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Critical factors affecting contractor's bidding decision for construction projects. An international review.

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Bidding is a critical point in the construction projects life cycle. After expending a lot money and resources on previous studies, pre-design and projects, companies join to the process with a very important role. The final contractor will have a lot of responsibilities on the success of the project. Before making decision, companies need to know the project, the administration in charge, the economical and legal context, the rest of the companies that are interesting on the bidding and, finally, any possible risk. In this research an international review of the critical factors affecting contractor's bidding decision is presented. These factors are classified and a ranking of them is proposed. Further making decision tools are analyzed and the possible research lines about the subject are listed.

Keywords: Construction Projects; Bidding; Decision Making Process;

Factores críticos que determinan la decisión de los contratistas de licitar a un concurso de obra pública. Una revisión internacional.

El momento de la licitación y posterior contratación de obra pública supone un punto crítico en el ciclo de vida de los proyectos de construcción. Tras la realización de los estudios previos, estudios de alternativas y proyecto de construcción es el momento en el que la empresa constructora se incorpora al proyecto, con una responsabilidad determinante en su éxito final. Previo a tomar la decisión de licitar o no, la empresa debe llegar a conocer perfectamente el proyecto, quién lo licita, su contexto económico y legal, la posible competencia y en definitiva, todo aquello que pueda ser fuente de posibles riesgos. En el presente artículo se exponen los resultados de la revisión internacional realizada sobre los factores que determinan dicha decisión, así como su clasificación y jerarquización. También se analiza la existencia de modelos de ayuda a la toma de decisiones en el proceso de licitación y las posibles líneas de investigación que se derivan del estudio.

Palabras clave: Proyectos de Construcción; Licitación; Toma de Decisiones;

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1. Introduction

Risk management is applied internationally in almost all sectors. Given the benefits which are obtained through its application, its use has become more widespread in recent years. The construction sector is not unfamiliar with these trends and, as with any other sector, it must be able to manage all risks stemming from project development in uncertain conditions throughout the entire life cycle of a project (Barber, 2005).

From their earliest stages, construction projects are vulnerable to risk (Schieg, 2006), and risks can appear throughout the life cycle of a project (Vose, 2000). Therefore, it is necessary to systemize the management of risk in order to avoid it becoming a burden on the viability of projects which are undertaken wanting sufficient guarantees of success (Martínez et al., 2012).

This risk management provides enormous benefits to all of the stakeholders in the different phases of a project. In the case of public projects, the benefits are enjoyed by society; improving the use of resources, which are always limited, and helping the welfare state to grow.

In a public works project, once the reach, deadline, quality and cost are defined (in a reasonably accurate manner, depending on the contractual model which is chosen), the project proceeds to the bid. At this moment in the project life cycle, as in all decision-making moments, the evaluation of risk is a key element for proceeding to the following phase (Smith et al., 1999), as new interested parties join the process with new objectives, and possible risks are redistributed, conditioning the viability of the bidding company.

When the market allowed it to happen, the contractor incorporated suitable economic margins into its quotes to cover said risks. However, given the evolution of the market and growing competition, the margins are gradually becoming lower, meaning that this focus is not effective (Baloi and Price, 2003).

An inaccurately placed bid can cause serious economic losses for the company awarded the bid, a deterioration in its relationship with its client, and even the start of legal proceedings to settle differences (Tan et al. 2010).

This whole process takes place within a general framework, within which the bid/no bid decision is purely commercial, set on the basis of an estimation of project costs for the company, along with additional information on the conditions and factors which introduce uncertainty to any project which is analyzed ex-ante (CIOB, 1983).

The bid covers strategic actions and requires a continuous learning process to allow for the improvement of decision making for each of the projects that are chosen for the bidding process, whether they win or not. This conceptual framework is shown in figure 1.

Being aware of the critical factors that will help them to provide the best possible solutions for the bidding process, including withdrawal, is considered as essential for companies.

The market for public projects has great international permeability and, once a certain contracting volume is reached, there are a lot of companies that start contracting processes in a great variety of countries, forcing them to recognize the factors which could determine the success or failure of such bids.

Figure 1: Bidding strategy and continuous learning process. Source: Created by the authors, based on Fu et al. (2003)



This awareness of critical factors has to be considered as one of the first steps in putting together a systematic management of risks present in the bidding process of any project or works, especially from the bidder's point of view.

2. Objectives

The objective of this research is to review all previous international studies regarding the critical factors which affect the decision-making process for bidding for a public construction contract. It will also analyze existing research on support models for decision making in bidding.

3. Methodology

In order to achieve the main objective of this research, it is essential to carry out a critical bibliographical review which can adequately guarantee to cover all the background knowledge.

The bibliographical review will not only allow the state of this issue to be understood, but it will also make it possible to detect any knowledge gaps, and, as a result, lines of research which are found at an early stage of development. In order to achieve this, the bibliographical review will be systematic, clear and reproducible, in a way in which it will be possible to identify, evaluate and interpret the state of the art of the research subject (Fink, 1998).

Therefore, carrying out a thorough bibliographical review achieves two objectives (Shaw, 1995):

1. It provides a consistent background to the issue, which justifies starting the research.

2. Shortages, limitations and good approaches can be detected through a critical approach to the literature, as well as opportunities for improving different theories.

The search terms, both combined and individual are: Construction projects; Bidding; Bid/no bid decision making process; Critical factors; Public tenders; Bidding framework.

Once the content has been checked and the direct relationship with the subject of the research has been checked, a detailed study has been carried out, from which the main discoveries of publication have been extracted, grouping them in an organized and tabulated manner, which will allow later critical analysis.

4. Results and discussion.

International awareness of the factors which can condition the decision of whether to bid or not, has become more important, if indeed that is possible, with the evolution of the construction market in recent years.

International construction groups who are market leaders have tried to diversify their work portfolios geographically, in order to be able to negotiate unfavorable economic cycles better, in terms of investment in infrastructure. The large Spanish construction companies, for example, have internationalized their portfolios in recent years, moving towards previously unknown figures, with two of them in the top twenty construction groups in the world (ENR, 2017).

The six largest Spanish construction companies had a portfolio of pending works in Spain which were valued at 9,747 million euros at the close of 2015, a drop of 17% when compared to the previous year. This means that the domestic market now only represents 11% of the total of the infrastructure projects which ACS, Acciona, FCC, Ferrovial, OHL and Sacyr have, which totals 82,200 million euros. These six largest groups continue to cushion the fall in work in Spain through their expansion abroad. At the end of 2015, international projects amounted to 72,457 million euros. This portfolio of foreign work produced a growth of 9% compared to the previous year and multiplied that which was developed in Spain six-fold. (Source: Europe Press; on http://www.europapress.es/ 13th june 2016).

These figures, even though not so extreme, are replicated in other countries, as in the case of the Korean Republic (South Korea) in which, after successive years of growth, its companies now estimate the volume of contracting abroad to be 40% of the total billing amount (Hwang, J., & Kim, Y. 2016).

The reasons of these successful Spanish companies have different origin: legal, geographical, business culture, economical and so on. It could be another deep research. Anyway, all these figures show, in great detail, the need to understand, on one hand, the factors which need to be present in decision making at the moment of bidding and, on the other hand, the existing methods and support models for decision making when preparing a bid for an international public construction contract.

In the following sections, both the results of the bibliographical review and its critical analysis will be presented in a summarized manner.

4.1. Critical factors in bid/ no bid decision making

After the bibliographical review it has been possible to chronologically organize previous works in which the decision making process involved with bidding for public construction contracts is analyzed. In table 1 the results of this study have been collected together, with the main findings of each piece of research.

Table 1: Previous Studies on factors present in bid decision making. Source: Created by the authors.

Author	Country	Main findings
Carr & Sandahl (1978)		Multiple regression analysis is applied to construction competitive bidding. Data from 48 projects bid by a contractor are collected and analyzed. Two models are developed, one for use in deciding whether or not to estimate and bid a job and one to aid in his markup decision.
Ahmad (1990)	USA	Competition and profitability are not the only factors that are important in bidding process decisions.
Shash (1993)	Arabia Saudi	This study highlighted the factors that affect markup size decisions in the bidding process in the Saudi Arabian environment.
Shash (1993)	UK	Need for work, number of competitors, contractor's experience in the project, current workload, client's identity, project type, project size, tendering method, risk, and project location.
Hassanein, Hakam (1996)	Egypt	Project type, project monetary size, expected duration, project owner, financing source, degree of hazard difficulty, prestige of project, contractor's own strategic objectives, and current work on hand.
Fayek, Ghoshal et al. (1999)	Canada	Type of project, likelihood of winning the project, desire for the project, familiarity with market, familiarity with geographical area, size of project, and company's strength.
Chua & Li (2000), Fayek, Ghoshal et al. (1999)	Korea	Hierarchy and relative weight between factors and subgoal.
Wanous, Boussabaine & Lewis (2000)	Syria	Fulfilling the to tender conditions imposed by the client, financial capability of the client, relations with and reputation of the client, project size, availability of time for tendering, availability of capital required.
Dulaimi & Shan (2002)	Singapore	Large-sized contractors are concerned about the type of work, whereas medium-sized contractors are concerned about their company's finances
Lowe & Parvar (2004)	UK	Company's objectives and policies, contract conditions/details, workload, type of work, resource availability, tender documentation, cost of preparing tender, contract size, project location, and the contract buyer or client.
Egemen & Mohamed (2007)	Northem Cyprus and Turkey	A bidding framework.
Oo, Drew et al. (2008)		Correlation Analysis between market condition, number of bidder and bid/no bid.
Bageis & Fortune (2009)	UK	The results from a review of the literature concerning the bid / no bid decision are presented, and a conceptual model is developed.
Banki, Esmaeeli et al. (2009)	Iran	Internal factors-expertise, experience, resources, capabilities. External factors-number of bidders, bidding risk, type of project, cash flow requirements. Environmental factors- availability of other projects, availability of qualified labor, availability of equipments.

Author	Country	Main findings	
Tan et al. (2010)	Hong Kong	Study of thirteen typical bidding strategies, their used frequency in bidding, and their effectiveness for winning contracts of different types and between different groups of contractors. Joint venture, better green practice, and better risk management are among other effective strategies.	
El-Mashaleh (2013)	Jordan	Empirical framework for bid/no bid decision making process.	
Jarkas et al. (2014)	Qatar	Using the "Relative Importance Index" technique, the following critical factors are identified: (1) previous experience with the employer, (2) need for work, (3) current workload, (4) previous experience in similar projects, (5) size of project, (6) identity and reputation of the employer in the industry, (7) financial stability of the employer, (8) availability of other projects, (9) promptness of the employer in the payment process, and (10) tender documents quality level.	
Leśniak & Plebankiewicz (2015)	Poland	Based on the analysis of the surveys, according to the contractors, the top three most vital factors influencing the bid/no bid decision are (1) the type of work, (2) experience in similar projects, and (3) contractual terms.	
Hwang & Kim (2016)	Korea	This study proposes a model that utilizes the logistic regression method by analyzing the correlation between various factors of project and bid decision-making o increase the effectiveness of future decision making.	
Shokri- Ghasabeh & Chileshe (2016)	Australia	The descriptive and empirical analysis demonstrated a disparity of ranking of the 26 bid/no bid criteria factors among the groups; however no statistically significant differences among the 26 bid/no bid criteria factors despite the absolute differences in the rankings and mean scores	
Oyeyipo et al., (2016)	Nigeria	The financial capability of clients, availability of capital and availability of material are the most important factors that contractors consider when making a bid/no bid decision.	

It is important to highlight that the decision-making process for a specific bid entails, in a schematic manner, two major determining factors:

- Make the bid/no bid decision.
- Set the mark-up.

One of the most important aspects to be taken from the bibliographical review is the awareness of those factors which are related to a project which, to a greater or lesser extent, affect the bid/no bid decision in a specific public bidding process. In table 2 a list of factors, in order of importance, according to Oyeyipo et al. (2016) is presented.

Table 2: Factors present in the bid/no bid decision	Source: Oyeyipo et al. (2016).
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Factors which affect the bid/no bid decision	Ranking	Factors which affect the bid/no bid decision	Ranking
Financial capability of the client	1	Project type	13
Availability of capital	2	Site accessibility	14
Availability of materials	3	Degree of hazard/safety	15
Fulfilling the "to tender" condition	4	Type of owner/client identity	16
Chances of getting the job	5	General overhead	17

Factors which affect the bid/no bid decision	Ranking	Factors which affect the bid/no bid decision	Ranking
Project size	6	Method of construction	18
Need for work	7	Site condition	19
Profitability(profit potential)	8	Anticipated rate of return	20
Availability of labour/equipment	9	Risk involved in investment	21
Relations with and reputation to client	10	Technological difficulty of project	22
Experience in similar project	11	Owner's requirement	23
Type of contract	12	Risk of fluctuation in material price	24

Only by reducing the number of factors to be considered could the development of support models for operative decision making be possible. The first step would be to proceed to grouping the factors according to their inherent characteristics. Many studies have been done in this manner, such as the Carr and Sandahl case (1978) which groups the factors into (1) work characteristics, (2) economic context and (3) competition conditions in the market, and also Bagies and Fortune (2009) which in an initial piece of work proposed a classification system of ten groups which corresponded to (1) project characteristics, (2) corporate profit, (3) client characteristics, (4) contract characteristics, (5) project financing, (6) company characteristics, (7) previous company experience, (8) bidding procedure, (9) economic situation, (10) market competition.

Other classifications are summarized in table 3.

Author	Classification	Author	Classification
Chua & Li (2000)	 Nature of Work Firm-related Factor Bidding Requirement Social and Economic Condition Firm-related Factor 	Egemen & Mohamed (2007)	 Firm related factors Project related factors Market condition & Strategic consideration
Lowe & Parvar (2004)	 Opportunities Resources Project Relationships Project Procedure Project Characteristics Risk Competitive advantages 	El-Mashaleh (2013)	 Project Characteristics Project Bidding and Contracting Project Requirement Project Expected Benefits Client Characteristics Consultant Characteristics Firm and Environmental

Table 3: Classification of critical factors in bidding procedures for construction companiesSource: Created by the authors, based on Hwang & Kim (2016).

With the objective of working with classifications which do not pose excessive subdivisions which complicate later use, some authors (Tan et al. 2010; Hwang & Kim 2016) have proposed a classification system of five large groups which correspond to (1) the client, (2) the project, (3) bidding characteristics, (4) the contract and (5) the contractor. The proposal presented by Hwang & Kim (2016) is that which is explained in table 4, in which a total of 42 factors are classified, 9 corresponding to the client, 7 to bidding characteristics, 8 to the contract and 10 to the contractor.

Table 4: Critical factors in bid decision making based on their inherent characteristics. Source: Created by the authors based on Hwang & Kim 2016.

	Critical factors according to their nature
PROJECT	Type of Project. Size of project. Location of project. Safety level required. Complexity level. Identity of designer. Identity of construction supervisor. Type of equipment required.
EMPLOYER	Previous experience of contractor with employer. Type of employer. Financial stability of employer. Identity and reputation of employer in the industry. Employer special requirements. Promptness of employer in payments process. Employer efficiency in decision making. Strength and position of employer in the industry. Qualifications and quality of employer staff.
BIDDIN SITUATION	Tendering method. Tendering duration. Number of bidders. Identity of bidders. Availability of other projects. Tender documents purchasing price. Bid bond size and validity.
CONTRACT	Contract type. Contract durations. Contract conditions. Payment scheme. Tender documents quality level. Value of liquidated damages. Size and validity of security bonds required. Insurance premium required.
CONTRACTOR	Availability of required cash. Facilities available to contractors from financial institutions. Quality of available contractor's staff. Previous experience in similar projects Need for public exposure. Availability of labor. Current workload. Need for work. Previous profit in similar projects. Availability of subcontractors

Just as there are previous studies which establish different rankings for the importance of the critical factors which condition a bid, other authors have studied the importance of the factors which are grouped by inherent characteristics. Jarkas et al. (2014), who use the same classification system as that in table 4, have developed a hierarchical list using a Relative Importance Index (RII), obtaining the results which are detailed in table 5.

Table 5: Ranking of groups of critical factors. Source: Created by the authors based on Jarkaset al. (2014)

Croups	Global values		
Groups	Average RII	Ranking N⁰	
Client	75.87	1	
Contrator	67.87	2	
Bidding	63.42	3	

Croups	Global values		
Groups	Average RII	Ranking N⁰	
Contract	60.52	4	
Project	57.74	5	

Enshassi et al. (2010) have obtained the ranking which is detailed in table 6. This was done by using the same methodology (generating a Relative Importance Index) and then carrying out a study which goes into detail about the critical factors for bidding, grouped into a total of 16 categories,

Table 6: Ranking of groups of critical factors. Source: Created by the authors, based onEnsahssi et al. (2010)

Category	RII	Rank
Project conditions	0,709	1
Firm conditions	0,704	2
Market conditions	0,688	3

Finally, the approach used by Fayek et al. (1999) is interesting in that it distinguishes between factors which make a company believe that it must win a bid. The factors are collected together in figure 2 and 3.

Figure 2: Factors which convince a company that winning a bid is a good opportunity. Source: Created by the authors, based on Fayek et al. (1999)



Figure 3: Factors which convince a company it must win a bid. Source: Created by the authors, based on Fayek et al. (1999)



4.2. Support models for decision making

It is equally important to know if previous work exists which has formulated a decision making model for a public bid.

To this effect, the study on South Korean construction companies holds real interest, as it managed to formulate a support model for bidding decisions for foreign construction projects (Hwang & Kim, 2016).

Once the project factors whose viability is considered to be the most important are established, a process of deliberation over these factors is carried out and a model of logistic regression is formulated.

As well as this model, other supporting methods with different applied tools, which are already used in other sectors, have been formulated (see table 7).

Author	Model name	
Wanous, Boussabaine & Lewis (2000)	To bid or not to bid: parametric solution	
Liu et al. (2000)	Multiple criteria decision-making models for competitive bidding	
Wanous, Boussabaine & Lewis (2003)	A neural network bid/no bid model	
Lowe & Parvar (2004)	A logistic regression approach	
Lin & Chen (2004)	A Fuzzy-Logic-Based approach	

Table 7: Support models for bid/ no bid decision making. Source: Created by the authors

However, it has been proved that a transfer of these pieces of research to the productive sector has not occurred, as the application of these models is scarce or non-existent, due to their complexity.

Because of this, construction companies use the development of small routines based on each company's know-how. These must be used by expert personnel who condition and interpret their outputs without them becoming definitive tools. A graphic example of this is in figure 4, in which the result of the risk assessment can be seen as high risk (red), acceptable risk (yellow) and low risk (green).





In this case, the critical factors of the bidding process are present and the study is orientated towards the deliberation of the risk of each of the factors depending on the distinctive features of each project.

From the quantification of the risks and depending on the temporary and strategic position of the company (such as work portfolio, resources, clients and project typology) it will be necessary to make a decision based on the experience of those who hold ultimate responsibility.

5. Conclusions

The moment of decision making when making a bid for a public project is an important milestone for later development. The decision made by companies to participate in the process sets the probability for success of a bid, provided that the factors which are sources of uncertainty and risk have been taken into consideration, whatever those factors may be: project, contract, client, competition or location among others.

External determining factors participate in this process (such as context, legal and geographical) and internal (such as strategic plans, work portfolio and resources available). As can be understood, the position of the majority of these are not fixed in any way, but evolve over time, even within the same fiscal year, making the capacity to adapt in real time necessary so that the decision making actually adapts to what is required by the company.

A multitude of previous studies exist which analyze, classify and prioritize the aspects which should be considered in the bidding process and in final decision making. Tools and/or models have even been developed to help in decision making. These establish different frameworks for work (such as fuzzy logic, neural networks and models for multicriteria decisions). However, the use of these by construction companies has not been widespread.

In future work, it would be interesting to cover some of the gaps which have been detected in this review, such as the study of the critical factors in the bidding process which exist for Spanish companies, both when bidding in Spain and in other countries. The importance of Spanish construction companies on an international scale indicates that it would be possible to draw conclusions which would be of international interest.

The development of a support model for decision making in the bidding process would be equally appropriate. This model would begin from the specifications of the companies actually immersed in the bidding process, in this way improving its use.

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