HOW TO PROPORTION CAPABILITY AND FEE PERCENTAGE FOR TEAM COMPARISON IN COMPETITIVE EARLY INVOLVEMENT

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Early involvement of the construction team is increasingly utilized in challenging projects to incorporate versatile expertise in their planning. For public owners this is a challenge since they are obliged to use competitive, transparent team selection based on the 'most economically advantageous criterion' which ensures that both price and quality viewpoints are taken into account. In the case of early involvement, the price component naturally does not include the total price, but may consist only of the fees of competing service providers. This study examines such a selection situation and seeks to find a way to integrate the fee component in a multi-criteria selection system and determine reasonable fees for different levels of capabilities. The study builds on the productivity difference between different competences, derived from a survey of practitioners, and determines an indifference curve arithmetically for the planning of a selection method. The influence of the owner's risk attitude and risk premiums are also taken into account based on the pricing methods of the theory of finance.

Keywords: alliancing, early involvement, contractor selection, partnering, procurement.

INTRODUCTION

It has long been the custom in construction to select service providers, especially contractors, solely on the basis of the lowest bid. The practice has led to adversarial relations and created problems in the sector thereby impeding its development. Pressures to renew the principles of implementer selection come also from a broader cultural change: a value-added strategy is now being pursued also in infrastructure construction and more collaborative, relational project practices are increasingly applied. A collaborative approach often also means early involvement of the key parties to the building process since traditional, sequential involvement of the parties does not allow mutual exchange of information and collaboration for the benefit of the project. Early involvement has also become part of governments' strategies (Valkenburg *et al.* 2008; Government Construction Strategy, 2012).

As if it were not difficult enough to use price-inclusive multi-criteria selection in the later stages, applying it to early involvement is even more challenging. At that stage,

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the project is fraught with too much uncertainty which makes it difficult to estimate costs reliably. Due to the resulting risk premiums, it is not sensible to organize normal price-inclusive competition and fix the price in the early stages of project development.

Instead, the solution is to strive for an open, transparent process where the price (target cost) is set later after a joint development phase by the owner and the team involved. However, it is not reasonable to ignore the cost and price elements totally even then and give the service provider disproportionate power to price the project subsequently. Actually, it is necessary especially for public owners to set constraints and/or a mechanism for price formulation also in the case of early involvement in order to comply with procurement directives (e.g. Directive, 2004) and their *most economically advantageous tender* criterion.

In this respect, the fees of participating companies are in key position. Although the direct costs cannot be estimated yet, it should be relatively easy to agree on percentage (or fixed) fees that include company overheads and profit considering that there is common understanding of which cost items are compensated as direct costs and which are not. The fee can represent the price component in competitive selection. The challenge is, however, that the direct costs of competing companies or teams cannot be expected to be the same which makes the decision-making situation different from the more usual total price plus quality competition. Yet, the system has to support the maximisation of value for money. For that, it also has to be objective and impartial to entice tenderers and incentivise them to do their best – not only play ‘lottery’.

This study aims to respond to the last mentioned challenge by developing a method to include the fee component in a selection system that covers team capability as a qualitative measure and fee percentage only as a price component. The objective is to override the typical problem of approximation by grounding the approach on a strict, reasonable mutual relationship between price and value and keeping the system as simple as possible.

The target application is a project alliance (see Department, 2011; Lahdenperä, 2009) team selection (for an infrastructure project in Finland) where the fee component covers both overhead costs and profit of the service providers, and is based on the team member companies’ fees weighted by their expected cost shares; team members are selected as a group including both design and construction resources, not separately. The study skips the examination of the quality/capability/competence assessment system assuming that it can take the form of a multi-criteria evaluation resulting in an overall score that will then be taken in account in the method resulting from this study to combine the fee and quality components.

STATE OF THE ART AND RESEARCH DESIGN

The challenge of selecting the best service providers for a project has generated a lot of research. Suffice it to say that Holt (2010) has completed a relatively comprehensive review of the multifaceted research on contractor selection. Considering the mass of studies on supplier selection, relatively few studies have focussed on the question of how to sensibly combine overall quality assessment and price for the determination of the best option in each case. Yet, Drew *et al.* (2001), Dreschler (2009) and Waara and Bröchner (2006) have examined the methods used in practice. None of them, however, deal with the situation examined in this study.

Moreover, current methods typically seem to follow an approach where the tenderer earning the highest total points is selected and the component scores for competitors are calculated in relation to the lowest price or the highest quality tendered. Chen (2008) points out that the approach results in serious shortcomings in the system's functioning and calls it a *ranking paradox*. Telgen and Schotanus (2010) state the same in even less uncertain terms: relative scoring methods will never guarantee that the selection is in line with the preferences of the buyer, as their exact form and position depends on the bids coming in; as such, relative scoring methods replace the preference of a buyer by a lottery. Chen (2008) concretizes his presentation by introducing the extra concept of *independence of irrelevant alternatives* reminding that the relative ranking of two alternatives must not be affected by a third alternative. Thus, it is quite clear that literature does not contain relevant awarding systems and the quality-price relation should be determined directly in terms of *value for money*.

While the value for money approach has generally been neglected, in the case of fee-inclusive competition (excl. total prices) its application is even more challenging due to the difficulty of price estimation. Here, the remarks by MacCall (1970) and Rosenfeld and Geltner (1991) about the need to view the cost plus fee market side-by-side with the more common fixed price (competition) market are appropriate. As a result better players are available to cost plus fee projects only if they can expect to earn the same profit they would make in alternative markets, where the price level is basically the same for efficient and inefficient players. This results in fee differences.

Therefore, in order to determine the *indifference curve* needed for the design of a selection method, the performance difference between the best imaginable, but realistic, and the weakest qualified performers (market extremities) is determined in an indifference situation where the value and price to the owner are both standardized (only direct costs and fees differ). A calculation method for that is developed in the next study stage and presented in the next section.

The performance difference cannot, however, be easily measured in the real world of one-off projects where various other factors tend to contribute to any existing data. For that reason, the study is based on a survey of experienced practitioners who were educated for the very same selection situation as in the study in the first of its kind procurement in the target market as explained above. Besides, the risk related to competing alternatives needs to be analysed and taken into account on a more theoretical basis since the owner may consider the acceptance of a higher fee risky.

The study constrains itself to the examination of a formula for drawing a conclusion based on overall capability evaluation and a fee proposal; it does not focus on detailed examination of capability more than is necessary to (conceptually) determine the extreme performers. The capability assessment is assumed to be trustworthy as it is based, for instance, on the methods and procedures used in a project in which the survey respondents participated, which has been reported by Lahdenperä (2012). The qualitative criteria used are numerous, diverse and intangible and would require much more detailed discussion than is possible in this summary.

BASIC FEE ELASTICITY CALCULATIONS

Deriving the basic formula

This section focusses on the cost efficiency difference between the supposed extremities, the 'weakest' and the 'best' performers. The target is to design a calculation model that allows determining a reasonable fee difference to be incorporated in the actual selection model that corresponds to the capability range. Figure 1 should clarify the presentation.

Let's start by looking at the case where a project is to be implemented by the weakest performer. Then, the direct cost (C_W) plus the team's fee percentage (F_W) would form the cost to the owner (P_W):

$$P_W = C_W * (1 + F_W) \quad (1)$$

Correspondingly, if the best performing team is able to construct the project at lower cost without compromising quality, it can be said to have an efficiency advantage (E_Δ [%]) over the weakest performer while doing the same work at the cost of P_B:

$$P_B = C_W * (1 - E_\Delta) * (1 + F_B) \quad (2)$$

If the best performer is allowed to reap the entire efficiency benefit, its fee can be significantly higher than that of the weakest performer. In such a case the alternatives would also be of the same cost to the owner, i.e. P_W would equal P_B. Since this assumption ignores risk attitude, as will be explained later, the situation is purely hypothetical – thus, F_B is replaced by F_N in Formula (2) to depict that 'neutral' case:

$$C_W * (1 + F_W) = C_W * (1 - E_\Delta) * (1 + F_N)$$

$$\Rightarrow 1 + F_W = (1 - E_\Delta) + (1 - E_\Delta) * F_N$$

$$\Rightarrow F_W + E_\Delta = (1 - E_\Delta) * F_N$$

$$\Rightarrow F_N = (F_W + E_\Delta) / (1 - E_\Delta) \quad (3)$$

In practice it is, however, unlikely that a conservative (public) owner selects the best performer on paper if it costs relatively as much as another option: the cost-oriented owner is not willing to pay that much for extra value, and moreover, there is no guarantee of better performance – which may require novel, still non-existent innovative approaches – yet the higher fee percentage would be fixed. In other words, the owner carries the risk related to the expected production efficiency. In such a case the owner may well require compensation for doing that in accordance with the general business practice.

A compensation, or absolute risk premium (R_A), means that the expected price of the best performer in the above case has to be lower than that of the weakest alternative:

$$P_W = P_B + R_A \quad (4)$$

Basically, the absolute risk premium is calculated as a share, i.e. relative risk premium (R_R), of the underlying risk (U_R) – which, again, is the price difference (resulting from different fee percentages) when the best performer is no better than the weakest one in terms of direct costs ($E_\Delta = 0$ and C_W is, therefore, valid for both teams):

$$R_A = R_R * U_R = R_R * [C_W * (1 + F_N) - C_W * (1 + F_W)]$$

$$\Rightarrow R_A = R_R * C_W * (F_N - F_W) \quad (5)$$

If we return to Formula (4), and replace its parameters with the equivalent parameters of Formulas (1), (2) and (5) respectively, it rewrites to

$$C_W * (1 + F_W) = C_W * (1 - E_\Delta) * (1 + F_B) + R_R * C_W * (F_N - F_W) \quad (6)$$

By dividing both sides of Formula (6) by C_W and by entering F_N of Formula (3) in it, the following ensues:

$$\Rightarrow 1 + F_W = (1 - E_\Delta) * (1 + F_B) + R_R * ((F_W + E_\Delta) / (1 - E_\Delta) - F_W)$$

$$\Rightarrow 1 + F_W = 1 - E_\Delta + (1 - E_\Delta) * F_B + R_R * ((F_W + E_\Delta) / (1 - E_\Delta) - F_W)$$

$$\Rightarrow F_W = - E_\Delta + (1 - E_\Delta) * F_B + R_R * ((F_W + E_\Delta) / (1 - E_\Delta) - F_W)$$

$$\Rightarrow (1 - E_\Delta) * F_B = E_\Delta + F_W - R_R * ((F_W + E_\Delta) / (1 - E_\Delta) - F_W)$$

$$\Rightarrow F_B = (E_\Delta + F_W - R_R * ((F_W + E_\Delta) / (1 - E_\Delta) - F_W)) / (1 - E_\Delta) \qquad (7)$$

This is the way to determine the reasonable fee for the best performer (F_B) in relation to that of the weakest performer (F_W) in an even case when actual estimates of efficiency advantage (E_Δ) and risk premium (R_R) exist.

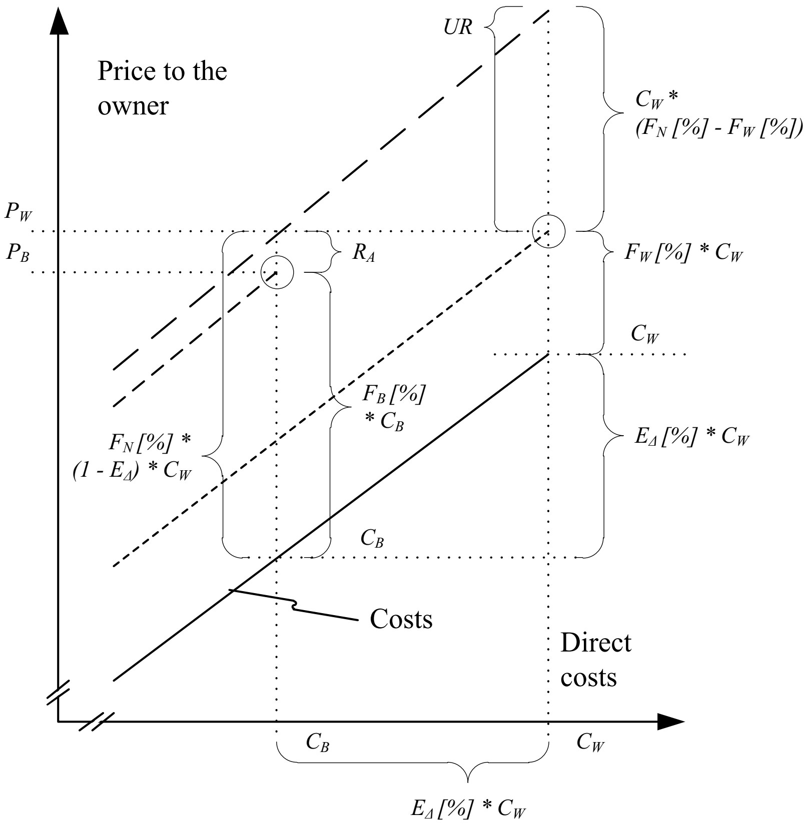

Figure 1. An illustration of fee elasticity calculations.

Defining the risk premium

Underlying price risk (U_R) can be considered the amount the owner has at stake when selecting the potentially best performer, i.e. a sum the owner expects to receive a return on. In finance, the capital asset pricing model (*CAPM*) is used to determine the required rate of return on an asset (e.g. Fama and French, 2004). It determines the return as the sum of a risk-free rate of interest and the product of systematic risk and the difference between the expected market rate of return and the risk-free rate of return:

$$E(R_i) = R_f + [E(R_M) - R_f] * \beta_{iM} \qquad (8)$$

where $E(R_i)$ = the expected return on asset i

R_f = the risk-free interest rate

$E(R_M)$ = the expected market rate of return

β_{iM} = the market beta of asset i

$E(R_M) - R_f$ = the equity risk premium (*ERP*), i.e. expected market rate of return in excess of the risk-free rate

In other words, the expected return on any asset is the risk-free borrowing rate plus a risk premium. In this work we are not interested in pricing assets but only in finding a relative, industry-related estimate for operation risk which is (tentatively) given by the product of beta and the market risk premium in Formula (8) above. The risk-free component can be ignored since the time-value of money has no meaning here: the owner does not make an actual deposit and the payment to an alternative service provider actualizes on the same schedule and, moreover, the payment is tied to an index in most cases also in multi-year contracts.

Therefore, in terms of the above parameters, the relative risk premium is simply as follows:

$$R_R = ERP * \beta_{iM} \qquad (9)$$

ACQUISITION OF INITIAL DATA

Literature survey for determining risk premium

There seems to be no unanimity about how risk premiums should be determined. Moreover, there are significant differences between time periods, sectors, sizes of business, and geographical areas and/or countries. While detailed discussion on the topic is beyond the scope of this summary, the study rests on the following findings:

In recent decades equity risk premiums (*ERP*) have been about half of the last century's average of 6−10% (e.g. Damodaran, 2011). Besides, the average view of chief financial officers (over a 10 year investment period) has typically remained within 3−4% in recent years (Graham and Harvey, 2010).

In engineering and construction the range of (unlevered) betas (β) has been from ½ to 1½ (Damodaran, 2012). However, it has been suggested that the so-called total beta be used for undiversified owners of businesses, which would give us approximate total beta values from 1 to 4, respectively.

Considering expert opinions and the recent trends against the long-term historical trend, the average range of *ERP* is 3−5%. The relatively short duration of the typical construction project for which the risk premium is defined would suggest a lower figure. Moreover, contracted work does not involve the risk of getting deals which is built in *CAPM* pricing. On the other hand, an individual project is subject to significantly bigger risk than a portfolio of projects where the projects tend to vary in terms of success; their successes and failures often roughly offset each other. The initial range can be considered appropriate.

As concerns the value of beta, here we deal with a stand-alone asset, to which total betas are applied (due to the risk related to it that cannot be diversified): values 1−3 tend to be reasonable. In summary, multiplication of the extreme beta and equity risk premium values according to Formula (9) produces a wide range (3%−15%) that yields a middle or basic value of 9% for further calculations.

Questionnaire survey for determining performance levels

A questionnaire survey was conducted to gather the practitioners' views on the estimates on the efficiency advantage (E_Δ) of the above formulas and the likely actual range of fees. The target group consisted of the key personnel involved in the first ever project alliance competition in Finland which used the type of selection criteria that are the subject of the study. Thus, the respondents can be considered to be familiar with the subject and the decision making situation in general. Altogether 74 owners' representatives, owner's consultants, and competing designers and contractors were sent a link to an Internet questionnaire. A total of 32 responses were received.

The overall survey covered a considerably broader field than is dealt with here, but the questions relevant to this study were the following (in condensed form):

Question 1. If the goal was to reap the added value generated by the best team only in the form of project cost savings (excl. implementer fees) other quality and value factors remaining the same, how much lower would the costs [%] of the best, realistic implementation team be compared to the weakest possible one that nevertheless meets the suitability criteria of a demanding project?

Question 2. In the case of a typical project suitable for delivery under an alliance contract in a normal economic situation, what is the broadest realistic average range of fee percentages [a%–b%] for different bidding consortia (considering that a quote is requested at the end of a laborious selection phase when polite and test bids are unlikely)?

Table 1 presents the results of the survey. As to efficiency advantage (E_Δ), 17% is a reasonable basic value for the analysis based on the survey. Yet, the calculated margin of error (for 95% confidence level) makes it necessary to extend the analysis to include also the extremity values of 13% and 21% (i.e. basic value ± margin of error). The suggested fee range is from 10% to 20% in the studied case.

Table 1. The results of the survey.

Question	1	2a	2b
Parameter	Efficiency advantage	Lowest fee%	Highest fee%
Number of responses	26	24	24
Average response	16.84	10.21	20.25
Standard deviation	10.02	5.45	8.58
Margin of error	3.85	2.18	3.43

RESULTS OF THE STUDY

The basic solution

By using the above determined Formula (7) together with estimates for efficiency advantage (E_Δ) derived from the survey (17%) and the relative risk premium (R_R) produced by the theoretical examination (9%), a reasonable F_B can be calculated as a function of F_W as presented by the solid line in Figure 2.

The figure shows how the difference between F_W and F_B in an indifference case – or *fee elasticity* in terms of the study – is nearly a constant 20 percentage units across the scale irrespective of the magnitude of F_W, which is an important observation from the viewpoint of the development of the selection method. Varying of the parameters (E_Δ, R_R) up to the extreme values (as a consequence of the margins of error of the survey and the ambiguousness of the risk premium examination) provided other estimates for F_B as illustrated by the broken lines of the figure. Thus, fee elasticity could be lower or higher than the suggested basic 20 percentage units. Sensitivity analysis shows that the reliability of the study is not excellent and much room for speculation still remains as becomes obvious in the next section.

Correspondingly, the *indifference curve* is any line from a point defined by the lowest performance level and a certain fee to a point defined by the highest performance level and a fee that equal to the former fee plus the fee elasticity. Thus, application of the research result is basically very simple. For instance, if the competing teams are evaluated based on their capability on a scale from 0 to 100 points (P_C) equalling relevant industry extremities (not extreme tenderers), the same scale is used for scoring the fee (P_F) as follows:

$$P_F = 100 - 100 * (F_I - F_L) / A_F \qquad (16)$$

where F_I = the fee (of tenderer *I*) to be scored
F_L = the lowest fee tendered
A_F = fee elasticity

Fee elasticity has to be decided project-specifically based on the above numbers (and considering the comments below). The highest total points (P_C+P_F) scored determine the best option, and no weighting is needed, which maintains the targeted simplicity. The model is transparent and allows tenderers to calculate the score for any potential performance combination in relation to other options thereby avoiding the *reference paradox*. Moreover, the method as an entity is based on *value for money* thinking.

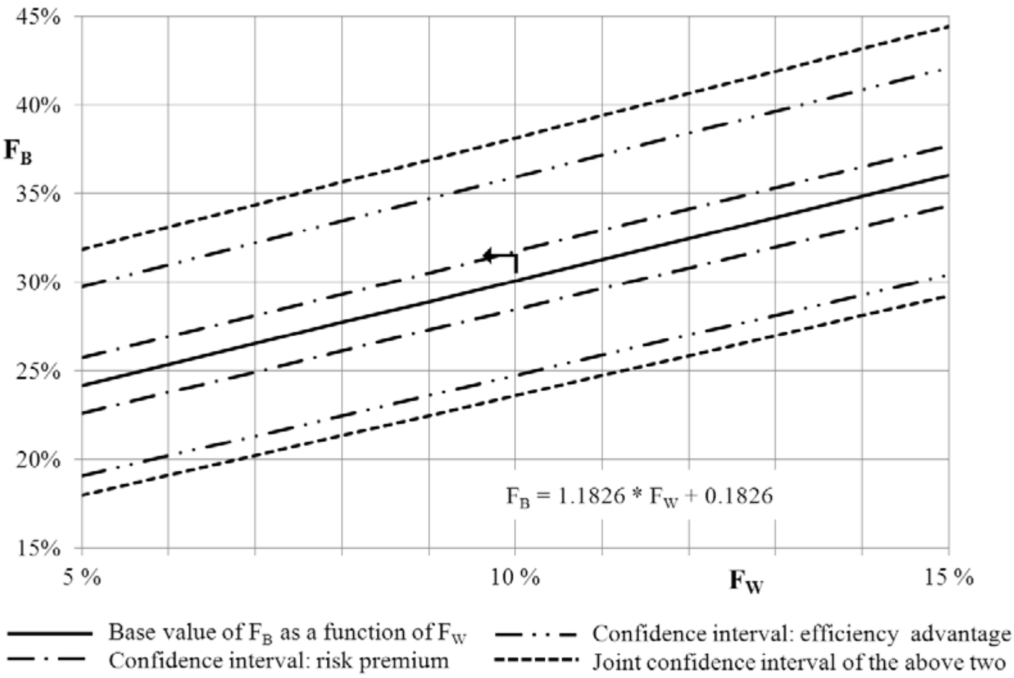

Figure 2. Fee ranges equivalent to capability variation.

Adjusting the solution for practical applications

The respondents to the survey were experienced professionals and obviously also aware of the targeted decision situation where their views would be made use of since they had just participated in a similar competition. Yet, the relatively wide deviation in views resulting in a wide margin of error in the combined estimate tends to lower the reliability of the study. And verification of the estimate is not easy due to the lack of relevant comparison views and/or data.

This being the case, public owners may well prefer lower fee elasticity than suggested by the basic value since they tend to be risk adverse considering the tradition of price-oriented selection and public accountability. In other words, the owner is likely to be conservative in valuing the anticipated better performance itself since it is not guaranteed while the possibility of loss, once the fee (percentage) has been accepted, becomes irreversible. Even then the owner should not accept less than 15 percentage units according to the study, since it has already taken the risk into account and the uncertainty is mainly related to the magnitude of the estimated efficiency advantage.

Although there is no exact means of estimating the direction of the possible error in the fee elasticity estimate, it is also possible that the respondents, although experienced practitioners, are not able to distinguish a team-related performance variation from other accidental or project-related variations whereby the estimated cost efficiency advantage becomes unreasonably large. That also speaks for a lower fee elasticity which should not be a problem either since 15 percentage units would still be more than the anticipated practical fee range according to the survey. Slightly lower fee elasticity is also suggested by the basic value of the *value-add* examination carried out in parallel with the presented *efficiency advantage* approach, but not reported in this summary (i.e. 18 percentage units instead of 20).

DISCUSSION AND CONCLUSIONS

There seem to be strong indications that early involvement of the key players of a construction project is often worthwhile in case of large, highly complicated and risky projects. There the candidate teams' capability and potential are subjected to a thorough review. Performance in reference projects, skills and the chemistry within the project team, management and project development approaches and, first and foremost, the ideas for improvement and cost savings will be examined thoroughly. Only then can a reasonable, knowledgeable decision on the service providers be made.

Yet, that it is not enough. If early involvement is chosen, it is certainly better to fix the fee than leave all components open to negotiation with selected service providers. Therefore, both capability and the fee become criteria for competitive selection. In fact, that is the only way public owners usually are able to apply early involvement in major projects due to procurement rules and/or probity auditing.

This being the case, a balance has to be found between the fee and capability components in an award system so that any change in them impacts the overall score in proportion to its real impact on the owner's value for money ratio – a fact forgotten in many academic and practical 'lottery' applications. Only then, however, the system can truly serve decision making based on the *most economically advantageous* criterion, incentivise the industry for better performance and enhance the actualization of the owner's objectives. And this is where the study at hand steps in with its relatively simple method, aimed to be easily understood and accepted by practitioners.

The results, or actually the numeric values for fee elasticity, are not definitive or universal solutions, but can be applied at one's discretion to the selection of an alliance team for the design and construction of Finnish transport infrastructure projects. For other projects, market areas and industries the figures may have to be adjusted. All in all, there are plenty of challenges for construction management research in filling the void of rational practices. The evaluation and scoring system for capability must also be developed very carefully – it was excluded from this study.

The survey completed as a part of the study also indicates that practical fee variation may not be as wide as could be justified by the variation in the candidate teams' performance. That leads to capability being the primary means of competition and key determinant of awarding the contract when the method of this study is used in selection. That, again, means that the owner can expect to attract highly competent teams for his/her projects and benefit from the procurement system. This being the case, use of the system indirectly fosters also development of the sector.

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