). Subcontracting provides a main (or general) contractor with access to workers with unique skills and talents for specialized work such as steel work, installation and sophisticated electrical-mechanical systems, without the need to directly employ those workers or invest in training programs (Tam et al. 2011). The risks for main contractors, due to fluctuating amounts of construction work, is reduced by subcontracting, as subcontractors are often contracted for individual tasks, rather than for an extended period of time.

On the other hand, the selection of subcontractors is often considered to have a negative impact on project goals such as the project's duration and quality. Thus, it has been argued that increased sub-contracting may reduce the main contractor's control over the construction process, and lead to cost and schedule overruns (Usdiken et al. 2008; Vilasini et al. 2012). A lack of adequate control and supervision by main contractors over subcontractors' work has also been reported to lead to low construction quality (Tam et al. 2011). The current "lowest bid" practice, in which the main contractor offers the subcontract to the bidder who submits the lowest price, is considered to leave subcontractors with very low profit margins, and with a lack of motivation to provide high quality work. Selecting appropriate subcontractors is consequently seen as contributing significantly to a project's success (Hartmann et al. 2009).

The choice of subcontractors thus affects other project stakeholders apart from the main contractors, such

as the clients. However, in standard project delivery methods those stakeholders usually have little say in the process of selecting the subcontractors. In fact, it is common for there to be a limited group of subcontractors who work regularly with a particular main contractor (Cheung et al. 2006). 94% of subcontractors in Australia, for example, have been reported to work with not more than three main contractors each (Vilasini et al. 2012).

In some projects, on the other hand, the client "nominates" a specialist subcontractor directly. This has been seen as a means for the client to protect his interests, ensuring that a subcontractor is selected on criteria other than the lowest bid, and avoiding the risk of choosing under-capitalized or inexperienced subcontractors (Hughes et al. 1994). Such a process has also been reported to be favored by consultants, since it enables them to influence the quality of work by using their preferred subcontractors, and to avoid having to provide solutions for work carried out by technically incompetent subcontractors who have been selected by the main contractor based on the lowest bid alone. Another approach that is sometimes used is for the client to impose upon the main contractor a list of potential subcontractors – "named subcontractors". Unlike the case of nominated subcontractors, the main contractor is responsible for the named contractor's work and payments.

However, the use of nominated and named subcontractors is the exception of the rule, with the majority of subcontractors being directly selected by the main contractor. Consequently, little is known regarding the factors that clients and consultants deem important in the selection of subcontractors, in spite of the fact that the choice of subcontractors also affects them. Up till now, most of the research on the selection of subcontractors in construction projects has focused on the considerations of the main contractors.

The main goal of this study is to identify the factors that all three main project stakeholders – the clients and consultants in addition to main contractors – believe should be taken into account when subcontractors are selected.

Literature review

Up till now, the few studies that have been carried out on the selection of subcontractors in construction projects have focused mostly on the factors considered by main contractors. In a study that was carried out among main contractors in Singapore, the relative importance of four factors in selecting a subcontractor was examined: price, technical know-how, quality, and cooperation (Hartmann et al. 2009). The study found that price was by far the most important selection criterion used by the main contractors, followed by quality, cooperation and technical know-how, in that order. Moreover, it was noticed that while main contractors were not willing to compromise on price, they were willing to accept a subcontractor known for delivering superior quality, but with lower levels of cooperation and technical know-how. Interestingly, another study conducted in England, came to different conclusions (Lavelle et al. 2007). This study, which was based on 140 questionnaires distributed to contractors, showed that price did not rank as the top selection factor. The considerations which received the majority of top rankings in this study were health and safety, closely followed by insurance, price and past performance.

Other studies agree with the findings of Hartmann et al. (2009). According to a study by Arslan et al. (2008), which was conducted in the USA, the lowest bid price is usually the key determinant factor for selecting subcontractors in traditional approaches, despite the fact that this may result in serious money losses for main contractors in the long run. Kumaraswamy and Matthews (2000) agree that "lowest

bid” price practices may appear simple, straightforward and reasonable, but carry the risk that those bids originate from inaccurate estimating, inadequate risk provisions, deliberate decisions to use substandard resources, and pricing strategies aimed at generating claims for extra payments through contractual loopholes.

One research that did look into the opinions of stakeholders other than the main contractor was a study carried out in Pakistan by Choudry et al. (2012). In this study questionnaires were sent to client and consultant firms, as well as contractors. It was found that out of five selection factors of Price, Quality, Ability to complete work on time, Subcontractors’ resources and Personal relationship, the most important criteria was the bid price, followed by the ability to complete the work on time, and thirdly the quality of the work. The study revealed a high level of consistency in the opinions of the three groups (clients, consultants, and contractors) on the selection criterion of subcontractors.

Most of the previous studies thus came to the conclusion that price is currently in practice the most common factor in selecting subcontractors. This, despite an additional conclusion, namely that choosing the subcontractor that submits the lowest bid often leads to problems with the quality, duration and final price of the project. So far, most of these studies have focused on exploring what matters the most to the main contractors when it comes to selecting a subcontractor, without examining the opinions of the other two main stakeholders in construction projects: clients and consultants.

Survey design and administration

The present research aims to systematically identify the main factors that the different parties that are involved in the construction industry believe to be important when selecting

subcontractors. It thus advances beyond the considerations of main contractors. This will enable a comparison of how the three different parties view these selection factors. In addition, the present research seeks to re-examine the prevailing notion that bid price is considered by practitioners to be the most important factor that should be taken into account when selecting subcontractors.

To this end, a questionnaire was designed and distributed among construction industry experts in Alberta, Canada, from the three project stakeholder organizations. The questionnaire consisted of two parts:

1. The first part of the questionnaire contained general questions related to the respondents’ professional background, including the relevant industry sector and segment, and level of experience. This part includes seven questions which were considered independent variables in the consequent statistical analysis.
2. The second section consisted of a twelve factors that could be deemed important in the selection of subcontractors. These factors were identified based on findings from the previous studies. Respondents were asked to rank each factor in terms of their importance on a Likert scale of 1 to 5. These factors were treated as dependent variables.

The ethical aspects of the questionnaire were reviewed and approved by the University of Calgary’s Conjoint Faculties Research Ethics Board. The questionnaire was used to survey different professionals involved in the construction industry in Alberta, and a total number of 137 responses were received from professionals from different walks of industry. The respondents were contacted through three modes of communications: in person (34.3%), by email (62%), and by regular mail (3.6%).

Survey Results

Background questions

The respondents were asked seven questions regarding their professional background:

- ▶ Industry sector (P1)
- ▶ Role of the organization (P2)
- ▶ Construction industry segment (P3)
- ▶ Years of experience in the construction industry (P4)
- ▶ Years of experience in Alberta (P5)
- ▶ Involvement in selecting subcontractors in projects (P6)
- ▶ Experience working directly with subcontractors (P7)

The responses of the respondents to those questions are summarized in this section. It was hypothesized that these independent variables might be related to the factors that were deemed important by the respondents in the selection of subcontractors

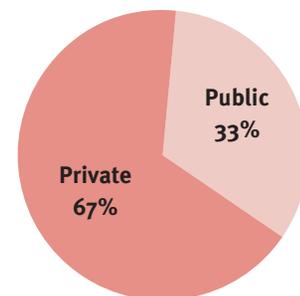


Figure 1a: Industry sector (P1)

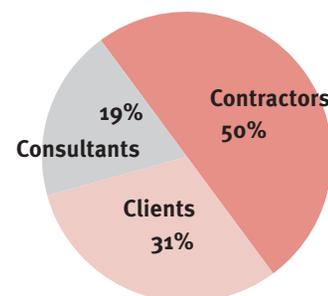


Figure 1b: Role of the organization (P2)

Figure 1: Industry sector and role of the respondent’s organization

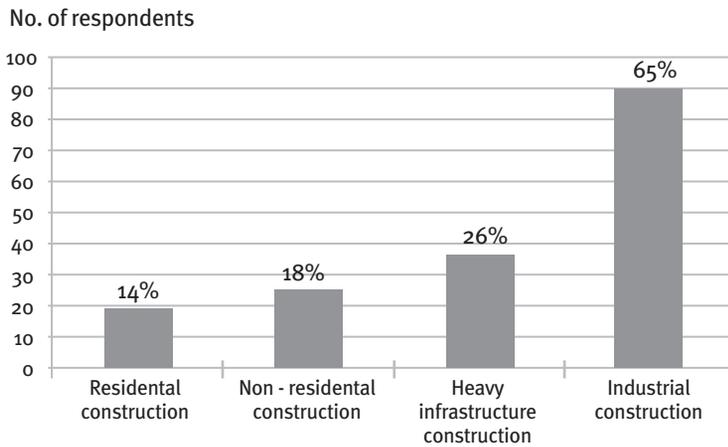


Figure 2: Construction industry segment in which the respondents were active (P3) (note: the respondents could choose more than one segment.)

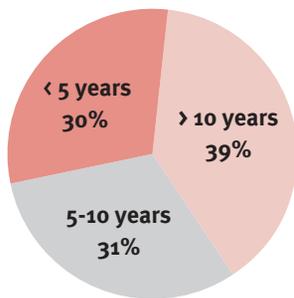


Figure 3a: Years of experience in the construction industry (P4)

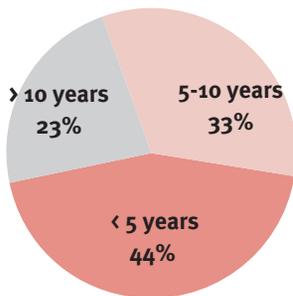


Figure 3b: Years of experience in Alberta's construction industry (P5)

Figure 3: Years of experience of the respondents in the construction industry and in Alberta

Industry sector (P1): According to the survey data, the majority of respondents were from the private sector (Figure 1a).

Role of the Respondent's Organization (P2): Half of the respondents worked in a contractor company, 31% were working for clients, and the remaining 19% were from consultant firms (Figure 1b).

Construction industry segment (P3): respondents were asked to identify the segment(s) of the construction industry that they were active in: Residential Construction, Non-residential Construction, Heavy Infrastructure Construction and Industrial Construction. These segments are classifications from North American Industry Classification System (NAICS) that are currently in use in North America. Each respondent could identify several segments, since they might be involved on more than one. The largest group of respondents was from the industrial construction segment (Figure 2).

Years of experience in the construction industry (P4): 30% of the contributors had relatively little experience (less than 5 years) in the construction

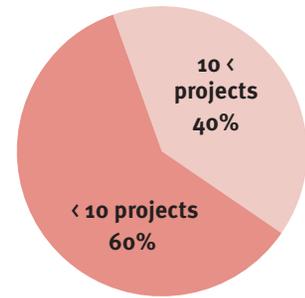


Figure 4a: Involvement in selecting subcontractors in projects (P6)

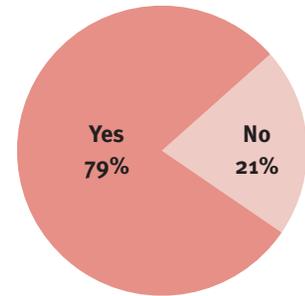


Figure 4b: Experience in working directly with subcontractors (P7)

Figure 4: Involvement and experience with subcontractors

industry. 31% of them had moderate experience (5-10 years) and the remaining 39% had extensive experience (more than 10 years) (Figure 3a).

Years of experience in Alberta (P5): The largest group of respondents had 0-5 years of experience in Alberta's construction industry. A comparison of this percentage with those of the previous question reflects the share of respondents who have immigrated to Alberta (Figure 3b).

Involvement in selecting subcontractors in projects (P6): More than half of the respondents (60%) were involved in selecting subcontractors in 10 projects or less, while the remaining 40% of the respondents were involved in selecting subcontractors for more than 10 projects (Figure 4a).

Experience working directly with subcontractors (P7): The majority of the respondents (about 80%) had

experience working directly with a subcontractor in one of their past projects (Figure 4b).

The main purpose of this study is to investigate the opinions of clients and consultants, in addition to main contractors, regarding the selection of subcontractors. However, it was deemed important to identify and take into account other characteristics of the respondents, in addition to the roles of their organizations, since these characteristics might influence their opinions as well. In fact, a careful statistical analysis could possibly reveal that an opinion that might seem to be determined by the role of the respondents' organizations is actually dependent upon another characteristic. As will be seen in the analysis of the results of the survey, this did indeed turn out to be the case in this study.

Factors considered in the selection of subcontractors

Respondents were asked to rank the importance of the following factors in the selection of subcontractors. For this they used a Likert scale of 1 to 5, with a score of 1 indicating the factor to be very unimportant and 5 indicating it to be very important:

- ▶ Subcontractor's experience in similar projects (F1)
- ▶ Subcontractor's familiarity with the local market (F2)
- ▶ Subcontractor submitting the lowest bid (F3)
- ▶ Compliance of the subcontractor's submitted schedule with the project's overall schedule (F4)
- ▶ Subcontractor's financial strength (F5)
- ▶ Subcontractor's available resources (F6)
- ▶ Subcontractor's reputation in the construction industry (F7)
- ▶ Subcontractor having a good execution plan in the proposal (F8)
- ▶ Subcontractor having a well-defined quality assurance and quality control (QA/QC) program (F9)

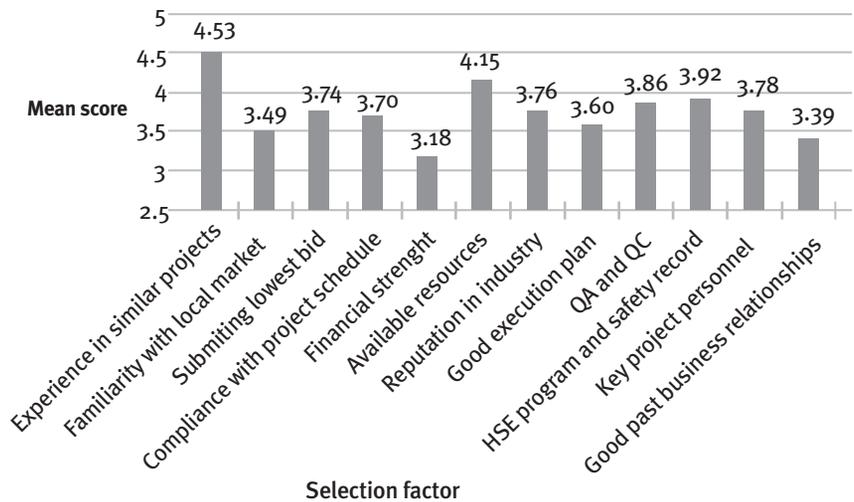


Figure 5: Mean scores for the importance of factors considered in the selection of subcontractors

- ▶ Subcontractor having a health and safety program, and the subcontractor's past safety record (F10)
- ▶ Qualification of the key project's personnel (F11)
- ▶ Good business relation with the subcontractor in past projects (F12)

The mean score for each factor, based on all the responses, is presented in Figure 5. The mean score of all the factors varied between 3.18

and 4.53. This confirms that overall, the respondents found all the factors as being relevant in the selection of subcontractors.

However, it is possible to distinguish between factors on which most respondents agreed that they were important, and others on which there was less of an agreement. The mean scores given for the factors (Figure 5) show that factor F1 (the subcontractors' experience in similar projects)

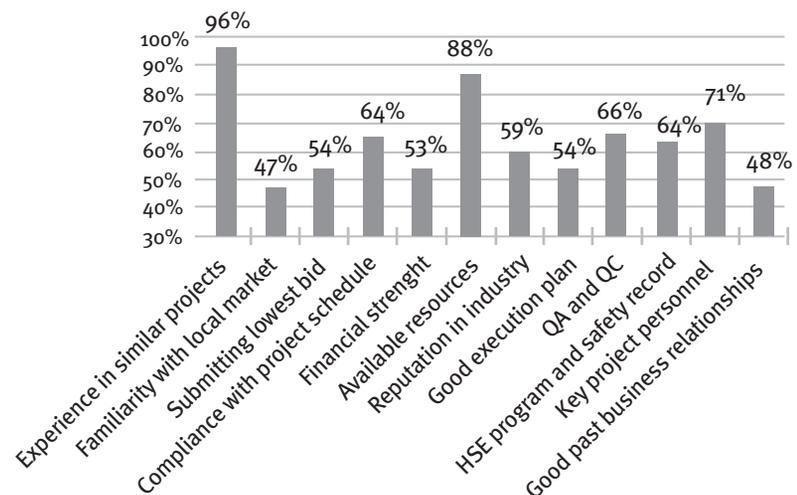


Figure 6: Percentage of respondents who ranked factors as being "important" or "very important"

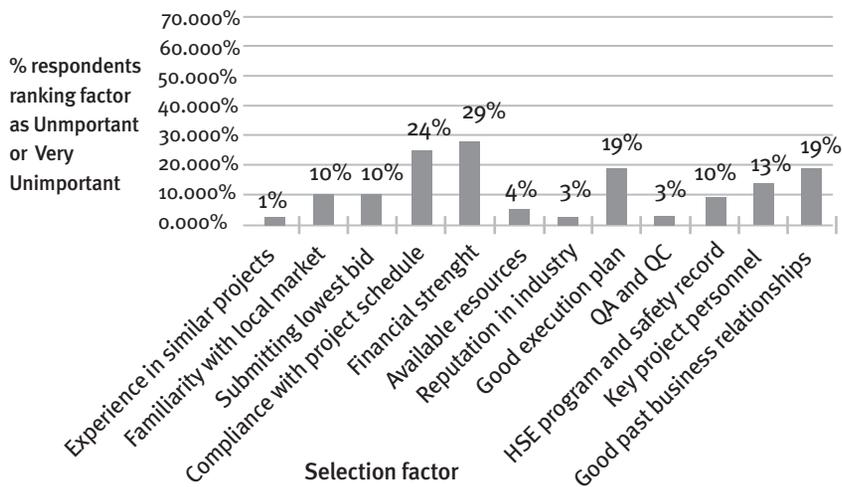


Figure 7: Percentage of respondents who ranked factors as being unimportant or very unimportant

was given the highest score, followed by F6 (the subcontractor's available resources). A closer look into the percentage of respondents who ranked each factor as important (4) and very

important (5) confirmed that nearly all the respondents (96%) identified the subcontractors' experience in similar projects (F1) as being an important factor in their selection (Figure 6).

Factor F6 (available resources) was also chosen by nearly 90% of the respondents as an important factor.

On the other hand, some factors, such as compliance of the subcontractor's submitted schedule with the project's overall schedule (F4), and the subcontractor's financial strength (F5), were ranked by a significant number of respondents as being unimportant or very unimportant (Figure 7). Interestingly, a significant number of respondents (29%) ranked financial strength (F5) as being "very unimportant", far more than any other factor. As will be shown in Section 5, this included in particular respondents who were contractors.

Survey Data Analysis

The collected data was analyzed using the Statistical Package for Social Science (SPSS), in order to examine if there were any significant

a		P1		Fisher's Exact Test	
		Public	Private		
P2	Client/Owner	40 (88.9%)	3 (3.3%)	.000	
	Contractor	2 (4.4%)	66 (71.7%)		
	Consultant	3 (6.7%)	23 (25%)		
	Count	45 (100%)	92 (100%)		
P5	0-5 years	15 (33.3%)	46 (50%)	.037	
	5-10 Years	14 (31.1%)	31 (33.7%)		
	> 10 years	16 (35.6%)	15 (16.3%)		
	Count	45 (100%)	92 (100%)		
b		P2			Fisher's Exact Test
		Client/Owner	Contractor	Consultant	
P4	0-5 Years	13 (30.2%)	20 (29.4%)	8 (30.8%)	.016
	5-10 Years	8 (18.6%)	30 (44.1%)	5 (19.2%)	
	> 10 Years	22 (51.2%)	18 (26.5%)	13 (50%)	
	Count	43 (100%)	68 (100%)	26 (100%)	

Table 1: Independent variables with statistically significant relationships

relationships between the respondents' professional background (the independent variables) and the subcontractor selection factors identified by them (the dependent variables).

In the first step, a Fisher's exact test was carried out in order to identify any possible interrelationships between the independent variables (regarding the respondents' professional background). The results of the test revealed a statistically significant relationship between the industry sectors the respondent belonged to (P1) on the one hand, and the respondent's role in the company (P2) and their experience in Alberta's construction industry (P5) on the other hand (Table 1a). Moreover, the respondents' role in the company (P2) was shown to be related to their experience in the construction industry (P4) (Table 1b).

In order to examine if there was any significant relationship between the respondents' professional background (the independent variables) and the subcontractor selection factors (the dependent variables), a cross tabulated analysis of the survey data was carried out in the next step,

using SPSS. Depending on the nature of the independent variable, either a t-test or an ANOVA test was applied. Whenever the ANOVA results demonstrated a statistically significant relationship between dependent and independent variables, it was followed by a "Student-Newman-Kelus" test in order to reveal which group means resulted in rejecting the null hypothesis of the ANOVA test (Ho: $\mu_1 = \mu_2 = \mu_3 = \dots$).

For independent variable P3 (the respondents' construction industry segment) the respondents sometimes belonged to more than one group (i.e. they were not mutually exclusive groups), and therefore four separate tests were carried out, one for each segment: the residential construction segment (P3/1), the non-residential construction segment (P3/2), the heavy infrastructure construction segment (P3/3) and the industrial construction segment (P3/4). This brought the total number of independent variables to 10. Considering the nature and number of dependent and independent variables (respectively 10 and 12), 120 possible relationships were examined.

The results of the tests revealed 74 statistically significant relationships with a p-value of less than 0.05. This number was reduced to 53 significant relationships, based on the previously identified interrelationships between independent variables (Table 2).

Following is an analysis of the significant relationships organized based on independent variables.

Role in project (P2):

Statistically significant relationships were identified between the role of the respondent in the project (client/owner, consultant or construction contractor) and the dependent variables F2 to F5, F7 to F8 and F10 to F12 (Table 3).

A further "Student-Newman-Kelus" test revealed that both clients and consultants put a similar degree of importance on all selection factors apart from variables F2 and F7. For the construction contractors are the means of the scores for selection factors are significantly different from this of consultants and clients. All three groups identified factors F1 (experience in similar projects) and F6 (available resources) as being important.

Dependent / Independent	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
P1			.000	.000	.000			.001	.041	.000	.000	.000
P2		.000	.000	.000	.000		.000	.000		.000	.000	.000
P3/1	.049	.049	.001	.000	.000		.001	.007	.011	.004	.01	
P3/2			.002	.006	.000			.006				
P3/3		.012	.025	.005	.000					.012	.004	.012
P3/4		.006	.002	.000	.000		.004	.008	.003	.000	.000	.000
P5			.009	.004	.001			.017				.004
P6		.007	.024	.000	.000		.04	.001	.004	.028	.007	
P7		.01	.017		.002			.001				

Table 2: P-values of significant relationships between dependent and independent variables (for p<0.05)

	Selection factor	Mean			Sig. (P)
		Client (31%)	Contractor (50%)	Consultant (19%)	
F1	Experience in similar projects	4.530	4.50	4.58	0.865
F2	Familiarity with local market	3.580	3.19	4.15	0.000
F3	Submitting the lowest bid	3.280	4.24	3.19	0.000
F4	Compliance with schedule	4.210	3.12	4.38	0.000
F5	Financial strength	3.840	2.43	4.08	0.000
F6	Available resources	4.230	4.06	4.27	0.390
F7	Reputation in industry	3.930	3.44	4.31	0.000
F8	Good project execution plan	3.860	3.04	4.00	0.000
F9	Well-defined QA/QC	4.000	3.71	4.00	0.131
F10	HSE program & past safety record	4.420	3.43	4.38	0.000
F11	Key project personnel	4.140	3.35	4.31	0.000
F12	Good past business relationship	3.740	2.91	4.04	0.000

Table 3: Relationships between the role of the respondents' organization and mean scores for selection factors

The clients and consultants identified the subcontractors' HSE program and past safety record (F10), and their compliance with the schedule (F4) as important selection factors, whereas the contractors did not. The subcontractor submitting the lowest bid (F3), on the other hand, was identified by clients and consultants as being the least important factor.

Contractors, in contrast, identified F3 (lowest bid) as being the most important factor, after F1 (experience in similar projects). Thus, the contractors' choice is in accordance with the findings in previous studies, most of which identified price as being the most common factor in selecting subcontractors. On the other hand, the clients' and consultants' emphasis on schedule and safety runs counter to those previous findings, in studies that focused on the considerations of main contractors. It is interesting to note that in addition to identifying lowest bid as an important factor, contractors identified the financial strength of

subcontractors (F5) as being unimportant, whereas clients and consultants did not. This could indicate a high level of concern with the main contractor's level of profit in the project, and a much lower level of concern with

the risk that a subcontractor would become bankrupt, leading to delays in project completion.

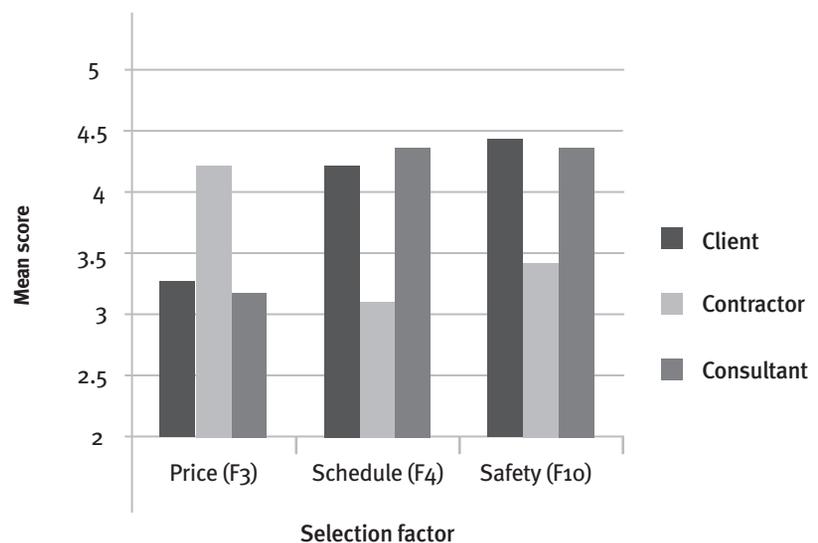


Figure 8: Relationships between respondent's organization role in the project and mean scores for selection factors

Construction industry segment (P3):

As previously mentioned, the questionnaire encompassed four segments of the construction industry: residential construction, non-residential construction, heavy infrastructure construction and industrial construction. Since the respondents sometimes belonged to more than one group (i.e. there were no mutually exclusive groups), four separate t- tests were carried out. The results of these four tests show that the industry segment to which a respondent belonged influenced his choice of selection factors (Table 4).

Respondents from all segments identified the subcontractors' experience in similar projects (F1) and availability of resources (F6) as being important factors. However, regarding other factors differences could be identified between the groups:

Respondents from the **residential construction segment** ranked bid price (F3) as being the least important factor, while compliance with the schedule (F4) was ranked as second most important after the subcontractor's experience (F1). In addition, reputation in industry (F7), well-defined QA/QC (F9) and safety (F10) were ranked by these respondents as important, relative to respondents from other groups.

Respondents from the **heavy infrastructure construction segment** identified safety (F10), key personnel (F11) and adherence to the schedule (F4) as being relatively important. These choices might reflect the importance of good site management and communication with subcontractors in large infrastructure projects, a lack of which will often affect the progress and success of such projects (Gosh and Jintanapakanont 2004, Memon et al. 2011).

Respondents from the **industrial construction segment** ranked lowest bid (F3) as the most important factor, after experience (F1) and availability of resources (F6). Other factors, such as compliance with schedule (F4), financial strength (F5), project plan (F8) and safety (F10) were ranked as less important by these respondents. This is in line with findings in previous research, according to which in projects in Alberta's oil and gas construction segment contracts are usually awarded on a low bid basis (Nutakor 2007).

Finally, the rankings of respondents from the **non-residential construction segment** lie, on average, somewhere in between those of respondents from the residential segment and those of respondents from the industrial segment in terms of ranking, with schedule (F4) and project plan (F8) being identified as relatively important (Figure 9).

	Selection factor	Construction Industry Segment							
		Residential Construction		Non-Residential Construction		Heavy Infrastructure Construction		Industrial Construction	
		N=19		N=25		N=36		N=89	
		Mean	Sig	Mean	Sig	Mean	Sig	Mean	Sig
F1	Experience in similar projects	4.74	0.049	4.64	0.318	4.58	0.524	4.51	0.617
F2	Familiarity with local market	3.79	0.049	3.56	0.620	3.81	0.012	3.36	0.006
F3	Submitting the lowest bid	3.05	0.001	3.24	0.002	3.42	0.025	3.93	0.002
F4	Compliance with schedule	4.47	0.000	4.20	0.006	4.14	0.005	3.42	0.000
F5	Financial strength	4.00	0.000	3.84	0.000	3.83	0.000	2.89	0.000
F6	Available resources	4.26	0.523	4.28	0.385	4.22	0.551	4.09	0.210
F7	Reputation in industry	4.32	0.001	3.96	0.166	3.94	0.076	3.63	0.004
F8	Good project execution plan	4.11	0.007	4.00	0.006	3.67	0.235	3.30	0.008
F9	Well-defined QA/QC	4.32	0.011	3.88	0.867	4.00	0.233	3.70	0.003
F10	HSE program & past safety record	4.47	0.004	4.28	0.064	4.28	0.012	3.69	0.000
F11	Key project personnel	4.37	0.010	3.96	0.360	4.22	0.004	3.53	0.000
F12	Good past business relationship	3.79	0.064	3.56	0.351	3.72	0.012	3.18	0.000

Table 4: Relationships between the respondents' construction industry segment and mean scores for selection factors

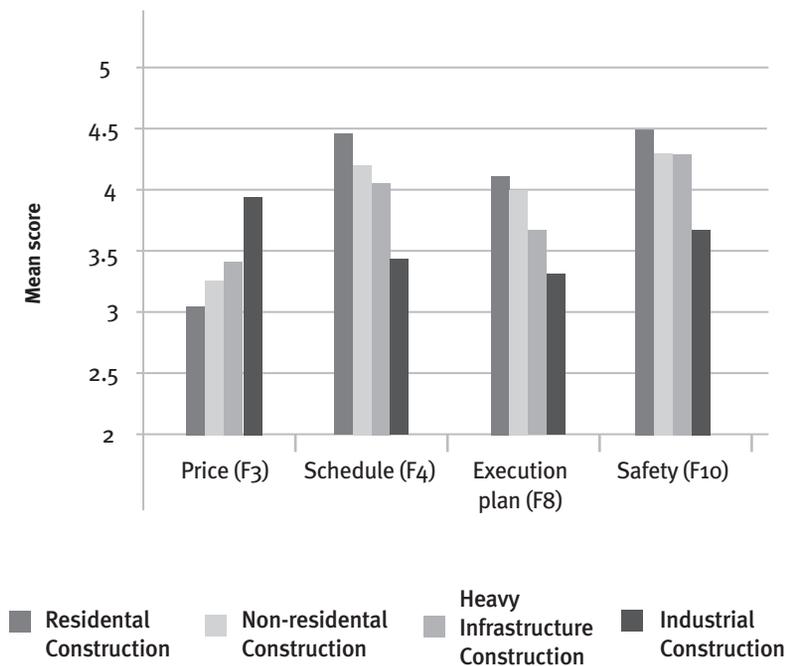


Figure 9: Relationships between construction industry segment and mean scores for selection factors

Involvement in selecting subcontractors in projects (P6):

Depending on the number of projects in which the respondents were involved in selecting a subcontractor, (less than or more than 10), they held opinions that were significantly different regarding all the dependent variables apart from F1 (experience in similar projects), F6 (available resources) and F12 (Table 5).

It is important to note that respondents who had been involved in selecting a subcontractor in more than 10 projects tended, like the contractors, to identify the lowest bid submitted by a subcontractor (F3) as being one of the most important selection factors. On the other hand, those with practical experience in selecting subcontractors in less than 10 projects held similar opinions to those of the clients and consultants, identifying as important selection factors a well-defined quality assurance and quality control program (F9), a health and safety program (F10) and the subcontractor's past safety

record, as well as the compliance of the subcontractor's submitted schedule with the project's overall schedule (F4) (Figure 10). Since no statistical relationship was found between the respondents' role as contractors and their additional experience in selecting subcontractors, an explanation for the above findings could be that it is the experience of working with the subcontractors, rather than the main contractors' financial interests, which influences the lowest bid as being identified as an important factor. This experience has the same effect on the respondents' evaluation of the factors' importance, regardless of their role in the project.

Direct experience in working with a subcontractor (P7):

The respondents' direct experience in working with a subcontractor was significantly related to all independent variables apart from F1 (experience in similar projects), F6 (available resources), F7, F9

ID	Selection factor	Number of projects involved in selecting subcontractors		
		Mean		Sig
		< 10 Projects (60%)	> 10 Projects (40%)	
F1	Experience in similar projects	4.51	4.55	0.764
F2	Familiarity with local market	3.66	3.25	0.007
F3	Submitting the lowest bid	3.57	3.98	0.024
F4	Compliance with schedule	4.02	3.20	0.000
F5	Financial strength	3.59	2.58	0.000
F6	Available resources	4.22	4.05	0.212
F7	Reputation in industry	3.88	3.58	0.040
F8	Good project execution plan	3.73	3.11	0.001
F9	Well-defined QA/QC	4.02	3.60	0.004
F10	HSE program & past safety record	4.09	3.67	0.028
F11	Key project personnel	3.99	3.47	0.007
F12	Good past business relationship	3.52	3.18	0.055

Table 5: Relationships between involvement in selecting subcontractors in projects and mean score for selection factors

ID	Selection factor	Mean		Sig
		Have direct Experience 79%	No direct Experience 21%	
F1	Experience in similar projects	4.58	4.31	0.124
F2	Familiarity with local market	3.40	3.86	0.010
F3	Submitting the lowest bid	3.84	3.34	0.017
F4	Compliance with schedule	3.61	4.00	0.096
F5	Financial strength	3.04	3.72	0.020
F6	Available resources	4.13	4.24	0.508
F7	Reputation in industry	3.72	3.90	0.299
F8	Good project execution plan	3.32	4.07	0.001
F9	Well-defined QA/QC	3.80	4.07	0.127
F10	HSE program & past safety record	3.83	4.24	0.070
F11	Key project personnel	3.75	3.90	0.517
F12	Good past business relationship	3.27	3.83	0.009

Table 6: Relationships between direct experience working with a subcontractor and the mean score for selection factors

and F11. Those who did have experience working with subcontractors, expressed to a large extent views similar to those with experience in selecting subcontractors (P6), including on the relative importance of the lowest bid (F3).

Conclusions

This research aimed to identify the main factors that the different parties involved in the construction industry believe should be considered when selecting subcontractors. One of its goals was to re-examine the prevailing notion that bid price is considered by practitioners to be the most important factor that should be taken into account when selecting subcontractors. While previous studies focused on price as the most common selection factor, this study presents a more complex reality of conflicting interests and priorities of the different project stakeholders in selecting subcontractors.

Nearly all the respondents identified the subcontractors' experience

in similar projects, and the subcontractor's available resources, as being important factors in their selection. However, respondents from contracting firms displayed significantly different priorities when selecting subcontractors than did other project stakeholders, attaching more importance to the lowest bid price submitted. The clients and consultants on the other hand, generally identified other factors such as safety and adherence to the schedule as being more important.

One way to explain this result, is in accordance with the conclusion of previous studies, according to which choosing the subcontractor that submits the lowest bid often leads to problems such as low construction quality (e.g. Tam et al. 2011). Continuing with this line of thought, one might propose that contractors have an interest in reducing their costs, whereas clients and consultants have other objectives such as ensuring the quality of the project, and this is what leads to

preferring different factors. However, this conclusion does not explain another finding in this study, which is that those respondents from client and consultant organizations who did have a richer experience in selecting subcontractors, also tended to attach more importance to low bids. Here one could counter, once again, that the experience of those respondents probably came from instances in which the client directly nominated and paid for the subcontractors – which influenced priorities.

However, this conclusion too has to be qualified by another finding, which is that a richer experience of working directly with subcontractors has an impact on the factors that were selected, which is similar to the impact of an increased experience in selecting the subcontractors. Since no statistically significant relationship was found between these two types of experiences, this means that even those who generally have little to say regarding the actual selection process, but who have experienced directly working with subcontractors, tend to put more of an emphasis on low bid prices.

At this stage, one can only suggest possible explanations for this finding: does an increased involvement in the management of projects lead to conforming to the prevailing norm of preferring the lowest bid price? Or perhaps the control and supervision mechanisms of main contractors over subcontractors' work are sufficiently adequate in most projects, contrary to what has been concluded in previous studies, so that price can be given a higher priority?

Given the importance of this topic for the performance in construction projects, it is recommended that further research be carried out to identify the incentives that currently cause stakeholders with more experience in working with subcontractors to give a high priority to low bid prices. Such

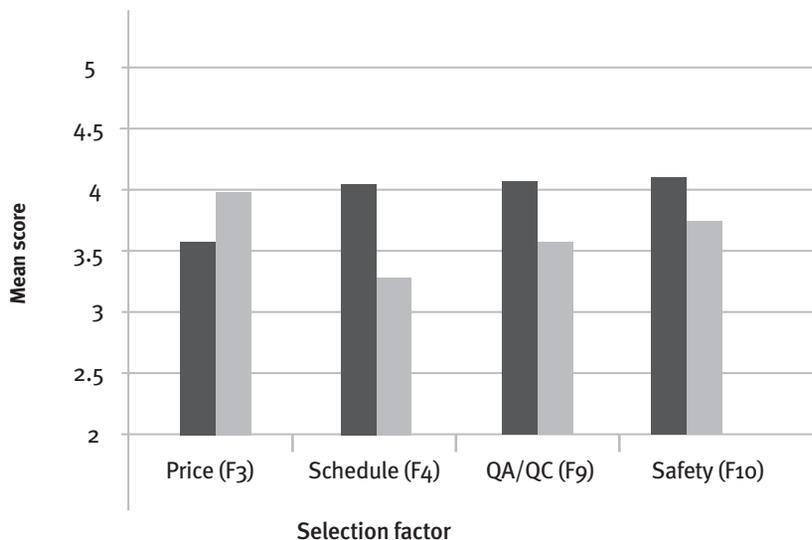


Figure 10: Relationships between involvement in selecting subcontractors in projects and mean score for selection factors

■ > 10 Projects
 ■ < 10 Projects

research could also lead to a better understanding of those incentives. It might clarify whether this practice does indeed have a negative impact on the project to the extent that has been reported in other studies. If this is the case, it could also bring about an understanding how these incentives might be changed in order to cause their owners to align their decisions with the interests of other project stakeholders, and improve the projects' outcomes.

References:

Arslan, G., S. Kivrak, M.T. Birgonul, and I. Dikmen. 2008. Improving sub-contractor selection process in construction projects: Web-based sub-contractor evaluation system (WEBSES). *Automation in Construction* 17, no. 4: 480-488.

Cheung, S. O., K.T. Yiu, and P.S. Chim. 2006. How relational are construction contracts?. *Journal of Professional Issues in Engineering Education and Practice* 132, no. 1: 48-56.

Choudhry, R. M., J.W. Hinze, M. Arshad, and H.F. Gabriel. 2012. Subcontracting practices in the construction industry of Pakistan. *Journal of Construction Engineering and Management* 138, no. 12: 1353-1359.

Ghosh, S., and J. Jintanapanont. 2004. Identifying and assessing the critical risk factors in an underground rail project in Thailand: a factor analysis approach. *International Journal of Project Management* 22, no. 8: 633-643.

Hartmann, A., F.Y. Ling, and J.S. Tan. 2009. Relative importance of subcontractor selection criteria: evidence from Singapore. *Journal of Construction Engineering and Management* 135, no. 9: 826-832.

Hughes, W., C. Gray, and J. Murdoch. 1994. Construction subcontracts: for what we are about to receive. *Proceedings, 7th Annual Construction Law Conference, London, UK, 413-442.*

Kumaraswamy, M. M., and J.D. Matthews. 2000. Improved subcontractor selection employing partnering principles. *Journal of management in engineering* 16, no. 3: 47-57.

Lavelle, D., J. Hendry, and G. Steel. 2007. The selection of subcontractors: is price the major factor?. *Proceedings 23rd Annual ARCOM Conference, Belfast, UK, 65-73.*

Association of Researchers in Construction Management, 65-73.

Maturana, S., L.F. Alarcón, P. Gazmuri, and M. Vrsalovic. 2007. On-site subcontractor evaluation method based on lean principles and partnering practices. *Journal of Management in Engineering* 23, no. 2: 67-74.

Memon, A. H., I. Abdul Rahman, M.R. Abdullah, and A.A. Abdu Azis. 2011. Factors affecting construction cost in Mara large construction project: perspective of project management consultant. *International Journal of Sustainable Construction Engineering and Technology* 1, no. 2: 41-54.

Nutakor, G. 2007. Assessing final cost of construction at bid time. *Cost engineering* 49, no. 11: 10-16.

Tam, V. W., L.Y. Shen, and J.S. Kong. 2011. Impacts of multi-layer chain subcontracting on project management performance. *International Journal of Project Management* 29, no. 1: 108-116.

Üsdiken, B., Z. Sözen, and H. Enbiyaoğlu. 1988. Strategies and boundaries: subcontracting in construction. *Strategic Management Journal* 9, no. 6: 633-637.

Vilasini, N., T.R. Neitzert, J.O.B. Rotimi, and A.O. Windapo. 2012. A framework for sub-contractor integration in alliance contracts. *International Journal of Construction Supply Chain Management* 2, no. 1: 17-33.