CASE BASED DECISION SUPPORT SYSTEM FOR BID MARKUP ESTIMATION OF INTERNATIONAL CONSTRUCTION PROJECTS AT THE TENDER STAGE

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ABSTRACT

CASE BASED DECISION SUPPORT SYSTEM FOR BID MARKUP ESTIMATION OF INTERNATIONAL CONSTRUCTION PROJECTS AT THE TENDER STAGE

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Subsequent to preparation of a valid base estimate for a construction project tender, it is required to add a bid markup on top of the base estimate. While an exaggerated bid markup weakens the competitiveness of the contractor, an underestimated one makes the contractor susceptible to financial losses. Therefore, an effective and reliable bid markup estimation method is indispensable to the success of a contractor both at the tender and the performance stages. The prevalent practice among contractors is to identify a certain percentage to add on the base estimate relying on their judgment without substantial explicit support. In this thesis, a case based decision support system, which will count on the experience of the top experts of Turkish international contractors, will be constructed. Meanwhile, factors which are essential to bid markup estimation are to be identified.

Keywords: Bid markup, case-based reasoning, decision support system, Turkish contractors

ÖZ

ULUSLARARASI İNŞAAT PROJELERİNDE TEKLİF HAZIRLIĞI AŞAMASINDA TEKLİF-MALİYET MARJI BELİRLENMESİ İÇİN VAKA BAZLI KARAR DESTEK SİSTEMİ

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Bir inşaat projesinin baz teklifinin hazırlanmasının ardından, baz teklifin üzerine teklif-maliyet marjı eklenmesi bir gerekliliktir. Abartılı bir teklif-maliyet marjı müteahhitin rekabet gücünü azaltırken, öte yandan düşük belirlenmiş bir marj ileride firmayı mali kayba sokacaktır. Dolayısıyla, etkili ve güvenilir bir teklif-maliyet marjı belirleme metodu müteahhidin hem ihale aşamasındaki hem de proje esnasındaki başarısı için vazgeçilmezdir. Firmalar arasındaki yaygın uygulama, kesin dayanakları olmaksızın, kişisel karar verme yeteneklerine dayanarak baz teklifin üzerine eklemek üzere bir yüzde oranı belirlemektir. Bu araştırmada, Türk uluslararası müteahhit firmalarının üst kademe yöneticilerinin deneyimlerine dayanan bir vaka bazlı karar destek sistemi oluşturulacaktır. Aynı zamanda, teklif-maliyet marjını belirleyici etmenler açığa çıkarılmış olacaktır.

Anahtar Kelimeler: Teklif-maliyet marjı, vaka bazlı çözümleme, karar destek sistemleri, Türk müteahhitleri

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To

My Family

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LIST OF ABBREVIATIONS

AACE	Association for the Advancement of Cost Engineering
AI	Artificial intelligence
CBR	Case based reasoning
DSS	Decision support system
METU	Middle East Technical University
PC	Personal computer
PM	Prediction model
ROC	Rank order centroid
RS	Rank sum
SPSS	Statistical Package for Social Sciences
TCA	Turkish Contractors Association
USD	United States Dollar

CHAPTER 1

INTRODUCTION

There are two ways through which a construction contractor may be awarded a construction project: (1) direct negotiation with an owner, or (2) competitive bidding. This thesis is concerned with Turkish contractors seeking projects abroad through competitive bidding.

The objective of this thesis is to reveal the level of impact and significance of various factors utilized in deciding for bid markup of international construction project tenders. Also, a decision support model is developed to illustrate ultimately the estimation of a proper bid markup for international construction projects.

Although some past research in the literature aimed at studying the effect of various factors in determining the size of bid markup, no study has exclusively mentioned and focused on risk, opportunity and competition aspects of the bidding situation individually and in the mean time collectively.

The thesis begins with an explanation of basic concepts on bid markup issue. Chapter 2 is followed by a general overview of the Turkish construction contractors operating abroad during the last three decades and a review of past research efforts on bid markup decision making is presented. In Chapter 4, research methodology is presented and potential impact of several factors in bid markup decision making is discussed. Chapter 5 presents preliminary research findings on the level of importance of factors in bid markup decision making and then introduces a linear bid markup estimation model. Chapter 6 aims at proving the appropriateness of utilizing a Case Based Reasoning (CBR) model in decision making and then

using the survey data, a decision support model aimed at predicting risk, opportunity and competition levels in a tender and ultimately aimed at assigning a proper bid markup is proposed and analyzed. Chapter 7 presents a practical application for the whole bid markup estimation model. Finally, the benefits and shortcomings of the system are discussed.

According to abundant anecdotal evidence, in Turkish construction sector it was evident so far that firms have not been employing a formal bid markup estimation procedure, hence opening up a way to improper and inconsistent markup decisions. Then, in light of the insight provided by Hawkins (2004) on the issue of how a brain works, case based reasoning methodology is selected as the method which proves to be very similar to the manner in which Hawkins claims that the brain works.

All in all, this thesis carries the aim of reinforcing the recent breakthrough view which claims that brain does not actually work in a way that many artificial intelligence engineers claim. Besides, it has the purpose of how a fundamentally basic algorithm can pretend the way that a brain uses to make predictions.

Following the main text, this thesis also includes three appendices. In Appendix A, a sample of the questionnaire used throughout the study can be found. Appendix B presents the list of similarity definitions utilized in constructing the bid markup model. And, Appendix C gives the definition for the scenario to be utilized for practical application in Chapter 7.

CHAPTER 2

BID MARKUP DETERMINATION

2.1 Competitive Bidding

A construction company obtains the contract to perform a construction project generally through competitive bidding. In a competitive bidding type of tender, contractors who are qualified according to the tender documents submit their bids to the client in a closed envelope. Each contractor typically submits his qualification documents and financial and technical offers on the day of tender. Announcement of the total bid amounts of contractors may take place on the day of the tender or it may be delayed until the finalization of the first phase of tender evaluation.

If qualification documents and technical offer of the contractor are found to be satisfactory during the first phase of the evaluation period, client initiates the second phase of evaluation for those who have been qualified in the first phase.

In the second stage of evaluation, contractor bids may be announced if they have not been announced previously and the contractor providing best value to the client is invited to sign the contract. With most tenders, best value offered to a client is characterized by the lowest offer amount.

2.2 Bid Markup & Direct – Indirect Costs

Typically, a bid amount is composed of direct costs, indirect costs and a bid markup.

The AACE defines direct costs as "...costs of installed equipment, material, and labor directly involved in the physical construction of the permanent facility" (AACE Int., 2003).

The AACE also defines indirect costs as "...all costs which do not become a final part of the installation, but which are required for its orderly completion. It includes (but is not limited to): field administration, direct supervision, capital tools, some start-up costs, contractor's fees, insurance, taxes, etc." (AACE Int., 2003).

The base estimate is calculated as the sum of direct and indirect costs. Then this base figure is increased by an estimated percentage factor called a bid markup. Typically, the bid markup size is determined by the sum of general overhead, profit and contingency in percentage (Dozzi et al., 1996, Shash, 1998).

General overhead is the contractor's cost to operate his overall business, and profit is the contractor's motivation, namely, the amount of money a contractor wants to make from a project. Contingency is the funds set aside for unforeseen construction difficulties or risks (Lee and Chang, 2004). Throughout this thesis, markup for profit is termed as profit markup, whereas that for contingency is termed as risk markup.

2.3 Bid Markup Estimation Problem

The bid markup estimation problem is a decision problem that is so highly unstructured that it is very difficult to analyze and formulate an adequate solution mechanism (Moselhi et al., 1993). And, considering the complexity of this problem, Ahmad (1990) states that, the usual practice is to make bid decisions on the basis of intuition derived from a mixture of gut feeling, experience, and guesses. Mochtar and Arditi (2000) claim that, pricing decisions would be much improved if they were not based only on intuition

and a hasty assessment of the competition, but if they also considered up-to-date information about all relevant market characteristics (such as owner and competitor characteristics, and demand level).

Li and Love (1999) explained that markup decisions simply emerge at a single step without going through a sequence of discourses or deep reasoning steps. Akintoye (2000) argued that contractors will set the markup at a margin perceived to be sufficient to win the tender and that is also in line with the strategic position of the firm within the market.

A contractor's success depends on his ability to assign an appropriate bid markup size that brings enough jobs and profit to the company (Shash and Abdul-Hadi, 1992). Therefore, contractors should take a strategic approach to the bid markup decision making, but in fact, the decision is mostly made on the basis of personal experience or perception (Ahmad and Minkarah, 1988).

2.4 Bidding and Pricing Strategies

Male (1991) states that contractors define a strategic domain at the corporate strategy level where that domain establishes market dimensions within which contractors plan to operate and compete for projects. Contractors then make decisions on which contracts to bid for at the business strategy level. If the contractor is opting to bid for a particular tender, the cost estimate is formulated at the operational strategy level and fed back to the business strategy level where senior management then decides the appropriate level of markup at a corporate meeting (Drew et al., 2001).

Bids submitted to a client may be classified as being either serious or unserious bids. There may be numerous motives for submitting an unserious bid. First, the contractor may be particularly invited by the client to

submit a bid, and in return he may unwillingly feel himself compelled to do so. Second, he may aim to make known that he is still active in the market after a certain period of inactivity. And third, he may want to gain market information and experience through studying for the tenders of a particular project type in his target market area, without the actual aim of becoming the winner.

Other classification terms for bids include misconstrued bids (containing errors) and suicidally low bids (well below cost, characterized as bids submitted by contractors experiencing cash flow problems) (Merna and Smith, 1990). The latter practice is usually employed by contractors who are on the verge of 'survival or death' mentality. Other than suicidal bidding, contractors may also offer merely the estimated base cost in a highly competitive environment hoping that future claims to be done, as allowed by the contract, will help them earn some profit.

According to Zikmund and d'Amico (1996) pricing strategies may be outlined as follows: skimming, meeting the competition, undercutting the competition and penetration pricing. A skimming price is a high price intended to "skim the cream off the market." It is best employed when a contractor is entering a new market which is at its early stages of development and lacks capable competitors. In such a case, clients may willingly pay unusually high prices because such construction projects are novel to them. However, as the market develops and new competitors come in, market prices gradually decrease in response to competitive pressures.

As a second sort of strategy, namely, meeting-the-competition strategy, in a market where competition is already in place and clients are experienced with similar projects, a contractor may opt for placing his bid at a level equal to or slightly below those of competitors. During the times of upward economical trend, this is the usual strategy because contractors will choose to avoid price-cutting wars.

Third, implementing the undercutting-the-competition strategy, contractors may go for placing way lower bids than those of competitors. This is common when the general economy is shrinking and the primary aim of companies is merely to survive. On the other hand, some companies who have a reach to vast resources and cheap labor may also undercut the competition, as it happens with Chinese contractors bidding for international projects.

Finally, implementing the penetration pricing strategy, a contractor may bid ignoring any profit and even bearing some loss in the short term. This is observed when a contractor is willing to penetrate into a new market and attack the status quo of his potential competitors. In this way, the contractor aims to increase his chances of obtaining future profitable contracts by means of establishing a bridgehead for further advance and therefore he focuses on survival in the long run rather then caring for the short term.

2.5 Factors Affecting Bidding Behavior of Contractors

Factors influencing bidding behavior and hence bid markup estimation were grouped by Drew and Skitmore (1993) into those affecting: (1) the behavior of contractors as a group (e.g. market conditions, number and identity of competitors); (2) individual contractor behavior (e.g. contractor size, work and tenders in hand, availability of staff); and (3) behavior toward the characteristics of the contract (e.g. type and size of construction work, client, location).

Flanagan and Norman (1982) found out that bidding behavior, in general terms, is likely to be affected by the following five major factors:

1. size and value of the project, and technical and managerial complexity required to complete it,

2. regional market conditions,

3. current and projected workload of the bidder,

4. type of client,

5. type of project.

2.6 Cost-based Pricing and Market-based Pricing

The construction industry in most countries is one of extreme competitiveness with high risks and low margins of profit. Therefore, contractors should employ solid and reliable strategies to establish their profit and risk margins for their offers.

Best (1997) claims that there are basically two extreme pricing strategies: cost-based pricing and market-based pricing. Any other pricing strategy is always in between these two extremes. Cost-based pricing starts by establishing the total cost of making a product. The product is then priced with additional cost-based markups, commonly a desired profit. On the other hand, market-based pricing starts by gathering intelligence from the market: total number and identities of bidders, competitors' bidding history, overall financial situation of the project and information about the client. Market-based pricing focuses on undercutting the possible value of successful bid amount and ignores the conventional cost estimation. The assumption underlying purely market-based approach is the belief that a contractor is, by some means, able to find ways and methods of constructing a project by means of slightly undercutting the established market prices while maintaining a still acceptable profit margin.

Mochtar and Arditi (2000) state that there are 2 hybrid pricing models in between cost-based pricing and market-based pricing. In the first model, which is closer to cost-based pricing, detailed project cost estimation is performed initially. Then, optimization process takes place to revise the cost estimate so that the bid fits into the price range practiced by market players.

In the second hybrid model, the principal information is competitors' historical bid data collected through market intelligence. Approximate cost estimates are calculated then, based on historical bidding data and confirming to bidding documents at hand. Then, cost analyses and adjustments are performed to optimize the cost and to see if the company can adopt market-based prices practiced by competitors.

According to the survey findings of Mochtar and Arditi (2000), on average, a construction company performs a detailed cost estimate, in exactly the same way employed in cost-based pricing, and then assigns a bid markup based on the company's preferences and general market conditions. No cost adjustments are made later. This is very close to the purely cost-based approach except that in setting the markup, some market conditions such as competitors' past bids are taken into consideration.

2.7 The Winner's Curse

In the 1960s American oil companies turned their eyes to the Gulf of Mexico with the aim of offshore drilling. So, numerous oil companies joined a race to bid for obtaining drilling rights in the region. After several years, oil companies realized to their disappointment that offshore oil wells operating in the region were not profitable. Later on, it was realized that it was not the technical difficulty or complexity of the new drilling process that was preventing companies from earning profits, but it was the bidding process given the plenty of uncertainties in information available to those oil companies (Capen et al., 1971).

Suppose that there are three oil companies that are competing for a particular offshore property. Back in the 1960s, considering the lack of ability of the methods to accurately determine the amount of oil present under the sea bed, the three companies are very likely to come up with largely varying estimates. The company which unrealistically comes up with

the largest oil reserve estimate among other competitors is very likely to win the tender. That company may very happily bid 10 million USD for a reserve that is supposedly worthy of 20 million USD. On the other hand, the remaining companies may automatically drop out of competition, if they have estimated the reserve's worth less than 10 million USD.

In an auction, the prize goes to the bidder who is the most optimistic about the value of the object for which bidders are competing. And in numerous cases this means that the winner is the person who has overestimated its value the most. And this phenomenon was termed as the "winner's curse" (Capen et al., 1971). After the winner's curse phenomenon became better understood by the oil companies, companies became more cautious in their reserve estimates by applying a safety factor to reduce their original estimate.

In a similar manner, construction contractors are also prone to the "winner's curse" phenomenon. The contractor who is the most optimistic about the project is also likely to underestimate to the greatest extent the risks inherent to the project. Therefore, during execution of the project it is virtually for sure that unexpected expenses will eat away from that contractor's expected profit markup.

The best solution for preventing such an undesirable event is first to seek and obtain more and more accurate information about all aspects of the whole bidding situation and second to become more cautious about the inherent risks.

2.8 Risk

It is believed that the word "risk" was originally a sailor's term that came from Spanish and meant "to run into danger or to go against a rock." Therefore the money spent to fund shipments overseas was the first

example of risk business in the early days of travel (Jannadi and Almishari, 2003).

Every activity we do is, in some way, characterized by the presence of risk. However, the riskier an activity is, the costlier the possible consequences are. Therefore, contractors would like to quantify risks, in advance, while they are planning for a project.

Estimates of level of risk are based on the likelihood of the event's occurrence and the significance of the consequences of such event (Jannadi and Almishari, 2003). In other words, there are two basic aspects of risk estimation: probability of occurrence and magnitude of risk event.

Slovic et al. (1980) claim that there are several qualitative features of risk that are not captured in a quantitative risk estimate, but which influence peoples' acceptance of risk:

1. amount of fear associated with the outcome
2. whether or not the risk is taken voluntarily (voluntary risks being more acceptable)
3. amount of control one has over the incidence of risk

Therefore, quantification of risks may differ from contractor to contractor depending on their attitude towards risk. And, as explained above, attitude towards risk varies according to factors such as courage, voluntarism and controllability of risks.

Bush (1991) identifies three aspects of risk (other than the magnitude) that are important to consumers: willingness, knowledge (degree to which risks are understood), and fairness (are they the primary beneficiaries who bear the risks?).

Understanding of the above factors help explain why risks posed by biotechnology may be less acceptable than risks posed by other daily activities, such as skiing, even though on a magnitude of risk basis, the activity of skiing may be riskier.

De Neufville and King (1991) identify two ways for compensating for risk when developing a bid. One is to develop a standard cost estimate not taking account of any risk and then varying the bid markup depending on the degree of risk. Second method is to develop a cost estimate that adjusts productivity factors or add contingencies based on the risk of each cost item and then assign a standard profit markup to this risk compensated estimate (cited in Drew and Skitmore, 1997).

2.9 Economic Risk Taking

In studies of psychology, normative models aim to describe how people should make decisions. In normative models based on decision theory, it is assumed that people are risk averse, i.e. when confronted with a choice between a sure option and a lottery of an equal expected value; they prefer the sure option (Zaleskiewicz, 2001). The prospect theory of Kahneman and Tversky (1979) states that people are risk averse in the domain of gains, but they become risk seeking in the domain of losses. In the light of that latter theory, risk behavior and financial situation of a contractor may be considered to be interrelated. While contractors facing financial problems tend to submit bids with low contingency margins, contractors who are content with their level of wealth may stand away from wavy waters in order to evade any sort of losses.

The distinction between the preferences for risk seeking and risk avoidance has been found to be related to such individual features as locus of control, achievement motivation and sensation seeking (Zuckerman, 1994). To define a further classification, Zaleskiewicz (2001) suggests that risky

behavior motivated by the need for achievement differs from risky behavior motivated by the need for stimulation. These two forms of risk preference are labeled as instrumental risk taking and stimulating risk taking, respectively. With the instrumental risk taking, risk serves as an instrument to reach a particular economic goal in the future and with the stimulating risk taking, risk is regarded as a source of strong and immediate emotional excitement.

Zaleskiewicz (2001) also argues that while stimulating risk is experienced as something emotionally positive, instrumental risk is experienced as something emotionally bad but necessary. In light of these, a contractor who is willing to win a tender with a marginal bid amount that barely covers costs can be labeled as a stimulating risk taker, because he is focused at the excitement of becoming winner of the tender and his strong sensations prevent him from holding a long term perspective. That sort of risk taker emotionally ignores losses and he pleasantly feels that greater risk taking is a means of achieving greater excitement. On the other hand, a contractor who opts for a moderate contingency markup in a risky project would be considered an instrumental risk taker provided that he realistically focuses on having a sustainable and fruitful business in the long run though he cannot earn much today.

CHAPTER 3

OVERVIEW OF TURKISH CONSTRUCTION CONTRACTING SECTOR OPERATING ABROAD

Turkish construction contractors embarked on their venture for carrying out projects abroad in the first half of the 1970s. Libya was the first country where Turkish contractors carried out construction services on a large scale. Importance of the sailing of Turkish contractors to new horizons should not be underestimated as it significantly helped the contractors to gain knowledge of new construction technologies. Later on, Turkish contractors have spread their activities to several countries starting from the Middle Eastern region, namely, Iraq, Saudi Arabia, Jordan, Kuwait, United Arab Emirates and Iran.

In the beginning of the 1980s, Turkish contractors have entered the USSR (The Union of Soviet Socialist Republics) market. Today, they are active in 4 continents and nearly 60 countries providing reliable and high quality construction services.

According to the data provided by the Turkish Contractors Association (TCA), the activities of the Turkish contractors operating abroad can be summarized, on basis of decades, as follows:

3.1 Turkish Contractors Abroad between 1972-1979

During that period majority of the services took place in North Africa and especially Libya (73%) followed by Saudi Arabia (15 %), Iraq (7 %), Kuwait (5%) and Greece (0.1%).

The most heavily weighting sector appeared to be housing construction (32%), followed by harbor construction (18%), road/ bridge/ tunnel construction (12%) and then urban infrastructure projects (8%).

The total value of projects undertook in that period reached to 1.8 billion USD.

3.2 Turkish Contractors Abroad between 1980-1989

During that decade, although the percentage of the works realized in Libya shrank to 54 %, it still maintained its majority share. Saudi Arabia (25%) and Iraq (12%) also preserved their ranks as the second and third largest markets. A promising new market that appeared in that decade was USSR with its share of 5 %. The other countries where Turkish contractors provided services were Jordan, Iran, United Arab Emirates, Kuwait and Turkish Republic of North Cyprus.

During that period, share of housing projects rose to 39%, followed by a more than doubled share of urban infrastructure projects (19%) with respect to the previous decade. Then came road/ bridge/ tunnel projects with a share of 7% and agricultural projects with a share of also 7%.

Between 1980 and 1989, the total amount of projects undertook abroad jumped to 12.3 billion USD.

3.3 Turkish Contractors Abroad between 1990-1999

During that third decade of international activity, an abrupt change in trend was observed. With the Turkish contractors building up experience and reputation in the Russian Federation, the share of the Russian market sharply rose to 36%, whereas that of the Libya has plunged to 11.5%. In case countries previously involved in the USSR are considered as a single market, the share of these countries amounts to a significant 61%. Libya, in

that decade, is succeeded by Pakistan (7%) and Turkmenistan (7%), both of which were new markets for Turkish contractors.

An important progress achieved in that decade was the significant widening of the array of countries in which Turkish contractors were active. This can be attributed to the strong trend among a wide range of contractors towards delivering their well built-up experience to new international markets.

Kazakhstan (6%), Uzbekistan (4%), Bulgaria (3%), USA (3%), Azerbaijan (2%) and Croatia (2%) appeared to be new markets. In addition, 33 other countries had a total share of 10%.

Also, it is worth attention that share of Saudi Arabia plunged to 3% from 25% of the previous decade. This is mainly attributed to the aggressive behavior of the Korean contractors in Saudi Arabia which resulted in substantial decrease in the competitiveness of Turkish contractors in the market in terms of pricing.

During that period although the share of housing projects decreased to 25%, it still maintained its first place. Housing was followed by road/ bridge/ tunnel projects (13%), industrial buildings (11%) and commercial buildings (8%).

Indicating an uptrend, the total amount of realized contracts reached to 19.8 billion USD. The 7 billion USD portion of that was performed in Russian Federation and 5 billion USD of that was performed in ex-USSR countries. The uptrend of the contract volume abroad bolsters the idea that the Turkish contractors had been continuously gaining strength abroad within that decade.

3.4 Turkish Contractors Abroad between 2000-2003

During that 4 year period, Russian Federation (19%) preserved its first place among the countries where Turkish contractors are active. Turkmenistan (15%), Kazakhstan (11%), Saudi Arabia (8%) and Afghanistan (6%) follow Russia with respect to their share. Share of Libya continued to follow its long-term downtrend and decreased to 6%. New markets that have appeared in that period are Ireland, India, Oman, Qatar and Afghanistan. Reconstruction efforts in Afghanistan and Iraq are closely watched by Turkish contractors in order to take a share from the cake.

When data is examined in terms of project types, it is realized that the share of industrial projects grew to an all-time high of 25%. This fact can be taken as an indicator of the growing technical capability of Turkish contractors abroad. Industrial facilities are followed by road/ bridge/ tunnel projects (23%), petrochemical facilities (11%), management buildings (7%) and commercial complexes (5%). It is worth attention that the share of housing projects plunged to 2%. This may also be considered as a sign of the Turkish contractors' growing trend towards undertaking prestigious projects requiring higher level of skills.

The volume of projects executed within that time period is estimated to be 4.5 billion USD.

The total volume of projects executed by the members of the TCA since 1970 is estimated as approximately 45 billion USD. It is also estimated that at least 5 more billion USD worth contracts have been executed abroad by non-member contractors. All in all, it is estimated that between 1972 and 2003, the total value of contracts executed abroad are in excess of 50 billion USD.

Taking into account the hugeness of the volume of contracts executed abroad, the importance of contracting abroad should not be underestimated

in terms of its ability to provide new employment opportunities abroad and to help Turkey earn foreign currency.

Taking into consideration first the improving economy at home, second the growing incomes of neighbor countries as a result of their constantly growing petrol and natural gas revenues and third the intensity of reconstruction efforts in Afghanistan and Iraq, it is believed that the annual contracting capacity of Turkish contractors will be promoted to a level well above the current figure of 3 billion USD.

In view of the above facts and figures, one should make his every effort in order to enhance the success of Turkish contractors in international construction projects. These efforts should obviously focus on proper estimation of the bid markup which improves in first place the chance of the contractor to win the tender. Moreover, a proper bid markup assignment will also secure the completion of the project in a well manner acting as a buffer against risks and will also provide a profit margin that is the ultimate motivation for a typical contractor.

CHAPTER 4

RESEARCH METHODOLOGY

This research consists of a set of questionnaires. Survey questionnaires were prepared and then delivered to construction experts in a face-to-face fashion. Construction experts in this survey were executives who are deeply involved in the making of bid markup decisions in their companies.

Before the questionnaires are evaluated, respondents are given a 5-minute presentation on the subject. The presentation is aimed at making sure that respondents fully comprehend the subject.

Each interview took about 1 ½ hours. During the evaluation of the questionnaires, respondents are encouraged to express their ideas verbally so that more fruitful results can be obtained.

The construction contracting companies surveyed were determined with the assistance of Prof. Dr. Talat Birgönül and Assoc. Prof. Dr. İrem Dikmen Toker of Civil Engineering at METU. Companies surveyed are Turkish contractors having at least some international construction experience. After contacting the companies over the telephone, 41 companies were selected for this survey. And these companies introduced 41 experts.

The questionnaire was developed in five sections.

Section one asked the construction experts to evaluate the degree of importance of factors which influence bid markup size. For the purpose of evaluation, a 1 to 5 scale is used where ‘1’ means ‘very low importance’ and 5 means ‘very high importance’. The respondents were asked to choose a level of importance value from the scale for each factor. Hence,

respondents indicate the extent to which they would consider these factors to be important in their bid markup decisions.

In section two of the questionnaire, experts were asked how comfortable they feel about the way they make their bid markup decisions, then were asked whether they utilize any analytical/statistical methods during bid markup estimation and finally were asked to list any other factors that they may deem important for their bid markup estimation.

Section three aimed at identifying the lower and upper limits and average values of risk markups and profit markups practiced by contractors. Here contractors were asked to consider best case, worst case and average scenarios in order to discover their estimate of risk and profit markups for each boundary case.

Section four aimed at identifying the risk attitude of contactors in order to categorize them as risk-seeking, risk-neutral and risk-averse.

Finally, section five asked the experts to describe their bidding scenarios by choosing values for individual factors that were previously presented to them in section one. Factors in the questionnaire were scaled as either nominal, ordinal or scale variables. After the experts fully described their scenario, they were asked to evaluate the bidding case in terms of risk, opportunity and competition ratings. For the purpose of evaluation, a 1 to 5 scale is used where 1 means ‘very low’ and 5 means ‘very high’. In case the respondent checks ‘5’ for the opportunity item, it means that the project offers ‘very high opportunity’ to the contractor. Opportunity rating defines the level of opportunity that the contractor perceives in winning the tender and hence performing the project. And, competition rating defines the level of pressure that the expert suffers due to the behavior of competitors.

And, then experts were asked to give their estimate of risk markup and profit markup for that particular scenario. They were informed that a standard and accurate cost estimate has already been prepared by estimators without considering any risk. In other words, the base cost estimates have not been adjusted for fluctuation in productivity and they exclude any contingency. Therefore, experts were asked to consider the whole risk solely within their risk markup.

Section five was repeated for as many scenarios as respondents could define.

4.1 Factors Affecting Bid Markup Decision Making

In order to develop a reliable decision support system, it is imperative to possess a sound knowledge of factors affecting bid markup decision of contractors. Only then it would be possible for a model to suggest a proper bid markup. If factors carrying significant importance can be identified, a rational way of determining bid markup may be developed.

Factors utilized in this study were identified from the extensive background research in the construction field and the papers prepared by Shash and Abdul-Hadi (1992), Moselhi et al. (1993), Dulaimi and Shan (2002), Moselhi et al. (1993), Chua et al. (2003), Chua and Li (2000), Liu and Ling (2005) and Ergin (2005). After conducting a thorough research, 44 candidate factors were carefully selected as factors having potential impact on bid markup size for a project. Table 4.1 embodies these 44 potential factors that are thought to influence bid markup size.

Table 4.1. Potential factors that influence bid markup decision making

A	**GENERAL FEATURES ABOUT COMPANY AND PROJECT**
1	Project size
2	Contract duration
3	Contract payment type
4	Type of project
5	Client type
6	Size of the contractor company
7	Level of experience of contractor in similar type of projects
8	Level of experience of contractor in the host country / similar countries
9	Financial capability of the contractor
10	Technical capability of the contractor
11	Managerial capability of the contractor
12	Planned % of subcontracted works
13	Amount of cash required in advance for the beginning of the project
B	**RISK FACTORS**
14	Vagueness of design (due to incomplete design / insufficient project drawings)
15	Lack of enough technical information (such as site and geological conditions etc.)
16	Vagueness of contract conditions (unclear risk allocation between client and contractor etc.)
17	Unavailability of required construction materials and supplies in the host country (resource risk)
18	Lack of competence of local parties (local subcontractors, local labour etc.) in the host country
19	Unfavorability of physical conditions that may adversely affect productivity at site (such as adverse weather conditions etc.)
20	Technical and technological complexity of the project
21	Strict quality requirements/ specifications (stricter than the contractor's usual practice)
22	Tightness of the project duration / existence of high penalty (liquidated damage) clauses
23	Lack of infrastructural and civil development in the host country
24	Geographical distance between host country and Turkey
25	International relations of the host country with Turkey
26	Economical / financial risk of the host country and /or client
27	Foreign exchange rate / inflation rate fluctuation risk
28	Immaturity / unreliability of the legal system to which the contractor is subject according to the contract (legal risk)
29	Instability of the political environment in the host country (political risk) / potential for negative changes in government policies
30	Bureaucratic delays/ difficulties (in approval of projects, receival of necessary permissions etc.)
31	Cultural differences between the host country and Turkey (cultural risk)
32	Security risk
33	Existence of language barrier
34	Level of experience of the client (in similar projects, with foreign contractors etc.)
35	Attitude of the client towards the contractor (about timeliness of payments etc.)

Table 4.1. Continued

36	Availability of funds for the project
C	**OPPORTUNITY FACTORS**
37	Contractor's potential for gaining reputation and experience with the project
38	Potential for gaining similar future projects in the same country
39	Immediate need to take a job
40	Existence of local agents that help the contractor with the project
41	General economic situation at the contractor's country
42	Potential for changes in the scope of works and/or bid prices during the course of the project
D	**COMPETITION FACTORS**
43	Number of bidders
44	Presence of highly competitive bidders (presence of potential lowest cost bidders like Chinese etc.)

The factors are divided into 4 groups, namely: (i) general features about company and project, (ii) risk factors, (iii) opportunity factors and (iv) competition factors.

The first group includes all qualities and quantities that describe the project, such as size, duration, type, etc. and that describe the contractor, such as size, experience, capacity, etc.

The second group includes all the main risk factors that are likely to have negative impact on the performance of a project such as country, project and market risks, etc.

The third group involves opportunity factors, which give contractors the incentive to decide on a lower bid markup, such as need for work, desire to gain experience, etc. In other words, opportunity factors are those factors which create pressure on the profit markup so as to enhance contractors' chances of winning the project.

Finally, the fourth group is composed of the two factors that reflect the level of competition in a tender, namely: the number of bidders and presence of highly competitive bidders.

4.2 A Judgmental Look on How Several Factors Affect Contractors' Bid Markup Level

4.2.1 General Factors about Company and Project

4.2.1.1 Project size

People tend to underestimate the importance of everyday tasks which they perform ordinarily, whereas they pay close attention to tasks that require substantial effort and offer high and exceptional returns. As an analogy, this is evident in the woman in the kitchen example. A woman preparing lunch as usual for her kids will almost perform the whole process in an automatic manner even with an eye on the TV show. On the other hand, a woman preparing a family dinner, to which her company boss is invited, will be acting at almost full capacity spending her best effort. And, she will be questioning her actions consciously every second to avoid an unwanted outcome like over-cooked meat or salty soup.

We observe a similar situation with the construction companies. Companies, while bidding for a project that is well below their capacity, tend to go for a standard risk markup and profit markup that have evolved over recent years. And, some of the time those markups of large companies may appear unrealistic and uncompetitive to smaller companies. But for projects which are deemed large in regard to the firm's capacity, contractors will be performing substantial mental work to estimate those margins cautiously. It is even quite likely that company executives will be having meetings to scrutinize their markups in order to achieve an overall reduction of half a percentage point. The above view is supported by the study of Flanagan and Norman (1982), where they found that the large scale bidder was more successful in bidding for large contracts rather than for small contracts.

Therefore, the larger the project size becomes (at the same time approaching the contractor capacity), the more the contractor spends effort to estimate his markup, feeling pressure to reduce it.

Also, availability effect should be mentioned regarding the size of projects. In a typical market, as the size of target projects gets larger, the number of available projects diminishes. Therefore, when faced with a large project tender, a construction executive may think that such a chance is not met so often and may feel a motive to reduce his initial markup level. However, small project tenders are rather abundant in the market and a large-size contractor may opt for bidding for several of them in a month with relatively high markups and may still not worry even if he loses all of them.

Economic theory of the firm suggests that firms are most efficient when they operate just under their capacity (Milgrom and Roberts, 1988). If contractor goes well over his capacity, his efficiency and productivity will decrease and eventually his competitiveness is also bound to decrease. Therefore, contractors have to balance their resources with the total size of their on-going contracts in order to achieve optimum efficiency.

Hillebrandt and Cannon (1990) state that, a company which has a large number of smaller on-going projects is likely to be subject to less overall risk than a company of similar size with a few number of larger contracts. Therefore, a contractor should pay close attention to risk, if he is carrying fewer eggs with considerably large sizes in his basket.

In addition, large contracts allow substantial cash flows through the contractor's bank account. That sort of monthly cash inflow is vital for every contractor's well-being and helps the contractors to establish healthy relationships with financial institutions on the matter of receiving loans and bonds. Therefore, contractors are likely to use their incentives to reduce their markups for large-size projects for the sake of attaining general financial health.

4.2.1.2 Contract duration

Contract duration may appear longer than normally expected for two typical reasons: first, because budget restrictions of client do not allow for a plenty of cash flow, second, because the size and complexity of the project demands such a length of duration.

In case the client suffers from budget unavailability, it is very important that contract duration be specified in the contract according to the real circumstances without misleading the contractor. In the latest Public Procurement Law[1], No 4734, for multi-year projects of clients that are subject to the law, it is specified that for the first year of the project at least 10% of the project's total budget must be allocated and clients are obliged to conform to the initially announced annual budget figures without any room for lowering them. This enforcement prevents public clients from announcing projects that will be a burden to contractors due to clients' default in providing proper financing. In this way, knowing that the client will abide by his financing responsibilities as specified in the original contract documents, contractors can bid without feeling any pressure to excessively increase their risk markups.

Turkey is well-known for its high inflation economic environment during '80s and '90s. Because of the fact that such an environment was very favorable to many financial investors, it can also be claimed that high inflation offered a lot favor to contractors as well as it caused many to suffer on the wide scale.

According to the view of many contractors, in high inflation environments, by means of price escalation clauses contractors may receive slightly or quite higher compensation than they really deserve. This is observed in contracts in which the real price inflation in construction work items is surpassed by

[1] Public Procurement Law No. 4734 was published on 04 Jan. 2002 in Official Gazette in Turkey, available at http:// www.kik.gov.tr.

the inflation figure that the escalation formula suggests. And during ‘80s and ‘90s in Turkey, it was not uncommon that initially underestimated construction bid prices had been inflated to quite profitable levels by such price escalation clauses. On the other hand, with the 12-month inflation rate seemingly lowered during 2005 to one digit figures, many contractors have been raising complaints that the current price escalation clauses do not reflect in a fair manner what the real inflation rate in the construction market came out to be.

Additionally, it is a fact that local currency devaluations that have happened overnight in Turkey during the recent decades have forced many contractors into financial crisis and even into bankruptcy.

High inflation rate and high governmental debt go hand in hand like the famous chicken and egg problem. High inflation rate can more than double the governmental debt amount in a year because loan rates at which the government takes loans are well above the inflation rate. At the same time, high debt amount of the government largely diminishes bargaining power of the government for receiving favorable loan rates. And, that causes the creditors to ask for sky-high loan rates which further worsen the situation.

In Turkey, a significant portion of project portfolios of prime contractors are constituted by public contracts which are characterized by budget unavailability. Due to that fact, Turkish contractors are very often faced with contract duration elongations due to budget restrictions. The apparent drawbacks of duration elongations are reduced productivity, excessive overhead expenses, lower than expected annual turnover figures and diminishing profit margins. Therefore, when faced with such a threat abroad, contractors have to take account of these effects in advance within their risk markups.

And, even if the reason for long duration of the contract is not due to budget restrictions but due to nature of the project, it should be kept in mind that

future always comes with surprises and uncertainties. Therefore, contractors should better think twice before they finalize their risk markup decision when they are faced with a project spanning multiple years.

In studies of behavioral economics[2], it is observed that individuals discount payoffs over short horizons at a higher rate than they do over long horizons. This phenomenon is termed as "hyperbolic discounting" first by Richard Herrnstein (cited in Ainslie, 1975). When confronted with the choice between receiving payments of $50 now and $100 after a year from now, most people tend to choose the instant $50. In this case, the applied discount rate exceeds an incredibly high 50%. However at some point in the time horizon, our preference reverses. Given the choice between 50$ in three years and $100 in four years from now most people will choose $100 in four years. In order to explain this observation, it was hypothesized that the discount function with regards to time is shaped like a hyperbola. In more simple terms, individuals typically show very sharp impatience for short horizon decisions, but much more patience at long horizons (Mullainathan and Thaler, 2000).

Contractors also seem to be affected by the "hyperbolic discounting" phenomenon. Let's assume that a contractor has to make a choice between two tenders which were announced for two short-term projects and for the sake of simplicity let's assume that contractors can not earn their profits until the completion of the project. For the first project, he is offered 10% advance payment and he also estimates to earn 10% profit. Whereas, for the second project he estimates to earn a real 12.5% (according to net present value) profit at the end of year one without receiving any advance payment. Most contractors will favor the first choice over the second one for the sake of immediate gratification of their need for earnings achieved by

[2] Behavioral economics is the combination of psychology and economics that investigates what happens in markets in which some of the agents display human limitations and complications (Mullainathan and Thaler, 2000).

means of receiving the advance payment. However when they are faced with two contracts of long durations – e.g. four years versus five years offering profit margins of 10% versus 12.5 %, most contractors favor 12.5% in five years over 10% in four years. It should be noted that the duration difference between two choices is one year in both experiments. In that aspect, in connection with the discount function of the profits to be earned, duration of contracts carries a particular importance in deciding on bid markups.

In his credit-card research, also David Laibson studied the concept of "hyperbolic discounting". He explained how the consumers were willing to pay higher than reasonable interest rates on their credit card debts, while they were expecting much smaller returns for their long-term investments. Laibson based his mathematical model on the finding that our discount rates are greater in the short run than the long run, where the resulting discount curve presents a hyperbolic manner (cited in Dupree, 2001).

In addition, Shash and Abdul-Hadi (1992) state that a project having a long construction duration will allow the contractor to keep his resources in revenue generating state for, at least, a period extending over the project duration, hoping that a prosperous economy will emanate before the completion of the project. This suggests another reason why contractors may assign lower profit margins for projects extending over long durations.

4.2.1.3 Contract payment type

Contract payment type, that is whether the contract is lump sum, unit price or cost-plus-fee, is of great importance to contractors while deciding for their risk markups.

Cost-plus-fee type contract payment is the most preferable contract type and lump-sum contract type is the least among contractors when considered from risk point of view.

With cost-plus-fee type, contractor guarantees himself an almost certain amount of profit which is very often expressed as a certain percentage of the base contract amount. This percentage is explicitly agreed upon with the owner of the contract. However, under some circumstances, contractors may not be content to have such a fixed profit margin that may seem relatively low when compared to that of their other projects and that has no room for growing. But, because of the usual practice that cost-plus-fee type contracts are performed on the basis of direct negotiation between the two parties without a formal tender procedure taking place, it offers a lot of incentive to the contractor for having such a contract payment type.

Some contractors are more content to have unit price contracts than to have cost-plus-fee type contracts. The main reason is that their profit margin is not explicitly known by the client. In particular situations, where there is no significant competitive pressure and where contractor has a desire to make large amount of profits through lump sum or unit price type contracts, the contractor will apparently not want his profit margin to be known to the client. Otherwise, the client organization may seek ways to reduce contractor's profit to a level that they deem reasonable. And, because some contractors have an optimistic tendency to believe that there is always room for more profit if they can work more effectively and efficiently, they may prefer unit price type to the cost-plus-fee type contracts.

Lump sum type contract is very often the least preferred type of contract payment among average contractors. Because, with lump sum contracts, generally, as a design document, only preliminary design documents are handed over to the contractor and the contractor is then asked to carry out the rest of the design with respect to predefined specifications. Although it is quite a good chance for a contractor to perform the design utilizing his hands-on experience gained from previous similar projects, it is a burden to many others who lack such an ability and experience. Therefore, in general, small size companies complain that with the use of lump sum type contracts

clients are transferring almost the entire risk to the shoulders of the contractor. And, the risky situation is doubly worsened for a small –size contractor, because in addition to lacking the design skills, the small-size contractor may not have sufficient experience and resources to elaborate on the particular risks specific to the project. The situation is different with large-size contractors having relevant experience. Because of the fact that large-size contractors are more likely to have in-house design capability or close business relationship with design companies, they may feel themselves more comfortable and competitive with the lump sum type contracts. If a contractor knows how to create a more efficient and effective design with the use of his own experience, he gains some significant competitive advantage against competitors who lack proper design skills. That is to say, in a lump sum project, utilizing his design know-how to create a leaner but more effective design, the contractor grabs an opportunity to deliver a construction project at a lower cost than his inexperienced competitors can.

One apparent advantage that unit price contracts have over lump sum contracts is that the contractor does not bear the risk of underestimating the actual amount of work items to be performed at the site. Exact estimation of the amount of work items from project drawings is a tiresome process requiring highly skilled personnel. And for a lump sum contract, in case the contractor underestimates the amount of work items or misses to include some cost items during tender preparation stage, his markup therefore his profit margin will get squeezed by the unexpected cost increases that he may incur during execution of the project. This is a good reason that pushes contractors to consider a wider risk margin for lump sum contracts than for unit price contracts.

Almost all contractors possess a formal or informal database of previously prepared price analyses for typical work items. Therefore, what is good with unit price contracts is that, once a contractor learns about the market costs

of typical construction materials, machinery and labor, he can automatically estimate the total direct cost for the contract by means of utilizing the price analyses already at hand. As a result, while typical cost study duration for a unit price type contract tender is one week, this duration can easily exceed one month for a lump sum type contract tender.

4.2.1.4 Type of project

When the general profile of large-size Turkish contractors is examined, it is hard to say that they can be distinctly classified as housing, building, industrial or infrastructural contractors. They rather tend to act as general contractors in diverse construction market sub-sectors. That attitude can be attributed to the boomy economic period of late ’80s and early ’90s during which the Turkish government was pouring vast financial resources into construction investments. During that period, the applicable public tender law did not strictly stipulate that contractors must have similar project experience realized within a certain number of previous years. Instead, a ‘contractor’s license’, that was relatively easy to obtain when compared to the current requirement of having a similar sized similar project completion certificate, opened the way to many contractors to be qualified for numerous and diverse type of projects. The law at the time demanded also some technical and financial requirements, but those did not prevent an average contractor from entering into competition.

As a result, during that particular period, contractors which had skillful and experienced managers and financial resources enough to provide at least the required performance bonds managed to be awarded large projects like dams, highways, etc. The public tender law effective at that date cannot be blamed for its above mentioned deficiency, first because there was not enough number of contractors holding similar-sized similar job completion certificates and second because one of the government’s primary aims at that time was to inject money into Turkish economy through the construction

sector. That is why the Turkish construction sector is titled as a ‘locomotive sector’ among many others in Turkey.

Regarding these facts, it is easy to infer that during ‘80s and ‘90s, the most logical strategy for Turkish contractors was to be active in diverse construction project types in order to have a larger piece of the cake. The benefit of this strategy is now evident in the fact that the current public tender law stipulates that contractors must possess a similar sized similar project completion experience in order to be qualified for a public tender. As this rule is also stipulated in the construction tenders of foreign countries, many large-size Turkish contractors operating abroad are now entitled to be active in more than one construction sub-sector at a time.

Although such a diversification is not quite easy for a small-size contractor to achieve, the general view among large-size contractors is that in case there is no qualification impediment in terms of previous project completion experience requirement, they will not hesitate to be involved in a new construction sub-sector. This is mainly because, if the size of the project is attractive, large-size contractors believe that they can hire any number of skillful technical personnel and they can make the entire range of necessary machinery and equipment ready through subcontracting or by means of leasing, although they originally lack the particular project experience.

However, a contractor accustomed to a certain project type would be likely to assign a lower risk markup than an inexperienced one would, because the former is likely to have greater confidence in himself in being able to perform the project in accordance with the requirements of the contract.

4.2.1.5 Client type

Due to the extent of opportunities offered by public projects during the recent decades, many Turkish contractors are accustomed to contracting for the public projects. And, this is for long seen as the sole strategy in order for

a construction company to have a stable path to healthy growth. Because, during the previous decades private sector lacked the abundant resources to finance worthwhile construction projects such as large infrastructural projects that were built under ownership of the public.

Being accustomed to that strategy, it is normal that Turkish contractors may prefer public clients to the private ones. And one of the most prominent reasons of that preference is the relatively better financial reliability of governments. Believing that governments have vast financial resources, contractors have the belief that in case a public client fails to pay a progress payment this month, he will pay it the next. And, in case a problematic situation is faced with a public client, there are numerous governmental organizations that contractors can resort to in order to solve the conflict. All in all, governmental organizations are expected to look after the best interest of the public, therefore they should spend their efforts to complete the project in a well manner promoting the contractor without seizing his rights.

On the other hand, in the case of a privately owned project, owner may shift budget of a contractor's project to another immediate need and the project may be left with scarce resources. And in case a problem is encountered with the private client, the main party that the contractor has to resort to is the boss of the client who will apparently look after only his own self interest.

Therefore, contractors are expected to pay closer attention to their risk markup estimation for private projects than for public projects. However, it should be noted that such a generalization may not hold true at all times since there also exist some giant international private corporations (such as The Coca-Cola Company, IKEA, etc.) which give away contracts for numerous construction projects. In many aspects, from the point of view of contractors, these giant private clients' image is also at least as much robust as that of public ones.

4.2.1.6 Size of the contractor company

Construction market is highly fragmented and it has low entry barriers especially for small contractors. Small contractors usually benefit from low capital requirements for market entry.

In case population distribution of contractors in terms of size in a typical market is visualized as a pyramid, small contractors constitute bottom of the pyramid whereas large contractors constitute the top. During the growth curve of companies because many companies fail to jump from small to medium size level or from medium to large size level, population of the contractors shrinks as one climbs up the pyramid.

Bosses of small contractors generally live with the desire to climb up the pyramid. They motivate themselves with the stories of how the union of two young engineers has evolved into a large contracting company. As they focus on the top of the pyramid, they also focus on achieving the mainly perceived attribute of large companies: high annual turnover. Because the long term desire of becoming a large company usually outweighs the need to be profitable in the short term, small companies may easily sacrifice from their profit margins for the sake of attaining large annual turnover figures. In addition, small companies are generally ruled by a single person and that single person may easily tend to act as trouble tolerant because he considers each trouble as a step helping him to climb up the pyramid. It may be substantially gratifying for him to become an active member of the contractor society in which he gains acceptance through completing numerous projects. All in all, he has not got so much to lose on his own.

Considering the high population of small contractors and their big need for achievement, it is easy to say that they will behave more aggressively than the upper level members of the pyramid will do to win new tenders. In case small contractors can not afford to participate in tenders as prime

contractors, they will opt for subcontracting for larger and reliable Turkish companies operating abroad.

An important threat for the sustainability of small contractors exists during the transition stage of the companies from subcontracting medium to prime contracting medium. Because of the fact that they have so far operated under the umbrella of prime contractors, subcontractors are likely to be unaware of the many risks that prime contractors live through. That is another reason why small contractors tend to underestimate their risk markups.

Medium-size contractors generally suffer from the false sense of confidence. That false sense of confidence emanates from the feeling that their risky behavior has so far successfully opened up their way in spite of the whole turbulence they have experienced, and now that they have already jumped up to the next level on the pyramid, they suppose that their growth trend that they have maintained so far will keep them climbing up to the top level.

Now that the need for achievement of the formerly small-size but currently medium-size contractor has partially cooled down with his recent achievement of transition from bottom level to the medium level, he should focus on earning previously ignored profits that should serve to earn him power and status in the society. Therefore, he should now act more selectively during identification of the potential tenders. But once he identifies a suitable candidate tender in line with his strategy, his false sense of confidence may cause him to underestimate the importance of risks, whereas he seeks slightly or fairly above the usual profit margins to satisfy his growing need for power.

Once a medium-size contractor achieves transition to the top level, he should have already realized some related-diversification along his business scope. When large Turkish contractors are examined, it is realized that

many of them have already diversified into running touristic hotels, developing real estate and investing in virgin lands that promise high returns on investment. Turkish contractors are even known for their establishment of joint ventures for real estate development abroad.

Now that the large-size contractor has diversified into numerous markets and sectors that have high and relatively sustainable returns, he becomes at least partially risk averse. In addition, if he thinks that the construction sector does not any more offer the profit margins that his other businesses do, he may become unwilling to bear the risk of undertaking a construction project even if he marks his bid up with a reasonable risk margin.

Besides, because large contractor organizations operate with a large and qualified array of executives who act with conscience, it is hard for one executive to make his risky and irrational decisions acceptable to the rest of the executives.

Even during a countrywide stagnant economic period in construction sector, many large Turkish contractors will not be eager to win new tenders with a tendency to knowingly underestimate the real risk margins. That is because; they can still enjoy the benefits of diversification and fairly high returns from their liquid assets. The bosses' order to the operational executives is clear and concise: "Don't get me into trouble!".

One important aspect of very large contracting companies' executives is that for them sustainability of well-being of the company comes before the aim of any further profit making. Large contractors should have already fed their hunger for power and they should be feeling themselves as one of the few top contractors which realize very important projects that serve the needs of the society. In addition, the company in itself has already become a large society that has to be sustained and preserved. For that reason, sometimes moderate profit margins may be acceptable to large contractors in order to meet just the overhead expenses of the company.

On the other hand, one should keep in mind that contractors sell mainly their skills that are necessary to combine manpower, machinery, material and design in order to satisfy the contract requirements. Therefore, when a large contractor is faced with a very large and complex project tender, he may pick a large bid markup provided that he is not too much sensitive to competition or competition does not exist at all. A possible lack of equivalent competitors gives large contractors an edge in setting prices and therefore markups.

4.2.1.7 Level of experience of contractor in similar type of projects

Stanovich and West (2000) distinguish between two types of cognitive processes which are labeled system 1 and system 2. The operations of System 1 are fast, automatic, effortless and difficult to control or modify. Whereas the operations of System 2 are slower, serial, effortful and deliberately controlled; they are also relatively flexible and potentially rule-governed. By means of that two system view, intuition (System 1) is distinguished from reasoning (System 2). Operations of System 1 generate impressions of the attributes of objects. Intuitive judgments are automatic. The label 'intuitive' is applied to judgments that directly reflect impressions. One of the functions of System 2 is to monitor the output of System 1 (Kahneman, 2002). However, the study of Kahneman and Frederick (2002) suggest that the monitoring is normally quite lax and allows many intuitive judgments to be expressed, including some that are erroneous. It also suggests that people are not accustomed to thinking hard, and are often content to trust a plausible judgment that quickly comes to mind.

Variations in the ability of System 2 to correct or override intuitive judgments are explained by variations in the accessibility of the relevant rules. An intuitive judgment that violates a rule which the respondent accepts will be overridden, if the rule comes early enough to the respondent's mind (Kahneman, 2002).

And in order for an expert to facilitate the applicability of rules to intuitive judgments, he should have a large and reliable set of rules. That is to be obtained mainly through hands-on experience. Unless a contractor has lived through the typical risks posed by a particular type of construction project, his intuitive judgments on risk may become prone to unrealistic optimism. Therefore it results in underestimation of the risk margin.

Because the end products that clients demand are to be tailor-made in the construction market, clients do not have the chance to go to shopping to look for the end product that meets their specific needs. On the contrary, they depend merely on the contractor and eventually on his ability to deliver what they need. Therefore, it may be suggested that contractor's ability is of utmost importance to the client. And, knowing that ability is built upon experience, one can easily claim that experienced contractors are more likely to satisfy the needs of clients with favorable terms such as low cost and high quality.

Small contractors should better abstain from projects abroad for which they deem themselves almost inexperienced. One can assume that he can avert prospective country or project risks making use of his own abilities or benefiting from client's compensation. However, once a contractor defaults to meet the expectations of a client, the client is very likely to become cruel so as to preserve the well-being of his own project. In such a case, the contractor is expected to incur some big losses that were initially very difficult to estimate during the bid preparation stage.

However, general tendency of large to very large contractors is that they are eager to undertake any type of profitable and large construction projects for which they are qualified according to tender documents. Their main assertion is that they are adept at hiring highly skilled technical personnel and delivering any sort of resources whenever they meet an attractive project. And this attitude occurs mainly because very large contractors have

vast contacts and resources in a way that they can anytime adopt a wide range of required skills and abilities.

4.2.1.8 Level of experience of contractor in the host country / similar countries

According to Weinstein and Klein (1996), people believe that negative events are less likely to happen to them than to others, and they believe that positive events are more likely to happen to them than to others. Weinstein and Klein (1996) also state that: 'According to popular belief, people tend to think that they are invulnerable. They expect others to be victims of misfortune, not themselves. Such ideas imply not merely a hopeful outlook on life, but an error in judgment that can be labeled unrealistic optimism.'

In the light of above view, perceived invulnerability of inexperienced contractors will cause them to underestimate the necessity for taking precautions against risks. Therefore, it may be claimed that a contractor who is unaccustomed to risks of the concerned foreign country is more susceptible to risks and therefore losses.

Large companies tend to have clearly defined short-term and long-term strategies that already point to their target foreign markets. Those markets are mostly identified through having arguments with experts or following the actions of other large companies who have wide experience abroad. And once they enter a foreign market, large companies want to assure that there is a strong prospect of long-term presence of the firm in profitable terms in the market. Therefore, large companies widely abstain from entering a foreign market, if it is out of the scope of their long-term strategy that has been imposed by the top management. In addition, large companies tend to stick with the countries where they have been already active. One advantage of such a strategy is that once they become accustomed to the particular risks of a country and learn how to control and prevent them, they can more comfortably enjoy profits rather than having to care for risks. And

the lower the risk becomes, the lower the profit expectation of shareholders is set. In that way, contractor becomes more competitive increasing its chances of winning new projects.

On the other hand, small-to-medium-size contractors may act more swiftly during entering and exiting a foreign market for the aim of completing a single project. And they rather prefer operating in countries where their elder brothers' presence gives them a peace of mind.

4.2.1.9 Financial capability of the contractor

Although keeping cash deposits except for vital and basic needs is not of very high importance to a contractor, it is very important for him to have a good reputation among financial institutions, suppliers and service providers. And because the failure of a contractor to service his debts to the market or banks will harm his overall reputation, he may then easily find himself in difficulty to provide bonds for tenders or he may have to purchase materials and services at inflated price levels that eventually cut into his profit margin.

One way for a client to relieve the possible trouble of a contractor in terms of finance is to offer the contractor an advance payment. With some contracts, contractors may also get paid in advance for their mobilization costs and material purchases. In such a favorable case, provided that the contractor can deliver required guarantee bonds, the original financial capability of the contractor may have no effect on his ability to undertake the contract.

In fact, in an ideal profit-generating project, contractors most of the time do not have to employ their cash deposits in notable terms. Even if they may have to charge the project with some cash in the beginning, they receive compensation within a month or so. Therefore, the concept of financial capacity of a contractor usually reduces to the contractor's capability to

provide guarantee bond in the required amount without taking into consideration the volume of his cash deposits or liquid assets.

4.2.1.10 Technical capability of the contractor

The issue of technical capability can be examined from two aspects, namely technical personnel and owned machinery. The issue of core technical personnel is very important at the stage of tender preparation, but the whole range of technical personnel need not be situated in-house as they can be hired on an at need basis. In addition, owning a fleet of construction machinery can sometimes pose burden to the company due to its high maintenance costs.

Having high technical capability in a particular sub-sector of the construction market signifies that the contractor is specialized in that particular field. And that sense of specialization may cause the contractor to give emphasis on that field neglecting others. Eventually he may feel pressure to build barriers in his field to his competitors by reducing his profit margins below the market's usual practice. The situation is worsened in case he cannot diversify to other fields in order to earn profits. In that way, the contractor's persistence in a particular field eventually erodes his markup in new tenders.

4.2.1.11 Managerial capability of the contractor

Bearing in mind the fact that every large company was initially established from level zero by a single or more number of wise managers, it should not be wrong to think that their managerial capability underlies the companies' success. And, should these managers persist to be in charge of their companies ever since the establishment stage, acceptance of the above view is further reinforced.

Hillebrandt and Cannon (1990) identified management, rather than fixed capital, as the most important determinant of capacity as well as capability

of construction firms. Contractors usually do not attach too much importance to the issue of availability of resources at their own direct disposal. Through utilization of good management skills, resource capabilities of contractors can be improved by means of subcontracting and hiring of personnel and machinery.

There is no doubt that business and operational strategies spread from top to bottom in the organizational hierarchy, so managers' contribution to the overall well-being of a construction project cannot be overlooked.

All in all, as managers at all levels are the sole agents that can react to the risky environment that the company is in, they are the ones who have force and control over the extent of unforeseen costs to be incurred by the company. During the execution of a project, managers are destined to hold the total amount of unforeseen costs within the limits of the initially established markup buffer. The more they polish up their management skills, the more it is likely that a lower markup is established beforehand against formidable events.

4.2.1.12 Planned percentage of subcontracted works

Small-size contractors generally tend to carry out their projects through directly hiring their labor and machinery and directly purchasing the materials. This 'direct model' helps them maximize their profit margins.

Medium-size contractors on the other hand, due to their wider and more complex scale of activity, cannot afford to directly supervise and control hiring of the entire labor force and procurement of the whole range material from the market. For that reason, in order to increase their efficiency and to transfer risks, they prefer to subcontract portion of the works to other parties. Subcontract prices of the work items are defined in a way to allow the prime contractor a reasonable profit margin so that the prime contractor increases the level of certainty of achieving the initially set profit markup.

Subcontracting is also considered as a means of outsourcing. Hence, subcontracting allows prime contractors to reduce their overhead expenses.

Most of the time, it is more profitable for contractors to subcontract their works to reliable subcontractors than to undertake the works themselves. Labor and material costs utilized during the bid estimation stage generally have a margin in themselves which can be transformed into extra profits in case the contractor pays close attention and spends extra efforts for bargaining over the initially collected offers from the market. However, medium-to-large-size contractors generally perform their procurement activities through several agents without enough level of bargaining. Therefore, they pay extra premiums on top of the product's original sale price at the initial point of sale.

Having been awarded the project, in case a contractor opts for subcontracting the works, he can receive bids from subcontractors well below his initial cost estimates for two reasons. First, a subcontracting company is very likely to have high bargaining power for the constituents of his share of relatively narrow range of work items, so his real cost is well below the initial cost estimate of an average contractor. Second, now that the contractor holds the contract, he also holds the initiative to heat up the competition among numerous subcontractors some of which are craving for new job opportunities.

At the same time, small-to-medium-size contractors may sometimes construct their bids based upon lump sum estimates prepared by subcontractors. This approach sometimes fits well to medium-size contractors because it decreases the level of effort that the contractor has to spend for bid preparation, lessening the burden on his limited number of personnel.

Large to very large-size contractors on the other hand, relying on their large and skillful staff, prefer the 'direct model' during the bid estimation stage.

For a project abroad, if they do not posses enough experience in that foreign country, large contractors prefer to employ agents to gather information about basic cost components. Most of the time, they have standard item lists for which pricing information should be gathered. They cannot usually rely on offers of local subcontractors in a foreign country. Because of the fact that local subcontractors generally have the belief that the foreign contractor is bound to work with them, they have a tendency to inflate their offers.

4.2.1.13 Amount of cash required in advance for the beginning of the project

In case the contractor is required to pre-finance a project, he will have to utilize his own resources or borrow from a bank. Although the cost of borrowing from a bank can be included into the cost estimate of the tender, the risk of failure to pay the loan back to the bank still exists. And this risk is very likely to be reflected in the risk margin as additional percentage points. Furthermore, if a contractor utilizes his own financial resources, such a commitment is also likely to reduce his overall economic leverage.

On the contrary, in some markets contractors have met projects which offered 20 – 40 % advance payment. In such a case, the contractor may feel that he will earn his whole profit at the very beginning in case he is awarded the project. People have a greater motivation for instant rewards than for delayed rewards. Since the main motivation of a contractor in performing a contract is earning profits, once he is proposed to make profits instantly, he will jump onto that opportunity. And being driven by such optimism, the contractor may ignore or underestimate the majority of risks inherent in the project.

4.2.2 Risk Factors

4.2.2.1 Vagueness of design (due to incomplete design / insufficient project drawings)

Vagueness of design constitutes the greatest risk for incapable contractors in case the contract payment type is lump sum. In the case of unit price type contracts, contractors may find it easy and appropriate to utilize their previously calculated unit prices adjusting them for relative difficulty of the project and differences in the description of work items rather than having to worry about the accuracy of quantity estimates.

Large contractors which possess design ability can transform that deficiency of design documents into a competitive advantage against contractors who cannot properly estimate what the client exactly requires. Small contractors, on the other hand, face the risk of submitting an offer that underperforms expectations of the client. Such an offer will either be rejected or in case that incapable contractor is awarded the project, the contractor will have to bear unexpected costs which squeeze his initially estimated profit margin.

4.2.2.2 Lack of enough technical information (such as site and geological conditions etc.)

Lack of enough technical information such as site and geological conditions is of high importance to contractors especially with lump sum type contracts. Ground improvement works include a wide array of construction methods which vary substantially in difficulty and cost. Therefore, in case the required ground improvement works can not be estimated with enough accuracy in advance, the contractor will have to bear the related extra costs during execution of a lump sum project. However, with most of the projects geological information, at least in the level of borehole log details, is handed over to contractor by the client. Therefore, relying on their level of experience with previous projects, contractors generally may not consider this issue as a big problem. If they do not feel comfortable with the available

technical data, they opt for visiting the project site having meeting with client's engineers in charge of the project.

4.2.2.3 Vagueness of contract conditions (unclear risk allocation between client and contractor etc.)

This is one of the factors to which contractors should pay utmost attention. Because a contract is the key source for the contractor to resort to in case of a critical dispute, contents of the contract can act both in an evil and a good manner against the contractor. Usually contractors are given a standard template contract at the tender stage. During the contract signing stage, in order to stipulate extra contract clauses to his own advantage the client may seek to benefit from the contractor's excitement to immediately sign the contract. In case the contractor fails to examine the contract clauses thoroughly before signing, he may face unprecedented risks during execution of the project.

So far many Turkish contractors are accustomed to working abroad with FIDIC type contracts which they generally deem fair and reliable. Therefore, in case a client intends to employ his own version of contract other than FIDIC, it will be a wise action to have the contract examined by capable lawyers and construction professionals. Also contractors should pay close attention to which courts are declared to be authorized in case of a dispute that may between contractor and client. In case solely the local courts are declared to be authorized, contractors should evaluate whether the local courts tend to have bias against foreign companies or not.

4.2.2.4 Unavailability of required construction materials and supplies in the host country (Resource risk)

According to anecdotal evidence, contractors usually reflect this resource related risk factor in their cost estimates. If they think the required materials are not available in the host country, they go for supplying them from Turkey. Since the logistic fleet of Turkey is quite strong, material supply

issue in nearby countries, to where highway transportation is relatively easy, should not pose a risk to contractors. They only have to plan the delivery schedule in advance so as not to cause interruptions in the progress of works. Also, in countries where terrorism along the transportation path poses a threat, contractors go for transferring their goods on the border onto lorries owned by local firms. In that way their logistics activities do not draw attention of possible menacing bodies.

4.2.2.5 Lack of competence of local parties (local subcontractors, local labor etc.) in the host country

Lack of competence of local parties such as local subcontractors and local labor in the host country is a factor worth great attention in case the contractor is inexperienced in that particular foreign country and is not capable of quickly deploying its key skilled labor to the project site.

Because the main construction markets for Turkish contractors are constituted by undeveloped and developing countries, local subcontractors that Turkish contractors work with are very often not accustomed to the performance and quality criteria imposed by large-scale international contracts. Therefore, contractors generally have to pay more than usual level of effort for supervision of the works subcontracted to local subcontractors and have to bear the risk of subcontractors' poor performance in international projects.

In undeveloped countries, because the locally available parties lack almost the whole range of technical and financial capabilities to undertake medium-to-large scale contracts, local parties most of the time can merely fill positions that require low level skills. Therefore, in undeveloped countries almost all the skilled construction force and technical personnel is composed of foreign people instead of local nationals.

On the other hand, in developing and developed countries, because governments are more sensitive to socio-economical issues and because they have more power to impose stipulations to foreign contractors, they may force foreign contractors to have their labor force comprised of local nationals at a considerable minimum percentage level. By that means, it is aimed to assure that the local society benefits from the project to the maximum extent, even during the project execution stage. In such countries from point of view of contractor, productivity of local labor may appear low due to three main reasons. First, local labor may lack necessary experience and skills. Second, local labor may not have enough motivation to work under harsh conditions requiring some level of physical effort because their national wealth is good enough. The last but not the least, local labor force may be very sensitive to their labor rights. Due to all these reasons, contractors often face situations such as having to pay above the usual level of wages and instances such as having to stop all the construction activity as soon as the pre-defined daily working shift is over. It is not unusual for Turkish contractors working abroad to observe an event such as a local crane operator stops his activity as soon as it is 6 pm while the bundle of goods is suspending in the air being still attached to the lifting rope of the tower crane. In addition, it is worth attention that local labor and subcontractors may ask high prices from the contractor because they know that the foreign contractor is bound to hire them as the government requires in the contract.

Due to the above mentioned reasons, Turkish contractors generally go for supplying to the maximum extent his technical personnel and a large percentage of labor force from Turkey.

4.2.2.6 Unfavorability of physical conditions that may adversely affect productivity at site (such as adverse weather conditions etc.)

According to anecdotal evidence, at the first instance, contractors tend to include unfavorability of physical conditions in their cost estimate as a reduction in overall productivity (such as by reducing the number of available working days in a year considering the annual weather reports). However, the level of reduction in instantaneous productivities of labor and machinery can not be easily quantified taking into account the lack of data and formulation. So, contractors may seek to alter their risk margins to account for the unfavorability of physical conditions at the project site.

4.2.2.7 Technical and technological complexity of the project

Large-size contractors feel that they can flexibly extend their technical and technological capability through acquisition of resources from outside parties such as hiring skilled personnel or skilled subcontractors. And they already reflect such complexity to their costs through extensive analysis and cost studies. All in all, they do not tend to reflect such complexity into their risk margin. However if a contractor believes that the capability that the unusual complexity demands is possessed largely by him but not the other competitors, he may feel that his profit margin has room to grow more than usual.

4.2.2.8 Strict quality requirements/ specifications (stricter than the contractor's usual practice)

The issue of quality specifications which are stricter than the contractor’s usual practice demands is remarkable. In case the contractor cannot meet the specifications stipulated in the contract, he is bound to incur high rework costs. Moreover if the situation gets worsened to a level at which dispute arises between the contractor and client, progress of the project is very likely to get blocked. Contractors are warned to evaluate carefully whether

they can satisfy the quality requirements of the client with their current resources or not. If not, they have to include the extra costs of improving their working methods and resources.

In addition, if the contractor does not realize that the requested standards or specifications are stricter than his usual practice, then it means that he wrongly assumed, in advance, the nature of actual construction practices. Such underestimations obviously result in cost underestimations. Therefore, when faced with strict and unfamiliar standards, contractors may prefer to push their risk markups up.

4.2.2.9 Tightness of the project duration / Existence of high penalty (liquidated damage) clauses

The most apparent problem with tight project durations is that, congestion at project site significantly increases. With tight project durations, performance of activities will overlap, idle hours of machinery and labor will increase due to planning deficiencies, rework will increase due to poor control and materials will be piled up at site in excess amounts therefore resulting in substantial material wastages.

In case contractors deem the contract duration very tight, they opt for including expected damages, which they may incur according to the contract, in their estimate. Such an approach is quite logical though it may not be the most feasible one. Contractors should anyway spend their best efforts to complete a project on time. Otherwise, they should take into account that their reputation may be significantly harmed and level of relations with the client may deteriorate.

4.2.2.10 Lack of infrastructural and civil development in the host country

At first sight, it appears that lack of infrastructural and civil development in a country is a disadvantage to a contractor because living conditions are

harsh and logistics facilities are poor. On the other hand, when developed and undeveloped countries are compared with regard to the favorability of their construction markets, it is realized that construction markets in developed countries have already saturated whereas those in undeveloped countries offer lots of opportunities to Turkish contractors.

Turkish contractors usually find it illogical to seek a project in developed countries. They see that these markets are stagnant and even shrinking in size while large-scale local contractors, there, are seeking projects merely for survival. Therefore, Turkish contractors understand that in developed countries no client would be willing to award a tender to a foreign contractor while, as a reality, local contractors are craving for work.

The biggest opportunities that undeveloped countries offer to foreign contractors arise when those contractors are one of the few first competitors to step in. Because these countries are in desperate need of civil development and competition in their market has not yet developed, clients are naturally willing to pay extra premiums that the contractors demand. Also, because construction market prices are yet far from the state of maturity, wildly high bid amounts may be acceptable to clients in many cases.

4.2.2.11 Geographical distance between host country and Turkey

The issue of geographical distance concerns the contractors from three aspects. First, as the project site gets farther away from the home country of the contractor, it is more likely that the contractor shall recognize greater number of eccentricities and unfamiliar characteristics in the environment. Therefore, contractor may face difficulties in adapting to the environment, impairing his overall ability to confront risks. Second, the psychological effect of distance takes stage. The contractor may feel that the isolation of the project site from the home office –due to the largeness of the distance between the project site and home country- eliminates the possibility of due

support from home in case an issue arises at the project site. Resultingly, the decision makers may elevate their markup estimates. The last but not the least, distance brings difficulties in terms of logistics. As the distance of the project site from home country gets larger, problems in logistics of material from home to the site gets tougher. In case material is to be largely supplied from the home country of the contractor, the uncertainties in due material supply increases.

Turkish contractors are usually eager to carry out attractive projects in any country as long as that country does not possess barriers to their entry. However, when recent markets in which Turkish contractors are active are examined, it is observed that contractors are mostly dealing with projects situated in the continents of Asia and Africa.

4.2.2.12 International relations of the host country with Turkey

Level of international relations of the host country with Turkey is an important factor for executives to consider while formulating their long term strategy. In case relations between the two countries are in good shape, it is most likely that attitude of clients to Turkish contractors will be positive. At least, in case a client has to make a selection between two contractors of different nationality with similar qualifications, he is expected to choose the one whose nation is favored by the host government.

Good shape of relations between the two countries also helps these countries build healthy economic relationships and sign economical agreements in order to facilitate the bilateral trading. And sometimes government officials may publicly make inviting declarations to encourage the contractors of their friend country to operate on their land.

In international tenders, also it is not unusual to meet instances such as; government officials openly promote the participation of amicable nations as a government policy and ban the participation of disliked ones.

4.2.2.13 Economical / financial risk of the host country and/or client

The impact of economic risk can be very significant when an economic recession or crisis occurs in a country.

A report to the World Bank (Kirmani, 1988) found that considerable delays in World Bank financed projects in Asia have been caused by financial failures of contractors because of adverse economic conditions (cited in Chua et al., 2003).

A significant portion of the construction sector is constituted by small-to-medium-size contractors. Therefore, when there appears a tightening in cash flow in the market, a large portion of the sector suffers due to the limited financial resources that these contractors possess.

Although economical risk of the host country –where the project is carried out- is a significant risk factor, some contractors may feel indifferent to it. That is because, large organizations backed by reliable countries frequently fund construction projects outside their home countries and they usually act as clients to these projects. In such a case, the reliability and trustability of the client or the backing organization precedes and sometimes completely outweighs the concerns about the economical reliability of the host country. Therefore, economical/ financial risk factor should be defined so as to consider both the host country's and client's risks.

4.2.2.14 Foreign exchange rate / inflation rate fluctuation risk

One of the very first items that an executive questions during a tender preparation is whether the payments are to be received in a reliable currency or not. The common currency that the Turkish contractors, abroad, rely on is USD. In case clients offer to pay in terms of their local currency instead of USD or any other widely accepted currency, the contractors' first reaction will be to insist on receiving payments in USD or to fix the contract

prices in USD. If that request is not welcomed by the client, this time contractor closely examines the exchange rate history between the two currencies and also the inflation rate history in host country. Provided that an anomaly is not observed, contractors may accept to receive payments in local currency.

Another important issue regarding exchange rate and inflation rate fluctuation risks is the extent to which the contract compensates the contractor's losses arising from happening of these risks. Price escalation formula suggested by the contract should be examined thoroughly, checking whether the compensation is fair considering several alternative scenarios of exchange rate and inflation rate fluctuations.

Apart from the inflation rate fluctuation risk, there appears some risk also in countries where there is constantly high inflation rate. However, according to his experiment results, Raftery (1996) states that there are indications that in the presence of inflation people are more likely to take risky options because they appear to let the inflation cloud the underlying real figures. Therefore, in environments where inflation is high, contractors may tend to underestimate their markups.

4.2.2.15 Immaturity / unreliability of the legal system to which the contractor is subject according to the contract (legal risk)

Contractors usually consider going to court as the final measure to resort in case of a conflict with the client. In case a dispute arises, contractor first refers the issue to the engineer in charge in writing, issuing a copy also to the client. And within a certain time period, the engineer gives a notice of his decision to the both parties. In case one of the parties is dissatisfied with the engineer's decision, that party gives notice to the other party to initiate arbitration. However, before the actual commencement of arbitration, engineer further tries to somehow amicably settle the issue between the

parties. In case that also fails, one or more arbitrators get appointed according to the governing rules with the appointment of settling the dispute.

Contractors strongly favor contracts that allow applying to international courts over those that allow applying solely to local courts. Because, foreign contractors are usually biased against local courts holding the belief that local courts have higher tendency towards judging in favor of their own nationals. And, it should be kept in mind that, in case of a dispute, clients may not bother to apply to their local courts – because they are already accustomed to local court procedures. But when a client is faced with the possibility of going to an international court, he may think twice and may favor a good-will solution over a tiresome court adventure. And, that is obviously in favor of the contractor.

All in all, contractors should be seeking all the options to evade going to court with client during execution of a project in order not the hamper the project's progress and well-being. Contractors should keep in mind that the compensation that they hope to gain from the court may be delayed well by many years. So, in case they can estimate in advance the expected financial quantity of dispute that is likely to arise according to the contract terms, contactors should rather include that amount in their risk markup. For that sort of estimation, they can also resort to the experiences of contractors that have previously worked for similar projects of the concerned or a similar client.

4.2.2.16 Instability of the political environment in the host country (political risk) / potential for negative changes in government policies

In the broad context of international business, political risk has been defined by Haendel (1979) as "the risk or probability of occurrence of some political events that will change the prospects for the profitability of a given investment" (cited in Chua et al., 2003).

Political risk events include sociopolitical disorder, political corruption and government interference. Foreign contractors are extremely vulnerable to the risk associated with changes in government policies, laws or regulations. Because, such events could easily impact their rights to operate in the country and to make expected profits. Also, interference of power groups in a project constitutes a significant risk as it may easily hinder the progress of a project (Chua et al., 2003).

Almost anywhere on the globe stability of political environment is seen as a prerequisite to economical stability. Since undeveloped countries are mostly characterized by ruling of dictatorships, they are more prone to political instability than developed countries are. And, since in those countries countrywide decision making at macro level is very much dependent on the politics of the single ruler, instead of the long term politics of democratized governmental bodies, economies of undeveloped countries are more likely to exhibit erratic behavior.

And the effect of current trend towards “democratization of nations” should not be underestimated. In such a transforming country, a countrywide turmoil that may bring foreign contractors’ activities to the brink of halt is inescapable.

In addition, in not truly democratized countries, once a ruling body is overthrown and a new one takes the seat, it is highly likely that the new ruling body will approach the contractors of on-going projects with dislike and suspicion. As a result, ongoing contractors will face challenges while undertaking their projects and moreover they may be ordered to cease their activities. At the same time, it should not be surprising if many other projects at the stage of initiation gets cancelled or suspended to be reviewed by the new ruling body.

4.2.2.17 Bureaucratic delays/ difficulties (in approval of projects, receival of necessary permissions etc.)

Most of the time bureaucratic delays do not pose a serious threat to contractors, because for the sake of well-being of their own projects, clients often help contractors with bureaucratic procedures. However, delay is always considered a risk as it disturbs the planned progress of activities and as the future always comes with uncertainties.

One of the worst possible scenarios in that aspect is a contractor winning a project whose contract poorly compensates for cost escalation. An international contractor once reported a project, in which issuance of notice to proceed by the government took almost 6 years since the tender date, yet the contract's price escalation clause did not compensate for the immense cost increases that took place in the market during that period.

4.2.2.18 Cultural differences between the host country and Turkey (cultural risk)

A culture represents a general pattern of values, attitudes and behavior in a nation. The difference in culture relates to fundamentally different philosophies regarding interpersonal relationships within their environment and concerns the interpersonal trust and people's attitude towards power and authority (Chua et al., 2003).

Turkish contractors operating abroad mostly ignore cultural differences as a risk factor. Highly tolerant and adaptable nature of Turkish people is an important factor contributing to their indifference against cultural differences.

4.2.2.19 Security risk

Security risk is an important factor mainly considered during the bid/ no-bid decision making stage. Because the highest interest of an organization should be preserving its own well-being and therefore lives of its members, no motive that puts lives into risk can be deemed reasonable. In case there

is a countrywide security problem, contractors often abstain from operating outside the military zones where international or local military forces lack control.

Generally, failure of a contractor to protect lives of its employees on a wide scale results in his immediate withdrawal from the market that poses security threats.

4.2.2.20 Existence of language barrier

Provided that tender documents are prepared in English, Turkish contractors generally express that they do not feel threatened by the local foreign language. In case one of the widely recognized languages is employed by the client, large contractors are confident that they can hire the required personnel to take care of the foreign language obstruction.

4.2.2.21 Level of experience of the client (in similar projects, with foreign contractors etc.)

The high level of experience of a client in similar projects with foreign contractors signifies that there are numerous past cases that may serve as benchmarks to help prospective bidders in their markup decision making. Also making use of the knowledge created through hands-on experience of previous contractors, prospective bidders can more accurately assess the potential impact of risks and can even take measures in advance to reduce those risks' impacts. Therefore, when compared to tenders of unexperienced clients, in tenders announced by highly experienced clients, contractors have the chance to establish their risk markups in minimal terms slimming unnecessary percentage points down.

A contractor's one of the prior expectations from a client would be receiving his rights in a fair manner regarding execution of the project. An inexperienced project engineer would be easily biased towards holding the side of the client even in cases that attack the obvious rights of the

contractor. Therefore, assuming that an experienced engineer would be mature enough to act fairly towards both the client and the contractor, and would act swiftly to defend obvious rights of the contractor, contractors should feel more comfortable with experienced engineers. In the opposite case, feeling that he will be deprived of his rights, contractor may feel uncomfortable and add a few percentage points to his risk margin in order to create a buffer to compensate for his possible future losses.

4.2.2.22 Attitude of the client towards the contractor (about timeliness of payments etc.)

Attitude of the client towards the contractor is one of the top factors that contractors consider during their bid / no-bid decision making stage. A client with a positive attitude, from the point of view of a contractor, mostly signifies that extensive disputes are not likely to arise and progress payments are likely to be received duly, provided that client does not suffer from cash shortages.

For large international projects in undeveloped countries, funds are generally provided mainly by financial institutions of developed countries. And it is very likely that project engineer assigned to that project will be an experienced and reputable one from a developed country. In such cases, contractors do not seem to care about clients' qualifications but the engineers' qualifications. At the strategic level, the common view of top executives of contractors is that they will willingly work for a project supervised by a reputable engineer and financed by a reputable financial organization without caring much about the rest of the factors.

Moreover, contractors seek to establish long-term relationships with clients through undertaking multiple projects of the same client. Therefore, contractors favor projects of clients to whom they are previously accustomed and who have developed positive attitude towards them.

4.2.2.23 Availability of funds for the project

While executives decide for the risk and attractiveness of a project, primary factors to be considered at the top executive level are mainly availability of funds and identity of the client and his engineer. During the quest of Turkish contractors for candidate tenders on the globe, contractors generally prefer searching - through the pile of projects - for the projects that are financed by widely recognized large financial institutions (such as World Bank, International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA) etc.). These financial institutions both provide finance in a reliable manner and stipulate guidelines for the clients to follow for the tendering of the project. Therefore, with such projects contractors feel themselves almost in safe heavens. In other words, for a contractor, funding of a project by a reliable bank is a satisfactory evidence for receiving progress payments on time.

In case the funds are largely provided from self financial resources of the client, in order to assess the degree of risk to which they are subject, contractors investigate the past attitude of the concerned client towards contractors in promptly making the payments

4.2.3 Opportunity Factors

Mannerings (1970) indicated that factors influencing the growth, security and reputation of a company should be taken into consideration during the bid markup decision. Besides, the dictionary definition for opportunity is given as a combination of circumstances, time, and place suitable or favorable for a particular activity or action.[3] In light of these, the below six factors are identified as opportunity factors.

[3] Definition is taken from Merriam Webster's unabridged dictionary.

4.2.3.1 Contractor's potential for gaining reputation and experience with the project

Contractors naturally seek to expand their field of activities through performing new types of construction projects in which previously they have not been wholly experienced. Sometimes for the sake of obtaining a coveted project completion certificate in a new field of construction, in cooperation with a local partner, contractors may opt for projects in risky environments where there exists relatively low competition. For such projects, contractors may feel satisfied with low to medium levels of profit. While in fact, bearing the troubles of those risky projects, their main motive is to become qualified for future projects in this new field of construction and to earn more profits in other lucrative geographical markets in the long run.

Although prospects of gaining reputation may not, at first glance, seem worthy of sacrificing a normal level of profit margin, cases are met in which an aimed contractor, embarking on his venture with a single project has reached to continents-wide recognition through undertaking a series of similar projects. And, his success in winning successive numerous projects may largely be attributed to his well-recognized achievements in his first project that has made him gain wide reputation.

Besides, receipt of an ‘invitation for offer’ or ‘invitation for negotiation’ for a distinctive project is every contractor’s wish, as it notably relieves them from the pressure of insane competition. And apparently, having a nice reputation in the market and enjoying comprehensive experience in the field are indispensable to receiving recognition and therefore invitation from select clients.

All in all, bearing in mind that reputation makes a contractor earn more in the long run, it may be considered a tactic for a contractor to trim a few percentage points from his usual profit margin for a particular project that is expected to help him earn wide recognition and reputation.

4.2.3.2 Potential for gaining similar future projects in the same country

During the early ‘70s Japanese car manufacturers entered into the European market through implementing a strategy which combined low price and low added value for their products. This strategy was fit for Japanese at that time because it enabled them to build sufficient sales volume and to gain experience before aiming at developing more profitable strategies. Later on, the impression of Japanese cars improved to a state that was as qualified as their European counterparts in terms of quality and reliability; and still at a cheaper price.

In a similar sense, construction companies may also try to penetrate a new market utilizing a low price strategy with slim profits at the beginning. In the long term this helps them found a robust presence in their target market provided that they can later manage to catch up with leading firms of the market and even manage to differentiate themselves.

4.2.3.3 Immediate need to take a job

Most of the time, contractors approach opportunities with intuitive judgments. And, the concept of accessibility is closely related to the way people make intuitive judgments. Accessibility is defined as the ease with which particular mental contents come to mind (Higgins, 1996).

According to Loewenstein (1996), states of high emotional and motivational arousal greatly increase the accessibility of thoughts that relate to the immediate emotion and current needs, and reduce the accessibility of the rest. With such an insight to the concept of accessibility, it may be claimed that when a contractor feels a strong arousal to win a new project, opportunities that the project offers to him may mentally outweigh the risks posed by the project. Even if the project may come with substantial risks, contractor’s mental situation is expected prevent him from elaborating on

risk factors by means of hindering accessibility of thoughts relating to the issue of risk.

The sense of risk emanates from uncertainty. Since uncertainty can result in both negative and positive outcomes, it is positively correlated with fear. As the extent of uncertainty grows in the negative direction, the extent of fear also grows larger. Because uncertainty of risk and fear are both considered to be negative sensations, risk-takers attempt to counter this situation by use of optimism and rationalization. Optimism can be regarded as a strong self-defense mechanism of the human brain in order to counter the distress caused by uncertainty that risk-takers face. In addition, risk-takers try to rationalize their risky behavior by claiming that they are skillful and experienced enough to handle any risk issue and by believing that their situation cannot get worse than what they can achieve in a moderate manner.

Most of the time, risk-takers tend to be in a state of denial of risk in order to focus their energy towards achieving their goal. Such a strategy is mostly utilized in case the risk-taker is strongly insistent on bearing the risk and the extent of benefit is perceived to be positively correlated with the extent of risk. In such a case, any measure for lessening the degree of risk is perceived to be lessening the expected benefit.

All in all, an executive of a contracting company, which is in immediate need of taking a new job, will strongly promote his hopes for success, while hindering the accessibility of negative thoughts in his mind and will approach the new opportunity with optimism. In view of all these understandings, one can easily claim that this executive is very likely to stick to profit and risk margins that are lower than usual, even if the real risk is high.

On the other hand, another executive in low need to take a new and risky job will arrive at a high markup decision taking into account or even magnifying the severity of the relevant risks.

4.2.3.4 Existence of local agents that help the contractor with the project

Clients of international projects tend to be reluctant to award their tenders to foreign contractors with whom they have no prior acquaintance. It is widely acknowledged that every company entering a new foreign market should better have a local guide than struggling on its own to establish local contacts. Because local experts know very well with which projects there are more room for profits and for which clients it is more appropriate to work; by means of employing a local agent, contractors may increase their chances of hitting the target instead of attempting to throw an arrow with eyes shut.

Since local agents, by the help of their extensive market experience, are able to make at least a rough estimate for the amount of the prospective winning bid and since they are eager to earn their agency fee helping the firm to win the project with the lowest bid amount, it may also be argued that they constitute a factor that most of the time pressurizes profit margins of contractors in the direction of gravity.

4.2.3.5 General economic situation at the contractor's country

In periods of stagnant or shrinking economies, businessmen are very likely to be in a desperate mood because they cannot see much hope in their future. In Turkey, growth and stability of construction market is positively correlated with the extent of public investments. And, in times of a countrywide economical slowdown, public investments are one of the first media from which funds are to be withdrawn. Therefore, Turkish contractors' revenues are very much dependent on the health of the general economy of their home country. And, whenever economy shrinks at home, contractors

feel a greater urge to sail to foreign markets in order to maintain their survival.

Once opportunities shrink at home together with the shrinking economy, contractors are obliged to increase their risk threshold in order to make use of opportunities abroad. Risk-taking cannot be viewed as a totally negative concept. At least, risk-taking behavior helps businesses to recover from a crippled economy at home by urging them to seek new markets. In a market where everyone is risk-averse, the market would be destined to collapse wholly in case of a general market downturn.

With the general economic situation going worse at home, contractors are expected to lower their profit margins for projects abroad in order to increase their overall job volume. Even, in some extreme cases, some contractors may opt for undertaking contracts just for generating cash flow without making any profit. Such a behavior helps the sustainability of contractors' work force and prevents negative cash flow situations at times of poor market economy.

There are pricing strategies that may be utilized by some contractors who do not assign any profit markup during the tender but still expect to earn some profit during execution of the contract or at least aim to benefit from positive cash flow to be generated during the project. Such strategies are also valid for the ones who want to further improve their profits and/or cash flow. Chow (1990) states that there are two pricing strategies which contractors usually utilize in order to facilitate their cash flows.

1. A contractor may load a much larger proportion of the tender price onto items which are expected to be executed during the early stages of a contract. This practice is termed front loading.

2. A contractor may insert higher margins into unit rates relating to those items which he expects to grow in quantity through variation orders during execution of the contract. This practice is termed claim loading.

Sawyer and Gillott (1985) commented that contractors are entitled to distribute the profit and overhead elements of their work in any manner they wish so. Xu and Tiong (2001) also comment that contractors' pricing strategies are favorable to the clients too. Pricing strategies reduce contractors' odds of falling into cash flow shortages and bankruptcy, thereby preventing clients from suffering losses that may happen due to contractor's financial default.

4.2.3.6 Potential for changes in the scope of works and/or bid prices during the course of the project

Small-size contractors generally have an appetite for having projects that houses potential for changes in the scope of works or bid prices during the course of the project. Since a minor expansion in the scope of works or making of a new price for a new work item can make a big difference in a small scale project, small-size contractors significantly pay attention to this potential during estimation of their bid markup. For a highly competitive tender, awareness of such a potential will significantly improve competitiveness of the contractor at the bidding stage allowing him to markup a lower profit margin relative to his competitors.

Large contractors, on the other hand, tend to avoid considering such potentials as factors that rationalize lowering of profit margins below usual levels. Because, in large projects it is hard to forecast and quantify impacts of such changes in advance. In addition, it should be kept in mind that changes in scope and bid prices may also be detrimental to the contractors' well-being where the degree of harm depends on the attitude of the client and his engineer. Client may either strictly implement the contract terms to

the disadvantage of the contractor or may agree to fairly compensate the contractor for his extra expenses.

4.2.4 Competition Factors

4.2.4.1 Number of bidders

In a tender, observation of the total number of bidders, even without evaluation of qualifications of the individual bidders, has primarily a psychological effect. Basically assuming that each of the bidders has even chance, the rough probability of any contractor winning the tender is one divided by the total number of bidders. Assuming that the probability of winning is inversely proportional to the number of bidders, one should be discouraged by the existence of large number of bidders. Therefore the contractor may tighten his profit margin, if he is sensitive to the perceived competition in the tender.

However, in case of a tender with high number of bidders but without prior knowledge of bidders' bidding behavior, the contractor may also still opt for sticking with his usual profit markup ignoring competition. That is because, contractor's sensitivity to competition is thought to be directly proportional to the level of opportunity offered by the prospective project. If a contractor sees low opportunity in winning the tender, he is likely to inflate his markup without caring for his resultingly diminishing chances of success.

4.2.4.2 Presence of highly competitive bidders (presence of potential lowest cost bidders like Chinese etc.)

Almost every contractor submits his bid following the collection and evaluation of some sort of market intelligence. This market intelligence can range from identifying the identities of the competitors to learning about their attitudes, competitiveness, capabilities and past bidding behavior.

Collection of such information allows contractors to adjust their profit markups accordingly. As a typical case, a contractor may change his mind so as not to bid for a tender, on which he was previously intent, after he learns that a Chinese contractor is eager to win that tender. That is because; it is very likely that his offer cannot financially beat that of the Chinese contractor even if he pulls his profit markup down to earth. However, for technically complex projects, qualified international contractors can still enjoy superiority of their technical capabilities without caring for the presence of low-cost and low-quality competitors.

4.3 Discussion on Factors Affecting Bid Markup Decision Making

As explained above for each factor, we have a general sense of how any one factor may individually affect the bid markup. But such a judgmental effort can not reveal the extent of interaction between each factor and markup. An analytic approach is required to study this relationship. In that way, the individual weights of the factors in affecting bid markup may be obtained.

In the coming chapters, the level of importance of the above factors in bid markup decision making is to be revealed through studying survey data. In addition, a model is to be constructed with the final aim of estimating bid markup for an international project through establishing a relationship between the above factors and the character of the project in view of risk, opportunity and competition. The factors which are believed to affect risk, opportunity and competition perception in an international project tender were categorized above in three separate sections, titled accordingly. The factors that belong to the fourth category titled “general features about company and project” do not exclusively relate to risk, opportunity or competition. Therefore, in the future model, these factors will be utilized for risk, opportunity as well as competition.

CHAPTER 5

RESEARCH FINDINGS

5.1 Data Analysis

Data collected from the survey were processed using mathematical and statistical techniques. The analysis ranged from simple calculations to sophisticated statistics using the software Statistical Package for Social Sciences (SPSS).

5.1.1 Objectives of the data analysis

The main objectives of this data analysis are:

1. Determining the factors that affect size of the bid markup that Turkish contractors consider for their international projects and determining the level of influence of these factors,

2. Testing the hypothesis that the level of importance of factors, that are emphasized by contractors during their bid markup size estimation, vary as the size of the contractor varies between categories of small-to-medium size and large-size,

3. Constructing a bid markup estimation model based on utility functions for risk, opportunity and competition ratings by means of assigning weights to each rating and then testing the model's accuracy. Then, reconstructing the same model utilizing regression to estimate weights and then testing the model's accuracy.

5.2 Respondent Profile

Respondents to the survey were composed of tender department managers, general managers and managing directors.

5.3 Contractors' Approach to Bid Markup Estimation

The entire sample surveyed indicated that they did not make use of any statistical/mathematical technique or program in determining their bid markup. This indicates that Turkish contractors determine their bid markup solely based on their experience, intuition and judgment. Contractors seem to be more comfortable with the way they make their bid markup decision without relying on scientific methods.

This picture is similar to that of the earlier findings. Ahmad and Minkarah (1988) stated that bid decisions were heuristic in nature, and thus they were made on the basis of experience, judgment and perception. They also noted that very few contractors were reported to use mathematical or statistical models in the determination of their markup sizes (cited in Dulaimi and Shan, 2002).

The respondents indicated that they were relatively comfortable with the way they make the markup decision: 54.3% were 'somewhat' comfortable, only 11.4% were 'uncomfortable', and the remaining 34.3% were 'comfortable'.

The study therefore concluded that the majority of the contractors were rather comfortable with the way they made their bid markup decisions, even without the use of statistical/mathematical techniques or programs.

5.4 Important Factors Influencing Bid Markup

For section one of the questionnaire, a total of 41 valid importance assessment surveys are received from respondents. The research used mean importance ratings in order to assess the importance that contractors attach to different factors during bid markup decision making.

After the responses are processed, the mean importance ratings for all the factors are calculated. The formula for calculating the mean importance rating is:

$$R_{mean} = (1(n_1)+2(n_2)+3(n_3)+4(n_4)+5(n_5)) / (n_1+n_2+n_3+n_4+n_5) \qquad (1)$$

Where n1, n2, n3, n4, n5 = number of respondents who indicated on the five-point scale, the level of importance as 1, 2, 3, 4 and 5; where 1 represented “very low importance”, 2 for “low importance”, 3 for “medium importance”, 4 for “high importance” and 5 stood for “very high importance”.

From the calculated mean importance ratings, factors are assigned ranking values on basis of importance under 4 categories: general features about company and project, risk factors, opportunity factors and competition factors (Table 5.1). For the purpose of categorization of the contractors according to their size, the size categorization values that were reported by respondents in their questionnaire are directly utilized.

Table 5.1. Factor rankings according to their mean importance ratings

Factors	Small-to-Medium size Contractors		Large Contractors		Overall	
	Mean	Rank	Mean	Rank	Mean	Rank
a.GENERAL FEATURES ABOUT COMPANY AND PROJECT						
Project size	3.89	17	3.87	19	3.88	19
Contract duration	3.72	23	3.61	27	3.66	26
Contract payment type	4.11	9	4.43	1	4.29	2

Table 5.1. Continued

Type of project	3.17	38	3.57	31	3.39	34
Client type	3.72	24	3.78	21	3.76	21
Size of the contractor company	3.67	25	3.74	23	3.71	23
Level of experience of contractor in similar type of projects	4.11	10	4.30	4	4.22	5
Level of experience of contractor in the host country /similar countries	4.50	1	3.96	14	4.20	8
Financial capability of the contractor	4.22	6	4.00	11	4.10	12
Technical capability of the contractor	4.00	13	3.91	17	3.95	15
Managerial capability of the contractor	3.89	18	3.87	20	3.88	20
Planned % of subcontracted works	2.56	42	2.83	42	2.71	42
Amount of cash required in advance for the beginning of the project	4.22	7	4.30	3	4.27	3
b. RISK FACTORS						
Vagueness of design (due to incomplete design / insufficient project drawings)	4.22	8	4.09	9	4.15	10
Lack of enough technical information (such as site and geological conditions etc.)	4.28	2	4.04	10	4.15	11
Vagueness of contract conditions (unclear risk allocation between client and contractor etc.)	4.11	11	3.96	15	4.02	13
Unavailability of required construction materials and supplies in the host country (resource risk)	3.44	31	3.48	32	3.46	32
Lack of competence of local parties (local subcontractors, local labour etc.) in the host country	2.94	40	3.17	37	3.07	39
Unfavorability of physical conditions that may adversely affect productivity at site (such as adverse weather conditions etc.)	3.39	33	3.00	39	3.17	37
Technical and technological complexity of the project	3.78	21	3.61	26	3.68	24

Table 5.1 Continued

Strict quality requirements/ specifications (stricter than the contractor's usual practice)	3.50	29	3.70	24	3.61	27
Tightness of the project duration / Existence of high penalty (liquidated damage) clauses	4.00	14	4.00	12	4.00	14
Lack of infrastructural and civil development in the host country	2.94	41	3.13	38	3.05	40
Geographical distance between host country and Turkey	3.28	36	2.83	41	3.02	41
International relations of the host country with Turkey	3.67	26	2.91	40	3.24	36
Economical / financial risk of the host country and /or client	4.28	3	4.26	6	4.27	4
Foreign exchange rate / inflation rate fluctuation risk	4.28	4	4.35	2	4.32	1
Immaturity / unreliability of the legal system to which the contractor is subject according to the contract (legal risk)	4.11	12	4.30	5	4.22	6
Instability of the political environment in the host country (political risk) / potential for negative changes in government policies	4.28	5	4.17	8	4.22	7
Bureaucratic delays/ difficulties (in approval of projects, receival of necessary permissions etc.)	3.33	35	3.57	30	3.46	31
Cultural differences between the host country and Turkey (cultural risk)	2.39	43	2.26	44	2.32	44
Security risk	3.94	16	3.91	18	3.93	16
Existence of language barrier	2.28	44	2.57	43	2.44	43
Level of experience of the client (in similar projects, with foreign contractors etc.)	3.06	39	3.17	36	3.12	38
Attitude of the client towards the contractor (about timeliness of payments etc.)	3.56	27	3.57	28	3.56	28
Availability of funds for the project	4.00	15	4.26	7	4.15	9

Table 5.1 Continued

c. OPPORTUNITY FACTORS						
Contractor's potential for gaining reputation and experience with the project	3.50	30	3.78	22	3.66	25
Potential for gaining similar future projects in the same country	3.78	22	4.00	13	3.90	17
Immediate need to take a job	3.83	19	3.65	25	3.73	22
Existence of local agents that help the contractor with the project	3.28	37	3.30	35	3.29	35
General economic situation at the contractor's country	3.44	32	3.57	29	3.51	29
Potential for changes in the scope of works and/or bid prices during the course of the project	3.56	28	3.43	33	3.49	30
d. COMPETITION FACTORS						
Number of bidders	3.39	34	3.43	34	3.41	33
Presence of highly competitive bidders (presence of potential lowest cost bidders like Chinese etc.)	3.83	20	3.96	16	3.90	18

5.5 Additional Factors Emphasized by Respondents during the Survey

In Section 2 of the implemented questionnaire, respondents were asked to list any additional factor that may affect bid markup. Only one of the respondents added two factors depending on his previous experience with an international project. According to his company's experience, the amount of performance bond furnished to the client should be considered in risk estimation of the bidding scenario. Because, in case a contractor defaults on his contract, the amount of money guaranteed by the performance bond is collected from the bank by the client. Then, in return, the bank asks this amount from the contractor. In regard of the contract default risk, the severance of the risk event increases as the amount of performance bond

increases. In the respondent's case, the amount of performance bond was 20% of the contract amount.

Although the amount of performance bond may be considered in risk markup estimation, it is not a factor directly affecting the level of riskiness of a project in terms of difficulty in undertaking the contract unlike other risk factors available in the questionnaire. It is only a factor that affects the severeness of the situation in case other risk events happen and contractor defaults on the contract. Hence, this factor's significance is dependent upon the level of risk of the scenario as identified from the degree of severeness of other risk factors. In case overall estimated risk for the scenario suggests that contractor is likely to default on the contract and the client requests an unusually high amount of performance bond, then the contractor may reflect this amount into his risk margin. In the usual practice, since every contractor is used to furnishing a usual amount of performance bond such as 10% of the contract amount and since no contractor would like to consider the risk of default on a contract for which he is eagerly bidding, it is not believed that this factor would have a wide and significant influence.

The second factor that was additionally mentioned by the respondent was the amount of cash that may be required during execution of the project. This factor may either be included in the factors list or it may be suggested that the cost of providing additional cash during execution of the project is already considered during the cost estimation.

5.6 Factors Emphasized in Bid Markup Decision Making of 'Contractors Categorized by their Size'

For the two sets of factor importance ranking given in Table 5.1, Spearman's coefficient of rank correlation is calculated for the purpose of understanding the relationship between the two categories of contractors, (1) small-to-medium-size and (2) large-size. The first category contains 18

contractors, whereas the second contains 23. The correlation coefficient between the importance rankings of factors for two categories of contractors is to be calculated. Fellows and Liu (1997) state that in order to measure the level of association between two sets of ranking data which was obtained by employing a Likert scale, one should employ the Spearman's coefficient of rank correlation, ρ:

$$\rho = 1 - \frac{6 * \sum_i D_i^2}{n(n^2 - 1)} = 1 - \frac{6 * 1234}{44(44^2 - 1)} = 0.913$$

where D_i is the is the difference between the two ranking values - for two groups of contractors - corresponding to the ith factor in the list

n is the total number of factors in the list

The Spearman's ρ comes out to be 0.913, which is close to 1 and hence suggests that high association exists between the factor rankings of the two categories. This high association implies that the two categories do not vary significantly in their evaluation for the importance of the factors influencing their markup size decision.

5.6.1 Attitude of small-to-medium-size contractors

According to Table 5.1, the top 10 factors identified by the small-to-medium-size contractors as the most influential in their bid markup decisions are: (1) Level of experience of contractor in the host country / similar countries, (2) Lack of enough technical information (such as site and geological conditions etc.), (3) Economical / financial risk of the host country and /or client, (4) Foreign exchange rate / inflation rate fluctuation risk, (5) Instability of the political environment in the host country (political risk) / potential for negative changes in government policies, (6) Financial capability of the contractor, (7) Amount of cash required in advance for the beginning of the

project, (8) Vagueness of design (due to incomplete design / insufficient project drawings), (9) Contract payment type, (10) Level of experience of contractor in similar type of projects.

Small-to-medium-size contractors assigned the highest importance to the level of their experience abroad. This factor is of particular importance because small-to-medium size contractors naturally have limited knowledge of foreign countries due to their limited capacity to operate on a wide scale. And, factors such as country's economical risk, foreign exchange rate fluctuation risk and political instability risks are identified as highly important aspects of the environment in which contractors plan to operate. Also it is found out that, contractors pay close attention to their own financial capability and requirement for pre-financing. This is because small-to-medium-size contractors may find it difficult to recover from any cash shortages that may happen during the project as they have relatively limited access to financial institutions. Vagueness of design and level of experience of contractor in similar type of project is of particular importance, because small-size contractors usually lack the resources to complement in a good manner the deficiencies in a given design and they lack the proper contacts and resources to make up for their deficiency in undertaking unfamiliar types of projects.

5.6.2 Attitude of large-size contractors

According to Table 5.1, the top 10 factors identified by the large-size contractors as the most influential in their bid markup decisions are: (1) Contract payment type, (2) Foreign exchange rate / inflation rate fluctuation risk, (3) Amount of cash required in advance for the beginning of the project, (4) Level of experience of contractor in similar type of projects, (5) Immaturity / unreliability of the legal system to which the contractor is subject according to the contract (legal risk), (6) Economical / financial risk of the host country and /or client, (7) Availability of funds for the project, (8)

Instability of the political environment in the host country (political risk) / potential for negative changes in government policies, (9) Vagueness of design (due to incomplete design / insufficient project drawings), (10) Lack of enough technical information.

Large-size contractors placed the highest emphasis on contract payment type of the project. Because, large-size contractors undertake a variety of contract types including cost-plus-fee, build-operate-transfer schemes in addition to the usual lump sum and unit price type contracts. In addition this finding is supported by the anecdotal evidence where large-size contractors stated that they opt for lump sum projects in which their design capability gives them a competitive advantage over average contractors and they disfavor unit price projects where competition is fiercer.

Also they play close attention to availability of funds. This reflects the fact that large-size contractors prefer to undertake and seek projects funded by reliable and large funding organizations such as World Bank or clients who possess vast financial resources. Legal risk that the contractor is subject to is also given high emphasis because of the fact that large projects usually involve a high variety of disputes between client and contractor where disputes may amount to millions of dollars in financial terms. Therefore, effective and rightful resolution of disputes in the shortest possible time with or without going to court is essential to large-size contractors. Otherwise, contractors are likely to inflate their bid markups to cover for their prospective losses that may arise due to conflicts with clients.

5.6.3 Differences between the small-to-medium and large-size contractors' attitudes

The research hypothesis is that contractor size has an affect on the importance rating of factors that contractors emphasize during their bid markup decision making.

The SPSS package was used in the analysis of variation between the two groups of contractors in their attitude towards the factors influencing their bid markup decision. It is decided to use the 'independent-samples t test'. This test would enable the research to establish whether the small-to-medium and large-size contractors' evaluation of the various factors differed significantly.

The research null hypothesis states that the means of the two categories of contractors are the same, and the alternative hypothesis states that they are not the same. The mean rating value reveals any difference between the two categories of contractors in evaluating the importance of the various factors influencing the bid markup decision. A higher mean rating value in one factor represents a higher importance level stressed by that particular category of contractors for that particular factor. The 2-tailed $p > |Z|$ value will determine whether the differences between the two categories vary significantly at 95% significance level. If p is less than the reference probability of 0.05, the result is statistically significant, and the null hypothesis is rejected, i.e. the two categories of contractors have varied significantly in their evaluation of a particular factor. If p is greater than 0.05, the null hypothesis is not rejected, concluding that there is no significant difference between the two groups of contractors. (Dulaimi and Shan, 2002)

Table 5.2 indicates that 'level of experience of contractor in the host country/ similar countries' factor has $p<0.05$. Hence its null hypothesis is rejected, concluding that there is significant difference between two groups of contractors. By comparing the mean importance rating values for the two categories, small-to-medium-size contractors demonstrated that while deciding on their bid markup size, they are significantly more concerned with this factor than are the large contractors. The differences between the two groups of contractors may be explained by the relative incapability of small-to-medium-size contractors to handle projects in multiple countries at a time. Therefore, they prefer sticking with projects which take place in

familiar countries instead of venturing on totally unfamiliar lands. On the other hand, large-size contractors can more easily enter foreign markets in which they have no previous experience thanks to their larger capability and their already established continents-wide branch office network.

Table 5.2. Test statistics of factors under the category 'general features about company and project'

Factors	Mean rating		p (2-tailed)
	Small-to-medium size contractors	Large size contractors	
GENERAL FEATURES ABOUT COMPANY AND PROJECT			
Project size	3.89	3.87	0.935
Contract duration	3.72	3.61	0.651
Contract payment type	4.11	4.43	0.150
Type of project	3.17	3.57	0.166
Client type	3.72	3.78	0.823
Size of the contractor company	3.67	3.74	0.724
Level of experience of contractor in similar type of projects	4.11	4.30	0.318
Level of experience of contractor in the host country / similar countries	4.50	3.96	**0.003**
Financial capability of the contractor	4.22	4.00	0.312
Technical capability of the contractor	4.00	3.91	0.722
Managerial capability of the contractor	3.89	3.87	0.935
Planned % of subcontracted works	2.56	2.83	0.400
Amount of cash required in advance for the beginning of the project	4.22	4.30	0.700

Table 5.3 indicates that 'international relations of the host country with Turkey' factor has $p<0.05$. Hence its null hypothesis is also rejected, concluding that there is significant difference between the mean ratings for

the two groups of contractors. The mean importance ratings reveal that small-to-medium-size contractors care more about this issue than large contractors do. This difference arises due to fact that large contractors are able to establish wider and more effective contacts with foreign authorities (through lobbying, etc.) than small-to-medium size contractors can do. Therefore, large contractors are less to prone to possible negativities that may arise between two countries.

Table 5.3. Test statistics of factors under the category 'risk factors'

Factors	Mean rating		p (2-tailed)
	Small-to-medium size contractors	Large size contractors	
Vagueness of design (due to incomplete design / insufficient project drawings)	4.22	4.09	0.551
Lack of enough technical information (such as site and geological conditions etc.)	4.28	4.04	0.328
Vagueness of contract conditions (unclear risk allocation between client and contractor etc.)	4.11	3.96	0.613
Unavailability of required construction materials and supplies in the host country (resource risk)	3.44	3.48	0.923
Lack of competence of local parties (local subcontractors, local labour etc.) in the host country	2.94	3.17	0.448
Unfavorability of physical conditions that may adversely affect productivity at site (such as adverse weather conditions etc.)	3.39	3.00	0.136
Technical and technological complexity of the project	3.78	3.61	0.454
Strict quality requirements/ specifications (stricter than the contractor's usual practice)	3.50	3.70	0.496

Table 5.3. Continued

Tightness of the project duration / Existence of high penalty (liquidated damage) clauses	4.00	4.00	1.000
Lack of infrastructural and civil development in the host country	2.94	3.13	0.516
Geographical distance between host country and Turkey	3.28	2.83	0.068
International relations of the host country with Turkey	3.67	2.91	**0.007**
Economical / financial risk of the host country and /or client	4.28	4.26	0.951
Foreign exchange rate / inflation rate fluctuation risk	4.28	4.35	0.806
Immaturity / unreliability of the legal system to which the contractor is subject according to the contract (legal risk)	4.11	4.30	0.450
Instability of the political environment in the host country (political risk) / potential for negative changes in government policies	4.28	4.17	0.722
Bureaucratic delays/ difficulties (in approval of projects, receival of necessary permissions etc.)	3.33	3.57	0.493
Cultural differences between the host country and Turkey (cultural risk)	2.39	2.26	0.646
Security risk	3.94	3.91	0.922
Existence of language barrier	2.28	2.57	0.299
Level of experience of the client (in similar projects, with foreign contractors etc.)	3.06	3.17	0.714
Attitude of the client towards the contractor (about timeliness of payments etc.)	3.56	3.57	0.976
Availability of funds for the project	4.00	4.26	0.327

For the rest of the factors in Tables 5.2 and 5.3 and for the factors under the categories of 'opportunity factors' and 'competition factors' (given in Tables 5.4 and 5.5), test results indicate that all of them have p>0.05. Hence, the null hypothesis is not rejected for any of them; concluding that at the 95 % confidence level there is no significant difference between the two groups of contractors in evaluating the importance of these factors in influencing the bid markup decision.

Table 5.4. Test statistics of factors under the category 'opportunity factors'

Factors	Mean rating		p (2-tailed)
	Small-to-medium size contractors	Large size contractors	
Contractor's potential for gaining reputation and experience with the project	3.50	3.78	0.273
Potential for gaining similar future projects in the same country	3.78	4.00	0.338
Immediate need to take a job	3.83	3.65	0.504
Existence of local agents that help the contractor with the project	3.28	3.30	0.931
General economic situation at the contractor's country	3.44	3.57	0.557
Potential for changes in the scope of works and/or bid prices during the course of the project	3.56	3.43	0.685

Table 5.5. Test statistics of factors under the category 'competition factors'

Factors	Mean rating		p (2-tailed)
	Small-to-medium size contractors	Large size contractors	
Number of bidders	3.39	3.43	0.898
Presence of highly competitive bidders	3.83	3.96	0.682

5.7 Markup Estimation Model with the Use of Utility Functions

After the level of importance of various factors in markup estimation is analyzed using statistical methods, the relationship between the three inputs; perceived risk, opportunity and competition and the two outputs; risk and profit markups is to be formulized.

5.7.1 Introduction

Friedman's competitive bidding model (1956) suggested that the bidder should select the bid markup that maximizes the expected value of the profit (cited in Shash and Abdul-Hadi, 1992). Expected value of the profit is calculated as the product of the bid markup and probability of winning the contract corresponding to that markup level. Estimation of the probability function (markup vs. probability of winning) constitutes the basis of his model. Such a probability function is to be built utilizing bidding data obtained from past tenders or to be built upon subjective judgment.

Friedman's approach focuses at optimizing the bid markup considering only a single bidding case and takes into account only the influence of competition. However, contractors generally bid for numerous projects ranging in frequency from a few times a year to several times a month. In addition, contractors are normally expected to adjust their markup estimating behavior according to also the opportunities offered and risks posed to them by the project. Therefore, Friedman's model is lacking to reflect the medium-to-long-term strategy of contractors meanwhile assuming that contractors feel themselves obliged to win the single tender at hand. To give an example, let's assume that a contractor has the opportunity to assign discrete profit markups of 5%, 10% and 15%; and the corresponding estimated probabilities of winning are 70%, 40% and 20% according to the established probability function. The resulting expected values of profit are calculated by multiplying two corresponding values where the products are

obtained as 3.5%, 4% and 3%; suggesting that the contractor should choose 10% mark-up in order to maximize his expected profit. On the other hand, that contractor may opt for choosing the 15% markup in line with his medium-term strategy given that there are several other bidding opportunities in the near future. He may well be motivated to stick with the 15% markup until he wins a project after a sufficient number of bidding trials. In the mean time, taking into account the immensity of the inherent risks of the project, shareholders may raise their usual profit expectations. For that particular project, other than considering only competition, contractor is also very likely to make adjustments to his usual markup considering opportunities and risks inherent in the project.

At this point, also the “probability matching theorem” of Estes and Suppes (1959) is worth mentioning. The “probability matching theorem” challenges the idea that people maximize their expected utility or value when they are making choices. During the 1960s a large data set was collected about the behavior of humans in repeated choice experiments. During a typical experiment, subjects had to predict at each trial whether a light would appear on his left or on his right. Which light actually appeared depended on a random device operating with fixed probabilities. The experiment then continued for many trials. During experiments, correct predictions were rewarded, whereas wrong ones were punished by requiring the payment of a small penalty (cited in Vulkan, 1998).

The striking feature of this experiment was that, subjects, while making their guesses, tended to match the underlying probabilities of the two outcomes (Vulkan, 1998). To give an example, let’s say that the lights flash at random with a higher probability on one side than the other – e.g., a 0.7 probability of flashing on the left-hand side versus a 0.3 probability of flashing on the right-hand side. After a number of trials, subjects learned the underlying probabilities and tended to respond to match the probabilities. In other words, after they realized that the left-hand light flashes 70 percent of the

time, during a following series of 10 trials they chose left 7 times and chose right 3 times. This "matching" behavior does not actually maximize rewards. Although those subjects tended to match the distribution of their choices to the probabilities of expected outcomes, their resulting overall probability of making the true prediction, in such a manner, appears to be 0.58 as calculated below.

$$p(correct) = p(L) \times p(gL) + p(R) \times p(gR) = 0.7 \times 0.7 + 0.3 \times 0.3 = 0.58 ;$$

where p(L): probability that the left-hand light will flash

p(R): probability that the right-hand light will flash

p(gL): probability that the subject guesses left-hand light

p(gR): probability that the subject guesses right-hand light

p(correct): probability that the subject makes a correct prediction

However, the strategy to maximize the expected value should have been to constantly choose the light with the higher probability of flashing. With such a strategy, the subject would ensure that he is correct 70% of the time which is obviously better than the former matching behavior.

The behavior of subjects as explained in the “probability matching theorem” can also be observed in the bidding behavior of contractors. Examining their past bidding data, contractors observe that bids with high markups have low probabilities of success, whereas bids with low markups have higher probabilities of success. Therefore, at the cost of submitting a bid that is significantly lower than the closest competitor’s bid, companies frequently submit bids with low markups. However, if contractors could have collectively and consistently submitted bids with normal to high level of markups, they would certainly increase the prospect of generating large

profits. All in all, together with increasing number of contractors who adopt the matching behavior; profit margins of winning bids are increasingly deteriorating.

Economics traditionally conceptualizes a world populated by calculating, unemotional and rational maximizers. Indeed, virtually all the behavior studied by psychologists was ignored in a standard economic framework (Mullainathan and Thaler, 2000). Mullainathan and Thaler (2000) counter the standard economic framework's view which claims that individuals who systematically and consistently make the same mistake will eventually learn the error of their ways. They argue that as long as there are some opportunity costs[4] to learning or experimenting with a new strategy, even a completely "rational" learner will choose not to experiment. According to their view, such a player is expected to get stuck in a non-optimal equilibrium, because the cost of trying something else is high. They also add that, the time required to converge to an equilibrium strategy can be extremely long. In addition, considering a continuously changing environment, one can easily be in a situation of perpetual non-convergence (Mullainathan and Thaler, 2000). This view gives some insight into the contractors' 'matching behavior' that was mentioned above previously. Although contractors are rationally expected to give up submitting bids constantly with significantly low markups (with the expectation that contractors should seek maximizing their profits), contractors can not get rid of the temptation of winning a project though in a manner of whatever it costs them to win. All in all, according to contractors' general view, the opportunity cost of assigning a fat bid markup is losing competitive edge over competitors and therefore losing the tender, although they lack exact knowledge to estimate in advance their competitors' likely bids. And nevertheless, most of the contractors can not converge to an equilibrium

[4] Opportunity cost can be defined as, "The advantage foregone as the result of the acceptance of an alternative." (Killian, 2005)

strategy with which they can assure sustainability and growth of their share and presence in the market through making sufficient profits.

Simon (1955) in his paper criticized the modeling of economic agents as having unlimited information processing capabilities. He came up with the term “bounded rationality” to give a more realistic description of human problem solving capabilities (cited in Mullainathan and Thaler, 2000). It is obvious that we possess limited brainpower and most of the time limited information about the problem that we are dealing with. And therefore, we cannot be expected to solve difficult problems optimally. It is “rational” for people to adopt rules of thumb as a way to economize on cognitive efforts (Mullainathan and Thaler, 2000).

So far it is made clear that, while contractors are assigning their bid markups, they evaluate risks, opportunities and competition together in a bounded framework. Here in this thesis a linear bid markup estimation model which simultaneously considers risk, opportunity and competition is to be presented. Taking into account the “bounded rationality” of decision makers the model is kept simple but is believed to be effective.

Lee and Chang (2004) developed a decision support system (DSS) to estimate bid markup for microtunneling projects utilizing a total of 17 factors that affect bid markup size. The factors included company factors such as confidence in workforce and availability of required cash; project factors such as profitability and project complexity and finally microtunneling factors such as soil conditions and safety. After utility functions were formulized for each factor and factor weights were derived via Analytical Hierarchy Process (AHP), a markup function was formulated that varied according to the overall utility that is calculated as the sum of weighted utilities for each factor.

In section five of the questionnaire, for each bidding scenario, the respondents had given their risk, opportunity and competition ratings on a

‘very low’ to ‘very high’ scale and had assigned the corresponding risk and profit markups in percentage. Utilizing these five pieces of data for each scenario, this part of the thesis aimed at building a decision support tool for markup estimation using utility functions and then tested its accuracy.

5.7.2 Development of utility functions

Utility theory is a theory of making rational decisions. Its basic concept is a generalized measure of value called utility. According to Lindley (1985) utility is a number measuring the attractiveness of a consequence. And, Rubinstein (1975) states that utility is a number which is a measure of your state of satisfaction. The utility of an outcome is evaluated by comparing it to two other outcomes, a `good' one, considered to be the very best that could happen in the decision situation, and a `bad' one, considered to be the very worst outcome. The value of a particular outcome is assessed as a proportion of the range between the worst and the best (Vignaux, 2005).

The outcome considered may be a combination of factors. For example, the `best' outcome for a decision about locating a new wind farm might be a combination of a large power output and no visual pollution; the `worst' might be a combination of small or zero power output and significant visual pollution. The range of options to be chosen would fall between the `worst' and the `best' combinations. These each would have a utility somewhere between 0 and 1, assuming this was the range of utility values chosen (Vignaux, 2005). The utility value for the desired outcome may be computed by utilizing the utility values of the factors. Weighted sum of the utilities of the factors gives the utility value for the outcome.

In the questionnaire, each measurement scale for risk, opportunity and competition ratings was established as a discrete 1 to 5 scale. For each

rating type, discrete utility scale which takes values between 0 and 100 are shown in Table 5.6.

Table 5.6. Utility scales for risk, opportunity and competition ratings

	Range of Scales				
	Very low	**Low**	**Medium**	**High**	**Very High**
Risk	0	25	50	75	100
Opportunity	0	25	50	75	100
Competition	0	25	50	75	100

Then utility functions are to be established for the purpose of obtaining utility values. In order to form the utility functions, firstly, four values are identified: lower and upper limits (y_L and y_U), threshold values (y_T), and the most preferred values (y_M). Here it is suggested that medium ratings of risk, opportunity and competition correspond to a neutral value, which means a medium rating can be assumed to be the boundary of a neither desirable nor undesirable scenario. This neutral point is called the threshold value. Utility functions for each criterion should give an output value of zero for a threshold value. Thus, $u_j(y_{Tj})=0$ for each criterion; where u(y) is the utility function. And the utility function should reach its maximum value of '1' when the criterion is at its most preferred value. Therefore, $u_j(y_{Mj})=1$ for each criterion.

In this study, straight-line utility functions are assumed for each criterion. Linear utility functions can be formulated as u(y) = a x y + b, where a and b are solved from the two conditions mentioned above. For instance, for risk, the threshold value is 50 (medium) and the most preferred value is 0 (very low). Hence a and b can be solved based on the following two equations: (i) 0 = 50 x a + b and (ii) 1 = 0 x a + b. Table 5.7 shows the lower, upper, threshold and most preferred values and linear utility functions for each criterion. Table 5.8 shows an example utility calculation for the three criteria evaluated for a specific project.

Table 5.7. Lower, upper, threshold, most preferred values and utility functions

Criteria	y_L	y_U	y_T	y_M	Utility function
Risk	0	100	50	0	u(y) = 1 – 0.02 x y
Opportunity	0	100	50	100	u(y) = 0.02 x y –1
Competition	0	100	50	100	u(y) = 0.02 x y –1

Table 5.8. Example utility values for a specific project

Criteria	Expert Evaluation	y_j	Utility value, $u(y_j)$
Risk	High	75	-0.5
Opportunity	Medium	50	0
Competition	Very low	0	-1

Then, overall utility value for a specific project can be calculated as follows by taking the sum of the weighted utility values for each criterion:

$$OU = 100 \times \sum_{j=1}^{3} W_j \times u_j \qquad (2)$$

where OU: Overall utility

W_j : Normalized weight for criterion j

u_j : Calculated utility value for criterion j

The utility values vary between -1 and 1. Therefore when the weighted sum of utility values are multiplied by 100 as it is in the above equation (2), the resulting overall utility is adjusted to vary between the range of -100 to 100.

Now, in order to calculate the overall utility through the above formula (2), the normalized factor weights for each criterion are required.

5.7.3 Estimation of factor weights

As mentioned earlier, risk markup and profit markup are to be estimated separately and then summed to obtain the total bid markup. Following the same logic, two separate overall utility functions should be defined for deriving risk and profit markups.

During estimation of the risk markup, it is apparent that level of the perceived risk of the scenario is the most important criterion that will influence the size of risk markup.

After risk, the level of opportunity offered to the contractor is the second most important criterion. As mentioned earlier, Loewenstein (1996) explains that states of high emotional and motivational arousal greatly increase the accessibility of thoughts that relate to the immediate emotion and current needs, and reduce the accessibility of other thoughts. Therefore, even if the project may come with substantial risks, the contractor's mental situation may cause him to choose a lower risk margin taking into account the opportunities offered. He may accept to undertake a greater extent of risk for the sake of reaching his goals. On the other hand, a contractor evaluating a project that offers little opportunity to him will be inclined to overestimate the risk markup. All in all, the contractor's attitude towards risk should be affected by the extent of opportunities offered to him by the project.

For risk markup estimation, competition criterion is not involved in the overall utility function because risk markup estimation is virtually independent of the level of competition in a tender. In other words, the degree of risk to which one is susceptible does not vary with the behavior of competitors and risk nature of a project is independent of presence or absence of competitors.

During estimation of profit markup, level of perceived opportunity offered by the scenario is the most important criterion that will influence the size of the expected profit markup. A contractor who sees significant opportunities in a prospective project feels himself compelled to sacrifice from his profit margin in order to increase his chances of winning the tender.

Then comes the level of competition as the second important criterion for profit markup estimation. Although the contractor's profit markup decision may be initially assumed to be directly related to the level of competition, it is not that much affected by competition unless the project offers significant opportunities to the contractor. In other words, sensitivity of a contractor to competition is dependent on the degree of opportunities offered to him. Therefore, opportunity precedes competition.

Finally, the level of perceived risk is the third and therefore the least important criterion considered in profit markup estimation. Although the amount of expected profit is expected to increase with the level of perceived risks as it is the same with financial investments, the degree of risk was already reflected into the risk markup previously. Therefore, degree of risk should not influence the profit margin as much as degree of opportunity and competition do.

Elicitation of weights for factors in a multi-attribute problem can be difficult. Many of the methods devised for that purpose involve asking the expert simple questions about the relative importance of factors and then seek to identify expert's true weights by some mathematical calculations. Jaccard et al. (1986) believe that weights produced by simple ranking of the importance of each attribute may be more precise than those envisaged by the decision maker. A number of methods have been developed so far that enable the rankings to be translated into weights that represent an approximation of the 'true' weights. Roberts and Goodwin (2002) give information on rank order centroid (ROC), rank sum (RS) and rank

reciprocal (RR) weights in their study. Roberts and Goodwin (2002) reveal in their study that RS weights outperform ROC and RR weights. In the RS procedure weights, $w_i(RS)$, are the individual ranks normalized by the sum of the ranks. The formula for obtaining RS weights can be written as:

$$w_i(RS) = 2(n+1-R_i) / n(n+1), \qquad i=1,\ldots, n. \tag{3}$$

where i is the rank of the attribute for which weight is to be calculated

the i th rank is denoted by R_i

n is the total number of attributes to be ranked

Barron and Barrett (1996) on the other hand, concluded that ROC weights were the most accurate. The formula for calculation of ROC weights can be written as:

$$w_i(ROC) = 1/n \sum_{j=i}^{n} 1/j, \qquad i=1,\ldots, n. \tag{4}$$

where i is the rank of the factor

n is the total number of attributes to be ranked

So, for example, when n=6 and i=4;

$w_4(ROC) = (0 + 0 + 0 + 1/4 + 1/5 + 1/6) / 6 = 0.1028$ for the attribute which is ranked in the fourth place in order of importance among a total of 6 attributes.

Table 5.9 gives the rank sum weights obtained via formula (3) for different number of attributes ranging from 2 to 10. It can be observed that along a column, the weight of an attribute naturally decreases as one travels towards the bottom of the column. Additionally, Table 5.10 gives rank order centroid weights.

Table 5.9. Rank Sum (RS) weights

	Total number of attributes								
Rank	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	0.6667	0.5000	0.4000	0.3333	0.2857	0.2500	0.2222	0.2000	0.1818
2	0.3333	0.3333	0.3000	0.2667	0.2381	0.2143	0.1944	0.1778	0.1636
3		0.1667	0.2000	0.2000	0.1905	0.1786	0.1667	0.1556	0.1455
4			0.1000	0.1333	0.1429	0.1429	0.1389	0.1333	0.1273
5				0.0667	0.0952	0.1071	0.1111	0.1111	0.1091
6					0.0476	0.0714	0.0833	0.0889	0.0909
7						0.0357	0.0556	0.0667	0.0727
8							0.0278	0.0444	0.0545
9								0.0222	0.0364
10									0.0182

Table 5.10. Rank Order Centroid (ROC) weights

	Total number of attributes								
Rank	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	0.7500	0.6111	0.5208	0.4567	0.4083	0.3704	0.3397	0.3143	0.2929
2	0.2500	0.2778	0.2708	0.2567	0.2417	0.2276	0.2147	0.2032	0.1929
3		0.1111	0.1458	0.1567	0.1583	0.1561	0.1522	0.1477	0.1429
4			0.0625	0.0900	0.1028	0.1085	0.1106	0.1106	0.1096
5				0.0400	0.0611	0.0728	0.0793	0.0828	0.0846
6					0.0278	0.0442	0.0543	0.0606	0.0646
7						0.0204	0.0334	0.0421	0.0479
8							0.0156	0.0262	0.0336
9								0.0123	0.0211
10									0.0100

Tables 5.11 and 5.12 give the RS and ROC weights for each of the three ratings to be utilized during overall utility estimation for risk markup and profit markup respectively. Please note that, during overall utility estimation for risk markup, competition rating is excluded from analysis. Therefore, in Tables 5.9 and 5.10, one should look at the columns which correspond to a

total no. of 2 attributes. On the other hand, because all three ratings are included during profit markup estimation, weights should be obtained from the columns corresponding to a total of 3 number of attributes.

Table 5.11. Utility weights for risk and opportunity ratings during risk markup estimation

	Risk markup estimation		
	Importance rank	**RS weights**	**ROC weights**
Risk rating	1	0.6667	0.7500
Opportunity rating	2	0.3333	0.2500
Competition rating	Excluded	-	-

Table 5.12. Utility weights for opportunity, competition and risk ratings during profit markup estimation

	Profit markup estimation		
	Importance rank	**RS weights**	**ROC weights**
Opportunity rating	1	0.5000	0.6111
Competition rating	2	0.3333	0.2778
Risk rating	3	0.1667	0.1111

One should note the slight difference between RS and ROC weights. ROC weight set assigns higher weight to the first ranking attribute than the RS weight set does. In the mean time, for attributes that follow the highest ranking attribute, ROC weight set assigns weights lower than RS weight set does. In other words, a weighting shift takes place towards the beginning of the rank with the ROC weights.

Dozzi et al. (1996) states that a markup function is derived from a straight-line relationship between three overall utilities and three bid markup sizes estimated for 3 scenarios: worst scenario, average scenario and best scenario. Respectively, the three corresponding bid markup sizes can be labeled as maximum, average and minimum markups.

Here, the worst scenario is represented by very high risk, very low opportunity and very low competition ratings. Such a scenario results in the maximum risk and maximum profit markup estimations. At the same time, it results in the minimum overall utility value which is -100. Here, the 'worst scenario' term should not be taken in its actual meaning. Instead of giving the meaning of a truly bad situation, the worst scenario stands for a case in which the contractor assigns the highest markup (which is bad in a sense that the contractor is quite unlikely to win the tender). On the contrary to the worst scenario, the best scenario is represented by very low risk, very high opportunity and very high competition ratings. This scenario results in the minimum risk and minimum profit markup estimations. And, it results in the maximum overall utility value which is 100. All in all, the best scenario defines the lowest markup case in which contractors are most likely to win the tender. Finally, the overall utility value for the average case is derived by inserting the threshold values of the criteria into the overall utility formula. Hence, the average markup corresponds to the overall utility value of zero.

After all, if a decision-maker calculates the overall utility for a specific project by means of equation (1) given above, he can then calculate the recommended bid markup size from the linear function established utilizing the three above mentioned markup sizes and corresponding overall utility values (Table 5.13). This linear markup function (overall utility vs. bid markup) is illustrated in Figure 5.1.

Table 5.13. The three markup values that define the linear markup function

	Level of Risk markup	**Level of Profit markup**	**Overall utility value**
Worst case	max risk markup	max profit markup	-100
Average case	average risk markup	average profit markup	0
Best case	min risk markup	min profit markup	100

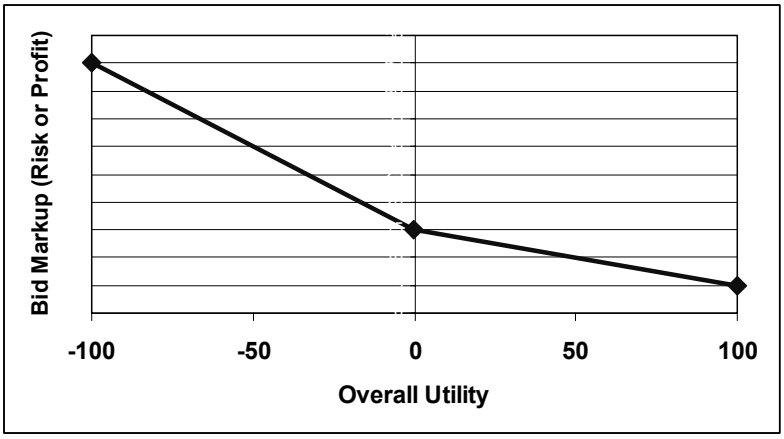

Figure 5-1. Linear markup function – Overall utility vs. bid markup

The resulting bid markup function, however, does not take into account the attitude of the contractor towards risk. A simple straight-line markup function is used for expressing the risk-neutral attitude, and exponential functions may be used for risk-averse and risk-seeking attitudes. A contractor with a risk-averse attitude will tend to over-estimate his bid markup decision; therefore the resulting overall utility function should be defined as a convex exponential function whose markup values are always above those of the straight-line function. On the other hand, a contractor with a risk-seeking attitude will tend to under-estimate his bid markup decision; therefore the resulting overall utility function should be defined as a concave exponential function whose markup values are always below those of the straight-line function (Lee and Chang, 2004). Sample markup functions for risk-averse and risk-seeking attitudes are given in Figure 5.2. The convex dashed curve which is above the straight line belongs to the risk-averse attitude, whereas the concave dashed curve which is below the straight line belongs to the risk-seeking attitude.

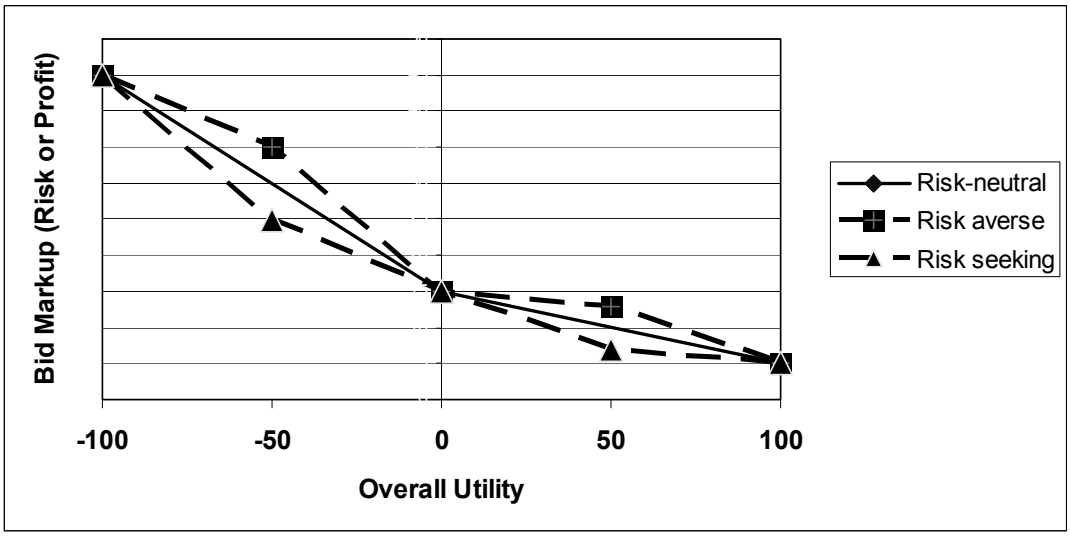

Figure 5-2. Graphical representation of markup functions for risk-averse and risk-seeking attitudes

For risk-seeking and risk-averse attitudes, the below exponential markup function is used (Lee and Chang, 2004):

$$\text{Markup (OU)} = c - a \times e^{b \times OU}, \text{ where } e = 2.718281. \quad (5)$$

However, in order to create the two exponential functions separately for both the negative and positive regions of the overall utility values, three data points are needed in each region. Therefore, a third data point should be identified for positive and negative overall utility regions. Because it is known that the utility curve should stretch above the original straight-line for risk-averse attitude, for the mid value of max and min overall utilities (50 and -50) a third point may be identified by multiplying their corresponding risk-neutral markup values by an escalation factor. Estimation of the escalation factor is performed subjectively. In case of the risk-seeking attitude, the same procedure applies this time to identify a third data point below the mid-point of the straight-line in each region. Parallel to the study of Lee and Chang (2004), 10% may be selected as the adjustment factor.

In section three of the questionnaire, the respondents had already been asked the three critical values of markups both for risk and profit. In addition, they had been asked to identify their risk markups separately for unit price and lump sum type contracts. Because, contractors usually differently identify their upper and lower limits of risk markup decision depending on whether the contract type is lump sum or unit price.

Section four of the questionnaire (titled `Risk profile identification questionnaire`) originally aimed to classify the respondents as risk-seeking or risk-averse. In the first question, respondents were given the choice of making an investment which offered the even possibilities of doubling the initial investment and losing the whole investment. In case the respondent is willing to make the investment, he is this time proposed to receive 1.000 USD with the condition that he changes his mind. On the other hand, if the respondent chooses not to make the investment in the first question, then a stipulation is imposed on him. He is forced to pay a fine of 1.000 USD in case he insists on not making the investment.

The logic behind the questionnaire is that, in case the respondents stuck to the investment opportunity ignoring the 1.000 USD reward, they could be labeled as at least partially risk-seeking. It is because they leave the sure money while their money is at risk. On the other hand, in case the respondents insisted on not making the investment while still paying the fine, they could be labeled as partially risk averse. It is because they agree to pay the fine in order not to risk their money at hand.

However, all of the contractors opted for paying the fine for the sake of not making the investment. As this questionnaire consistently resulted in the same outcome, it is believed that it does not appear to be a good measure of risk behavior of contractors. Otherwise, the fact should be that all of the contractors were really risk-averse, which is not very likely.

Survey results of a randomly selected contractor may be utilized here to serve as an example for bid markup calculation. For confidentiality, the company name is not given. The respondent stated that his company utilizes the risk markup size of 5% as a minimum, 7.5% as an average and 30% as a maximum for lump sum projects. For unit price projects, the maximum risk markup was stated as 20% and the minimum risk markup was defined as 3%.

That selected scenario of the contractor was defined for a unit price type contract. In addition, for that scenario, risk, opportunity and competition ratings were all stated as high by the respondent. Accordingly, in Tables 5.14 and 5.15 overall utilities for risk and profit markups are calculated respectively. Please note that at the bottom row of each table, two separate overall utility values are calculated, one for ROC weights and one for RS weights.

Table 5.14. Overall utility calculation for 'risk markup' for the example scenario

	Rating in number	Rating in text	(1) Utility value	(2) ROC weights for risk markup	(3) Weighted utility (1)x(2)	(6) RS weights for risk markup	(7) Weighted utility (1)x(6)
Risk	4	high	-0.5	0.75	-0.375	0.667	-0.333
Opportunity	4	high	0.5	0.25	0.125	0.333	0.167
Competition	4	high	0.5	0	0	0.000	0.000
				(4) Overall utility (OU)	-0.25	(8) Overall utility	-0.167
				(5) OU on 100 scale	**-25.00**	**(9) OU on 100 scale**	**-16.67**

Table 5.15. Overall utility calculation for 'profit markup' for the example scenario

	Rating in number	Rating in text	(1) Utility value	(2) ROC weights for risk markup	(3) Weighted utility (1)x(2)	(6) RS weights for risk markup	(7) Weighted utility (1)x(6)
Opportunity	4	high	0.5	0.611	0.306	0.500	0.250
Competition	4	high	0.5	0.278	0.139	0.333	0.167
Risk	4	high	-0.5	0.111	-0.056	0.167	-0.009
				(4) Overall utility (OU)	0.389	(8) Overall utility	0.407
				(5) OU on 100 scale	**38.89**	**(9) OU on 100 scale**	**40.74**

These overall utility values are to be inserted into the linear markup function given in Figure 5.1 so that the markup values can be estimated.

The resulting graphs and values are given below. In order to enable a better zoom onto the graph, the negative x-axis portion is disregarded in Figure 5.4.

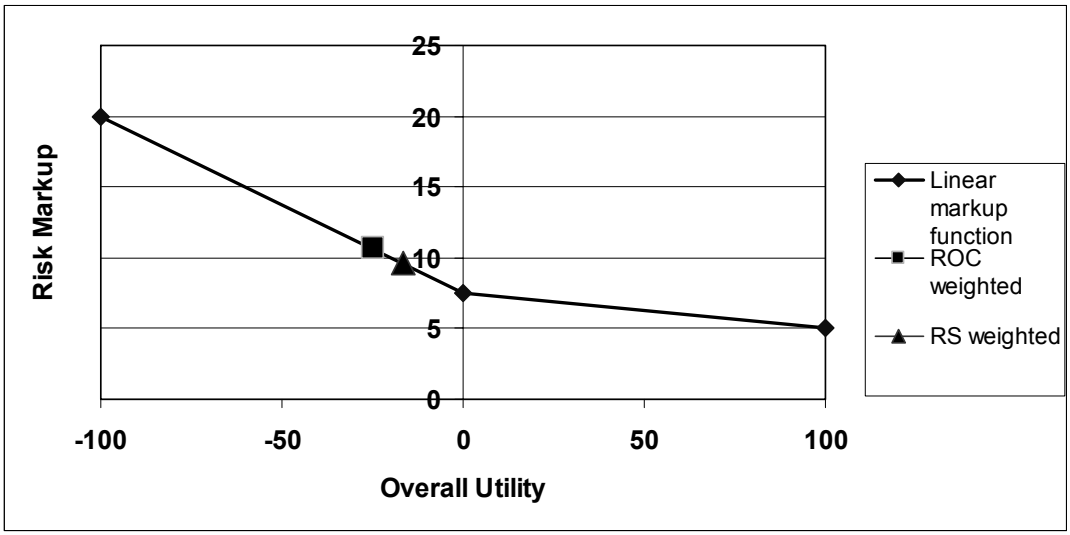

Figure 5-3. Risk markup estimation for the two derived overall utilities

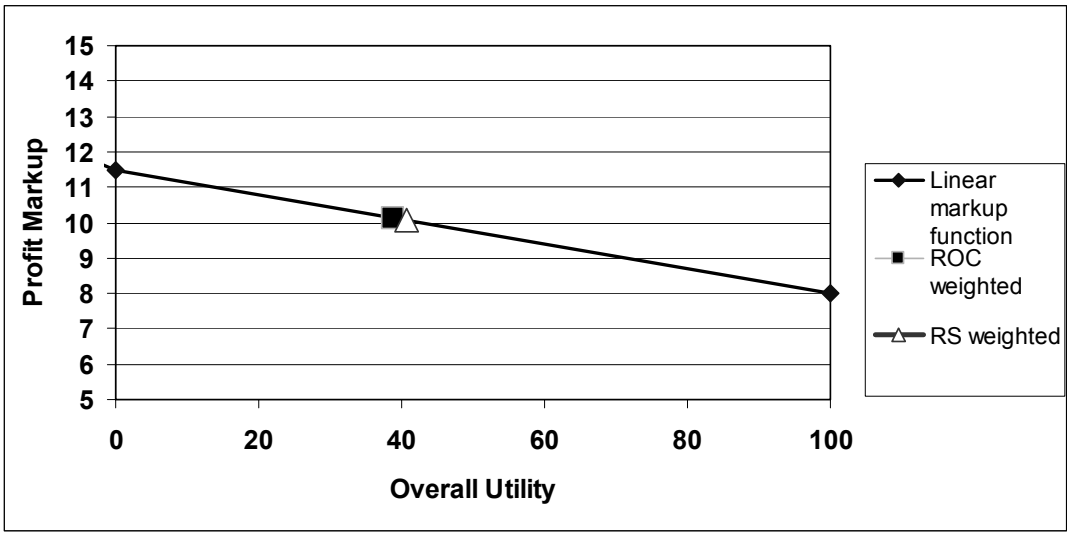

Figure 5-4. Profit markup estimation for the two derived overall utilities

Table 5.16. Comparison for estimations obtained by the model and given by the respondent

	Risk markup (%)	Profit markup (%)
ROC weighted estimation	10.63	10.14
RS weighted estimation	9.58	10.07
Actual figure given by the respondent	10.00	10.00
Abs. error for ROC weighted estimation	0.63	0.14
Abs. error for RS weighted estimation	0.42	0.07

As Table 5.16 indicates, the linear markup estimation model performed quite well. The third and fourth rows give the resulting absolute estimation errors which are all significantly less than 1 percent of the base estimate of the project. In this particular example, RS weighting method seems to outperform the ROC weighting method, since the error values of the former are smaller than those of the latter.

5.7.4 Accuracy check for the markup estimation model

For the purpose of accuracy check of the outputs derived by the above markup estimation model, the outputs of the model are compared to the risk and profit markup decisions of experts. This is accomplished by taking the absolute value of the estimation error for each bidding scenario. Estimation error is the value of the difference between the values estimated by experts and by the model. Finally, average of the absolute errors is taken to see the overall average error. Comparing the two sets of estimations (one by expert and one by model), analysis results give an average absolute error of 3.35 percentage points for risk markup estimation and 2.66 percentage points for profit markup estimation, with ROC weights. When the results are compared, this time with utilizing RS weights, the absolute error for risk markup slightly climbs to 3.55 percentage points whereas that for profit markup remains the same (Table 5.17). Taking into account the fact that, experts usually assign markups in 5 percentage point increments such as 5, 10, 15; it can be claimed that results obtained by the model are successful, with relatively low level of error.

Table 5.17. Average absolute estimation errors for ROC and RS weighted estimations

	Average abs. estimation error for risk markup (%)	**Average abs. estimation error for profit markup (%)**
ROC weighted estimation	3.35	3.55
RS weighted estimation	2.66	2.66

5.8 Factor Weights Estimation through Regression Analysis

5.8.1 Linear regression for risk markup estimation

Linear regression is used to model the value of a dependent scale variable based on its relationship to one or more predictors. For a scale variable,

data values are numeric values on an interval, like age or income. The linear regression model assumes that there is a linear, or “straight line” relationship between the dependent variable and each predictor. This relationship is described in the following formula.

$$y_i = b_0 + b_1 x_{i1} + ... + b_p x_{ip} + e_i \qquad (6)$$

where y_i is the value of the ith case of the dependent scale variable

p is the number of predictors

b_j is the value of the jth coefficient, $j = 0,...,p$

x_{ij} is the value of the ith case of the jth predictor

e_i is the error in the observed value for the ith case

In order to carry out a linear regression analysis, SPSS software is utilized.

In this study, dependent variable is defined as the actual overall utility value of the case in view of risk markup. Utilizing the linear markup function given in Figure 5.1 and knowing the boundary risk markup values and the risk markup (%) assigned by the expert for his set of bidding cases, one can easily calculate the overall utility value corresponding to the expert-defined risk markup value.

For each case, first of all, utility values corresponding to expert-assigned risk, opportunity and competition ratings are calculated as shown in Table 5.8 and the resulting actual overall utility value is calculated as explained above. These four sets of data constitute the database on which linear regression analysis is to be applied. The only missing connection, now, between the utility values of ratings and overall utility value is the identification of weights for the three ratings. Previously, weights were assigned by means of the Rank Sum (RS) and Rank Order Centroid (ROC) weights. As it was given in the above equation (2), overall utility is obtained

as the sum of weighted utility values belonging to the three ratings, resulting in a value ranging between -100 and 100. The overall utility formula is rewritten below.

$$O.U.(risk) = b_0 + b_1*RiskUtility + b_2*Opp.Utility + b_3*Comp.Utility \quad (7)$$

where O.U. is overall utility of the case in view of risk markup

b_0 is the value of the y-intercept

b_1, b_2 and b_3 are coefficients (weights) for each type of utility

Risk Utility, Opp. Utility and Comp. Utility ranges between -1 and 1.

Running the linear regression analysis application in SPSS, the resulting summary table is given as Table 5.18.

Table 5.18. Model summary table

R	R Square
0,777	0,604

The model summary table reports the strength of the relationship between the model and the dependent variable. R, the multiple correlation coefficient, is the linear correlation between the actual and model-predicted values of the dependent variable. Its large value indicates a strong relationship. R Square, the coefficient of determination, is the squared value of the multiple correlation coefficient. It shows that slightly more than half of the variation in overall utility is explained by the model.

Table 5.19 also gives the coefficients and significance values for each variable.

Table 5.19. Coefficient and significance values for predictor variables

	Coefficient	Significance
(Constant)	11,35	0,017
Risk utility	77,79	0,000
Opp. utility	5,66	0,549
Comp. utility	17,39	0,060

First having a look at the significance values, it is understood that there are two non-significant variables, each having a significance coefficient greater than 0,05. Significance coefficients of 0,549 and 0,06 indicate that opportunity and competition related variables do not contribute much to the model.

To determine the relative importance of the independent variables (predictors), one must look at the coefficients given in Table 5.19. Risk utility is the most highly contributing variable to the risk markup estimation model because it has the largest absolute coefficient.

In order to eliminate the insignificant variables, this time a stepwise linear regression algorithm is run.

The new model's ability to explain sales compares favorably with that of the previous model. Comparing the R-square statistics of the two models, it is seen that they are nearly identical (Tables 5.18 and 5.20)

Table 5.20. R and R Square results

R	R Square
0,762	0,581

The stepwise algorithm chooses first the risk utility variable to construct its model, because it is the most highly correlated variable with overall utility. The remaining variables are then analyzed to determine which, if any, is the most suitable for inclusion at the next step. Having chosen the risk utility as

the first variable, the following statistics are obtained for the remaining two variables as given in Table 5.21.

Table 5.21. Results for the second step of the regression analysis

	Significance	Partial Correlation
Opp. utility	0,510	0,077
Comp. utility	0,056	0,220

In Table 5.21, it is realized that none of the remaining variables are significant since their significance coefficients are both greater than 0,05. Also in the same table, for each variable, partial correlation value, which is the linear correlation between the proposed predictor variable and the dependent variable after removing the effect of the current model, is given. The low partial coefficient values that are close to zero also support the view that these two variables are insignificant.

The coefficient for the single significant predictor parameter (risk utility) and the constant coefficient are both given in Table 5.22.

Table 5.22. Resultant regression analysis results

	Coefficient	Significance
(Constant)	13,938	0,001
Risk utility	80,182	0,000

The final step is to check the accuracy of the model for its risk markup prediction ability. Predicted overall utility for each bidding scenario is calculated via the coefficients given in Table 5.22 being inserted into the equation (7). Then in order to predict the risk markup, these predicted overall utility values are inserted into the linear risk markup estimation function (overall utility vs. risk markup) as it was done previously in Figure

5.3. However, it should be noted that yet there is no unique set of boundary values defined for risk markup (lower, upper and average values), because they are left to the judgment of experts. Therefore, for each bidding case in the database, while constructing the linear bid markup function, the initially collected expert defined boundary markup values, which are specific to experts, are utilized.

Next, the absolute value of the estimation error for each bidding scenario is calculated. Estimation error is the value of the difference between the risk markup values estimated by experts and by the model. Finally, average of the absolute errors is taken to see the overall average error.

Analysis results give an average absolute error of 2,53 percentage points for risk markup estimation. This result indicates an improvement over the previous prediction models constructed by means of ROC and RS weights, which resulted in 3,35% and 2,66% average absolute errors, respectively.

5.8.2 Linear regression for profit markup estimation

This time, in order to construct a model to predict profit markup, stepwise linear regression is carried out by means of defining the overall utility for profit as the dependent variable and the three rating values as predictor variables.

Table 5.23 gives the resulting R and R Square values. R, the multiple correlation coefficient, indicates a lower performance when compared to that of the previous regression model constructed for risk markup. The R Square value of 0,318 shows that less than half the variation in overall utility is explained by the model.

Table 5.23. R and R Square results

R	R Square
0,564	0,318

The stepwise algorithm chooses first solely the risk utility variable to construct the model no 1, because it is the most highly correlated variable with overall utility. The remaining variables are then analyzed to determine which, if any, is the most suitable for inclusion at the next step. Having chosen the risk utility as the first variable, the following statistics are obtained for the remaining two variables as given in the first two rows of Tables 5.24 and 5.25, the rows that correspond to model no 1.

Table 5.24. Stepwise regression analysis results

Model		Coefficients	Sig.
1	(Constant)	17,298	0,002
	Risk utility	44,736	0,000
2	(Constant)	15,026	0,005
	Risk utility	41,326	0,000
	Comp utility	30,571	0,009
3	(Constant)	9,431	0,105
	Risk utility	39,463	0,000
	Comp utility	29,685	0,010
	Opp. utility	24,684	0,036

Table 5.25. Significance results for the stepwise regression analysis

Model	Variable	Sig.	Partial Correlation
1	Opp. utility	0,035	0,242
	Comp. utility	0,009	0,296
2	Opp. utility	0,036	0,242

As seen in Table 5.25, competition utility variable results in a significance value that is closer to 0 when compared to that of opportunity utility variable. It indicates that there is less probability that competition utility is an insignificant variable than opportunity utility variable may be. Therefore, while constructing the next model (no 2), this time competition utility is

included in the model in addition to risk utility. And for model no 2, the only excluded variable, opportunity utility, results in a significance value of 0.036 that is still lower than 0.05 (Table 5.25). Therefore, opportunity utility variable is also decided to be incorporated into the model. Finally, the third model is constructed taking into consideration the all three utility variables and it results in the coefficients given in Table 5.24 corresponding to model no 3.

When the three resulting coefficients each belonging to risk, competition and opportunity utilities are analyzed (39.46, 29.69 and 24.68, respectively), it is realized that risk rating has more weight in profit markup determination when compared to competition and opportunity ratings. This finding suggests that a shift in risk rating results in a greater change in profit markup when compared to a similar degree of shift in opportunity or competition ratings. In other words, contractors appear to be more sensitive to risk in regard of profit markup determination when compared to their level of sensitivity to opportunity and competition. This may be the result of the current situation that Turkish contractors are busily seeking quite high levels of profits in countries such as Iraq and Afghanistan, where risks are substantially high.

Also, because competition is the second most highly weighted factor in profit markup determination, preceding opportunity factor, it is suggested that the international construction market is tight and contractors are sensitive in a high degree also to the perceived competition for the tender.

All in all, weights of the three factors are close to each other with no weight dominating others. Unlike the situation with risk markup determination, where only the risk utility matters, the resulting profit markup estimation model suggests that all three factors are significantly considered during assignment of profit markup.

In addition, because all the coefficients resulting from regression analysis appeared to be positive, the initial assumption for the direction of relationship between risk, opportunity and competition ratings and profit markup is verified. It was assumed in the very beginning that slope of the relationship between profit markup and risk rating is positive, whereas slope of the relationship between profit markup; and opportunity and competition ratings is negative.

The final step is to check accuracy of the model for its profit markup prediction ability. Predicted overall utility for each bidding scenario is calculated via the coefficients given in Table 5.24 (indicated by model no 3) by means of inserting them into the equation (7), where overall utility for risk is to be substituted by overall utility for profit. Then, in order to predict the profit markup, these predicted overall utility values are inserted into the linear profit markup estimation function (overall utility vs. risk markup) as it was done previously for risk markup estimation.

Next, the absolute value of the estimation error for each bidding scenario is calculated. Estimation error is the value of the difference between the risk markup values estimated by experts and by the model. Finally, average of the absolute errors is taken to see the overall average error.

Analysis results give an average absolute error of 3.24 percentage points for profit markup estimation. This result indicates an improvement over the previous ROC weighted prediction model (3.55 %) while still being above the average absolute error achieved by the RS weighted model (2.66 %).

CHAPTER 6

A DECISION SUPPORT TOOL FOR DETERMINING BID MARKUP

6.1 A Book on Intelligence

Jeff Hawkins's latest book titled "On Intelligence" really inspires anyone interested in the theory of how the human brain works. Understanding of how the human brain works is the requisite to building truly intelligent machines. Yet there are no effective theories about what intelligence is or how brain works.

In this thesis study, at the stage of selection of a method to construct a decision support tool for determining bid markup, insights provided by Hawkins (2004) helped a lot.

Hawkins (2004) states that brain uses vast amounts of memory to create a model of the world. Everything a person knows and has learned is stored in this model. The brain uses this memory-based model to make continuous predictions of future events. It is the brain's ability to make predictions about the future that is the puzzling problem of intelligence.

Hawkins claim that artificial intelligence (AI) research implemented in computer medium by computer programmers so far, is totally far from imitating the actual way a brain works. Hawkins believes that the claim of computer scientists that computers will be intelligent when they are powerful enough is wrong. Because, according to Hawkins, computers and brains do fundamentally different things. He states that computers are programmed, whereas brain is self-learning. Computers have to be perfect at all, whereas

brain is naturally flexible and tolerant of failures. Computers have a central processor, whereas brain has no centralized control.

During the last decade, AI research generated excitement with the IBM's Deep Blue's triumph against chess champion Gary Kasparov. However, Hawkins claims that Deep Blue did not win by being smarter than a human, it won by being millions of times faster than a human. An expert human player looks at the chess board and immediately sees what areas of play are most likely to be fruitful or dangerous, whereas a computer has no inherent sense of what is important and has to explore many more options. Computer played chess, yet did not understand chess. (Hawkins, 2004)

Hawkins states that neural networks were a genuine improvement over the AI approach, because their architecture is based, though very loosely, on real nervous systems. The network's knowledge and memories are distributed throughout its connectivity between neurons – just like real brains. Unlike artificial intelligence, where everything have to be programmed, neural nets learned by example, which seems somehow more intelligent. However, many neural networks could not go beyond three-row neural network applications (Hawkins, 2004). Above all, neural network tools are black boxes that fail to explain how they obtained the output.

Hawkins (2004) explains, through an example, the difference between computing a solution to a problem and using memory to solve the problem. He illustrates the task of catching a ball. A ball is thrown towards the catcher, catcher sees the ball traveling towards him and in less then a second he catches the ball. This does not seem too difficult – until someone tries to program a robot arm to do the same. When computer scientists try to tackle this problem, they first try to calculate the flight path of the ball to determine its location when it should meet the arm. This calculation requires solving a set of equations. Next, all the joints of a robotic arm have to be adjusted to move the hand into the proper position. This involves solving

another set of mathematical equations. Finally, this whole operation has to be repeated multiple times, for as the ball approaches, the robot gets better information about the ball's location and trajectory. The robot has to start moving in order to catch the ball when it has only a poor sense of its location and it continually adjusts as the ball gets closer. A computer requires millions of steps to solve the numerous mathematical equations to catch the ball. However, a brain solves it in a different way. It uses memory (Hawkins, 2004).

Hawkins (2004) also explains how a person catches the ball using memory. Brain has a stored memory of the muscle commands required to catch a ball. When a ball is thrown, three things happen. First, the appropriate memory is automatically recalled by the sight of the ball. Second, the memory recalls a sequence of muscle commands. And third, the retrieved memory is adjusted as it is recalled to accommodate the particulars of the moment, such as the ball's actual path and position of body. The memory of how to catch a ball is not programmed into the brain; it is learned over years of repetitive practice, and it is stored, not calculated, in neurons.

The brain does not compute answers to problems. In fact, it retrieves the answers from the memory. It only takes a few steps to retrieve something from memory. Brain uses stored memories to solve problems and produce behavior (Hawkins, 2004).

According to Hawkins, intelligence is rooted in the brain's ability to access memories rather than in its ability to process new data. The brain, Hawkins says, accesses previous experiences, compares them with existing circumstance, and predicts what is most likely to happen next. In line with the insight provided by Hawkins, in this thesis case based reasoning (CBR) method is selected to help construct a model in order to propose bid markup for international construction projects. Because, it is realized that CBR

system very closely resembles how brain makes judgments in the way explained by Hawkins.

A CBR system draws its knowledge from a reasonably large set of cases contained in the case library of past problems rather than from only a set of rules. It solves new problems by adapting solutions that were used to solve old problems.

Let us consider what a CBR system does, using a simple example: Assume you work for a bank and have to advise on the suitability of a person for a loan. One way of solving this problem is to compare each new loan application against your knowledge of loans you have granted in the past. If a person's circumstances are similar to those of someone who successfully repaid a loan in the past, then you would grant the loan. Conversely, if their circumstances are similar to those of someone who defaulted on a loan, then you would not grant the loan (Watson,1997).

Let us examine what mental tasks you perform in solving this problem:

1. You search your memory of previous loans and make an assessment of similarity.

2. You attempt to infer an answer from the most similar loan you remember.

3. You may have to make allowances and adjustments for changes in circumstances over the years – for example, $20.000 is a small annual salary in 2005 but was not such a small salary in 1980.

4. If you grant the loan, you will monitor and record the outcome of the loan for future use.

This mental process can be simplified to describe CBR typically as a cyclical process comprising the four RE's (Watson,1997):

1. Retrieve the most similar case(s).
2. Reuse the case(s) to attempt to solve the problem.
3. Revise the proposed solution if necessary.
4. Retain the new solution as a part of a new case.

A new problem is matched against cases in the case-base, and one or more similar cases are retrieved. A solution suggested by the matching cases is then reused and tested for success. Unless the retrieved case is a close match, the solution will have to be revised or adapted, producing a new case that can be retained (Watson, 1997).

The first essential feature to a case base is case representation that is how a case is defined. A case can be an account of an event or some record typically comprising (Watson, 1997):

- The problem that describes the conditions when the case occurred
- The solution that states the derived solution to that problem

When acquiring cases, it is important that they are representative of the problem domain. This presents two problems:

1. What features should the cases have?
2. Which cases should be acquired?

A case is defined in terms of features (parameters or factors) taking values. Therefore, all of the factors that are significant to the definition of the problem and solution should be identified first in order to define a case in a reliable manner.

Our brain does not remember exactly what it sees, hears or feels. We do not remember or recall things with complete fidelity – not because neurons are error-prone but because the brain remembers the important relationships in the world, independent of the details (Hawkins, 2004). According to Hawkins, memories have to be stored in an invariant form so that the knowledge of past events can be applied to new situations that are similar but not identical to the past. In CBR, this is accomplished by employing a set of significant and relevant features that is believed to fully describe the problem situation and to fully relate to the solution. For example, for the loan granting problem, features such as monthly income, job status and monthly loan repayments are incorporated as case features, whereas features that do not relate to the problem are ignored. Very similar to the way that memories are stored as explained by Hawkins, memories of cases in CBR are stored in an invariant form where each case is represented by a single set of features identified for a unique problem domain.

In the late 1960s and early 1970s, a series of papers by Amos Tversky and Daniel Kahneman revolutionized academic research on human judgment. The central idea of the "heuristics and biases" program introduced by Tversky and Kahneman was – that judgment under uncertainty often rests on a limited number of simplifying heuristics rather than on an extensive algorithmic processing. Heuristics have been defined as something akin to strategies that people use deliberately in order to simplify judgmental tasks that would otherwise be too difficult for the typical human mind to solve (Gilovich et al., 2002).

Kahneman and Tversky described three heuristics that underlie many intuitive judgments under uncertainty. These heuristics are named - availability, representativeness, and 'anchoring and adjustment'.

Availability, representativeness, and anchoring and adjustment were proposed as a set of highly efficient mental shortcuts that provide subjectively compelling and often quite serviceable solutions to judgmental problems (Gilovich et al., 2002).

Availability heuristic is related to making judgments about the frequency or likelihood of an event based on the ease with which evidence or examples come to mind. For example, most people think that dying from a shark attack is more likely than dying from being hit by falling airplane parts, yet the opposite is true by a factor of 30. Perhaps this is because sharks are inherently terrifying or because shark attacks receive more media coverage (Psychcentral, 2005).

Representativeness is an assessment of the degree of correspondence between a sample and a population, an instance and a category or more generally, between an outcome and a model. Representativeness - entails looking at an event and making a judgment as to how closely it corresponds to other events as found in the general population. When deciding whether an elegantly-dressed lawyer is more likely to be a public defender or a member of a large corporate firm, for example, one cannot help computing the similarity between the individual and the prototype of each profession (Gilovich et al., 2002). Or, if we want to know how likely it is that a student will pass the course, we might consider the degree to which that student represents the group of students who passed previously.

The term anchoring and adjustment implies a particular cognitive process whereby decision makers spontaneously anchor on information that readily comes to mind and adjust their responses in a direction that seems appropriate (Epley and Gilovich, 2002). Anchoring and adjustment is a useful way of making judgments. Imagine that you are trying to set a value on an antique chair that you have inherited from a distant aunt. You might recall seeing a very similar chair in slightly better condition at a local antique

dealer. You might start with that price as an anchor, and then incorporate the difference in quality (Chapman and Johnson, 2002).

All in all, the three heuristics utilized for the purpose of judgment under uncertainty, as defined by Kahneman and Tversky, exactly match with the basics of CBR. While availability heuristic correspond to case retrieval, representativeness heuristic correspond to similarity assessment; and finally anchoring and adjustment heuristic is counterpart of the adaptation process applied to retrieved cases in CBR.

6.2 Model Development and Construction

6.2.1 Esteem Software

Given its user friendliness and availability for research studies, ESTEEM Software version 1.4 is selected to implement the CBR model in Microsoft Windows environment on a PC.

The ESTEEM Case-Based Reasoning (CBR) development tool is a professional tool that allows developers, as well as non-programmers, to develop decision enabling applications built through the use of previous problem-solving experiences (cases). ESTEEM allows you to create the definition of what a CBR application is, how to retrieve the critical prior experiences, and how to use them in new problem solving situations. (ESTEEM, 1992)

6.2.2 Problem definition

The first step in model development is definition of problem. The problem is defined in terms of inputs, outputs and a model that will transform the inputs into outputs. Inputs correspond to the features (factors) that describe the nature of the case. On the other hand, outputs correspond to the three features that we are seeking to predict: risk rating, opportunity rating and

competition rating. These input and output factors were described and explained in Chapter 5. Once risk, opportunity and competition ratings are predicted for a target case, a proper bid markup may be estimated for that target case through the model developed in Chapter 5.

6.2.3 Case definition

Each source case is a problem previously defined and solved by experts. During the survey, a total of 95 cases were collected from experts. Each case is composed of feature values defined for each feature. The questionnaire form that was utilized during the survey in order to collect the cases is given in Appendix A.

In order for the software to properly assess the similarity between the cases, feature types should be defined first for each feature. The first step in developing a CBR application in ESTEEM is the definition of the structure of a case. Built into the ESTEEM software, there are 3 main feature types deemed as most useful, namely: text, numeric and one of a list. Definition of feature types in ESTEEM language for each feature is given in Table 6.1.

Table 6.1. Feature type definition

Feature description	Abbreviation	Feature type
Case title		text
GENERAL FEATURES ABOUT COMPANY AND PROJECT		
Project size	PRJ_SIZE	numeric (min:1, max:4)
Contract duration	CONT_DUR	numeric (min:1, max:3)
Contract payment type	CONT_PAY_TYPE	one of a list (lump sum, unit price, cost+fee)
Type of project	PROJ_TYPE	one of a list (housing, building, industrial, infrastructural)
Client type	CLNT_TYPE	one of a list (private, public)
Size of the contractor company	CONTOR_SIZE	numeric (min:1, max:5)
Level of experience of contractor in similar type of projects	EXP_SIM_PROJ	numeric (min:1, max:3)

Table 6.1. Continued

Level of experience of contractor in the host country / similar countries	EXP_SIM_COUNTR	numeric (min:1, max:3)
Financial capability of the contractor	FIN_CAPB	numeric (min:1, max:3)
Technical capability of the contractor	TECH_CAPB	numeric (min:1, max:3)
Managerial capability of the contractor	MAN_CAPB	numeric (min:1, max:3)
Planned % of subcontracted works	PLND_%_SUBC	numeric (min:1, max:3)
Amount of cash required in advance	CASH_ADV	numeric (min:1, max:3)
RISK FACTORS		
Vagueness of design	VAG_DSGN	numeric (min:1, max:3)
Lack of enough technical information	TECH_INFO	numeric (min:1, max:3)
Vagueness of contract conditions	VAG_CONTRCT	numeric (min:1, max:3)
Unavailability of required construction materials and supplies in the host country	UNAVA_MATRL	numeric (min:1, max:3)
Lack of competence of local parties in the host country	LOCAL_PRTS	numeric (min:1, max:3)
Unfavorability of physical conditions that may adversely affect productivity at site	UNFAV_PHY_COND	one of a list (insignificant, significant)
Technical and technological complexity of the project	TECH_COMPLXTY	numeric (min:1, max:3)
Strict quality requirements/ specifications	STR_QUAL_REQ	one of a list (non-existent, existent)
Tightness of the project duration / Existence of high penalty clauses	TGHT_PRO_DRTN	numeric (min:1, max:3)
Lack of infrastructural and civil development in the host country	LACK_DEV_COUNTR	numeric (min:1, max:3)
Geographical distance between host country and Turkey	GEO_DIST	numeric (min:1, max:3)
International relations of the host country with Turkey	INT_RELTNS	numeric (min:1, max:3)
Economical / financial risk of the host country and /or client	ECO_RISK	numeric (min:1, max:3)
Foreign exchange rate / inflation rate fluctuation risk	XCHANGE_INFL_RISK	one of a list (insignificant, significant)
Immaturity / unreliability of the legal system to which the contractor is subject according to the contract (legal risk)	LEGAL_RISK	numeric (min:1, max:3)

Table 6.1. Continued

Instability of the political environment in the host country (political risk) / potential for negative changes in government policies	POL_RISK	numeric (min:1, max:3)
Bureaucratic delays/ difficulties	BUREA_DELY	numeric (min:1, max:3)
Cultural differences between the host country and Turkey (cultural risk)	CULT_RISK	numeric (min:1, max:3)
Security risk	SECRTY_RISK	numeric (min:1, max:3)
Existence of language barrier	LANG_BARR	one of a list (insignificant, significant)
Level of experience of the client (in similar projects, with foreign contractors etc.)	EXPR_CLNT	numeric (min:1, max:3)
Attitude of the client towards the contractor (about timeliness of payments etc.)	ATT_CLNT	numeric (min:1, max:3)
Availability of funds for the project	AVAI_FUND	numeric (min:1, max:3)
OPPORTUNITY FACTORS		
Contractor's potential for gaining reputation and experience with the project	REPTTN_EXP	numeric (min:1, max:3)
Potential for gaining similar future projects in the same country	SIM_FUTR_PROJ	numeric (min:1, max:3)
Immediate need to take a job	IMM_NEED	numeric (min:1, max:3)
Existence of local agents that help the contractor with the project	LOC_AGENT	one of a list (non-existent, existent)
General economic situation at the contractor's country	GEN_ECON	numeric (min:1, max:3)
Potential for changes in the scope of works and/or bid prices during the course of the project	POT_CHANG	numeric (min:1, max:3)
COMPETITION FACTORS		
Number of bidders	NO_BIDDR	numeric (min:1, max:3)
Presence of highly competitive bidders (presence of potential lowest cost bidders like Chinese etc.)	HI_COMP_BIDDR	one of a list (yes, no)
OUTPUT FACTORS		
Risk rating	RISK_RATING	numeric (min:1, max:5)
Opportunity rating	OPP_RATING	numeric (min:1, max:5)
Competition rating	COMP_RATING	numeric (min:1, max:5)

While coding the case data into the software, feature values are stored in the program in the manner as defined in Table 6.1. For example, in the questionnaire, the value scale for ‘financial capability of the contractor’ was comprised of low, medium and high. However, during insertion of the case data into the software, the original string scale is converted into a numerical scale composed of ordinal integers. By that means, for example, feature values of low, medium and high are converted into 1, 2 and 3 respectively.

Since each feature in our case can take only discrete values, each one of them is labeled as a categorical variable. One thing that requires particular attention here is the distinction between ordinal and nominal variables. For ordinal variables, data values represent categories with some intrinsic order (for example; low, medium, high). On the other hand, for nominal variables, data values represent categories with no intrinsic order (for example; housing, building and industrial).

Taking into account the above distinction, the feature types in Table 6.1 are either numeric or one of a list. To the software, ordinal variables are introduced as numeric, whereas nominal variables are introduced as ‘one of a list’ type. Only the first item in the table, case title, is of text type. However, it does not play a role during model formation other than helping to distinguish between cases.

One exceptional situation happens with the ‘project size’ factor where its value can range between 0 and infinity (practically a few billion US dollars). During the survey, the project size was assigned by the expert an integer value that is supposed to be the project’s value in million USD. However, during evaluation of the collected data, ‘project size’ values are transformed into categorical values. As a categorical variable, ‘Project size’ takes 1 when the project value is less then 10 million USD, 2 when it is between 10 and 25 million USD, 3 when it is between 25 and 75 million USD, and 4 when it is greater than 75 million USD. This categorization enables the definition of

“feature matching type” in an appropriate manner in accordance with the functioning mechanism of the ESTEEM software. The concept of “feature matching type” is to be discussed in the coming pages alongside the explanation given for similarity assessment between feature values.

6.2.4 Preliminary elimination of insignificant features

The original survey, as explained in Chapter 5, included 44 input factors. However, three of these factors which received an average importance rating of below 3 (indicating significance below medium level) in Table 5.1 in Chapter 5 are excluded during model construction due to their low importance and hence low significance. These three factors are namely: (1) planned % of subcontracted works, (2) cultural differences between the host country and Turkey (cultural risk), and (3) existence of language barrier. Therefore, the CBR model is constructed utilizing the remaining 41 input factors and 3 output factors. From now on, these three factors are to be ignored during analysis.

6.2.5 Formation of the case library

A total of 95 cases described by experts for international construction projects constitute the case library of the CBR model. Applying the usual 85% - 15% principle, cases are grouped into training and testing samples. In other words, cases are randomly split into seven subsets, each having almost equal population. Then, each of the subset constitutes a testing sample for the rest of the population which constitute the training sample. In that way, one-seventh of the whole population, which is actually 14.3%, meets the 15% criteria set for the required size of testing sample in the 85%-15% principle.

Identifying only a single testing population was an option. But the idea behind the above mentioned splitting and testing methodology is to prevent the bias of researchers against utilization of a single set of testing cases. In

this manner, the accuracy and hence success of the model is tested for several times against isolate sets of cases.

6.2.6 Weight generation for similarity assessment

The ultimate aim in a CBR application is the retrieval of the most similar case that is supposed to suggest the right problem solution or outcome. Following the case library definition stage, during weight computation stage of the CBR algorithm each feature is to be assigned a numeric weight value which indicates its relative importance during functioning of the case retrieval algorithm.

During weight computation stage, ESTEEM generates numerical weights for each input feature and finally normalizes them so that they add up to 1. As an extreme example, should the weights of factor 1 and factor 2 come out to be both 0.5 while those of remaining factors appear to be zero, we understand that only factors 1 and 2 are significant in determining the output whereas the remaining factors are not. In other words, the similarity of cases should be assessed considering only these two factors in equal weights. Besides, it is revealed that the rest of the factors are irrelevant to the outcome in the context of the problem.

For the purpose of weight computation for similarity assessment, the gradient descent weight generation method available with ESTEEM is utilized throughout this study. The method's basic algorithm works as follows: several random cases are selected from the case library, and the cases that are most similar to them (based on the current weights of the features) are found. Information on how much the weight of the source features should be incremented or decremented is calculated, based on how well the matching cases' feature values match as well as how well the matching cases' target feature values match. After examining several random cases, the resulting "weight updates" vector is normalized, scaled by a factor Delta, and added to the current weight vector. The factor Delta

is then decreased, and the algorithm begins examining more random cases. This process continues until Delta reaches a certain value, or until the user tells ESTEEM to stop (ESTEEM, 1992).

As mentioned earlier, each scenario in the case library includes 41 input factors and 3 output factors (risk rating, opportunity rating, competition rating). When a target case is to be matched to the cases available in the case library, the model is to be run for a total of three times each for the purpose of retrieving the similar cases in view of risk, opportunity and competition separately in each step. Therefore, when the model is to be run for assessing similarity of cases in view of risk, only the risk relevant factors are to be incorporated into the model. And the same logic follows for both opportunity relevant and competition relevant factors during opportunity and competition analysis.

6.2.7 Prediction model for risk rating

For the risk rating prediction model, the initially incorporated factors which are deemed to be risk relevant involve the whole 12 factors under 'general features about company and project' category and the whole 21 risk factors, adding to a total of 33 factors.

During weight generation phase in ESTEEM, user is asked to identify the features which are to be treated as input factors. The features that are deemed by the user to be irrelevant in the first place to the concerned outcome are wholly excluded from the analysis. Subsequently, the user is asked to identify the output feature, which is one of the three ratings: risk, opportunity or competition.

For the purpose of weight generation for risk rating prediction, these 33 factors and their corresponding risk rating values are identified to be utilized with the gradient descent weight generation method. Other than utilizing feature values, this method requires assignment of type of feature matching

and initial weights as input. For the purpose of feature matching, absolute fuzzy range function with an appropriate range value is selected. The absolute fuzzy range matching function returns a number between 0 and 1, depending upon how large the absolute value of the difference between the two values is when compared to the specified range. Mathematically, the number returned by the function is:

Max (0, 1 – Abs (value1 - value2) / Range)

For example, for a numeric feature with similarity type "Absolute Range: 20", the values 45 and 60 have a similarity of 1-Abs (45-60)/20 = 0.75.

Therefore, an outcome of 1 specifies that the two numeric values are equal, whereas the outcome linearly decreases to a value of zero while the difference between the two values widens to the specified range. After the difference exceeds the range, the result given by the function remains zero.

For the features of ordinal variable type with three values on the scale, absolute fuzzy range function with a range of 2 is assigned. In this way, when the algorithm is assessing the match between the values of low (numerically defined as 1) and high (numerically defined as 3) for two cases, the function returns a value of zero. It signifies that the algorithm did not figure out any similarity between the two cases in terms of that particular feature since the difference value of two (Abs(1-3)) has already reached the maximum tolerable margin of ‘2’. Should the difference become ‘1’ (such as a feature having values of low and medium for two cases), the matching function returns ‘0.5’ indicating a higher closeness of match.

For the features of nominal variable type, exact feature matching is utilized. It means, unless a factor has the same values for the two compared cases, the matching function returns a value of zero, resembling no match between the two cases in terms of that feature. On the other hand, an exact match between feature values results in an output of ‘1’, resembling a total match

as the name implies. For example, feature labeled as ‘contract payment type’ is assigned to utilize exact feature matching. Because, feature values of lump sum, unit price and cost-plus-fee are totally different concepts among which it would not be realistic to set up a measure for degree of closeness between different values of the factor.

The feature matching types specified for each feature is given in Table B.1 in Appendix B.

The second set of values given as input to the algorithm other than the feature matching type was the set of initial weights for features. The initial weights to be utilized by the algorithm are all initially set to 1 for the purpose of preventing bias against any factor. In other words, when the algorithm starts running, it initially assumes equal weights for each factor and weight updating takes place from an all equal state.

Because the weight generation method comes up with slightly different weight vectors each time the algorithm is run, the method is to be run several times to see if the resulting weight vectors are consistent. Regarding the possibility that the method may be biased against the initially set weights, after the program is run 5 times, the average of the resulting five weight vectors is calculated and it is utilized as the relatively unbiased initial weight vector for the subsequent set of runs. Utilizing this average weight vector, the program is run for five more times and then the average of the resulting five weight vectors is also calculated. And to take the iteration further, the second average weight vector is utilized as initial weight vector to derive five more weight vectors. And finally, the third resulting average weight vector is calculated for the latest five weight vectors. All in all, three average weight vectors have been obtained so far which are expected to converge to the true weight vector. Convergence of the three average weight vectors is checked by calculating the 2-tailed Pearson's correlation coefficient for the vectors. The resulting final weight vector is assumed to be

acceptable if the resulting correlation between the second and final weight vectors is significant at the 0.05 level.

For the next step, the obtained final weight vector is incorporated into the software together with previously defined feature matching types, in order to assess the overall similarity between the available cases and the target case. When the end-user interface is run, target case feature values are defined and then the software retrieves the most similar cases, displaying their corresponding similarity scores in percentages and originally defined risk ratings.

The retrieved similar cases are sorted according to their similarity scores in descending order. The ones which fall below the previously defined threshold value for similarity are not displayed. The threshold value for similarity score is set to 75%.

6.2.8 Adaptation of the retrieved outputs for risk rating

Now that a set of similar cases of close match have been obtained, their corresponding similarity scores and risk ratings may undergo adaptation in order to conclude and suggest the optimal risk rating for the target case. Although in our situation every target case originally possesses a risk rating already defined by an expert, this original rating is to be compared to the rating suggested by the CBR application.

There are a number of alternatives to suggest a risk rating for the target case by means of adapting retrieved similar cases. That final complementary prediction algorithm takes place in the spreadsheet medium. After the similarity scores and corresponding risk rating values are manually transferred to a spreadsheet medium, several types of calculations may be performed. These calculations range from utilizing the best matching case's output value, to choosing the mode of the output values and averaging the results in several alternative forms. Table 6.2 gives the

explanation for the eight utilized final complementary prediction models implemented on the cases which achieved the 75% similarity threshold.

Table 6.2. Explanation for final complementary prediction models (sub-models)

Final Complementary Prediction Model	Explanation
PM1	Mode of the outputs of the retrieved cases
PM2	Output of best match among the retrieved cases
PM3	Average of the outputs of the retrieved cases
PM4	Weighted average of the outputs of the retrieved cases utilizing the similarity scores as weights
PM5	Weighted average of the outputs of the retrieved cases utilizing the modified similarity scores as weights
PM6	Result of PM3 rounded to the closest integer
PM7	Result of PM4 rounded to the closest integer
PM8	Result of PM5 rounded to the closest integer

Best match may not always indicate the true solution. In order not to limit the ability of the whole program to a single retrieved case, the subsequent 4 models taking place in Table 6.2 are also developed. The PM5 differs from PM4 in that, the similarity scores are subtracted by 65 and then incorporated to the weighted average calculation. By this means, the weights of the uppermost cases are relatively inflated in regard to those of cases taking place at the bottom rows of the similarity ranking. For instance, the case with lowest successful score attains a modified score of 75 subtracted by 65, 10. Whereas, the case on the highest end with a score of 100 attains a modified score of 35. Therefore, in the final scheme with PM5, the weight of the latter case more than triples that of the former. It is a

favorable situation in a sense that better matching cases are assigned higher relative weights when compared with the situation taking place with PM4.

6.2.9 Prediction model for opportunity rating

For the opportunity rating prediction model, the incorporated factors which are deemed to be opportunity relevant involve the whole 12 factors under 'general features about company and project' category, the whole 6 opportunity factors and the risk rating, adding to a total of 19 factors.

Opportunity rating for target case is estimated following the same procedure as it was explained above for risk rating prediction.

6.2.10 Prediction model for competition rating

For the competition rating prediction model, the incorporated factors which are deemed to be competition relevant involve the whole 12 factors under 'general features about company and project' category, the 2 competition factors and the risk and opportunity ratings, adding to a total of 16 factors.

Competition rating for target case is estimated following the same procedure as it was explained above for risk rating prediction.

6.3 Model Testing for Prediction Accuracy

As it was explained in the paragraph titled "Formation of the case library", the whole CBR application described above is implemented utilizing the portion of the case population that remains after extracting the sub-set that is set apart for testing. As there are 7 randomly and distinctively formed testing sub-sets, the whole methodology is to be carried out for 7 times, each with a different testing set and hence a different training set. Therefore, for risk rating estimation, 7 main models are obtained so far and each model differs in its accuracy. Taking into account also the presence of

8 final complementary models (sub-models) for each main model, a total of 56 sub-models are studied during the CBR application for risk rating.

With one sub-model, an output value may be suggested for every one of the testing cases available in the testing subset. Therefore, once the main model is run and a weight set is obtained, each sub-model is applied to 14 available target cases. For each one of the target cases, prediction accuracy of the sub-model is recorded and its average accuracy is to be calculated for a total of 14 cases.

Taking into account the fact that in statistical calculations an outlier data point may significantly hamper the statistical character of the whole data set, during further calculations the lowest accurate case is ignored. Moreover, it is quite a good chance that out of 14 testing cases one case may well be ill-prepared or ill-evaluated by the human expert, so that the CBR model fails at suggesting an output that matches with that of the expert for that particular case.

Having run the CBR application in order to predict risk rating, Table 6.3 illustrates the resulting accuracy levels (in %) of each sub-model against different sets of training cases and hence different sets of testing cases.

The measure of accuracy used to validate the prediction results is given below.

Prediction accuracy (PA)

$$= \left(1 - \frac{\left|\text{Actual value} - \text{Model's predicted value}\right|}{4}\right) \times 100\,\% \qquad (1)$$

$$\text{Average prediction accuracy} = \frac{\sum_{i=1}^{n} PA}{n} \qquad (2)$$

where n = number of predictions

Since rating values to be predicted vary between 1 and 5, the maximum possible estimation error given by the difference between actual value and model's predicted value may be 4 in the worst case. In such a case, formula (1) results in a prediction accuracy of 0%. On the other hand, as the gap between the actual rating and the model's predicted rating narrows down, the accuracy result given by formula (1) linearly reaches up to 100%, which indicates an accurate prediction.

Formula (2) gives the average prediction accuracy for each testing sub-set.

Table 6.3. Average accuracy levels of each sub-model against different sets of training cases for risk rating estimation (%)

	Case Set1	Case Set2	Case Set3	Case Set4	Case Set5	Case Set6	Case Set7	Average Accuracy
PM1	86.9	86.5	88.5	86.5	85.4	83.3	81.3	**85.5**
PM2	82.7	84.6	84.6	84.6	83.3	79.2	85.4	**83.5**
PM3	89.0	88.3	88.5	86.6	86.4	88.5	85.8	**87.6**
PM4	89.1	88.9	88.6	86.5	86.5	88.4	85.8	**87.7**
PM5	89.4	89.6	88.9	86.4	86.6	88.1	86.1	**87.9**
PM6	90.4	90.4	86.5	86.5	89.6	87.5	89.6	**88.6**
PM7	90.4	88.5	88.5	86.5	89.6	89.6	87.5	**88.6**
PM8	92.3	90.4	90.4	86.5	89.6	89.6	87.5	**89.5**
Max. Acc. in the column	**92.3**	**90.4**	**90.4**	**86.6**	**89.6**	**89.6**	**89.6**	
Avg. Acc. in the column	**88.8**	**88.4**	**88.1**	**86.3**	**87.1**	**86.8**	**86.1**	

In Table 6.3 the two bottom rows gives the maximum and average values of accuracy data present along each column. According to that, except case set 4, all other case sets performed quite well with PM8 achieving accuracy

values very close to 90%. Among these sets, only case set1 managed to reach north of the 90% with a margin of 2.3%.

Examining the average accuracy values along each row in Table 6.3, it is observed that PM2 is the poorest performing sub-model. Therefore, it is reinforced that the best matching case may not always offer the true or best solution. The second poorest performing model appears to be PM1 which counts on mode calculation. At the bottom ranks, PM3 and PM4 precede PM2. PM4 very slightly outperforms PM3 which indicates that the weighting approach did not work well. Also the very slight margin between PM4 and PM5 suggests that modified weighting approach did not prove to be successful as much as expected. However, the relative achievement of rounding approach is realized at a glance given that rounded sub-sets attained higher accuracy scores with respect to their counterparts employing untouched (not rounded) figures.

Having run the application with the aim of opportunity rating prediction, Table 6.4 illustrates the resulting accuracy level (in %) of each sub-model against different sets of training cases.

Table 6.4. Average accuracy levels of each sub-model against different sets of training cases for opportunity rating estimation (%)

	Case Set1	Case Set2	Case Set3	Case Set4	Case Set5	Case Set6	Case Set7	Average Accuracy
PM1	88.6	89.2	82.7	84.4	83.3	83.3	89.6	**85.9**
PM2	82.7	92.3	84.6	82.7	81.3	81.3	85.4	**84.3**
PM3	87.2	87.5	86.2	84.9	85.7	85.7	89.5	**86.7**
PM4	87.4	87.6	86.2	85.0	85.6	85.6	89.1	**86.6**
PM5	87.9	88.1	86.3	85.3	85.3	85.3	88.6	**86.7**
PM6	90.4	90.4	86.5	88.5	85.4	85.4	93.8	**88.6**

Table 6.4. Continued

PM7	90.4	90.4	86.5	88.5	85.4	85.4	93.8	**88.6**
PM8	92.3	90.4	86.5	88.5	85.4	85.4	91.7	**88.6**
Max. Acc. in the column	**92.3**	**92.3**	**86.5**	**88.5**	**85.7**	**85.7**	**93.8**	
Avg. Acc. in the column	**88.4**	**89.5**	**85.7**	**86.0**	**84.7**	**84.7**	**90.2**	

According to average accuracy values of the sub-models given in Table 6.4, opportunity rating model could not outperform the overall performance of the risk rating prediction model. However, the performance ranking of the sub-models indicates almost the same behavior realized in the risk model. While the best matching model gets stuck to the very bottom rank, rounded sub-models evidently outperform their counterparts that ignore rounding.

However, this time three case sets manage to run over the 90% barrier in all of the sub-models. One case even reaches a respectable 93.8% accuracy level.

Having implemented the CBR methodology for the prediction of competition rating, Table 6.4 illustrates the resulting accuracy level (in %) of each sub-model against different sets of training cases.

Table 6.5. Average accuracy levels of each sub-model against different sets of training cases for competition rating estimation (%)

	Case Set1	**Case Set2**	**Case Set3**	**Case Set4**	**Case Set5**	**Case Set6**	**Case Set7**	**Average Accuracy**
PM1	92.1	93.1	87.2	83.8	79.2	87.5	87.5	**87.2**
PM2	88.5	80.8	82.7	84.6	83.3	87.5	81.3	**84.1**
PM3	87.7	91.3	85.1	84.3	84.8	87.9	87.9	**87.0**
PM4	87.8	91.1	85.2	84.3	84.9	88.0	87.9	**87.0**

Table 6.5. Continued

PM5	87.9	90.5	85.5	84.4	85.7	88.1	87.9	**87.1**
PM6	88.5	96.2	90.4	84.6	85.4	93.8	87.5	**89.5**
PM7	86.5	96.2	90.4	84.6	87.5	91.7	89.6	**89.5**
PM8	86.5	94.2	88.5	84.6	87.5	91.7	89.6	**88.9**
Max. Acc. in the column	**92.1**	**96.2**	**90.4**	**84.6**	**87.5**	**93.8**	**89.6**	
Avg. Acc. in the column	**88.2**	**91.7**	**86.9**	**84.4**	**84.8**	**89.5**	**87.4**	

The trend in ranking of average accuracy rates of sub-models seems to be assured in Table 6.5 where PM2 still underperforms PM1 with slightly more than 3 points margin. The sub-models that employ rounding enhanced their performance with all three of them being close to 90 percent.

Unlike the risk and opportunity prediction models, this time maximum accuracy levels along each case set shows fantastic performance skyrocketing to a max level of 96.2% with case set 2. Case sets 1, 3 and 6 are also worth attention all exceeding the psychological 90% barrier.

All in all, evaluating the three recent accuracy tables together, one can say that PM7 (average weighting method with rounding) worked best with feature weighting sets that were derived from case sets 1, 7 and 2 each with prediction accuracy results of 90.4, 93.8 and 96.2 and for prediction of risk, opportunity and competition, respectively.

6.4 Overall Model for bid Markup Estimation

For a target case, so far values of ratings for risk, opportunity and competition are predicted. And, accuracy of these predictions proved to be satisfactory. Now, these values may be utilized to estimate risk and profit

markups for the target case by means of the linear markup estimation model developed previously in Chapter 5.

It is a fact that when experts are making markup estimations, they make use of previously established lower, average and upper markup values that act as boundary values (anchors) between which estimates vary. And, because of the fact that these boundary values differ from contractor to contractor, it would not be very proper for the target case to directly employ the markup values of the retrieved cases. It would be better to interpret the overall utility value of the retrieved markup according to its corresponding utility estimation function and then introduce that calculated overall utility value into the linear markup model constructed for the target firm. In that way, overall utility values for markup estimation of target and retrieved cases remain the same, whereas markup values may differ according to the experts' upper and lower boundary preferences for markup values.

All in all, as seen in Figure 6.1, the CBR model transforms the scenario features into primary outputs, which are risk, opportunity and competition rating. However, as explained before, there are a total 3 micro-level CBR models as given in Figure 6.2.

In the second step, these three rating values are transformed into risk and profit markups (%) by use of the linear utility models given in Chapter 5.

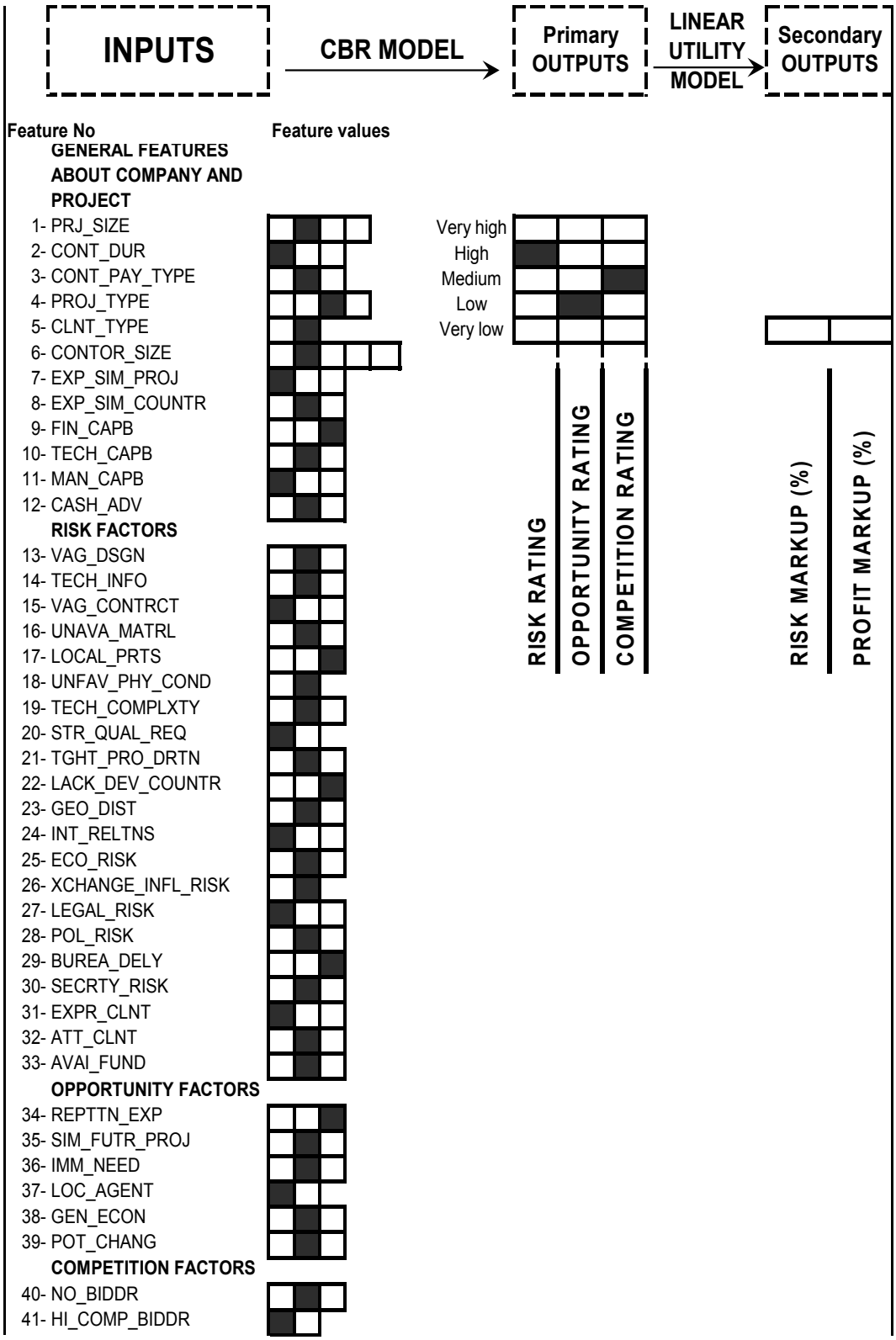

Figure 6-1. Overall view of the model for bid markup estimation

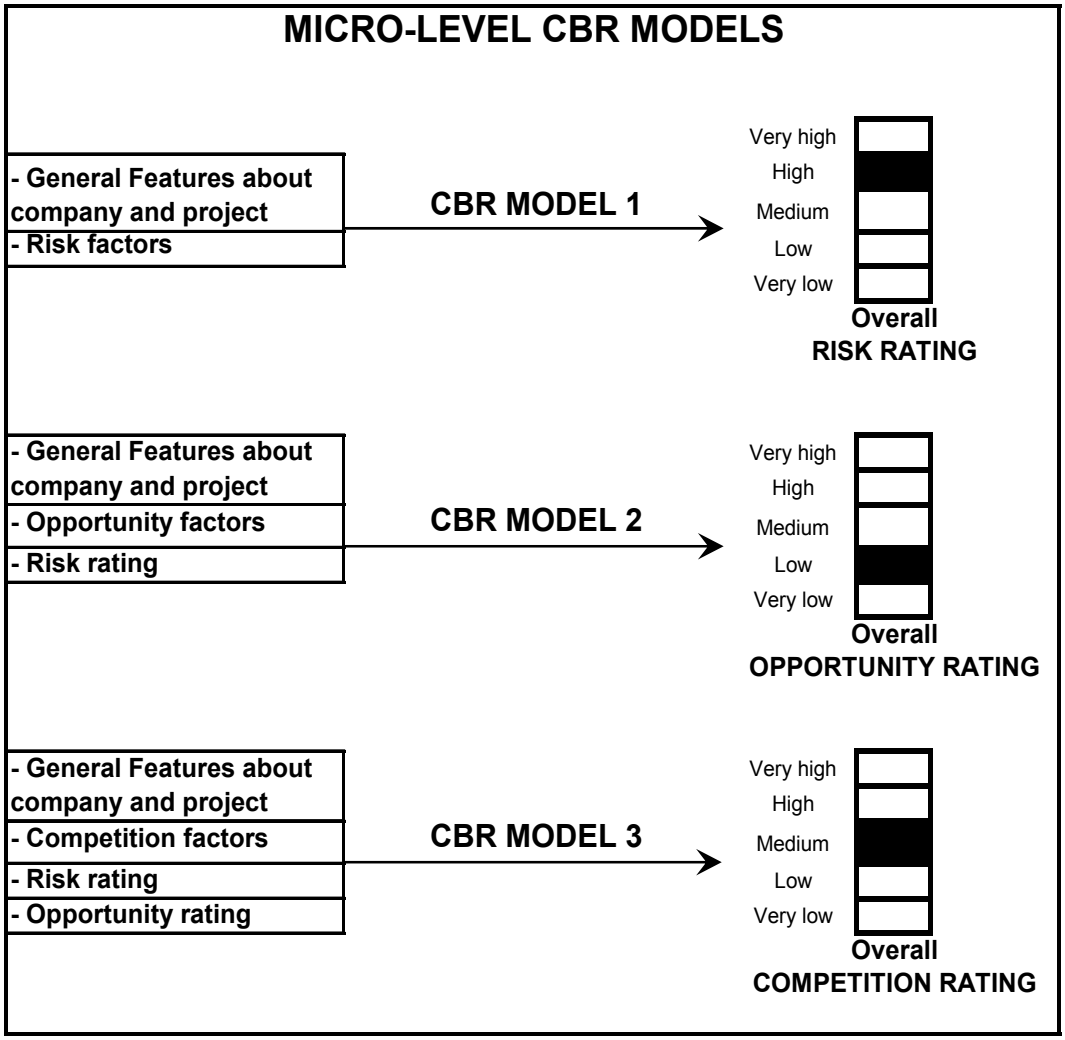

Figure 6-2. Micro-level CBR models for risk, opportunity and competition rating estimation

6.5 Evaluation of Feature Weights Derived from CBR Application

6.5.1 Risk relevant feature weights

During running of the CBR application in order to predict one of the risk, opportunity or competition ratings, for each one of the 7 training sets the algorithm has generated a feature weight set. Therefore, a total of 21 weight sets have been generated so far throughout the study.

Features which are most critical have been weighted more heavily to indicate a greater importance during retrieval than a feature which is less important and has a lower weight.

Table 6.6 gives the normalized feature weights generated for 7 different training sets for the purpose of risk rating prediction. At the right end column of the table the average feature weight is computed for each feature. Later, utilizing this average weight data factors are re-arranged and rank ordered in Table 6.7. Observing the categories of features given in the second column of the table, it is quickly noticed that risk factors are gathered in the primary ranks, whereas general features constitute bottom of the rank.

Country risks such as economical/financial risk, exchange rate / inflation rate risk and political risk occupy the top three ranks of the importance list. The first feature under the general category appears to be project type.

Table 6.6. Normalized feature weights estimated by ESTEEM in order to predict RISK rating

	Feature weights derived by ESTEEM							**Average weight**
Feature Abbreviation	**Case Set 1**	**Case Set 2**	**Case Set 3**	**Case Set 4**	**Case Set 5**	**Case Set 6**	**Case Set 7**	
GENERAL FEATURES ABOUT COMPANY AND PROJECT								
PRJ_SIZE	**0.012**	0.011	0.015	0.014	0.013	0.009	0.000	**0.011**
CONT_DUR	**0.013**	0.007	0.004	0.011	0.009	0.003	0.011	**0.008**
CONT_PAY_TYPE	**0.049**	0.059	0.008	0.060	0.040	0.044	0.035	**0.042**
PROJ_TYPE	**0.043**	0.055	0.084	0.046	0.081	0.036	0.042	**0.055**
CLNT_TYPE	**0.019**	0.019	0.014	0.016	0.031	0.012	0.011	**0.017**
CONTOR_SIZE	**0.013**	0.008	0.003	0.016	0.010	0.008	0.015	**0.010**
EXP_SIM_PROJ	**0.018**	0.019	0.010	0.020	0.013	0.010	0.011	**0.014**
EXP_SIM_COUNTR	**0.031**	0.044	0.029	0.055	0.013	0.025	0.040	**0.034**
FIN_CAPB	**0.009**	0.008	0.013	0.015	0.013	0.007	0.012	**0.011**
TECH_CAPB	**0.006**	0.025	0.008	0.015	0.009	0.014	0.007	**0.012**
MAN_CAPB	**0.012**	0.015	0.003	0.006	0.007	0.009	0.009	**0.009**
CASH_ADV	**0.035**	0.023	0.025	0.011	0.018	0.026	0.020	**0.023**

Table 6.6. Continued

RISK FACTORS								
VAG_DSGN	**0.016**	0.020	0.014	0.016	0.035	0.021	0.026	**0.021**
TECH_INFO	**0.016**	0.024	0.019	0.043	0.062	0.024	0.017	**0.029**
VAG_CONTRCT	**0.033**	0.021	0.032	0.020	0.020	0.032	0.013	**0.024**
UNAVA_MATRL	**0.027**	0.015	0.030	0.027	0.040	0.041	0.027	**0.030**
LOCAL_PRTS	**0.048**	0.043	0.056	0.022	0.054	0.053	0.049	**0.046**
UNFAV_PHY_COND	**0.077**	0.072	0.065	0.046	0.025	0.077	0.048	**0.059**
TECH_COMPLXTY	**0.014**	0.035	0.031	0.021	0.024	0.015	0.034	**0.025**
STR_QUAL_REQ	**0.027**	0.025	0.022	0.038	0.014	0.031	0.031	**0.027**
TGHT_PRO_DRTN	**0.023**	0.037	0.039	0.041	0.038	0.027	0.017	**0.032**
LACK_DEV_COUNTR	**0.035**	0.049	0.038	0.036	0.047	0.066	0.058	**0.047**
GEO_DIST	**0.016**	0.012	0.023	0.014	0.018	0.051	0.028	**0.023**
INT_RELTNS	**0.013**	0.006	0.016	0.021	0.017	0.013	0.016	**0.015**
ECO_RISK	**0.067**	0.060	0.069	0.090	0.083	0.067	0.068	**0.072**
XCHANGE_INFL_RISK	**0.075**	0.086	0.095	0.076	0.048	0.054	0.066	**0.071**
LEGAL_RISK	**0.027**	0.039	0.036	0.020	0.035	0.041	0.048	**0.035**
POL_RISK	**0.062**	0.030	0.070	0.061	0.061	0.071	0.082	**0.062**
BUREA_DELY	**0.050**	0.044	0.050	0.030	0.026	0.040	0.050	**0.041**
SECRTY_RISK	**0.018**	0.009	0.012	0.013	0.017	0.030	0.047	**0.021**
EXPR_CLNT	**0.003**	0.016	0.005	0.034	0.010	0.008	0.008	**0.012**
ATT_CLNT	**0.050**	0.021	0.021	0.014	0.020	0.013	0.039	**0.025**
AVAI_FUND	**0.043**	0.044	0.042	0.029	0.049	0.021	0.015	**0.035**
TOTAL WEIGHT	**1.000**	1.000	1.000	1.000	1.000	1.000	1.000	**1.000**

Table 6.7. Feature weights in ranked order derived for RISK prediction model

Rank order	Feature Category	Feature Abbreviation	Weight	Cumulative weight
1	Risk	ECO_RISK	0.072	0.072
2	Risk	XCHANGE_INFL_RISK	0.071	0.143
3	Risk	POL_RISK	0.062	0.206
4	Risk	UNFAV_PHY_COND	0.059	0.264
5	General	PROJ_TYPE	0.055	0.320
6	Risk	LACK_DEV_COUNTR	0.047	0.367
7	Risk	LOCAL_PRTS	0.046	0.413
8	General	CONT_PAY_TYPE	0.042	0.455
9	Risk	BUREA_DELY	0.041	0.497
10	Risk	LEGAL_RISK	0.035	0.532
11	Risk	AVAI_FUND	0.035	0.567

Table 6.7. Continued

12	General	EXP_SIM_COUNTR	0.034	0.600
13	Risk	TGHT_PRO_DRTN	0.032	0.632
14	Risk	UNAVA_MATRL	0.030	0.662
15	Risk	TECH_INFO	0.029	0.691
16	Risk	STR_QUAL_REQ	0.027	0.718
17	Risk	ATT_CLNT	0.025	0.743
18	Risk	TECH_COMPLXTY	0.025	0.768
19	Risk	VAG_CONTRCT	0.024	0.793
20	Risk	GEO_DIST	0.023	0.816
21	General	CASH_ADV	0.023	0.838
22	Risk	VAG_DSGN	0.021	0.859
23	Risk	SECRTY_RISK	0.021	0.880
24	General	CLNT_TYPE	0.017	0.898
25	Risk	INT_RELTNS	0.015	0.912
26	General	EXP_SIM_PROJ	0.014	0.927
27	Risk	EXPR_CLNT	0.012	0.939
28	General	TECH_CAPB	0.012	0.951
29	General	FIN_CAPB	0.011	0.962
30	General	PRJ_SIZE	0.011	0.972
31	General	CONTOR_SIZE	0.010	0.983
32	General	MAN_CAPB	0.009	0.991
33	General	CONT_DUR	0.008	1.000

6.5.2 Opportunity relevant feature weights

Table 6.8 gives the normalized feature weights generated for 7 different training sets for the purpose of opportunity rating prediction. Again, utilizing the resulting average weight data, factors are re-arranged and rank ordered in Table 6.9. Observing the categories of features given in the second column of the Table 6.9, it is quickly realized that opportunity factors abound in the first half of the importance list (in terms of cumulative weight), whereas the second half is constituted almost by features under the general category. It is also found out that risk rating factor has the least importance indicating that overall risk feature has no significance in estimating opportunity offered by the tender.

The three factors, namely: potential for gaining reputation and experience, immediate need to take a job and potential for gaining similar projects in the

future constitute the top 3 rows of the list. ‘Potential for changes’ feature occupies the fourth rank reinforcing the view that not every contractor can count on such a prospect. Together with the four above feature, ‘client type’ and ‘contract payment type’ features –combining their weights - account for slightly more than 50% percent of the similarity assessment function. Although it is not evident from the results which client type the contractors favor over the other, it is understood that one is significantly more favored. ‘Contract payment type’ feature, with its weight very slightly below that of ‘client type’, also comes out to be a significant factor in opportunity assessment. ‘Existence of local agents’ and ‘general economical situation at the contractor’s home country’ together account for the 11.5% of the similarity assessment function. ‘Project type’ feature maintains 6.1% importance with the eighth rank in the list while the ‘level of experience in similar projects’ feature occupies the second row when counted from end of the list. This finding suggests that contractors see more opportunity in some particular project types without taking account of their experience in the concerned field. ‘Experience of the contractor in similar countries’ also affects the contractor’s similarity assessment with a 5% weight. The weights of the above mentioned top ten features add up to 73.7%, therefore leaving a total of 26.3% significance for the remaining 9 factors.

Table 6.8. Normalized feature weights estimated by ESTEEM in order to predict OPPORTUNITY Rating

	Feature weights derived by ESTEEM							**Average weight**
Feature Abbreviation	**Case Set 1**	**Case Set 2**	**Case Set 3**	**Case Set 4**	**Case Set 5**	**Case Set 6**	**Case Set 7**	
GENERAL FEATURES								
PRJ_SIZE	0.055	0.042	0.033	0.028	0.009	0.043	**0.025**	**0.034**
CONT_DUR	0.027	0.008	0.014	0.035	0.043	0.029	**0.036**	**0.027**
CONT_PAY_TYPE	0.06	0.112	0.042	0.09	0.03	0.067	**0.075**	**0.068**
PROJ_TYPE	0.062	0.07	0.044	0.035	0.079	0.091	**0.047**	**0.061**
CLNT_TYPE	0.055	0.047	0.056	0.100	0.089	0.073	**0.064**	**0.069**

Table 6.8. Continued

CONTRCTOR_SIZE	0.021	0.016	0.013	0.019	0.036	0.027	**0.023**	**0.022**
EXP_SIM_PROJ	0.025	0.025	0.009	0.024	0.025	0.03	**0.011**	**0.021**
EXP_SIM_COUNTR	0.05	0.017	0.053	0.062	0.054	0.065	**0.051**	**0.050**
FIN_CAPB	0.041	0.015	0.04	0.011	0.048	0.029	**0.048**	**0.033**
TECH_CAPB	0.05	0.025	0.041	0.04	0.043	0.037	**0.054**	**0.041**
MAN_CAPB	0.04	0.039	0.03	0.033	0.02	0.022	**0.017**	**0.029**
CASH_ADV	0.043	0.049	0.057	0.042	0.021	0.02	**0.028**	**0.037**
OPPORTUNITY FACTORS								
REPTTN_EXP	0.098	0.159	0.135	0.138	0.099	0.119	**0.145**	**0.128**
SIM_FUTR_PROJ	0.065	0.092	0.102	0.107	0.065	0.057	**0.059**	**0.078**
IMM_NEED	0.102	0.089	0.097	0.056	0.081	0.118	**0.115**	**0.094**
LOC_AGENT	0.061	0.07	0.082	0.05	0.084	0.031	**0.055**	**0.062**
GEN_ECON	0.032	0.068	0.044	0.029	0.082	0.081	**0.034**	**0.053**
POT_CHANG	0.086	0.053	0.089	0.089	0.057	0.04	**0.106**	**0.074**
RISK_RATING	0.027	0.004	0.017	0.012	0.033	0.018	**0.008**	**0.017**
TOTAL WEIGHT	1.000	1.000	1.000	1.000	1.000	1.000	**1.000**	**1.000**

Table 6.9. Feature weights in ranked order derived for OPPORTUNITY prediction model

Rank order	Feature Category	Feature Abbreviation	Weight	Cumulative weight
1	Opportunity	REPTTN_EXP	0.128	0.128
2	Opportunity	IMM_NEED	0.094	0.222
3	Opportunity	SIM_FUTR_PROJ	0.078	0.300
4	Opportunity	POT_CHANG	0.074	0.374
5	General	CLNT_TYPE	0.069	0.443
6	General	CONT_PAY_TYPE	0.068	0.511
7	Opportunity	LOC_AGENT	0.062	0.573
8	General	PROJ_TYPE	0.061	0.634
9	Opportunity	GEN_ECON	0.053	0.687
10	General	EXP_SIM_COUNTR	0.050	0.737
11	General	TECH_CAPB	0.041	0.779
12	General	CASH_ADV	0.037	0.816
13	General	PRJ_SIZE	0.034	0.849
14	General	FIN_CAPB	0.033	0.883
15	General	MAN_CAPB	0.029	0.911
16	General	CONT_DUR	0.027	0.939
17	General	CONTOR_SIZE	0.022	0.961
18	General	EXP_SIM_PROJ	0.021	0.982
19	Rating	RISK_RATING	0.018	1.000

6.5.3 Competition relevant feature weights

Table 6.10 shows the 7 seven weight sets generated for the purpose of competition rating prediction. As done for risk and opportunity relevant factors previously, utilizing the resulting average weight data, factors are re-arranged and rank ordered in Table 6.11. Observing the categories of features given in the second column of the Table 6.11, it is instantly noticed – as expected - that the two competition factors occupy the top two posts accounting for a total of 43.7% weight in similarity assessment. It is also found out that risk rating factor has the least importance indicating that overall risk feature has no significance in estimating opportunity offered by the tender. ‘Contract payment type’ and ‘project type’ features occupy the succeeding posts, each having more than 10% significance (13.1% and 10.0% respectively). This finding gives rise to the idea that some particular construction sub-sectors, depending also on whether the project is of lump sum, unit price or cost-plus-fee type, attract more attention from contractors, hence resulting in different competition levels. ‘Experience of the contractor in similar countries’ is the final feature that achieves to go beyond the 5% barrier with a 6.0% importance level. It suggests that one he gets to know better the bidding environment of the foreign country, the degree of attention that he pays to his competitors is affected. The remaining 11 competition relevant factors accounts for a total of 27.2% weight in case similarity assessment.

Table 6.10. Normalized feature weights estimated by ESTEEM in order to predict COMPETITION rating

	Feature weights derived by ESTEEM							Average weight
Feature Abbreviation	**Case Set 1**	**Case Set 2**	**Case Set 3**	**Case Set 4**	**Case Set 5**	**Case Set 6**	**Case Set 7**	
GENERAL FEATURES ABOUT COMPANY AND PROJECT								
PRJ_SIZE	0.02	**0.02**	0.025	0.027	0.003	0.009	0.027	**0.019**
CONT_DUR	0.016	**0.013**	0.027	0.012	0.009	0.031	0.012	**0.017**
CONT_PAY_TYPE	0.113	**0.145**	0.135	0.13	0.118	0.149	0.13	**0.131**
PROJ_TYPE	0.096	**0.075**	0.126	0.096	0.122	0.089	0.096	**0.100**
CLNT_TYPE	0.056	**0.038**	0.057	0.03	0.034	0.038	0.03	**0.040**
CONTOR_SIZE	0.028	**0.027**	0.014	0.003	0.012	0.014	0.003	**0.014**
EXP_SIM_PROJ	0.016	**0.022**	0.03	0.032	0.014	0.027	0.032	**0.025**
EXP_SIM_COUNTR	0.044	**0.074**	0.032	0.082	0.052	0.053	0.082	**0.060**
FIN_CAPB	0.04	**0.076**	0.025	0.018	0.042	0.04	0.018	**0.037**
TECH_CAPB	0.023	**0.012**	0.027	0.024	0.008	0.013	0.024	**0.019**
MAN_CAPB	0.01	**0.023**	0.032	0.023	0.023	0.046	0.023	**0.026**
CASH_ADV	0.023	**0.021**	0.016	0.049	0.057	0.031	0.049	**0.035**
COMPETITION FACTORS								
NO_BIDDR	0.206	**0.201**	0.217	0.214	0.217	0.205	0.214	**0.211**
HI_COMP_BIDDR	0.255	**0.191**	0.211	0.229	0.244	0.221	0.229	**0.226**
RISK_RATING	0.009	**0.018**	0.012	0.004	0.011	0.01	0.004	**0.010**
OPP_RATING	0.043	**0.045**	0.015	0.026	0.033	0.024	0.026	**0.030**
TOTAL WEIGHT	1.000	**1.000**	1.000	1.000	1.000	1.000	1.000	**1.000**

Table 6.11. Feature weights in ranked order derived for COMPETITION prediction model

Rank order	Feature Category	Feature Abbreviation	Weight	Cumulative weight
1	Competition	HI_COMP_BIDDR	0.226	0.226
2	Competition	NO_BIDDR	0.211	0.436
3	General	CONT_PAY_TYPE	0.131	0.568
4	General	PROJ_TYPE	0.100	0.668
5	General	EXP_SIM_COUNTR	0.060	0.728
6	General	CLNT_TYPE	0.040	0.768
7	General	FIN_CAPB	0.037	0.805

Table 6.11. Continued

8	General	CASH_ADV	0.035	0.840
9	Rating	OPP_RATING	0.030	0.870
10	General	MAN_CAPB	0.026	0.896
11	General	EXP_SIM_PROJ	0.025	0.921
12	General	PRJ_SIZE	0.019	0.940
12	General	TECH_CAPB	0.019	0.958
14	General	CONT_DUR	0.017	0.975
15	General	CONTOR_SIZE	0.014	0.990
16	Rating	RISK_RATING	0.010	1.000

Table 6.12 is formed in order to show the harmony in between the best performing weight set and the average weight set calculated for the whole of the 7 training case sets. Case sets 1, 7 and 2 were previously identified to be best performing models each for risk rating, opportunity rating and competition rating predictions, respectively. The 2-tailed Pearson's correlation coefficient calculations between weight set pairs all result in outcomes that are greater than 90%. Therefore, results suggest best performing and average weight sets agree with each other.

Table 6.12. 2-tailed Pearson's correlation coefficients between average weight set and best performing weight set

Best performing case set	Risk rating prediction	Opportunity rating prediction	Competition rating prediction
Case set 1	0.903	-	-
Case set 7	-	0.930	-
Case set 2	-	-	0.970

CHAPTER 7

A PRACTICAL APPLICATION FOR BID MARKUP ESTIMATION

An example of how the model for estimation of bid markup works is now given. In order to prove the applicability of the model in the business environment, the data of a real bidding situation is utilized. The feature values for this target case are assigned by an experienced respondent and given in Table C.1 in Appendix C.

Also the values acting as anchors during risk and profit markup estimation as identified by the particular respondent are given in Table 7.1.

Table 7.1. Anchor values given by the respondent for risk and profit markup estimation

	Risk markup (%)	Profit markup (%)
Maximum	20	30
Average	7.5	15
Minimum	5	8

Output values for the particular scenario as estimated by the respondent are also given in Table 7.2.

Table 7.2. Output values estimated by the respondent for the particular scenario

Output Feature	Value
Risk rating	4 (high)
Opportunity rating	4 (high)
Competition rating	3 (medium)
Risk markup (%)	10
Profit markup (%)	15

After starting ESTEEM, the user selects “Load Application” command from the file menu. From the appropriate folder, when “RISK.EST” application is selected, program loads the required data and builds the case library.

As defined earlier, there are three micro-level CBR models each for estimating risk, opportunity and competition ratings. In fact, these three models differ only in the assignment of feature weights for similarity assessment.

Second step involves identification of the similarity definition. When the user clicks on the “Similarity Definition” icon, a window appears for the selection of the appropriate similarity definition. SIM1 is selected to assess the similarity between cases in view of risk. This similarity definition includes the weights for every feature involved in risk similarity assessment.

In the next step, “Run User Interface” button is clicked. As seen in Figure 7.1, “Application Interface” window appears. Within this window, target case feature values are defined. Finally, when the “Retrieve” button is clicked, the program performs the similarity assessment between source cases and the target case and displays the retrieved similar cases sorted in order of their similarity scores. Figure 7.2 displays the 3 similar cases retrieved from the case library. These are the only cases which achieved the 75% similarity threshold. The data under the column labeled “key” identifies the individual cases. And, in the far right column originally defined risk rating values corresponding to each retrieved scenario appear.

Final step involves calculation of the predicted risk rating value for the target case. This is achieved by the use of PM7 (average weighting method with rounding) which was explained earlier in Chapter 6, Table 6.2. With PM7, weighted average value of the outputs of retrieved cases is calculated utilizing the similarity scores as weights. And then, the output value is rounded to the closest integer. In this case, as all the suggested risk rating

values are 4 (which indicates high risk), the overall risk rating prediction appears to be also 4 without need for further calculation.

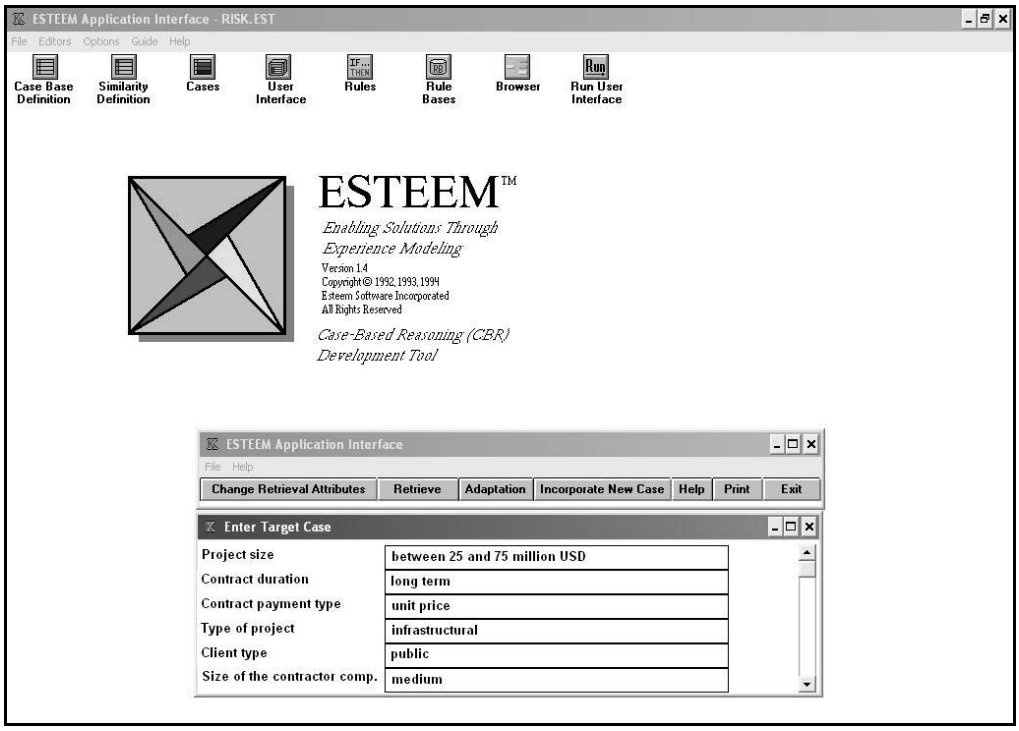

Figure 7-1. Target case entry

Then, in order to predict the opportunity rating value, “OPP.EST” application is loaded after clearing the current application. And, “SIM2” is loaded in order to define similarity assessment weights. Later, after running the “Application Interface” and defining the target case, similarity assessment is performed in order to obtain the retrieved case list (See Figure 7.3). A total of 17 cases managed to achieve the 75% similarity threshold. Again, PM7 is utilized to derive the overall predicted value for opportunity rating.

The same procedure also applies for competition rating prediction, whereas this time “COMP.EST” application and “SIM3” similarity definition are loaded. Figure 7.4 displays a portion of the retrieved similar cases with their corresponding similarity scores and originally defined competition rating values. A total of 25 cases managed to achieve the 75% similarity threshold.

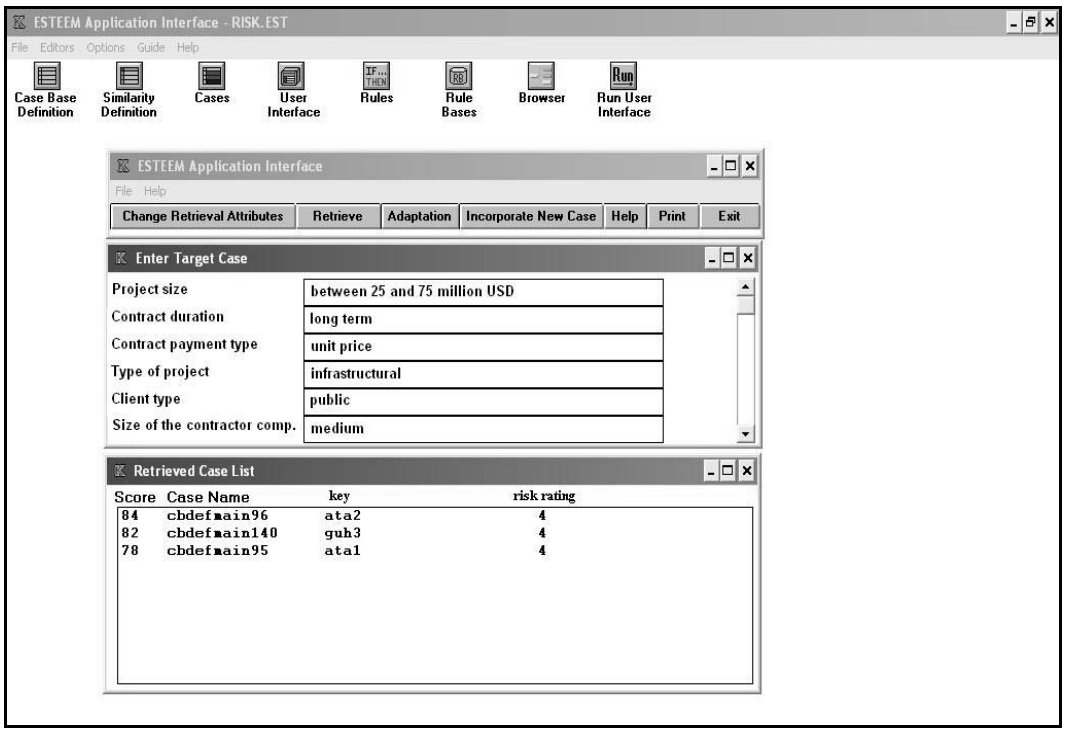

Figure 7-2. Retrieved case list with similarity scores for risk rating estimation

In Table 7.3, the predicted rating values calculated through PM7, before and after rounding to the nearest integer value are given. Also, in the last column, rating values originally defined by the respondent are given. When the predicted and originally defined values are compared, it appears that they accurately agree.

Table 7.3. Comparison of predicted and originally defined rating values

	Weighted average value		Value originally defined by the respondent
	before rounding	after rounding	
CBR model for			
Risk rating prediction	4.00	4	4 (high)
Opportunity rating prediction	3.82	4	4 (high)
Competition rating prediction	3.07	3	3 (medium)

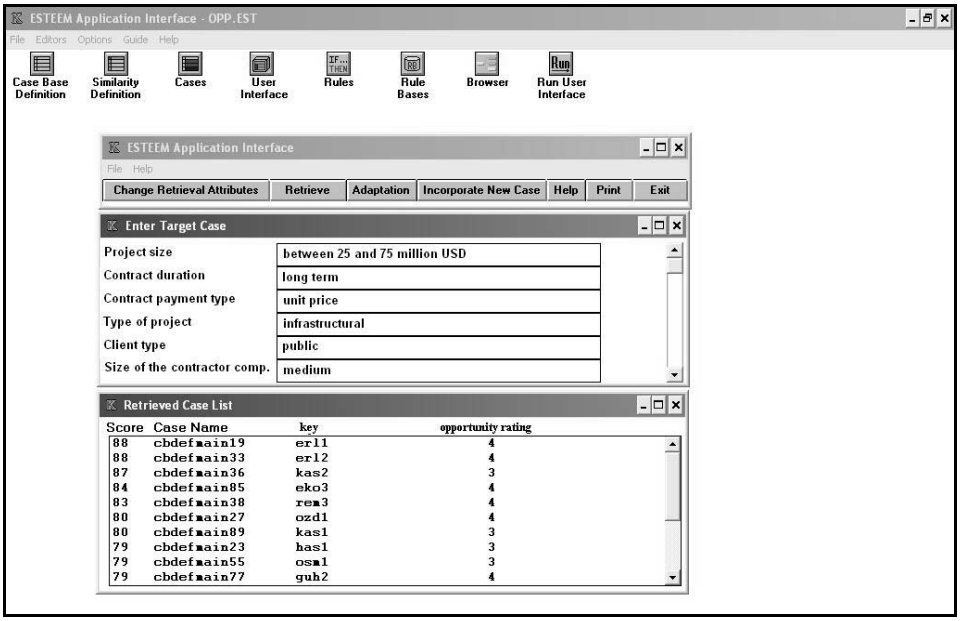

Figure 7-3. Retrieved case list with similarity scores for opportunity rating estimation

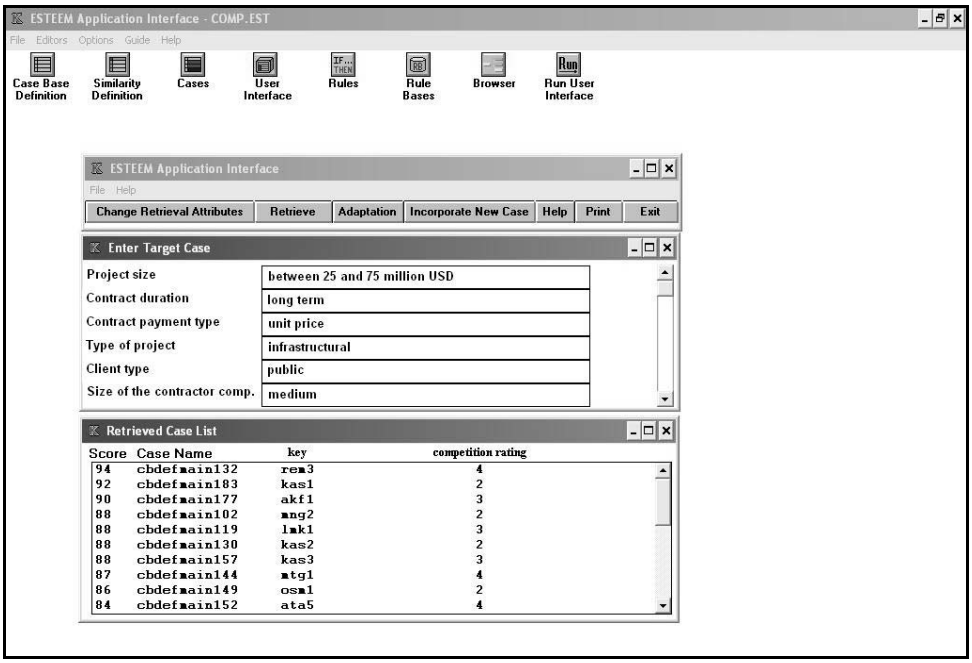

Figure 7-4. Retrieved case list with similarity scores for competition rating estimation

So far, it has been predicted that the target case poses a high degree of risk, and offers also a high degree of opportunity, while the degree of

perceived competition is medium. The next step should be the prediction of risk and profit markups, so that they can be added up to estimate the overall bid markup value for the target case. This is to be achieved by means of implementing the linear utility model utilizing the weights obtained through linear regression as given in Chapter 5, Section 5.7.

As given in Table 7.4, overall utility value (on the -100 to 100 scale) in view of risk markup estimation is derived as '-26.15'. This negative outcome indicates that, the estimated risk markup (%) will appear to be above the average (anchor) risk markup value expressed initially by the respondent.

The overall utility value calculated for profit markup estimation (2.04) as given in Table 7.5 is very close to 0. Therefore, the estimated profit markup (%) will come out to be very slightly below the average (anchor) profit markup value that was expressed initially by the respondent.

Table 7.4. Overall utility calculation for 'risk markup' for the target case

	Rating in number	Rating in text	(1) Utility value	(2) Coefficient	(3) Product (1)x(2)
Constant	-	-	-	13.94	13.94
Risk	4	high	-0.5	80.18	-40.09
Opportunity	4	high	0.5	0	0
Competition	3	med.	0	0	0
				(4) Overall utility (OU)	**-26.15**

Table 7.5. Overall utility calculation for 'profit markup' for the example scenario

	Rating in number	Rating in text	(1) Utility value	(2) Coefficient	(3) Product (1)x(2)
Constant	-	-	-	9.43	9.43
Risk	4	high	-0.5	39.46	-19.73
Competition	3	med.	0	29.69	0
Opportunity	4	high	0.5	24.68	12.34
				(4) Overall utility (OU)	**2.04**

These overall utility values are to be inserted into the linear markup function given in Figures 7.5 and 7.6, so that the corresponding markup values can be estimated.

The resulting graphs and values are given below. In order to enable a better zoom onto the graph, the positive x-axis portion in Figure 7.5 and negative x-axis portion in Figure 7.6 are disregarded.

The predicted markup values calculated through linear interpolation and their comparison against original estimates are given in Table 7.6.

Table 7.6. Comparison for predicted and originally estimated markup values

	Predicted markup (%)	Markup originally estimated by respondent (%)	Absolute prediction error (%)
Risk markup prediction	10.77	10	0.77
Profit markup prediction	14.86	15	0.14
Total markup	25.63	25	0.63

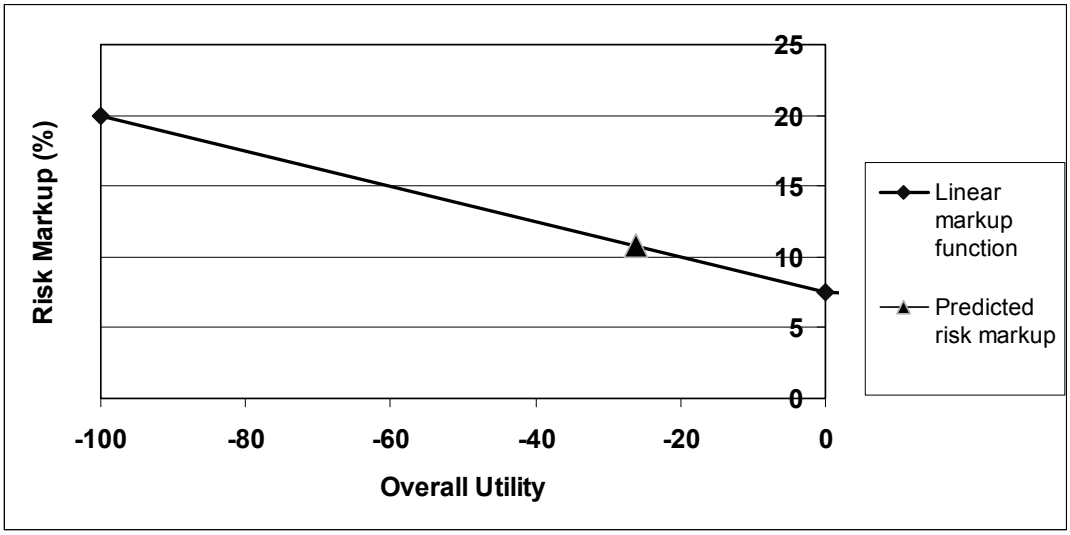

Figure 7-5. Risk markup estimation for the derived overall utility through linear interpolation

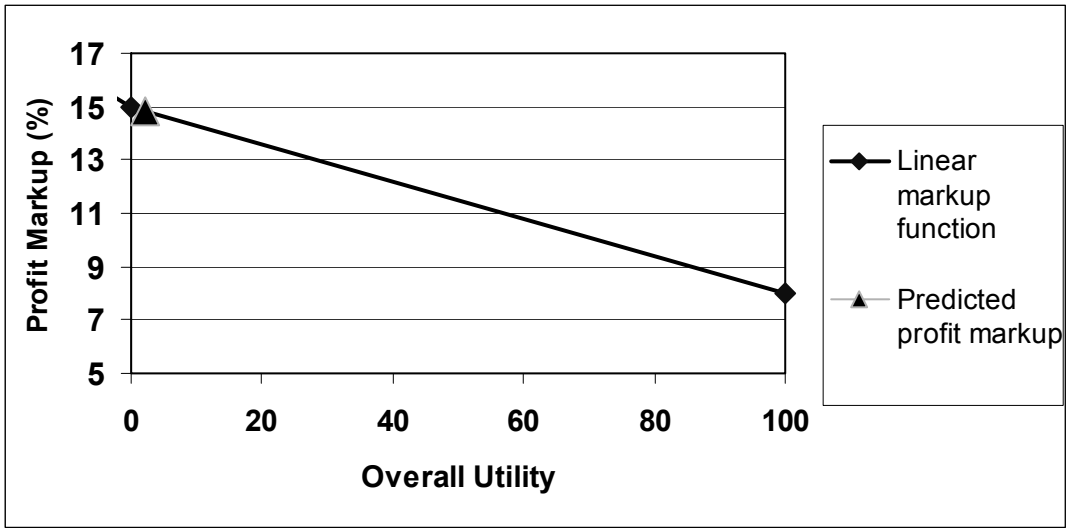

Figure 7-6. Profit markup estimation for the derived overall utility through linear interpolation

Evaluating the resulting absolute estimation errors for risk and profit markup (0.14 % and 0.63 %, respectively) as seen in Table 7.6, it can be claimed that the model is capable of almost accurately predicting the bid markup estimate of an expert for a given scenario.

CHAPTER 8

SUMMARY AND CONCLUSIONS

Throughout this study, initially, a comprehensive list of factors that may affect bid markup size for an international project is formed. Preliminarily, the results obtained from the factor importance assessment survey are studied. The research hypothesis was that contractor size had an affect on the importance rating of factors that contractors emphasize during their bid markup decision making. Analysis of variation technique is implemented between the replies of two groups of contractors (small-to-medium-size and large-size) utilizing the 'independent-samples t test'. Resultingly, it has been revealed that the two groups of contractors' importance evaluation of the various factors did not differ significantly except for two factors. This may be attributed to the suggestion that the surveyed international contractors generally possess a common wisdom in terms of international contracting.

This study differs from other studies, which had similar purposes, in that it attacks the problem from three aspects: risk, opportunity and competition. And it provides a different perspective to the bid markup estimation problem through utilization of the utility model which incorporates three rating values.

The overall assessment of the degree of these three factors has been accomplished by running a CBR application. First, in order to construct a basis for the appropriateness of the CBR approach in decision making, supportive literature findings about human brain and human judgment are presented. Later, the application is generated under a software package, ESTEEM, which adopts CBR principles. The case library for this CBR application has been developed through an extensive survey study carried out with 41 Turkish contractors which operate internationally. In this way, markup estimation ability of a wide array of experts has been tabulated in

the form of 95 international bidding scenarios. Subsequent predictions for new cases draw their knowledge from this case library by means of similarity assessment. CBR offers a medium in which knowledge for bid markup estimation is to be retained and utilized.

After assessment of ratings for risk, opportunity and competition for the target bidding scenario, the utility model given in Chapter 5 bridges the gap to bid markup estimation. Utility model first required assessment of the factor weights. Although the normative approach implemented through utilization of ROC and RS weights proved to be satisfactory in assigning factor weights, one may deem regression analysis results more dependable as it was a descriptive approach.

For the profit markup estimation problem, the research findings suggest that opportunity and competition factors are also to be considered in addition to risk factors. On the other hand, risk markup may be assessed by only considering the degree of overall risk in the bidding scenario.

The accuracy tests for prediction of both the triplets (risk, opportunity and competition ratings) and the bid markup proved to be satisfactory.

Finally, extent of the ability of the overall model to estimate a proper bid markup is presented and proved through its implementation over a sample scenario.

In case contractors study their future bid markups in the light of this study, it is almost assured that contractors will not face the frustration of neither overestimating nor underestimating the proper bid markup. This is to be achieved by the comprehensive assessment of the whole aspects of the bidding situation as already defined by the model. Above all, the model created throughout this research offers an average contractor the opportunity to greatly benefit from the experiences and knowledge of the reliable experts.

In order to improve the accuracy of the model, more number of scenarios should be incorporated into the case base so that the case base covers the scenario space in a more comprehensive and homogeneous manner. Also, enlarging the value scales for features is another option for increasing accuracy of the similarity assessment between cases. In addition, rules may be incorporated into the software so that the resulting hybrid model can adjust its predictions for existing differences in feature values between the target case and the retrieved source cases.

This model serves as a solid tool in bid markup estimation problem domain by means of relieving the construction executives from the burden of depending merely on their intuition in making predictions.

Buehler et al. (1994) state that prediction, by its very nature, elicits a focus on the future rather than the past, and this future orientation may prevent individuals from looking backward. People may sometimes attend to their past, but nevertheless fail to incorporate this information into their predictions because it does not seem relevant. In that aspect, case based reasoning system for markup estimation is very useful and essential because it compels decision makers to think on and make use of past cases and experiences. As the adage says; “The only thing that people learn from the past is that they did not learn anything from the past”. Samuel Jackson reinforces the view of that adage by commenting that; marrying a second time represents the “triumph of hope over experience”.

Although utilization of experience is indispensable to achievement of success in life and business, power of hope and therefore optimism should not be underestimated. Looking at the future through rose-colored glasses is strongly discouraged. However, optimism works well under some circumstances.

Armor and Taylor (1998) suggest that optimism may lead to self-fulfilling prophecies. They explain that in circumstances in which the attainment of

outcomes is at least partially under the predictor's control, the potentially negative consequences associated with overly optimistic expectations may be avoided to the extent that the statement of optimistic expectations help people attain the outcomes they desire. In other words, what people optimistically predict may come out to be the reality as long as they stick to their expectations together with taking the necessary measures.

The concept of self-fulfilling prophecies signifies the importance of assigning a well prepared bid markup. One should note that under the same circumstances, when an optimist and another pessimist face with an event, outcome of that event may appear to be actually positive with the former attitude and actually negative with the latter attitude. In other words, pessimists may not be able to make use of the opportunities at hand. Let's consider an example: for two partially risky and identical projects, let's assume that one optimist wins the project with a low risk markup whereas a pessimist wins an identical project with a high risk markup. Because both contractors will naturally endeavor to fit their actual unexpected expenditures into their preset risk markups, the optimist may succeed to evade potential risks by spending efforts to the greatest extent while the latter's pessimism and false sense of confidence provided by high risk markup may curb his utilization of necessary measures against potential risks. Therefore, although conditions were the same, the two identical projects may end up with two different risk markups, both of which coincide with the initial predictions. In summary, the prophecies fulfilled themselves. Therefore, it can be claimed that the level of optimism or pessimism of a decision maker is very likely to affect the level of optimum bid markup. One bid markup may work well for an optimist contractor, whereas it may prove to be insufficient for a pessimist one.

All in all, every prediction is made under varying degrees of uncertainty, with no prediction ever being completely certain. Decision maker's predictions will therefore necessarily contain some component of error. However,

utilizing a vast case library of markup decision making situations, decision maker's possible size of error diminishes, because he has already become knowledgeable about a wide array of scenarios.

In the mean time, Zadeh (1980) argues that attempts to model or emulate human reasoning by formal systems of increasing precision will lead to decreasing validity and relevance because most human reasoning is essentially shallow in nature (Mak, 1995). Therefore, it is believed that the CBR's simplicity and effectiveness in resembling the way that a brain works underlies its success as a decision support tool.

Also, one should not forget that bidding decisions involve emotional responses to the pressures particular to that moment. Therefore, no artificial computing model should be expected to exactly simulate the actual bidding decision making behavior of construction experts.

"We will never achieve a perfect model. That would be the world itself." David Laibson says. "But we can build richer and richer systems to make better and better approximations of reality" (cited in Dupree, 2001).

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APPENDIX A

SAMPLE QUESTIONNAIRE USED IN THE SURVEY

Questionnaire - Section 1

LEVEL OF IMPORTANCE EVALUATION (while estimating bid mark-up)

Please evaluate the importance levels of the following 44 factors while estimating the bid mark-up for an international construction project tender.

Key:

No	Feature Definition	Level Of Importance				
		Very Low Imp.	**Low** Imp.	**Medium** Imp.	**High** Imp.	**Very High** Imp.
	General Features about Company and Project					
1	Project size	O	O	O	O	O
2	Contract duration	O	O	O	O	O
3	Contract payment type (lump-sum, unit price, cost-plus-fee)	O	O	O	O	O
4	Type of project (housing, building, industrial, infrastructural)	O	O	O	O	O
5	Client type (private sector, public)	O	O	O	O	O
6	Size of the contractor company	O	O	O	O	O
7	Level of experience of contractor in similar type of projects	O	O	O	O	O
8	Level of experience of contractor in the host country / similar countries	O	O	O	O	O
9	Financial capability of the contractor	O	O	O	O	O
10	Technical capability of the contractor	O	O	O	O	O
11	Managerial capability of the contractor	O	O	O	O	O
12	% of subcontracted works	O	O	O	O	O
13	Amount of cash required in advance for the beginning of the project	O	O	O	O	O
	Risk Factors					
14	Vagueness of design (due to incomplete design / insufficient project drawings)	O	O	O	O	O
15	Lack of enough technical information (such as site and geological conditions etc.)	O	O	O	O	O
16	Vagueness of contract conditions (unclear risk allocation between client and contractor etc.)	O	O	O	O	O
17	Unavailability of required construction materials and supplies in the host country (Resource risk)	O	O	O	O	O
18	Lack of competence of local parties (local subcontractors, local labour etc.) in the host country	O	O	O	O	O
19	Unfavorability of physical conditions that may adversely affect productivity at site (such as adverse weather conditions etc.)	O	O	O	O	O
20	Technical and technological complexity of the project	O	O	O	O	O
21	Strict quality requirements/ specifications (stricter than the contractor's usual practice)	O	O	O	O	O

22	Tightness of the project duration / Existence of high penalty (liquidated damage) clauses	O	O	O	O	O
23	Lack of infrastructural and civil development in the host country	O	O	O	O	O
24	Geographical distance between host country and Turkey	O	O	O	O	O
25	International relations of the host country with Turkey	O	O	O	O	O
26	Economical / financial risk of the host country and/or client	O	O	O	O	O
27	Foreign exchange rate / inflation rate fluctuation risk	O	O	O	O	O
28	Immaturity / unreliability of the legal system to which the contractor is subject according to the contract (legal risk)	O	O	O	O	O
29	Instability of the political environment in the host country (political risk) /potential for negative changes in government policies	O	O	O	O	O
30	Bureaucratic delays/ difficulties (in approval of projects, receival of necessary permissions etc.)	O	O	O	O	O
31	Cultural differences between the host country and Turkey (cultural risk)	O	O	O	O	O
32	Security risk	O	O	O	O	O
33	Existence of language barrier	O	O	O	O	O
34	Level of experience of the client (in similar projects, with foreign contractors etc.)	O	O	O	O	O
35	Attitude of the client towards the contractor (about timeliness of payments etc.)	O	O	O	O	O
36	Availability of funds for the project (bank credit, client's resources)	O	O	O	O	O
	Opportunity Factors					
37	Contractor's potential for gaining reputation and experience with the project	O	O	O	O	O
38	Potential for gaining similar future projects in the same country	O	O	O	O	O
39	Immediate need to take a job	O	O	O	O	O
40	Existence of local agents that help the contractor with the project	O	O	O	O	O
41	General economic situation at the contractor's country	O	O	O	O	O
42	Potential for changes in the scope of works and/or bid prices during the course of the project	O	O	O	O	O
	Competition Factors					
43	Number of bidders	O	O	O	O	O
44	Presence of highly competitive bidders (presence of potential lowest cost bidders like Chinese etc.)	O	O	O	O	O

Questionnaire - Section 2

1. Are you comfortable with the way you make your markup decisions?

O Uncomfortable

O Somewhat comfortable

O Comfortable

2. Do you use any statistical / mathematical technique or program in determining your bid markup?

O Yes

O No

3. Are there any additional factors that you may consider during estimation of the bid mark-up for an international construction project tender?

If so, please list below.

1.

2.

3.

4.

5.

Questionnaire - Section 3

WORST CASE SCENARIO

Amount of cash required in advance for the beginning of the project	**High**
Technical and technological complexity of the project	**High**
Foreign exchange rate / inflation rate fluctuation risk	**High**
Attitude of the client towards the contractor	**Negative**
Availability of funds for the project	**Client's self resources**

Unit price contract	Risk margin (%)	
Lump-sum contract	Risk margin (%)	

Immediate need to take a job	**High**
General economic situation at the contractor's country	**Bad**
Number of bidders & Competitiveness of the competitors	**High**

Expected Profit (%)	

BEST CASE SCENARIO

Amount of cash required in advance for the beginning of the project	**Low**
Technical and technological complexity of the project	**Low**
Foreign exchange rate / inflation rate fluctuation risk	**Low**
Attitude of the client towards the contractor	**Positive**
Availability of funds for the project	**Bank credit is ready**

Unit price contract	Risk margin (%)	
Lump-sum contract	Risk margin (%)	

Immediate need to take a job	**Low**
General economic situation at the contractor's country	**Good**
Number of bidders & Competitiveness of the competitors	**Low**

Expected Profit (%)	

FOR AN AVERAGE PROJECT:

Average Risk margin(%)	

Average Expected Profit (%)	

Section 4 - RISK PROFILE IDENTIFICATION QUESTIONNAIRE

A- You have a total of 20.000 USD.

You are given the possibility of making a 10.000 USD investment.

In case you make the investment:

With 50% possibility you will lose the whole investment.

With 50% possibility the investment will double to 20.000 USD.

Question: Would you be involved in such an investment?

O Yes* O No**

(* go to question B) (** go to question C)

B- In order to change your mind away from making the investment, you are proposed to receive a reward of 1.000 USD.

Question: Would you still insist on making the investment and hence refuse the 1.000 USD payment?

O Yes O No

--- END OF THE QUESTIONNAIRE ---

C- You are forced to make the investment.

If you still don't want to make the investment, you should pay a fine of 1.000 USD and then you will be free not to make the investment.

Question: Would you pay the 1.000 USD fine in order to avoid the restriction to make the investment?

O Yes O No

--- END OF THE QUESTIONNAIRE ---

Questionnaire - Section 5

EVALUATION OF A SELF-DEFINED SCENARIO

Please **define your own scenario**, and estimate the risk rating, opportunity rating and competition rating considering all the 44 factors. Finally, please give your estimate of bid mark-up (%) and expected profit (%) for the tender.

Please also give your estimate of "Overhead, Tax, Insurance and Bond expenses (%)", if you included them in your bid mark-up.

Key:

PART 1- SCENARIO DEFINITION (PLEASE PUT A CHECK FOR EACH FACTOR.)

No	Feature Definition					
	General Features about Company and Project					
1	Project size				million USD	
2	Contract duration		O Short term	O Medium term	O Long term	
3	Contract payment type		O Lump-sum	O Unit price	O Cost + fee	
4	Type of project	O Housing	O Building	O Industrial (factory, power plant etc.)	O Infrastructural (dam, irrigation, road etc.)	
5	Client type		O Private	O Public		
6	Size of the contractor company	O Very small	O Small	O Medium	O Large	O Very large
7	Level of experience of contractor in similar type of projects		O Low	O Medium	O High	
8	Level of experience of contractor in the host country / similar countries		O Low	O Medium	O High	
9	Financial capability of the contractor		O Low	O Medium	O High	
10	Technical capability of the contractor		O Low	O Medium	O High	
11	Managerial capability of the contractor		O Low	O Medium	O High	
12	Planned % of subcontracted works		O 0-30 %	O 31-70 %	O 71-100%	
13	Amount of cash required in advance for the beginning of the project		O Low	O Medium	O High	

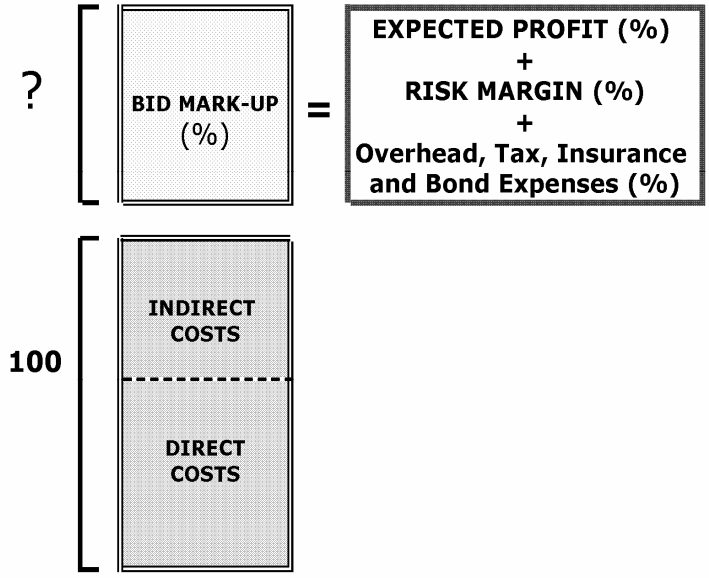
	Risk Factors					
14	Vagueness of design (due to incomplete design / insufficient project drawings)		O Low	O Medium	O High	
15	Lack of enough technical information (such as site and geological conditions etc.)		O Low	O Medium	O High	
16	Vagueness of contract conditions (unclear risk allocation between client and contractor etc.)		O Low	O Medium	O High	
17	Unavailability of required construction materials and supplies in the host country (resource risk)		O Low	O Medium	O High	
18	Lack of competence of local parties (local subcontractors, local labour etc.) in the host country		O Low	O Medium	O High	
19	Unfavorability of physical conditions that may adversely affect productivity at site (such as adverse weather conditions etc.)		O Insignificant	O Significant		
20	Technical and technological complexity of the project		O Low	O Medium	O High	
21	Strict quality requirements/ specifications (stricter than the contractor's usual practice)		O Non-existent	O Existent		
22	Tightness of the project duration / Existence of high penalty (liquidated damage) clauses		O **Normal** duration, **No** significant risk of paying high penalty	O **Tight** duration**, Low risk** of paying high penalty	O **Tight** duration**, Significant risk** of paying high penalty	
23	Lack of infrastructural and civil development in the host country		O Low	O Medium	O High	
24	Geographical distance between host country and Turkey		O Low	O Medium	O High	
25	International relations of the host country with Turkey		O Positive	O Neutral	O Negative	
26	Economical / financial risk of the host country and /or client		O Low	O Medium	O High	
27	Foreign exchange rate / inflation rate fluctuation risk		O Insignificant (Escalation clause compensates possible losses)	O Significant (Escalation clause **does not** substantially compensate possible losses)		
28	Immaturity / unreliability of the legal system to which the contractor is subject according to the contract (legal risk)		O Low	O Medium	O High	

29	Instability of the political environment in the host country (political risk) / potential for negative changes in government policies		O Low	O Medium	O High	
30	Bureaucratic delays/ difficulties (in approval of projects, receival of necessary permissions etc.)		O Low	O Medium	O High	
31	Cultural differences between the host country and Turkey (cultural risk)		O Low	O Medium	O High	
32	Security risk		O Low	O Medium	O High	
33	Existence of language barrier		O Insignificant	O Significant		
34	Level of experience of the client (in similar projects, with foreign contractors etc.)		O Low	O Medium	O High	
35	Attitude of the client towards the contractor (about timeliness of payments etc.)		O Positive	O Neutral	O Negative	
36	Availability of funds for the project		O Readily available as bank credit	O To be financed partially by the bank, partially by the client	O To be financed wholly by the client's self resources	
	Opportunity Factors					
37	Contractor's potential for gaining reputation and experience with the project		O Low	O Medium	O High	
38	Potential for gaining similar future projects in the same country		O Low	O Medium	O High	
39	Immediate need to take a job		O Low	O Medium	O High	
40	Existence of local agents that help the contractor with the project		O Non-existent	O Existent		
41	General economic situation at the contractor's country		O Bad	O Medium	O Good	
42	Potential for changes in the scope of works and/or bid prices during the course of the project		O To the advantage of contractor	O Not possible	O To the disadvantage of the contractor	
	Competition Factors					
43	Number of bidders		O Low	O Medium	O High	
44	Presence of highly competitive bidders (presence of potential lowest cost bidders like Chinese etc.)		O Yes	O No		

PART 2 - GENERAL EVALUATION (PLEASE FILL IN THE BLANKS.)

	very low	low	medium	high	very high
Risk Rating	○	○	○	○	○
Opportunity Rating	○	○	○	○	○
Competition Rating	○	○	○	○	○

Risk Margin (%)	(A)	
Expected Profit (%)	(B)	
Overhead, Tax, Insurance and Bond Expenses (%) (If they are included in the below Bid Mark-up)	(C)	
Bid Mark-up (%)	TOTAL (A+B+C)	



APPENDIX B

FEATURE MATCHING TYPES UTILIZED WITH ESTEEM

Table B.1. Feature matching types specified for each feature

Feature description	Feature matching type
GENERAL FEATURES ABOUT COMPANY AND PROJECT	
Project size	Absolute fuzzy range:3
Contract duration	Absolute fuzzy range:2
Contract payment type	Equal
Type of project	Equal
Client type	Equal
Size of the contractor company	Absolute fuzzy range:4
Level of experience of contractor in similar type of projects	Absolute fuzzy range:2
Level of experience of contractor in the host country / similar countries	Absolute fuzzy range:2
Financial capability of the contractor	Absolute fuzzy range:2
Technical capability of the contractor	Absolute fuzzy range:2
Managerial capability of the contractor	Absolute fuzzy range:2
Planned % of subcontracted works	Absolute fuzzy range:2
Amount of cash required in advance	Absolute fuzzy range:2
RISK FACTORS	
Vagueness of design	Absolute fuzzy range:2
Lack of enough technical information	Absolute fuzzy range:2
Vagueness of contract conditions	Absolute fuzzy range:2
Unavailability of required construction materials and supplies in the host country	Absolute fuzzy range:2
Lack of competence of local parties in the host country	Absolute fuzzy range:2
Unfavorability of physical conditions that may adversely affect productivity at site	Equal
Technical and technological complexity of the project	Absolute fuzzy range:2
Strict quality requirements/ specifications	Equal
Tightness of the project duration / Existence of high penalty clauses	Absolute fuzzy range:2

Table B.1. Continued

Lack of infrastructural and civil development in the host country	Absolute fuzzy range:2
Geographical distance between host country and Turkey	Absolute fuzzy range:2
International relations of the host country with Turkey	Absolute fuzzy range:2
Economical / financial risk of the host country and /or client	Absolute fuzzy range:2
Foreign exchange rate / inflation rate fluctuation risk	Equal
Immaturity / unreliability of the legal system to which the contractor is subject according to the contract (legal risk)	Absolute fuzzy range:2
Instability of the political environment in the host country (political risk) / potential for negative changes in government policies	Absolute fuzzy range:2
Bureaucratic delays/ difficulties	Absolute fuzzy range:2
Cultural differences between the host country and Turkey (cultural risk)	Absolute fuzzy range:2
Security risk	Absolute fuzzy range:2
Existence of language barrier	Equal
Level of experience of the client (in similar projects, with foreign contractors etc.)	Absolute fuzzy range:2
Attitude of the client towards the contractor (about timeliness of payments etc.)	Absolute fuzzy range:2
Availability of funds for the project	Absolute fuzzy range:2
OPPORTUNITY FACTORS	
Contractor's potential for gaining reputation and experience with the project	Absolute fuzzy range:2
Potential for gaining similar future projects in the same country	Absolute fuzzy range:2
Immediate need to take a job	Absolute fuzzy range:2
Existence of local agents that help the contractor with the project	Equal
General economic situation at the contractor's country	Absolute fuzzy range:2
Potential for changes in the scope of works and/or bid prices during the course of the project	Absolute fuzzy range:2
COMPETITION FACTORS	
Number of bidders	Absolute fuzzy range:2
Presence of highly competitive bidders (presence of potential lowest cost bidders like Chinese etc.)	Equal
OUTPUT FACTORS	
Risk rating	Absolute fuzzy range:4
Opportunity rating	Absolute fuzzy range:4
Competition rating	Absolute fuzzy range:4

APPENDIX C

SAMPLE BIDDING SCENARIO

Table C.1. Feature values for the sample scenario

Feature description	Feature value
GENERAL FEATURES ABOUT COMPANY AND PROJECT	
Project size	30 million USD
Contract duration	Long term
Contract payment type	Unit price
Type of project	Infrastructural
Client type	Public
Size of the contractor company	Medium
Level of experience of contractor in similar type of projects	High
Level of experience of contractor in the host country / similar countries	High
Financial capability of the contractor	Medium
Technical capability of the contractor	High
Managerial capability of the contractor	Medium
Planned % of subcontracted works	0- 30%
Amount of cash required in advance	Low
RISK FACTORS	
Vagueness of design	Medium
Lack of enough technical information	High
Vagueness of contract conditions	High
Unavailability of required construction materials and supplies in the host country	Low
Lack of competence of local parties in the host country	High
Unfavorability of physical conditions that may adversely affect productivity at site	Insignificant
Technical and technological complexity of the project	Medium
Strict quality requirements/ specifications	Non-existent
Tightness of the project duration / Existence of high penalty clauses	Tight duration, Low risk of paying high penalty
Lack of infrastructural and civil development in the host country	High

Table C.1. Continued

Geographical distance between host country and Turkey	Low
International relations of the host country with Turkey	Positive
Economical / financial risk of the host country and /or client	High
Foreign exchange rate / inflation rate fluctuation risk	Significant
Immaturity / unreliability of the legal system to which the contractor is subject according to the contract (legal risk)	High
Instability of the political environment in the host country (political risk) / potential for negative changes in government policies	High
Bureaucratic delays/ difficulties	High
Cultural differences between the host country and Turkey (cultural risk)	Low
Security risk	Medium
Existence of language barrier	Insignificant
Level of experience of the client (in similar projects, with foreign contractors etc.)	Medium
Attitude of the client towards the contractor (about timeliness of payments etc.)	Positive
Availability of funds for the project	To be financed wholly by the client's self resources
OPPORTUNITY FACTORS	
Contractor's potential for gaining reputation and experience with the project	Medium
Potential for gaining similar future projects in the same country	Medium
Immediate need to take a job	Medium
Existence of local agents that help the contractor with the project	Existent
General economic situation at the contractor's country	Bad
Potential for changes in the scope of works and/or bid prices during the course of the project	To the advantage of contractor
COMPETITION FACTORS	
Number of bidders	Medium
Presence of highly competitive bidders (presence of potential lowest cost bidders like Chinese etc.)	No
OUTPUT FACTORS	
Risk rating	**High**
Opportunity rating	**High**
Competition rating	**Medium**