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Project procurement management: A structured literature review☆

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Abstract

Selecting the right supplier for an assignment, as well as evaluating this supplier's performance while the contract is being implemented, plays an important role in ensuring a good project outcome. In this context, this paper presents the results of a systematic literature review of the criteria and the methods used in the phases of selecting and evaluating suppliers in projects, as given in papers published from 1973 to 2015. The papers were classified into categories in accordance with the type of project and the phase of the procurement process, investigating what criteria and methods are the most widely used for selecting suppliers and evaluating the performance of suppliers in projects. The results have revealed that the procurement process may have to consider new perspectives, such as client/supplier relations, due to the importance of having partnerships with suppliers that meet organizational needs.

Keywords: Project procurement management; Supplier selection; Supplier evaluation; Criteria

1. Introduction

Due to high competitiveness, outsourcing has become a popular business strategy (de Almeida, 2007). The influence that suppliers have on the success or failure of projects is significant since their performance affects the results of the entire business effort (Liu et al., 2014; Zolghadri et al., 2011a). Moreover, selecting an appropriately qualified supplier improves stakeholders' confidence since this is more likely to lead to project goals being achieved (Turskis, 2008).

In this context, excellence in the procurement process is essential in order to achieve good outcomes in any project. Therefore, selecting the right supplier for an assignment, as well as evaluating this supplier's performance while the contract is being implemented, plays an important role in ensuring a good outcome. Thus, managers should pay special attention to two phases of the project procurement process: (1) supplier selection and (2) supplier evaluation.

In this paper, we call supplier selection the stage during which a company chooses adequate suppliers to whom they will contract-out services. Cheng and Li (2004) affirm that this is one of a company's primary activities since it must select appropriate suppliers to ensure that projects are completed successfully. Moreover, according to Zolghadri et al. (2011b), this choice is critical because it has a direct impact on the client's financial health and production capability. Evaluating suppliers is the process in which suppliers who are

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already working with the organization are assessed by observing their performance while a contract is being carried out. Ng et al. (2002) affirm that a supplier's performance should be supervised and controlled on a regular basis so as to identify problems and make repairs without further losses or delays.

Choosing criteria is an important issue when selecting and evaluating suppliers as these influence the entire process (Safa et al., 2014). However, the criteria may be in agreement with the clients' needs and may change in line with a company's or stakeholders' judgments, the industry and the context. Furthermore, Zolghadri et al. (2011a) assert that the selection process must be improved by taking into account high-level selection criteria or long-term possibilities, for instance.

Moreover, another topic that highly influences these processes is what methods are used to select and evaluate suppliers. Lambropoulos (2007) highlights the importance of choosing an appropriate procurement method. This choice depends on various aspects, such as the type of criteria and the quantity of information required. Therefore, Lambropoulos (2007) asserts that a "best overall" award method does not exist, but the most appropriate method depends on the specific conditions for each particular project.

In this context, the project procurement process is an area of vital importance and interest to organizations responsible for delivering project outcomes (Alias et al., 2012). Therefore, this paper aims to investigate procurement processes, considering the following research questions:

1) What criteria and methods are the most widely used for selecting suppliers in projects?
2) What criteria and methods are the most widely used for evaluating the performance of suppliers in projects?

Therefore, we present the results of a systematic literature review of the criteria and the methods used in the phases of selecting and evaluating suppliers in projects as given in papers published from 1973 to 2015. After analyzing these articles, we also discuss directions for future research.

The paper is structured as follows: Section 2 describes the methodology of the systematic literature review, and undertakes a descriptive analysis of the papers which includes dividing them into categories related to the type of project and the phases of the project procurement process. Section 3 presents the results of evaluating this material while Section 4 engages on discussion. Finally, Section 5 presents the conclusions and indicates future directions of the study.

2. Research method

The systematic literature review has been used so as to offer a critical overview of the current understanding of the research topic under study (Sartor et al., 2014; De Almeida et al., 2016a).

The review builds on the method used by Seuring and Müller (2008), which has four steps: material collection, descriptive analysis, category selection and material evaluation.

The material collection component is described in Section 2.1. Section 2.2 gives a descriptive analysis of the material selected. A discussion of how the categories were selected is offered in Section 2.3, while the material is evaluated in Section 3.

2.1. Material collection

To identify papers related to supplier selection and evaluation in project environments, a structured, keyword search was conducted in five databases: Web of Science, Web of Knowledge, Scopus, SpringerLink and the Wiley Online Library. The searches sought the following combinations of keywords: "Contractor selection AND Project", "Suppl* selection AND Project", "Suppl* evaluation AND Project", "Contractor evaluation AND Project", "Suppl* performance AND Project", "Contractor performance AND Project", "Vendor selection AND Project", "Vendor evaluation AND Project", "Vendor performance AND Project", "Partner selection AND Project", "Partner evaluation AND Project", "Partner performance AND Project", "Contractor choice AND Project", "Suppl* choice AND Project", "Vendor choice AND Project" and "Partner choice AND Project."

Only papers in English that were included in peer-reviewed journals were considered. Initially, the search resulted in 676 articles, excluding duplicates, which were filtered as set out in Fig. 1.

As shown in the flow chart, after the structural keyword search was conducted, the papers went through three filters: title analysis, abstract analysis, and text analysis, which resulted in identifying 119 papers that were related to the theme.

2.2. Descriptive analysis

A descriptive study was undertaken considering the following characteristics of the articles used: the total number of papers; their relevance; and how they were distributed among journals. These data give a general perspective on the methodology used in the review to highlight the most relevant journals on the subject, and to show how the importance of the issue and research methodologies have increased and developed over time. As a result, we indicate the tendencies of this field of study over time.

2.2.1. Number and relevance of papers

One hundred nineteen (119) papers related to selecting and evaluating suppliers in project environments were chosen. The relevance of these articles was measured according to how often they have been cited. The most relevant paper was a literature review written by Holt

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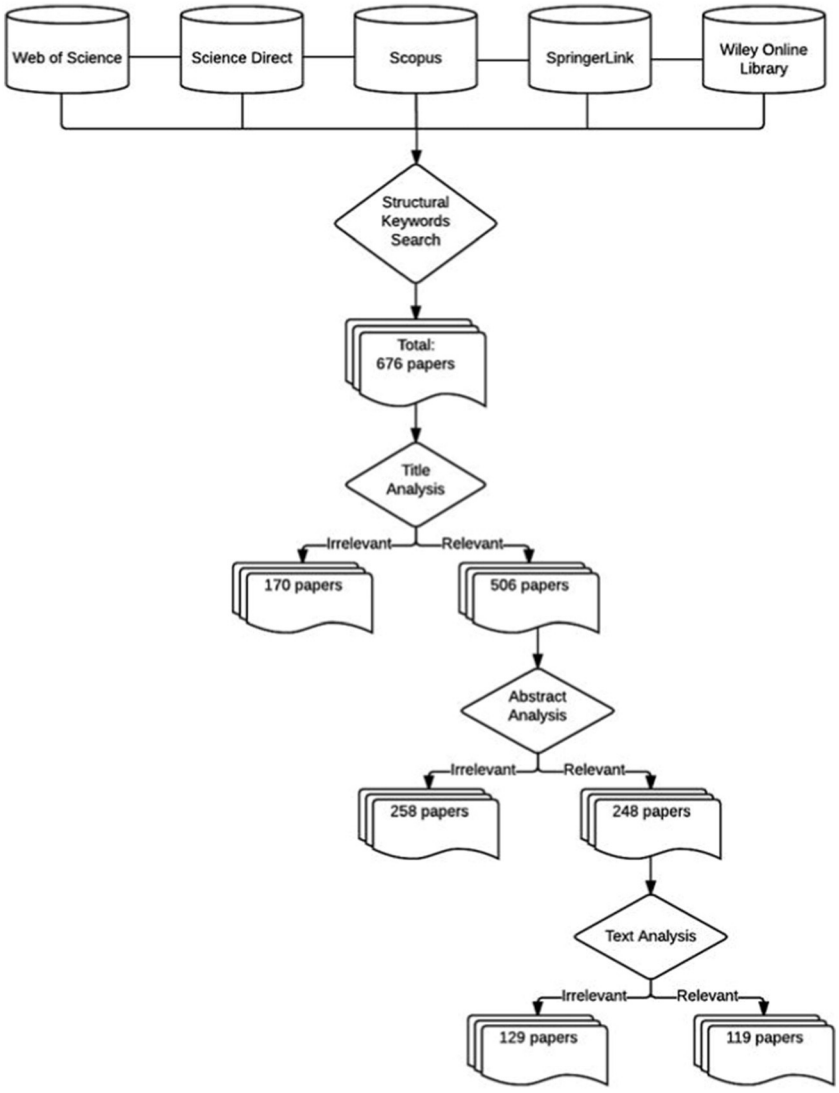

Fig. 1. Filtering process. Adapted from Igarashi et al. (2013).

(1998), which summarizes the primary methodologies for contractor selection in construction projects and was cited by 318 authors.

In this context, the five most-cited papers were: a literature review, proposed by Holt (1998), with 318 citations; three conceptual works of Hatush and Skitmore (1998), cited by 238 authors, Lu et al. (2007), cited 194 times and Chen and Wang (2009), with 167 citations and; a case study proposed by Cheng and Li (2004), cited by 166 authors.

2.2.2. Distribution of articles across journals

The 119 papers were distributed across 60 different journals in several research fields, as shown in Table 1.

The International Journal of Project Management is in second position regarding the number of cited articles it has published (8).

2.2.3. Distribution of papers across time and research methodology

The distribution of articles and research methods in the study period (1973–2015) is shown in Fig. 2. The categorization of research methods is based on Hesping and Schiele (2015). According to the authors, these methodologies are classified as (1) conceptual or theoretical publications; (2) case studies; (3) literature reviews and (4) surveys.

The first published paper in this field was a conceptual work by Smith (1973). From 1974 to 1990, no articles in this research area were published. Publication of such articles resumed in 1991, and has grown at a faster rate from 2008 to the present. As shown in Fig. 2, 80.7% (96) of published papers are conceptual; this number has significantly increased since 2008. To be more precise, the number of conceptual papers published from 2008 to 2015 is approximately 2.5 times higher

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Table 1
Research fields and papers considered in literature review.

Research field	Main journals
Operations management	Journal of Construction Engineering and Management (10), Expert Systems with Applications (5), Journal of Management in Engineering (4), Advances in Engineering Software (2), Industrial Management & Data Systems (2).
Construction management	Automation in Construction (7), Construction Management and Economic (5), Engineering, Construction and Architectural Management (5), Journal of Civil Engineering and Management (5), Building Research & Information (5).
Environmental management	Building and Environment (6), Built Environmental Journal (1), Energy Conversion and Management (1), International Journal of Natural and Engineering Sciences (1), Journal of Cleaner Production (1) and Journal of Grey System (1).
Decision analysis	Decision Science Letters (1), Fuzzy Optimization and Decision Making (1), Group Decision and Negotiation (1) and Journal of Decision Systems (1).
Computer science	Informatica (1), International Journal of Computer Integrated Manufacturing (1) and International Journal of Digital Content Technology and its Applications (1).
Others	International Journal of Project Management (8), Journal of Purchasing and Supply Management (2), Industrial Marketing Management (1) and Transportation Research Record: Journal of the Transportation Research Board.

than it was from 1973 to 2007. This rate is superior to the growth in the overall number of papers, which was at a rate of 2.1 from 2008 to 2015, when compared with the period from 1973 to 2007.

Although publications in the area began in 1973, empirical papers have only emerged since 1994. In the research period, 13 surveys (10.9%), 8 case studies (6.7%) and 2 literature reviews (1.7%) were identified. Among these research methodologies, only surveys occur in all of the time intervals.

These data highlight some tendencies in this area:

1. The high number of conceptual works, 96 out of 119, shows that the researchers perceive the need to propose new methods for selecting and evaluating suppliers, which need to consider different types of industry, decision maker (DM) preferences and available data.
2. The increase in the number of surveys and case studies demonstrates that authors seek to adapt their methodologies to the reality of organizations.
3. There are few literature reviews in this field. However, research in this area is valuable since this helps researchers and managers to take advantage of a significant amount of information which is easily and quickly accessed and which can serve as a clear guide to research findings already published.
4. The high increase in the number of papers, from 39 until 2007 to 119 by the end of 2015, shows that the researchers perceive the increasing importance of this field of study.

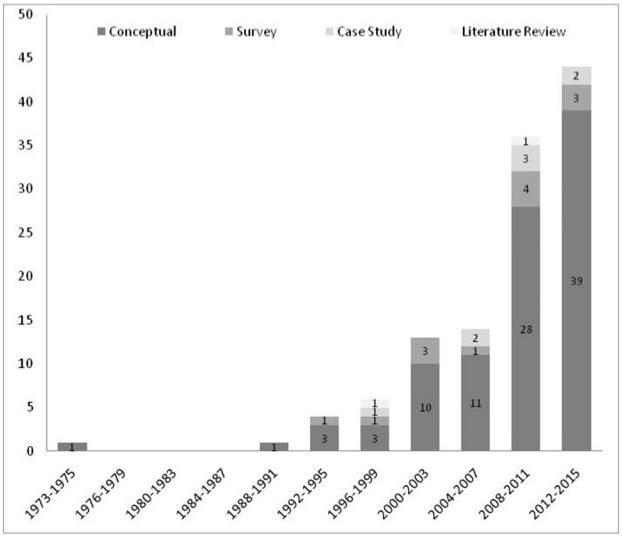

Fig. 2. Distribution of papers across the time and the research methodology.

2.3. Category selection

As mentioned in the Introduction, the objective of this paper is to identify what criteria and methods are the most widely used ones in the procurement process in project environments. Therefore, the papers are classified into two categories: the procurement process phases and by type of project.

2.3.1. Phases of the procurement process

This process has two main phases, which have different objectives that complement each other: (1) supplier selection, which sets out to choose adequate suppliers to whom services will be contracted-out; and (2) supplier evaluation, which assesses the performance of suppliers who are already working with the company. Due to these phases having different objectives, the criteria and methods that each of them, separately, most uses must be identified.

Thus, this study initially classified the papers according to these phases. The first was discussed in 101 articles and reports on those that deal with choosing suppliers to whom services

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will be contracted out. The second, which has 19 papers, considers the assessment of suppliers that are already working with the organization. One article that presents a formal model for selecting and evaluating suppliers was identified. This paper was counted in both phases. The higher number of articles on supplier selection is related to the fact that papers on this theme started being published longer ago. The first article in this category was published in 1973 while the publication of papers on supplier evaluation in projects began in 2001.

2.3.2. Type of project

Different types of industries normally have different objectives and preferences for which criteria must be used in the procurement process. Thus, this paper seeks to identify if the criteria vary depending on the type of project being investigated. Therefore, the second classification of papers is according to the type of project performed. First, the literature review showed that fourteen types of project were cited, which are deemed to be in the following categories: an aviation project (1), a capital project (1), construction projects (67), energy projects (4), an engineering project (1), highway projects (11), hydro projects (4), information system/information technology projects (IT) (6), maintenance projects (3), product development projects (9), R&D projects (3), a supply chain (1), refurbishment projects (2) and general (6).

Most of the papers were related to Construction Projects, which is explained because the correct choice of supplier is essential to the success of projects in this sector (Holt, 1997; Yilmaz and Ergönül, 2011). Finally, Fig. 3 shows the distribution of papers in different phases of the project procurement process in the type of projects that are cited.

This result reveals a greater interest from academics in the supplier selection phase and demonstrates the need for more research on supplier evaluation. Moreover, further studies in different industries are recommended because there is a large concentration on the construction industry; however, the procurement process is essential to most projects in all industrial sectors.

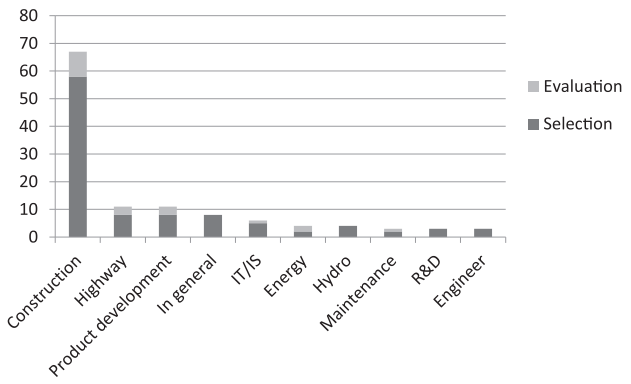

Fig. 3. Distribution of papers considering the phases of procurement and type of projects.

3. Material evaluation

The results of the Systematic Literature Review are presented in the following topics: (1) criteria for supplier selection, (2) criteria for supplier evaluation and (3) methods used for supplier selection and/or evaluation.

3.1. Criteria for supplier selection in project environments

The supplier selection criteria found in the literature review are classified into twenty-eight categories and forty-one subcategories. The categories and their relative importance (expressed by the equation: relative importance of class = number of citations of criteria in this category / total number of citations in the supplier selection criteria) are listed in the Appendix. The categories that were most cited in the literature and their descriptors are shown in Table 2.

These findings confirm that, in general, projects aim to achieve good results regarding cost, quality and time (Walraven and de Vries, 2009; Idrus et al., 2011; Yilmaz and Ergönül, 2011). The factors listed can be used as a basis for managers setting possible criteria as to selecting suppliers since the literature shows that criteria are very useful in the project procurement process in a general way.

However, different types of projects have different needs and priorities. Therefore, it is important for organizations to consider the characteristics of projects within the supplier selection process. Thus, the main categories of criteria for the selection process in different areas were compiled – see Table 3.

Construction projects is a popular topic in the project procurement process and most papers (56%) are related to this area. This importance arises from the fact that, according to Walraven and de Vries (2009), the construction industry is competitive and projects face adversity and uncertainty; contractors that do not adequately meet a company's needs increase the chance of delays, cost overruns, substandard work, disputes, or even bankruptcy. In this context, the most-cited categories of criteria in the supplier selection area are: staff features (10.0%), quality (9.8%), financial issues (9.6%), experience (8.3%) and cost/price (7.7%). Besides these, other categories, such as flexibility/responsiveness, time, technical/technology, company management (Arslan, 2012), reputation/image, performance, health and safety, environment and risk (Nassar and Hosny, 2013), among others, were cited. In summary, construction was the type of industry with the greatest diversity of criteria (all categories mentioned were included in this area).

In the review, it was observed that highway projects are frequently related to the public sector (Lam and Gale, 2014; Lambropoulos, 2007), which makes the cost criterion an

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Table 2
Description of categories most cited for supplier selection.

Category (% of citation)	Description
Quality (9.2%),	This is about the ability of a company to provide products and services according to the specifications, to perform quality control and monitor if the desired quality is being achieved. Some ways to measure quality are: to compare products with their specifications; to compare the quality actually achieved with that contractually specified, the rejection rate of parts, to check that there are quality assurance systems and that they are being used, and so on.
Cost/price (8.2%)	This is related to the monetary expression of a project product or service in the market and controlling the costs and prices of the company and its suppliers. This factor can be measured by: the value of the proposed project budget, the value of the tender price, the amount of cost discount, making a comparison between the proposal and average bid prices, and so on.
Staff features (7.9%)	This factor considers the staff of the organization, the suitability and qualifications of personnel for the work, their experience in similar works and the training conducted by the company. Some ways to measure the staff features factor are: to observe the adequacy of the staff for the work, to evaluate the qualifications of key personnel, to consider the number of critical persons available for the project, to check if staff have experience in similar projects, and so on.
Financial (7.9%)	This is related to the financial aspects of the company and its suppliers, such as: economic capacity, financial viability, financial stability, cash flow, cash discount, financial control, adequacy of bank arrangements, financial status of suppliers and credit reference.
Company management (7.6%)	This evaluates how the company is administered, by considering several issues: the existence and use of management and control systems, the management and organization of works, the integration between functions, the capability of the company's management and of the overall organization. This factor is usually measured in a qualitative way, using criteria such as: managerial capability, quality of labor plan, project organization, the effectiveness of management capabilities, and so on.
Experience (6.5%)	This factor considers the experience of suppliers in similar situations, such as similar works, geographical areas and so on. It can be measured by: level of experience in similar jobs, work volume in a similar project using a unit-price contract, experience in the geographical area of the project, the size of projects completed, the level of experience level, and so on.
Time (6.0%)	This is related to the time taken to complete a project. This factor can be measured by: the ability to complete projects in a timely way, on time fabrication, delay in completing the project, the average lateness, time quoted to complete the project, total weight flow time, bidding time, and so on.

important one. Additionally, Lambropoulos (2007) affirms that, in this type of project, the total time required from inception to commissioning can be as much as 10 years, so that the time remaining to complete a project becomes critical and should, therefore, be a competition criterion in order to ensure that the public client accepts the offer. Finally, due to the long duration of projects, Lam and Gale (2014) affirm that there are long-term relationships between clients and their suppliers. This, in turn, enhances the quality of works and, hence, the value of money from the council's highway budgets. The results of the literature reviews confirm these statements, since the five categories that are most cited for supplier selection in highway projects are: (1) cost, (2) time, (3) quality, (4) staff features and (5) financial.

Table 3
Categories of criteria most cited for supplier selection in different sectors.

Type of project	Categories
Construction projects	1. Staff features, 2. Quality, 3. Financial, 4. Experience, 5. Cost/price
Highway projects	1. Cost, 2. Time, 3. Quality, 4. Staff features, 5. Financial.
New products development projects	1. Relationship with stakeholders, 2. Quality, 3. Cost, 4. Product features, 5. Company management.
Information system/information technology	1. Cost, 2. Quality, 3. Flexibility/responsiveness, 4. Time, 5. Technical/technology.
Hydro projects	1. Quality, 2. Flexibility, 3. Cost, 4. Financial, 5. Time
R&D projects	1. Company management, 2. Technical/technology, 3. Cost/price, 4. Quality, 5. Staff features.
Aviation project	1. Quality, 2. Relationship with stakeholders, 3. Company management, 4. Technical/technology, 5. Site capacity/facilities.
Capital projects	1. Time, 2. Transport, delivery and storage, 3. Cost/price, 4. Resources, 5. Quality.
Energy projects	1. Financial, 2. Quality, 3. Supplier performance, 4. Experience, 5. Technical/technology.
Engineering projects	1. Cost/price.
General	1. Technical/technology, 2. Company management, 3. Cost/price, 4. Supplier performance, 5. Site capacity/facilities.
Maintenance projects	1. Site capacity/facilities, 2. Maintenance, 3. Cost/price, 4. Company management, 5. Staff features.
Refurbishment project	1. Experience, 2. Staff features, 3. Quality, 4. Company management,5. Cost/price.

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According to Chen et al. (2013), increased competitiveness and the shorter life cycles of new products have caused the owner of a product to collaborate more often with partners in the design chain when developing a new product. Humphreys et al. (2005) affirm that organizations are adopting more collaborative relations with their main suppliers in product development projects. Moreover, they state that this competitiveness demands more constant innovation and a higher quality from firms. This confirms why the categories of criteria most cited in the literature review with regard to developing new products include the relationship with stakeholders (11.8%), quality (9.8%), cost (9.8%), product features (8.8%) and management of the company (7.8%).

Additionally, Chen and Wang (2009) assert that advances in technology have meant that organizations develop their core competencies by outsourcing strategic information system/information technology, such that the selection of suppliers is considered an important strategic decision in this area. Tsay and Stackhouse (1991) cited some characteristics of information technology project environments: they need relevant and timely information to support company management decision-making, the short life cycles of systems and the necessity to develop information systems continuously. The most-cited categories in this area were cost, quality, flexibility/responsiveness, time, technical/technology, product features and the market.

In relation to hydro projects, Xu and Yan (2011) explain that the right vendors provide robust support for production flexibility and quality; so, while as these authors state, the right choice of suppliers is a sufficient guarantee for reducing costs, Adhikary et al. (2015a, 2015b) affirm that inaccurate design, improper selection of project, or *failure to keep* within any *other* parameter will have a high negative impact on the overall cost and efficiency since this results in producing less power at a higher cost per watt. In this context, the literature review shows that quality, flexibility, cost, finance and time are the categories most used to select suppliers in this sector.

It was observed that quality and cost/price, are present in most of the papers about supplier selection, thus confirming their importance in the process. Moreover, the criteria most cited in each sector are related directly to the characteristics and priorities of each type of industry.

3.2. Criteria for evaluating suppliers in project environments

In this paper, the supplier evaluation criteria are classified into twenty categories and thirty-five subcategories. The Appendix shows the most-cited categories of criteria for supplier evaluation in general.

It was observed that the defined categories include some of those cited in supplier selection, but their ordering was quite different. The quality class, which was the most mentioned in the selection process, was ranked second in the evaluation process; cost/price category was ranked eleventh in the assessment phase but second in the supplier selection phase. Ebrahimi et al. (2015) assert that issues such as high competitive pressure, globalization, limited resources and quick changes in the environment, have caused organizations to need to reconsider their management methods. Furthermore, using models that consider management criteria is critical to the supplier evaluation process. According to Elyamany et al. (2012a), quality tests help the supplier evaluation phase because they offer a lot of information about the supplier's performance.

Moreover, Zolghadri et al. (2011a) affirm that the quality of collaborations with suppliers influences the performance of the overall project; so that well-coordinated activities between customer and supplier improve the chances of the project being successful. Furthermore, it is important that the client creates a partnership with suppliers that meets their needs since, as Cheng and Carrillo (2012) affirm, supplier performance improves when the supplier considers the partnership does so. Several authors observe the need to consider the criterion 'relationship with stakeholders' when assessing suppliers, and thus to take into account both good relations and difficulties in the relationship. These assertions arise from the most-cited categories of criteria for supplier evaluation: company management, quality and relationship with stakeholders.

Supplier evaluation was cited in papers about six project types. In some sectors, the criteria for selection and evaluation are different. The main categories of criteria

Table 4
Categories of criteria for supplier evaluation in various types of projects.

Type of project	Categories
Construction projects	1. Relationship with stakeholders, 2. Company management, 3. Quality, 4. Staff features, 5. Time
Highway projects	1. Time, 2. Product features, 3. Quality, 4. Cost/price, 5. Health and safety/environment
New products development projects	1. Health and safety/environment, 2. Relationship with stakeholders, 3. Quality.
Energy project	1. Staff features; 2. Health and safety/environment; 3. Technical/technology; 4. Company management; 5. Cost/price
Maintenance projects	1. Quality, 2. Supplier performance, 3. Financial, 4. Other.
Supply chain	1. Cost/price, 2. Time, 3. Financial, 4. Company management.

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Table 5
Methods used for procurement in project environment.

Method		Authors
Multiple criteria based methods	Hierarchy methods	Eshtehardian et al. (2013), Alptekİn (2014), Hadidi and Khater (2015), Mahdi et al. (2002), Zolghadri et al. (2011b), Topcu (2004), Eshtehardian et al. (2013), Cheng and Li (2004), Rashvand et al. (2015).
	Multi-attribute value/utility function	Holt (1998), Wong et al. (2001), Holt et al. (1994a), Holt et al. (1994b), Holt et al. (1995), Ng et al. (2002), Lambropoulos (2007).
	Distance-based methods	Zhao and Ren (2012), Zavadskas et al. (2010), Cristóbal (2011), Safa et al. (2014), Adhikary et al. (2015b).
	Additive models	Hatush and Skitmore (1998), Arslan et al. (2008).
	Other multicriteria models.	Adhikary et al. (2015a), Cristóbal (2011), Cheng and Kang (2012), Zavadskas et al. (2010), Zavadskas and Vilutiene (2006).
Fuzzy set methods		Xu and Yan (2011), Padhi and Mohapatra (2009), Li and Wan (2014), Holt (1998), Abbasianjahromi et al. (2013), Alhumaidi (2015), Singh and Tiong (2005), Carrera and Mayorga (2008), Dowlatshahi et al. (2015), Adhikary et al. (2015b), Chen and Wang (2009), Yawei et al. (2005), Alias et al. (2012), Bashiri et al. (2011), Yang et al. (2012), Ebrahimi et al. (2015), Lu et al. (2007).
Multimethodologies		Ben-David et al. (2012), Rodríguez et al. (2013), Cheng et al. (2011), Sarkis et al. (2012), Zolfani et al. (2012), El-Abbasy et al. (2013), Zavadskas et al. (2009), Nasab and Ghamsarian (2015), Darvish et al. (2009), Juan (2009), Nassar and Hosny (2013), Walraven and de Vries (2009), Humphreys et al. (2005), Mi et al. (2013), Elyamany et al. (2012b)
Structured framework		Micheli (2008), Palaneeswaran and Kumaraswamy (2000b), Tsay and Stackhouse (1991), Arslan (2012), Kumaraswamy (1996), Yasamis et al. (2002), Stegen and Palovic (2014), Kumaraswamy and Matthews (2000), Harvey (1997), Palaneeswaran and Kumaraswamy (2001), Yilmaz and Ergönül (2011), Masi et al. (2013).
Probability and statistical methods		Holt (1998), Aziz (2008), Holt (1998), Du et al. (2015), Liu et al. (2014), Turskis (2008), Holt et al. (1994a), Holt et al. (1994b), Holt et al. (1995), Holt et al. (1993), Maturana et al. (2007), Cheng and Carrillo (2012), Zavadskas et al. (2008).
Best value model		Lin et al. (2007), Abdelrahman et al. (2008a), Abdelrahman et al. (2008b),Elyamany and Abdelrahman (2010), Elyamany et al. (2012a), Wang et al. (2013), Yu and Wang (2012), Palaneeswaran and Kumaraswamy (2000a).
Mathematical programming		Chen et al. (2013), Bashiri et al. (2011), Ip et al. (2004), Padhi and Mohapatra (2010), Cao and Wang (2007), Eckhause et al. (2009).
Cluster analysis		Holt (1998), Chinyio et al. (1998), Holt (1997).
Total cost of ownership		Micheli et al. (2009), Masi et al. (2013).
Other		Ilie-Zudor and Monostori (2009), Azambuja and O'Brien (2012), Holt (1998), Alarcón and Mourgues (2002), Zhang et al. (2013), Chen et al. (2008), Cheng et al. (2012), MacKerron et al. (2015), Straub and Mossel (2007), Lesniak et al. (2012), Lam and Gale (2014), Lee et al. (2009), Micheli et al. (2009), Aretoulis et al. (2010), Zolghadri et al. (2011a), Masi et al. (2013), Soetanto et al. (2001), Safa et al. (2015).

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for the assessment process in different areas are listed in Table 4.

Rashvand et al. (2015) affirm that management is a critical criterion in construction projects. Moreover, as a result of a survey made by Butcher and Sheehan (2010) in this sector, they conclude that many of the traditional performance measures, such as time, quality, cost and health and safety, are treated as required performance in the current environment rather than as indicators of excellence. In this study, the most-cited categories of criteria in the evaluation of suppliers in construction projects were: (1) relationship with stakeholders, (2) company management, (3) quality, (4) staff features and (5) time.

In the evaluation phase of highway projects, the most-cited categories are (1) time, (2) product features, (3) quality, (4) cost/price and (5) health and safety. Due to the high competitiveness and the need for partnerships with suppliers so as to develop new products, the quality and relations criteria appear in all procurement phases; in the evaluation phase, the most cited criteria were: (1) health and safety/environment, (2) relationship with stakeholders and (3) Quality.

Finally, it was observed that, even if sustainability is an important issue, considered by Sarkis et al. (2012) as a strategic imperative for business, only two authors cited this dimension in their research (Ebrahimi et al., 2015; Lu et al., 2007).

3.3. Methods used in the project procurement process

The use of adequate methods is essential in the acquisition process. Therefore, this subsection presents the methods identified in the literature for selecting and evaluating suppliers in project environments. However, it is important to observe that, as Lambropoulos (2007) stated, there is no "best overall" procurement method, but an adequate method depends on the specific conditions at the time and place from which each project is put out to tender.

Therefore, this study does not objectively compare the methods listed but shows situations in some of them that can be used to discuss issues such as: how many criteria to consider, the existence of uncertainty, the number of DMs, preference aggregations, and so on. Thus, Table 4 presents the procurement methods identified in the literature review, listed according to the number of citations.

As shown in Table 5, the most-cited methodologies to support the acquisition process were: multiple criteria-based methods, fuzzy methods and the use of multimethodologies. The models that were cited only once were assigned to the "other category."

Multicriteria analysis can be used when the DM wants to use several, generally conflicting, criteria in the decision process. Moreover, this analysis can be used for a different recommendation, such as ranking (Adhikary et al., 2015a; Yang et al., 2012), categorization (Nassar and Hosny, 2013; Humphreys et al., 2005) and so on.

There are several multiple criteria methods (for more details, please see Figueira et al., 2005) each of them suits different situations such as those involving uncertainty, imprecision, group decision, preference aggregation, and so on. For instance, outranking methods, such as ELECTRE and PROMETHEE (Adhikary et al., 2015a), should be used in problems with non-compensatory logic aggregation (Araújo and Alencar, 2015) in which high performance in some criteria does not compensate for low performance in others. Distance-based methods, for example, VIKOR and TOPSIS, can be used when the DM wants to compare the alternatives for ideal solutions. According to Adhikary et al. (2015b), TOPSIS methods are used to choose options that simultaneously are at the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution. Moreover, the authors affirm that the VIKOR method is used to solve problems with conflicting and non-commensurable criteria, assuming that compromise can be acceptable for conflict resolution when the DM wants a solution that is the closest to the ideal and the alternatives can be evaluated against all the criteria established.

Fuzzy methods should be used to search for solutions to problems which have elements of human subjectivity (Alias et al., 2012) and involve uncertainty (Xu and Yan, 2011). Normally, this type of method is used in situations in which DMs cannot express their preferences in numerical terms. Additionally, Singh and Tiong (2005) affirm that these models make it possible for DMs to express their opinions about the performances of attributes on decision criteria in qualitative and linguistic or approximate terms that better correspond to real-world situations. Thus, these words are transformed into fuzzy numbers.

The use was also observed of several multimethodologies, such as TOPSIS and the analytic hierarchy process in a fuzzy environment (Rodríguez et al., 2013), AHP and ANP (Sarkis et al., 2012), AHP and COmplex PRoportional ASsessment of alternatives to Grey relations (Zolfani et al., 2012). Each method was used in one step of the selection or evaluation problem. Combining methods is a good strategy by which to associate the advantages of each methodology or to use in situations where using more than one recommendation to achieve an adequate result must be considered. However, it is important that combinations are in accord with the objectives of the problem and avoid making the situation much more complex.

Mathematical programming, probability and statistical methods are used when it is possible to use quantitative criteria. According to Hadidi and Khater (2015), quantitative methods allow alternatives to be objectively evaluated.

Other methods, such as an agent-based approach (Ilie-Zudor and Monostori, 2009), the aspiration interactive method (Azambuja and O'Brien, 2012), the gray relevancy model (Zhang et al., 2013) and the logic scorecard (MacKerron et al., 2015), were used in the procurement problems. Choosing an adequate method depends on the type of criteria, information available, the level of accuracy

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needed, the standard of complexity accepted and so on. Therefore, the application these models should be in accord with the situation and needs of the organization.

4. Discussion

This section highlights the most significant findings of this literature review in the procurement process in project environments. The following issues were observed:

– Usually, authors consider various factors when selecting and evaluating suppliers.

It was observed that only Micheli (2008) and Eckhause et al. (2009) consider a single criterion to guide decision-making in procurement. The former used the criterion of cost to select an adequate supplier, while the latter considers the readiness of levels of technology when selecting a supplier for a product development project. The other 117 papers consider a minimum of two criteria to aid decision-making.

In this context, it was observed that supplier selection and evaluation consider multiple factors in the decision-making process (Singh and Tiong, 2005; Chen and Wang, 2009). These can be both quantitative and qualitative evaluations (AlptekİN, 2014). Because of this, it is necessary to use adequate methods to reach a decision on procurement by taking into account the number and type of factors required. This finding suggests the relevance of the process of building decision-making models, which take into account several criteria that aid solutions to be found for project procurement problems.

– The choice of adequate criteria for the procurement process depends on the type of project.

During the material collection, it was observed that the papers are related to projects in different sectors, such as construction (Darvish et al., 2009; Eshtehardian et al., 2013; Alhumaidi, 2015), highways (Lam and Gale, 2014; El-Abbasy et al., 2013; Abdelrahman et al., 2008b) and product development (Du et al., 2015; Dowlatshahi et al., 2015), among others. Section 2.3 lists and describes fourteen classes of project.

When evaluating papers, it was observed that different types of projects have distinct needs and priorities, as the factors considered for the processes of supplier selection and evaluation change according to each need. Thus, the results of this paper can help managers and researchers choose criteria suitable for different industries.

– There is not a general model adequate for all types of project; each model should be constructed according to the organization's needs.

It was perceived that consideration must be given to the types of criteria, the level of information that is required and available, the kind of information (complete or partial), the type of recommendation (ranking, selection of one supplier, selection of a subgroup of suppliers) and so on, in order to select which methodology to use in the procurement process, since each model is designed to be adequate for specific conditions.

This study identified several methods that are suitable for particular situations of project procurement, such as: problems that consider only quantitative factors, when managers apply statistical methods (Cheng and Carrillo, 2012; Du et al., 2015; Liu et al., 2014), and mathematical programming (Chen et al., 2013; Bashiri et al., 2011; Padhi and Mohapatra, 2010); situations in which there are quantitative and qualitative factors, and multicriteria methods can be used (Hadidi and Khater, 2015; Lambropoulos, 2007; Adhikary et al., 2015b). The type of multicriteria method to choose depends in large part on the aggregation logic, the number of DMs and the information that is required and available.

In situations with both types of criteria and considering risks, fuzzy methods (Xu and Yan, 2011; Li and Wan, 2014), which consider the uncertainties of the procurement process, can be used. In situations where information about DM preferences is partial, the flexible and interactive trade-off method (De Almeida et al., 2016b), which determines the most preferred alternative according to the scope of an additive model, may be used. Moreover, multimethodologies, which combine different methods to achieve the objectives of a problem, combine the advantages of each methodology.

Furthermore, various methods should be used in accordance with the type of recommendation sought. For instance, Safa et al. (2014) used the TOPSIS method and Adhikary et al. (2015a) used PROMETHEE II and ELECTRE II to rank suppliers in the selection phase. Bashiri et al. (2011) used a linear programming model to select projects and assign each project to the most appropriate contractor. Additionally, Nassar and Hosny (2013) used a multimethodology (AHP plus Fuzzy Cluster Categorization) to classify suppliers into five categories in the supplier selection phase. Finally, Rashvand et al. (2015) used the analytic network project model to compare multiple contractors in accordance with management practices in the evaluation phase.

Therefore, the findings of this paper can help managers and researchers to identify and use appropriate methods for different situations.

– Few papers propose formally integrated models for supplier selection and evaluation.

MacKerron et al. (2015) propose a formal supplier selection and evaluation model in a project environment in the information technology sector. In this case, the authors proposed a framework with the following stages: problem detection, important process analysis, process capability analysis, business case, outsourcing decision, requirement definition, supplier selection, outsourcing contract, performance management considerations and performance management at an evaluation level. According to MacKerron et al. (2015), in the selection phase, the potential suppliers are

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assets which have capability, capacity, cultural fit and price. After the outsourcing contract had been signed, the logic scorecard was used to evaluate the suppliers. This evaluation is used to ensure that the suppliers always updated and obtained hands-on experience regarding their capability, capacities and dedication.

Furthermore, some authors consider an evaluation index so as to monitor a supplier's performance and they use it in the selection process (Arslan et al., 2008; Kumaraswamy, 1996; Rashvand et al., 2015). In these cases, this index is used as feedback on the performance of suppliers which will be used in future selection processes. According to Rashvand et al. (2015), these criteria are commonly tailored to select competent contractors. Thus, an important link is noted between the phases of a procurement process. However, most researchers consider only one of these phases in their studies.

Methods that consider both phases are critical because if supplier selection is structured, but the performance phase is not, it is possible that the performance of the supplier who was contracted will decrease over time and the company will not perceive this due to the lack of an assessment process. On the other hand, to choose suppliers who meet the organization's needs and objectives, a structured selection process is required; suppliers' performance should be evaluated after the supplier has been contracted and is working on the project. Therefore, as claimed by Araújo and Alencar (2015), integrated models are needed because an unstructured selection process may result in contracting unsuitable suppliers, while when the firm does not assess supplier performance during the contract period, this may decrease over time. In conclusion, these two phases are essential if a procurement process in project environments is to be successful.

– Environmental, social and risk criteria are often missing in research studies.

This study verifies that the factors most cited for supplier selection in project environments are (1) quality, (2) cost/price, (3) staff features, (4) finance and (5) company management. For the evaluation of suppliers, the criteria most considered were: (1) management of the company, (2) quality, (3) relationship with stakeholders, (4) staff features and (5) time.

It was observed that sustainability is an important issue for an organization's strategy (Sarkis et al., 2012), and that the procurement process deals with risk and uncertainty (Turskis, 2008). This process should consider risks in natural and social factors during the development of a project (Zhang et al., 2013), yet this factor is cited by few authors. The study reveals that 1.9% of citations were related to environmental criteria, 1.0% considered policy, society and regulations and 0.4% cited risks (The Appendix gives detailed information). As to the evaluation phase, 2.3% of criteria mentioned were related to environmental issues, 0.8% considered policy, society and regulations and there were no citations related with risks. Further studies should consider these criteria.

– Supplier engagement criteria are often misplaced in the literature.

Finding good partners is a vital issue for the management of a company. In this study, engagement criteria, such as collaboration with contractors, cooperative managers, partnering history, risk sharing with the owner, the level of risk sharing with the client and the ability to cooperate were assigned to the subcategory of 'cooperation relations' (the Appendix gives detailed information).

The literature review revealed that only 2.8% of the 101 papers related to supplier selection cited the cooperation relations subcategory (Cheng et al., 2011; El-Abbasy et al., 2013; Zhao and Ren, 2012; Mahdi et al., 2002; Kumaraswamy and Matthews, 2000; Padhi and Mohapatra, 2010; Walraven and de Vries, 2009; Palaneeswaran and Kumaraswamy, 2001; Plebankiewicz, 2010; Zavadskas et al., 2009) and 2.8% of the 19 articles were about supplier evaluation (Butcher and Sheehan, 2010; Mi et al., 2013; Ng et al., 2002; Xiao and Proverbs, 2003) cited criteria of this subclass.

The small number of citations in this area is considered a significant gap in the literature since the competitiveness of organizations is closely related to establishing and maintaining collaborative relations with suppliers. Therefore, it is essential to contemplate this issue in the procurement process.

5. Conclusions

Since suppliers' performance is critical for the success of projects, their performance also critically influences the procurement process. Moreover, in order to select and evaluate suppliers adequately, it is essential to use criteria and methods that support the client's needs. Thus, this paper presents the criteria and methods used to select and evaluate suppliers in different project environments. In this context, a systematic review of the literature was undertaken, covering publications issued between 1973 and 2015. The search for papers used five databases: Web of Science, Web of Knowledge, Scopus, SpringerLink and Wiley Online Library. A growth in the number of studies in this area was noted.

The papers were classified by the type of project in which the project occurs and the phase of the procurement process. In the literature review, it was observed that most papers consider the phase of supplier selection while supplier evaluation was considered by only 15% of the studies and only 1 of 119 articles proposes an integrated model for supplier selection and evaluation. Due to the high number of criteria found in the review, they were classified into

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categories and subcategories and took the phase of the process into consideration. There were 28 categories for supplier selection and 20 for supplier evaluation.

The criteria that each phase of the procurement process most used were examined and after ordering them by the type of project. It was observed that the main criteria considered are different for each of these classifications, so this fact must be taken into account when choosing the most suitable criteria for each project. Moreover, the methods for the project procurement process cited in the literature review were presented. The selection of a method depends on, for example, the type of criteria used, the existing information and the desired results. It was also noted that there is no best method, but rather methods that are suitable for different decision problems.

This paper has contributed to the literature by integrating knowledge from studies on criteria and methods with a view to selecting and evaluating suppliers for projects. Therefore, as these themes are highly related and commonly used together for practical applications and to propose models, this paper helps researchers and managers to find research material more quickly, and condenses high-quality articles available on relevant databases that can be drawn on for their research.

Therefore, this study offers a basis of reference for managers and researchers, so they can inform themselves about criteria and methods that they have not considered hitherto and decide whether or not they should be used in their organization. Recommending a robust set of criteria or methods for all companies, even to those in the same sector, is dangerous because each organization has different characteristics and preferences.

5.1. Practical implications

The findings of the study may serve to provide some assistance to managers in using criteria that are suitable for their type of project and procurement phase so as to improve the project procurement process.

The factors synthesized in Tables 2 to 4 may be used as a starting point or a reference list when surveying the most important factors to be considered in selecting and evaluating a supplier. However, given the specificity of each organization, we recommend that an organization should build its own list of criteria. We have also observed that the type of project may guide the development of criteria for supplier selection and evaluation.

Also, this research highlights the need to discuss the aspiration levels for both agents, contractors and contracting during project supplier selection and evaluation.

Finally, the outcomes of this paper provide a good source of information for researchers seeking to conduct future studies on this theme, as well as a list of publications from academic journals which could be useful.

5.2. Limitations

Although this paper has contributed to knowledge about the supplier selection and evaluation process in a project environment, it has some limitations:

- The taxonomy used in the paper was proposed based on reviewing the literature, and no primary research was performed to test this taxonomy.
- This research does not discuss the aspiration levels for clients and suppliers during the procurement process.

5.3. Direction for future research

The observations from this study provide insights to explore the issues raised here. These results show some opportunities for future research studies in this field.

First, quantitative and qualitative studies are needed on the use of several measures to define the importance rating of criteria for selecting and evaluating suppliers. Additionally, these criteria must be used in practical applications in different sectors.

Moreover, due to the strategic importance of sustainability, environmental, ecological, social and risk factors, it is important to consider these criteria and conduct an analysis of their expected performance in future studies.

The methods cited in the review can be used as a basis for real world applications. It is critical to choose the adequate methodology for the problem, and to take into consideration the type of criteria used, the information available, the type of recommendation and the complexity level.

Finally, the results have revealed that the procurement process may have to consider new perspectives, such as client/supplier relations, due to the importance of having partnerships with suppliers that meet organizational needs. Finally, it would be useful to conduct exploratory studies on the perception of different stakeholders in contractual partnerships in the supplier selection phase. Also, models of negotiation that explain in depth the multiple and conflicting factors in this phase may be proposed.

Conflict of interest statement

The authors declare that there is no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

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Appendix A. Sub-category and number of citations of each category of criteria for selection and performance evaluation

Table A1
Categories for supplier selection.

Quality [9.2%]		
Subcategory	Some criteria	Authors [number of citations of each author]
Quality control [2.5%]	Auditors' assessment, audits, QA/QC programs, qualification assessment, quality assurance measures, quality assurance system, quality assurance, quality control and assurance plan, quality certifications, quality control certification, satisfaction index.	Cheng et al. (2012)[3], Darvish et al. (2009), Holt (1997), Dowlatshahi et al. (2015)[3], Holt et al. (1993), Holt et al. (1995), Humphreys et al. (2005)[2], Juan (2009), Kumaraswamy (1996), Palaneeswaran and Kumaraswamy (2000a), Mahdi et al. (2002)[2], Yang et al. (2012), Smith (1973), Plebankiewicz (2010)[2], Yasamis et al. (2002)[8], Yilmaz and Ergönül (2011)[3], Zavadskas and Vilutiene (2006), Zhao and Ren (2012), Zavadskas et al. (2009),
Quality failures [1.0%]	Failure to comply with the quality specifications, failures affecting a client's critical objectives, failures affecting a client's secondary objectives, rejected items.	Bendaña et al. (2008)[2], Holt (1997), Holt et al. (1993), Holt et al. (1994a), Holt et al. (1995), Dowlatshahi et al. (2015), Cheng and Li (2004), Marzouk et al. (2013)[2], Palaneeswaran and Kumaraswamy (2000a), Shahadat (2003), Wong et al. (2001), Xu and Yan (2011).
Quality standards [0.6%]	Standard of quality, standards and corporate qualifications, adherence to specifications.	Abbasianjahromi et al. (2013), Arslan et al. (2008), Harvey (1997), Yang et al. (2012), Cheng et al. (2012), Zavadskas and Vilutiene (2006), Zavadskas et al. (2009)[3].
Quality achieved [0.5%]	Actual quality achieved for similar works, actual quality achieved on contract, actual quality achieved.	Cheng and Li (2004), Eshtehardian et al. (2013), Holt (1997), Holt et al. (1993), Holt et al. (1994a), Holt et al. (1995), Wong et al. (2001).
Other quality criteria [4.6%]	Completeness, compliance with contract, compliance, engineering reliability, proposed project quality, Q&A, Q.C. policy, QA/QC activities, qualification, quality and airworthiness, quality concerns, ability to guarantee quality, quality objectives, quality of material used, quality of material, quality of completed projects, quality of product, quality of subcontractors, quality of the public space, quality performance level, reliability, reliable in quality, response to instructions, staff and equipment quality, customer satisfaction, quality awareness, quality level, quality risk, level of client needs satisfied, quality and safety, quality systems, regularly meets quality specifications.	Abbasianjahromi et al. (2013)[3], Abdelrahman et al. (2008a), Adhikary et al. (2015b), Abdelrahman et al. (2008b), Adhikary et al. (2015a), Alhumaidi (2015), Alias et al. (2012), Arslan (2012)[4], Azambuja and O'Brien (2012), Bendaña et al. (2008), Carrera and Mayorga (2008), Chen et al. (2013),Chen and Wang (2009), Cheng et al. (2012), Chinyio et al. (1998), Eshtehardian et al. (2013), Dowlatshahi et al. (2015)[2], Holt et al. (1994a), Arslan et al. (2008)[4], Elyamany and Abdelrahman (2010), Ilie-Zudor and Monostori (2009), Kumaraswamy (1996), Li and Wan (2014),Kumaraswamy and Matthews (2000), Nassar and Hosny (2013), Lesniak et al. (2012), Mahdi et al. (2002)[2],Marzouk et al. (2013), Nasab and Ghamsarian (2015)[3], Padhi and Mohapatra (2009), Padhi and Mohapatra (2010), Smith (1973), Palaneeswaran and Kumaraswamy (2000a)[2], Palaneeswaran and Kumaraswamy (2001)[2], Turskis (2008), Sarkis et al. (2012), Shahadat (2003)[2], Walraven and de Vries (2009), Wang et al. (2013), Xia et al. (2015), Yang et al. (2012), Yasamis et al. (2002)[2], Yawei et al. (2005), Zavadskas and Vilutiene (2006), Zavadskas et al. (2008), Zavadskas et al. (2009), Zhao and Ren (2012)[2], Zolfani et al. (2012).
Cost/price [8.2%]		
Cost/price control [0.8%]	Cost control and reporting systems, cost management, comparison of client's estimate with tender price.	Bendaña et al. (2008), Wong et al. (2001)[4], Smith (1973)[3], Nassar and Hosny (2013), Yasamis et al. (2002).
Bid cost/price [1.8%]	Proposed project budget, bid price, bid price quoted by a contractor, bid amount, tender price, the quoted price, number of lowest bids, the difference from the lowest bid, the ratio of the bid to the average of all bids, investment cost, item bid price, project bid price.	Abdelrahman et al. (2008a), Abdelrahman et al. (2008b), Alhumaidi (2015), Carrera and Mayorga (2008), Cheng and Li (2004), Cheng et al. (2012), El-Abbasy et al. (2013), Elyamany et al. (2012a), Hatush and Skitmore (1998), Idrus et al. (2011), Liu et al. (2014), Mahdi et al. (2002), Marzouk et al. (2013), Nassar and Hosny (2013)[3], Padhi and Mohapatra (2009), Topcu (2004), Padhi and Mohapatra (2010), Watt et al. (2010), Singh and Tiong (2005), Wang et al. (2013)[3], Yang et al. (2012)[2].
Discounts [0.3%]	Cost discount, cost reduction, discount percentage.	Aretoulis et al. (2010), Carrera and Mayorga (2008), Cheng and Kang (2012), Shahadat (2003).
Budget [0.3%]	Budget change, completion of job within the budget.	Abbasianjahromi et al. (2013), Cheng et al. (2012), Juan (2009), Arslan et al. (2008).
Other cost/price [5.0%]	Contracts overrun: contract (tender value) cost, cost overruns, cost performance level, cost performance level in similar projects, costs and the weighted injury frequency rate, low	Abbasianjahromi et al. (2013), Abdelrahman et al. (2008a), Arslan (2012), Abdelrahman et al. (2008b), Alarcón and Mourgues (2002), Aretoulis et al. (2010)[4], Azambuja and

(continued on next page)

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Table A1 (*continued*)

Quality [9.2%]		
Subcategory	Some criteria	Authors [number of citations of each author]
	maintenance costs, material costs, net cost, overruns: cost, transportation costs, item price, lump sum items price, proposal price to "homogenized" price ratio, the price of main section, total price, guarantees price protection, conversion, cost of building management, cost of common property management, cost risk, dollar value of performance incentives associated with contracted items, lane rental costs, management cost, procurement cost, total evaluated cost to destination.	O'Brien (2012)[2], Bendaña et al. (2008), Ben-David et al. (2012), Cao and Wang (2007), Chen and Wang (2009), Cheng and Li (2004), Chen et al. (2008)[2], Chen et al. (2013), Chinyio et al. (1998), Cristóbal (2011), Dowlatshahi et al. (2015)[4], Du et al. (2015)[2], Elyamany and Abdelrahman (2010), Arslan et al. (2008), Harvey (1997), Holt (1997), Holt et al. (1993), Holt et al. (1994a), Ilie-Zudor and Monostori (2009), Lambropoulos (2007), Holt et al. (1995)[2], Kumaraswamy and Matthews (2000), Li and Wan (2014), Lesniak et al. (2012)[2], Mahdi et al. (2002)[2], Lin et al. (2007)[2],Micheli (2008),Nassar and Hosny (2013), Safa et al. (2015), Sarkis et al. (2012), Palaneeswaran and Kumaraswamy (2000a), Safa et al. (2014), Rodríguez et al. (2013), Zolfani et al. (2012), Turskis (2008), Wang et al. (2013), Xia et al. (2015), Palaneeswaran and Kumaraswamy (2001), Shahadat (2003)[2], Tsay and Stackhouse (1991)[2], Xu and Yan (2011), Yang et al. (2012)[2], Yawei et al. (2005), Yilmaz and Ergönül (2011), Zavadskas and Vilutiene (2006)[5], MacKerron et al. (2015).
Staff features [7.9%]		
General topics [2.3%]	Personnel potential, personnel turnover, other staff assigned to the contractor, pen portraits of the key staff likely to be involved in the project, site manager and other key staff, manpower resources, manpower availability, manpower schedule, manager personality, project manager, human resource management.	Abdelrahman et al. (2008a), Alptekİn (2014), Bendaña et al. (2008)[4], Cheng and Li (2004), Dowlatshahi et al. (2015), Cheng et al. (2012), Cheng et al. (2011), Harvey (1997)[2], Hatush and Skitmore (1998), Mahdi et al. (2002)[2], Holt et al. (1993), Sarkis et al. (2012)[3], Safa et al. (2015), Palaneeswaran and Kumaraswamy (2001), Plebankiewicz (2010)[2], Shahadat (2003), Singh and Tiong (2006), Smith (1973), Wong et al. (2001), Walraven and de Vries (2009), Yilmaz and Ergönül (2011), Yasamis et al. (2002), Zavadskas and Vilutiene (2006), Zavadskas et al. (2009)[2].
Workload [0.9%]	Workload, current and future workload, current workload, current workload (contract duration), current workload at time of tendering.	Alhumaidi (2015), Cheng and Li (2004), Harvey (1997), Wong et al. (2001), Holt et al. (1993), Holt et al. (1994a), Holt et al. (1994b), Holt et al. (1995), Mahdi et al. (2002), Singh and Tiong (2006), Palaneeswaran and Kumaraswamy (2001), Topcu (2004).
Adequacy of personnel [0.5%]	Adequacy of technical staff, adequacy of labor resources, adequacy of manpower-facilities.	Abbasianjahromi et al. (2013)[2], Arslan (2012), Smith (1973), Arslan et al. (2008)[2].
Qualification of personnel [1.6%]	Qualification of key personnel, qualification of QA/QC personnel, qualification of these key people, quality and quantity of human resources, qualification and experience of management staff.	Abbasianjahromi et al. (2013), Dowlatshahi et al. (2015), Arslan et al. (2008), Hadidi and Khater (2015), Mahdi et al. (2002), Holt (1997)[2], Holt et al. (1993)[2], Holt et al. (1994a)[3], Holt et al. (1994b), Holt et al. (1995)[2], Singh and Tiong (2006)[3], Wong et al. (2001)[2], Yilmaz and Ergönül (2011)[2], Zavadskas and Vilutiene (2006).
Amount of personnel [1.1%]	Number of key personnel for the project, number of qualified personnel, key persons available for this project, availability of key personnel, number of employees, number of executives.	Abbasianjahromi et al. (2013), Arslan et al. (2008), Holt (1997), Holt et al. (1993), Dowlatshahi et al. (2015)[2], Holt et al. (1994a), Holt et al. (1994b), Holt et al. (1995), Nasab and Ghamsarian (2015), Nassar and Hosny (2013), Plebankiewicz (2010), Topcu (2004),Zavadskas et al. (2010), Wong et al. (2001)[2].
Experience of personnel [0.8%]	Availability of experienced technical staff for each project, experience of technical personnel, years that key personnel have spent with the company, years with co, experience of executives.	Alias et al. (2012), Bashiri et al. (2011), Darvish et al. (2009), Hatush and Skitmore (1998), El-Abbasy et al. (2013), Holt (1997), Holt et al. (1994a), Plebankiewicz (2010), Nasab and Ghamsarian (2015), Smith (1973), Yilmaz and Ergönül (2011), Zavadskas et al. (2010).
Training [0.7%]	Personnel training, extent of formal training regime, formal training regime, training or skill level of craftsmen, staff in-service training.	Abbasianjahromi et al. (2013), Arslan et al. (2008), Holt (1997), Holt et al. (1993), Holt et al. (1994a), Holt et al. (1995), Nassar and Hosny (2013), Wong et al. (2001), Yasamis et al. (2002), Zavadskas and Vilutiene (2006).
Financial issues [7.9%]		
Financial references [0.9%]		Cheng and Li (2004), Cheng et al. (2012), Holt et al. (1993), Hatush and Skitmore (1998), Holt (1997)[2], Holt et al.

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Table A1 (*continued*)

Quality [9.2%]		
Subcategory	Some criteria	Authors [number of citations of each author]
	Bank reference, bank referenced rating, AAA grade credit assessment certificate, bank arrangements and bonding, letter of credit.	(1994a)[3], Holt et al. (1995)[2], Topcu (2004), Nasab and Ghamsarian (2015).
Financial capacity/ability [1.4%]	Economic capacity, financial soundness, finance capability, financial ability, financial capacity, financial condition, financial capability, has favorable financial capacity to do the work, maximum resource/financial capacity, financial viability.	Abbasianjahromi et al. (2013), Alptekİn (2014), Chen et al. (2013), Xia et al. (2015), Cheng and Li (2004), Cheng et al. (2011), Dowlatshahi et al. (2015), El-Abbasy et al. (2013), Liu et al. (2014), Arslan et al. (2008), Hatush and Skitmore (1998), Idrus et al. (2011), Lambropoulos (2007), Nasab and Ghamsarian (2015), Singh and Tiong (2005), Safa et al. (2015), Shahadat (2003), Wang et al. (2013), Wong et al. (2001), Zavadskas et al. (2009).
Payments [1.3%]	Advance payment, cash credit, credit level, credit rating, credit standing, extended payment terms, authorized and paid-up capital, contractor's difficulty in reimbursement, liquidity ratio.	Abbasianjahromi et al. (2013), Dowlatshahi et al. (2015), Arslan et al. (2008), Arslan (2012)[4], Hatush and Skitmore (1998)[2], Marzouk et al. (2013), Mahdi et al. (2002)[2], Lambropoulos (2007), Nasab and Ghamsarian (2015)[2], Shahadat (2003), Singh and Tiong (2006)[2], Topcu (2004).
Financial stability [0.8%]	Financial stability, financial stability-controls, financial strength and stability.	Alhumaidi (2015), Arslan (2012), Bendaña et al. (2008), Darvish et al. (2009), El-Abbasy et al. (2013), Hatush and Skitmore (1998), Mahdi et al. (2002), Holt (1998), Nasab and Ghamsarian (2015), Plebankiewicz (2010), Smith (1973), Yawei et al. (2005).
Financial measures [1.2%]	Balance sheet, cash flow, cash discount, equity capital, leverage ratio, net present value, profitability, expected total return.	Bashiri et al. (2011), Dowlatshahi et al. (2015), Holt (1997), Holt et al. (1993), Holt et al. (1994a), Holt et al. (1995), Mahdi et al. (2002)[2], Safa et al. (2015), Sarkis et al. (2012)[2], Shahadat (2003), Topcu (2004)[3].
Other [2.3%]	Finance, financial arrangements, financial asset, financial control, financial liability, financial performance, financial standing, financial statement, financial status, financial strength and ownership, owned financial funds, total operational income, working capital, economics/business, economics, economic situation.	Adhikary et al. (2015b), Adhikary et al. (2015a),Aretoulis et al. (2010), Alias et al. (2012)[2], Carrera and Mayorga (2008), Chen and Wang (2009), Chen et al. (2013), Cheng and Li (2004), Cristóbal (2011), El-Abbasy et al. (2013), Harvey (1997), Hatush and Skitmore (1998), Mahdi et al. (2002), Padhi and Mohapatra (2009), Safa et al. (2015)[3], Padhi and Mohapatra (2010),Plebankiewicz (2010)[2], Sarkis et al. (2012)[2], Palaneeswaran and Kumaraswamy (2001), Singh and Tiong (2006), Topcu (2004)[2], Wong et al. (2001), Zavadskas et al. (2009)[2], Yawei et al. (2005), Zavadskas and Vilutiene (2006).
Company management [7.6%]		
Management systems and control [0.6%]	Availability of project management software, organization and management system, project management system.	Harvey (1997), Palaneeswaran and Kumaraswamy (2001), Wong et al. (2001)[2], Plebankiewicz (2010), Smith (1973)[2], Yilmaz and Ergönül (2011), Yasamis et al. (2002).
Work management [0.7%]	Management and organization of works, contractor work strategy, labor plan, work breakdown.	Cheng et al. (2012)[2], Kumaraswamy (1996), Mahdi et al. (2002), Smith (1973)[2], Zavadskas and Vilutiene (2006)[2], Zavadskas et al. (2009), Yawei et al. (2005).
Integration [0.6%]	Integration management, key management: years with contractor, engineering co-ordination.	Dowlatshahi et al. (2015), Holt et al. (1995), Mahdi et al. (2002), Smith (1973),Walraven and de Vries (2009), Wang et al. (2013), Wong et al. (2001), Yang et al. (2012), Yasamis et al. (2002).
Management capability/ability [0.8%]	Management capability, managerial capability, project management capabilities, project management expertise, management capability.	Cheng et al. (2011), Cristóbal (2011), Hatush and Skitmore (1998), Mahdi et al. (2002)[2], Plebankiewicz (2010), Singh and Tiong (2005), Smith (1973), Watt et al. (2009), Watt et al. (2010), Wong et al. (2001), Yawei et al. (2005).
Management knowledge [0.9%]	Management knowledge, organizational expertise related to each project, organizational expertise, understanding of the project.	Bashiri et al. (2011), Bendaña et al. (2008), Chen et al. (2013), Hatush and Skitmore (1998), Li and Wan (2014), Plebankiewicz (2010), Smith (1973)[3], Topcu (2004), Wong et al. (2001), Zavadskas and Vilutiene (2006).
Organization [1.0%]	Organization, interface management, schedule, overall organization -management, project management organization, project organization, work organization.	Bendaña et al. (2008), Hatush and Skitmore (1998), Holt et al. (1995), Holt et al. (1994a), Smith (1973)[3], Wang et al. (2013), Zavadskas and Vilutiene (2006), Yang et al. (2012)[2], Holt et al. (1993),Yilmaz and Ergönül (2011).
Other [3%]	Traffic management, high caliber management, management experience, management resource, project management,	Abbasianjahromi et al. (2013), Arslan (2012), Chen et al. (2008), Chen et al. (2013), Darvish et al. (2009), Holt et al.

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Table A1 (*continued*)

Quality [9.2%]		
Subcategory	Some criteria	Authors [number of citations of each author]
	project management processes, construction management and sub-contractor management, management safety accountability, procurement management, qualification of key management.	(1993), Dowlatshahi et al. (2015)[5], Arslan et al. (2008), Hatush and Skitmore (1998), Holt et al. (1995)[2], Kumaraswamy (1996), Holt et al. (1994a)[2], Mahdi et al. (2002)[2], Safa et al. (2015), Sarkis et al. (2012), Shahadat (2003), Walraven and de Vries (2009), Wang et al. (2013)[3], Xia et al. (2015), Wong et al. (2001), Yang et al. (2012)[2], Yasamis et al. (2002)[5], Yilmaz and Ergönül (2011), Zavadskas and Vilutiene (2006), Zhao and Ren (2012)[3], Zavadskas et al. (2009), Zavadskas et al. (2010).
Experience [6.5%]		
Similar works [1.9%]	Experience in similar jobs, experience in similar projects, experience in similar works, experience in the construction industry, experience level of project team on similar type of project, experience of firm in construction, similar projects.	Abbasianjahromi et al. (2013)[2], Bendaña et al. (2008), Arslan et al. (2008)[2], Cristóbal (2011), El-Abbasy et al. (2013), Holt (1997), Holt (1998), Holt et al. (1993), Holt et al. (1994a), Holt et al. (1994b), Holt et al. (1995), Idrus et al. (2011), Kumaraswamy and Matthews (2000), Mahdi et al. (2002)[4], Padhi and Mohapatra (2009), Topcu (2004), Padhi and Mohapatra (2010), Wong et al. (2001), Singh and Tiong (2006)[2], Yilmaz and Ergönül (2011), Zavadskas et al. (2008).
Geographic questions [1.1%]	Experience geographically, experience in geographic area of project, experience in the geographical region, experience in local area.	Cheng and Li (2004), Darvish et al. (2009), Holt (1997), Holt (1998), Holt et al. (1993), Holt et al. (1994a), Holt et al. (1994b), Holt et al. (1995), Mahdi et al. (2002)[2], Nasab and Ghamsarian (2015), Wong et al. (2001)[4], Yilmaz and Ergönül (2011).
Characteristics of projects [0.9%]	Scale of projects completed, size of projects completed, size of past projects completed.	Cheng and Li (2004)[2], Harvey (1997), Holt (1997)[2], Holt et al. (1993)[2], Holt et al. (1994a)[2], Holt et al. (1995)[2], Singh and Tiong (2006).
General [2.6%]	Organization experience, past experience, contractor experiences, experience level, experience modification rate, industrial experience, organizational experience, work experience, age of contractor company, number of constructed houses, number of years in construction, total number of works performed by contractor, work history.	Alhumaidi (2015), Alptekİn (2014), Chen and Wang (2009), Cheng and Li (2004), Darvish et al. (2009), Holt (1997), El-Abbasy et al. (2013), Holt (1998), Hadidi and Khater (2015), Hatush and Skitmore (1998)[2], Holt et al. (1993)[2], Holt et al. (1994a)[2],Holt et al. (1995)[2], Juan (2009), Lambropoulos (2007),Mahdi et al. (2002),Singh and Tiong (2006), Nasab and Ghamsarian (2015)[2], Plebankiewicz (2010)[2], Palaneeswaran and Kumaraswamy (2001), Wang et al. (2013), Watt et al. (2009), Watt et al. (2010), Xia et al. (2015), Yang et al. (2012), Zhao and Ren (2012),Yawei et al. (2005), Yilmaz and Ergönül (2011)[2], Zavadskas et al. (2008), Zavadskas et al. (2010).
Time [6.0%]		
Timeliness [1.4%]	Ability to timely complete projects, ability to complete similar projects on time, ability to complete on time, completion of contract on time, completion of job on time, completion of job within the time.	Abbasianjahromi et al. (2013), Aretoulis et al. (2010), Arslan (2012)[5], Azambuja and O'Brien (2012)[2], Bashiri et al. (2011), Chinyio et al. (1998), Dowlatshahi et al. (2015), El-Abbasy et al. (2013), Eshtehardian et al. (2013), Arslan et al. (2008), Shahadat (2003), Topcu (2004), Wong et al. (2001), Zavadskas et al. (2009)[2].
Problems in time [1.2%]	Contracts overrun: contract time, overruns: time, incompetence of suppliers as to delivering materials on time, delay, delay in completing the project.	Abdelrahman et al. (2008a), Abdelrahman et al. (2008b), Holt et al. (1995),Cheng and Li (2004), Holt (1997), Holt et al. (1994a), Marzouk et al. (2013)[2], Nassar and Hosny (2013)[4], Padhi and Mohapatra (2009), Padhi and Mohapatra (2010), Xu and Yan (2011), Zavadskas et al. (2009), Yang et al. (2012).
Proposed time/Schedule [1.1%]	Time quoted to complete the project, timeframe, construction schedule and assurance measures for time limit of project, due-date, proposed project schedule, proposed time schedule of project.	Bendaña et al. (2008), Cheng et al. (2012), Juan (2009), Ilie-Zudor and Monostori (2009), Mahdi et al. (2002)[2], Nassar and Hosny (2013), Padhi and Mohapatra (2009), Padhi and Mohapatra (2010), Singh and Tiong (2006), Smith (1973), Stegen and Palovic (2014), Xia et al. (2015), Yang et al. (2012),Zavadskas et al. (2008)[2].
Production time [0.5%]	Total weighted flow time, fabrication lead time, lead time, construction duration.	Azambuja and O'Brien (2012), Safa et al. (2014), Wang et al. (2013), Nassar and Hosny (2013), Dowlatshahi et al. (2015)[2], Zavadskas et al. (2008).
Other [1.8%]	Bidding time, completion time, delivery time, the discounted total weighted completion time, time control, time management, transit time, completion/time performance,	Abbasianjahromi et al. (2013), Alhumaidi (2015), Chen et al. (2013), Arslan (2012), Azambuja and O'Brien (2012), Carrera and Mayorga (2008), Chen and Wang (2009), Chen et al. (2008),

Table A1 (*continued*)

Quality [9.2%]		
Subcategory	Some criteria	Authors [number of citations of each author]
	workload: project duration, can deliver quickly, duration control abilities, length of time in maintenance business.	Cheng and Kang (2012), Cheng et al. (2011), Cristóbal (2011), El-Abbasy et al. (2013), Eshtehardian et al. (2013), Arslan et al. (2008), Holt (1997),Li and Wan (2014), Ilie-Zudor and Monostori (2009),Sarkis et al. (2012), Nassar and Hosny (2013)[2], Lambropoulos (2007), Turskis (2008), Shahadat (2003), Yasamis et al. (2002), Zavadskas and Vilutiene (2006).
Technical/technology [5.8%]		
Technical [2.9%]	Technical ability, technical evaluation, technical expertise, method/technical solution, technical performance, technical score, technical-economic analysis, construction technique, has technical ability and knowledge, maintains technical service, technical capability, technical capacity, technical competence, technical proposals.	Arslan (2012), Bendaña et al. (2008), Chen and Wang (2009), Cheng et al. (2012), Cheng et al. (2011), Harvey (1997), Cristóbal (2011), Dowlatshahi et al. (2015)[2], Elyamany et al. (2012a)[2], Hadidi and Khater (2015), Hatush and Skitmore (1998)[2], Idrus et al. (2011), Kumaraswamy and Matthews (2000), Lambropoulos (2007), Nasab and Ghamsarian (2015), Palaneeswaran and Kumaraswamy (2001), Plebankiewicz (2010), Singh and Tiong (2005), Shahadat (2003)[2], Smith (1973)[2], Walraven and de Vries (2009), Wang et al. (2013)[5], Watt et al. (2009)[2], Watt et al. (2010)[2], Wong et al. (2001)[2], Xia et al. (2015), Yang et al. (2012)[2].
Technology [1.0%]	Technology capabilities, technology, technological capacity, technology and equipment, technology program is complete and reasonable, technology readiness levels.	Carrera and Mayorga (2008), Chen et al. (2013), Harvey (1997), Darvish et al. (2009), Dowlatshahi et al. (2015), Li and Wan (2014), Eckhause et al. (2009), Liu et al. (2014), Nassar and Hosny (2013), Palaneeswaran and Kumaraswamy (2001), Safa et al. (2015), Yang et al. (2012), Zhao and Ren (2012)[2],Zolfani et al. (2012).
Equipment [1.9%]	Equipment, plant and equipment, condition and availability of equipment, designated facilities and equipment, equipment availability, equipment condition, equipment schedule, equipment suitability, government equipment and facilities used.	Abbasianjahromi et al. (2013), Alias et al. (2012), Cheng et al. (2012), Alptekİn (2014), Bendaña et al. (2008), El-Abbasy et al. (2013), Nasab and Ghamsarian (2015)[2], Hatush and Skitmore (1998), Lambropoulos (2007), Mahdi et al. (2002)[2], Nassar and Hosny (2013)[2], Palaneeswaran and Kumaraswamy (2001), Wong et al. (2001)[4], Shahadat (2003), Plebankiewicz (2010), Smith (1973)[2], Yawei et al. (2005), Yilmaz and Ergönül (2011)[2].
Relationship with stakeholders [5.5%]		
General relations [1.8%]	Competition, client–supplier relations, relationship with surroundings, design-build team relationships, relationship with design team, relationship with insurance companies, relationship with local authority, relationship with subcontractors.	Bendaña et al. (2008), Dowlatshahi et al. (2015)[2], Safa et al. (2014), Hatush and Skitmore (1998), Mahdi et al. (2002)[4], Safa et al. (2015), Nasab and Ghamsarian (2015), Palaneeswaran and Kumaraswamy (2001), Shahadat (2003), Singh and Tiong (2006), Wang et al. (2013), Smith (1973), Turskis (2008), Walraven and de Vries (2009), Watt et al. (2009), Watt et al. (2010), Wong et al. (2001), Zavadskas et al. (2009)[2], Zhao and Ren (2012)[2].
Cooperation relations [0.9%]	Collaboration with other subcontractors, cooperation and coordination offered, cooperation with contactors, cooperation with designers and other contractors, cooperative managers.	Cheng et al. (2011)[2], El-Abbasy et al. (2013), Zhao and Ren (2012), Mahdi et al. (2002), Kumaraswamy and Matthews (2000)[2], Padhi and Mohapatra (2010), Walraven and de Vries (2009), Palaneeswaran and Kumaraswamy (2001), Plebankiewicz (2010), Zavadskas et al. (2009).
Power relations [0.6%]	Company and partner are balanced, company is stronger than partner, partner is stronger than company.	Sarkis et al. (2012), Zolghadri et al. (2011b)[3], Zolghadri et al. (2011a)[5].
Prior relations [0.9%]	Relationship with insurance companies in similar projects, relationship with sub-contractors in similar projects.	Cheng and Li (2004), Dowlatshahi et al. (2015), Hatush and Skitmore (1998), El-Abbasy et al. (2013),Mahdi et al. (2002)[3], Holt (1997), Holt et al. (1993), Holt et al. (1994a), Holt et al. (1994b), Holt et al. (1995), Plebankiewicz (2010).
Problems in relations [0.9%]	Conflicts and complaints, contractor litigation tendency, disputes/claims history, fraudulent activity, failed contract, and previous debarment.	Abdelrahman et al. (2008a), Abdelrahman et al. (2008b), El-Abbasy et al. (2013), Holt (1997), Holt et al. (1993), Holt et al. (1994a), Holt et al. (1995), Juan (2009), Topcu (2004),Zavadskas et al. (2009)[3], Palaneeswaran and Kumaraswamy (2001).
Promptness relations [0.4%]	Exhibits desire for business, interest shown by the contractor, promptness, desire for business, enthusiasm for the project.	Bendaña et al. (2008), Dowlatshahi et al. (2015), Kumaraswamy and Matthews (2000), Palaneeswaran and Kumaraswamy (2000a), Shahadat (2003).

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Table A1 (*continued*)

Quality [9.2%]		
Subcategory	Some criteria	Authors [number of citations of each author]
Supplier performance (past and current) [4.6%]		
Performance (past and current) [4.6%]	Past project performance, debarment and/or demerit point in past projects, past failures, past failures in completed projects, past quality grade, quality performance level in similar projects, past performance and quality, past performance score of the contractor, past performance-experience, past performance-reputation, value of work done by the contractor in each project assigned to him in the past, client satisfaction performance level in similar projects, safety performance level in similar projects.	Alarcón and Mourgues (2002), Alhumaidi (2015), Alias et al. (2012)[2], Cao and Wang (2007), Chen and Wang (2009), Cheng and Li (2004), Cheng et al. (2012)[2], El-Abbasy et al. (2013), Harvey (1997), Holt et al. (1993)[3], Holt (1997), Holt (1998), Hatush and Skitmore (1998)[2], Idrus et al. (2011), Holt et al. (1994a)[2], Holt et al. (1995)[2], Ilie-Zudor and Monostori (2009), Liu et al. (2014), Mahdi et al. (2002)[6], Nasab and Ghamsarian (2015)[3], Nassar and Hosny (2013)[2], Padhi and Mohapatra (2009)[2], Padhi and Mohapatra (2010)[2], Palaneeswaran and Kumaraswamy (2001), Safa et al. (2014), Safa et al. (2015), Singh and Tiong (2005)[2], Plebankiewicz (2010)[3], Singh and Tiong (2006), Smith (1973)[3], Topcu (2004), Wang et al. (2013)[2], Xia et al. (2015), Watt et al. (2009), Watt et al. (2010), Wong et al. (2001), Yang et al. (2012)[2], Yawei et al. (2005), Yilmaz and Ergönül (2011)[2], Zhao and Ren (2012), MacKerron et al. (2015).
Site capacity/facilities [4.2%]		
Site infrastructure [1.6%]	Infrastructure, infrastructure constraints, adaptable building arrangements, building and area correspondents with the surroundings.	Adhikary et al. (2015a)[2], Chen et al. (2008), Padhi and Mohapatra (2009), Padhi and Mohapatra (2010), Safa et al. (2015)[2], Stegen and Palovic (2014), Walraven and de Vries (2009)[9], Wong et al. (2001), Yilmaz and Ergönül (2011), Zavadskas and Vilutiene (2006)[3].
Site capacity [0.4%]	Workload/capacity, potential to expand capacity, capacity in area of interest, production capacity.	Carrera and Mayorga (2008), Harvey (1997), Holt et al. (1993), Watt et al. (2009), Shahadat (2003), Watt et al. (2010).
Site facilities [1.3%]	Mechanical, electrical, and plumbing, illumination in and outside the building, energy saving materials and installations, facilities assurance, facilities fully and advances.	Cheng and Li (2004), Holt et al. (1993), Marzouk et al. (2013), Holt et al. (1995), Holt et al. (1994a), Holt et al. (1994b), Holt (1997), Padhi and Mohapatra (2009), Padhi and Mohapatra (2010), Shahadat (2003), Yang et al. (2012)[2], Walraven and de Vries (2009)[4], Zhao and Ren (2012)[2], MacKerron et al. (2015).
Site organization [0.9%]	Site organization, rules and policies, site supervision/ management.	Walraven and de Vries (2009)[5], Wong et al. (2001)[3], Yilmaz and Ergönül (2011), Zavadskas and Vilutiene (2006)[4].
Health and safety [3.8%]		
General [2.9%]	Health and safety management, health and safety records, health and safety management system, health and safety policy, health record, health/safety/environment (HSE) management ability, safe working environment, safety and occupational health requirements, safety consciousness on the job site, safety in constructions, safety management.	Abbasianjahromi et al. (2013)[3], Adhikary et al. (2015a), Alhumaidi (2015), Bendaña et al. (2008), Cheng and Li (2004), Cheng et al. (2011), Chinyio et al. (1998), Cristóbal (2011), El-Abbasy et al. (2013), Arslan et al. (2008)[3], Hadidi and Khater (2015), Holt (1997), Hatush and Skitmore (1998)[3], Holt et al. (1993), Holt et al. (1995), Holt et al. (1994a), Liu et al. (2014), Mahdi et al. (2002)[2], Marzouk et al. (2013), Nasab and Ghamsarian (2015)[2], Nassar and Hosny (2013)[2], Sarkis et al. (2012), Yang et al. (2012), Palaneeswaran and Kumaraswamy (2000a)[2], Plebankiewicz (2010)[2],Yawei et al. (2005), Yilmaz and Ergönül (2011)[3], Palaneeswaran and Kumaraswamy (2001).
Problems in health and safety [0.2%]	Accidents, duration weighted injury frequency rate.	Nassar and Hosny (2013)[2], Plebankiewicz (2010).
Infrastructure [0.7%]	Audiological comfort, ergonomic, internal climate.	Cheng et al. (2011), Walraven and de Vries (2009)[5], Zavadskas and Vilutiene (2006), Rodríguez et al. (2013)[2].
Procurement process [3.2%]		
Bid process [0.7%]	Bid estimates, bid validity, capital bid, tender variations and alternatives offered, expiry date of bidder's quotation, part quotation, bidder's promises.	Abbasianjahromi et al. (2013), Alhumaidi (2015), Wang et al. (2013), Arslan et al. (2008), Yawei et al. (2005), Aretoulis et al. (2010), Azambuja and O'Brien (2012), Carrera and Mayorga (2008), Hatush and Skitmore (1998), Zavadskas et al. (2008).
Documentation and contract [1.3%]	Contracting record, difficulties of obtaining bond and price of contract, documentation, form of contract, other project	Abdelrahman et al. (2008a), Abdelrahman et al. (2008b), Aretoulis et al. (2010)[2], Bendaña et al. (2008), Harvey

Table A1 (*continued*)

Quality [9.2%]		
Subcategory	Some criteria	Authors [number of citations of each author]
	contractual provisions, terms of business, documentation control.	(1997), Dowlatshahi et al. (2015)[2], Holt et al. (1993), Holt et al. (1994a), Holt et al. (1994b), Kumaraswamy (1996), Smith (1973), Wang et al. (2013), Yang et al. (2012), Zavadskas and Vilutiene (2006), Zavadskas et al. (2009)[2].
Proposals [0.4%]	Proposal accuracy, proposals review – unit price/labor cost/ resources schedule, construction proposal	Abbasianjahromi et al. (2013), Cheng et al. (2012), Arslan et al. (2008), Kumaraswamy and Matthews (2000), Wong et al. (2001).
Other [0.8%]	Client requirements, maintains frequent sales calls, makes available test or demonstration models, makes sales people available as needed.	El-Abbasy et al. (2013), Hatush and Skitmore (1998), Topcu (2004), Mahdi et al. (2002)[2], Rodríguez et al. (2013), Shahadat (2003)[3], Palaneeswaran and Kumaraswamy (2000a), Stegen and Palovic (2014), Yilmaz and Ergönül (2011).
Flexibility and responsiveness [1.4%]		
Flexibility [0.7%]	Flexibility and cooperation when resolving delays, flexibility in critical activities, flexibility index, flexibility of supplier/ vendor.	Adhikary et al. (2015b), Adhikary et al. (2015a), Li and Wan (2014), Chen and Wang (2009), Chinyio et al. (1998), Humphreys et al. (2005), Marzouk et al. (2013)[2], Sarkis et al. (2012), Walraven and de Vries (2009).
Responsiveness [0.7%]	Ability to deal with unanticipated problems, ability to meet further requirements, responsiveness, responsiveness to minor incidents, responsiveness to problems.	Adhikary et al. (2015b), Adhikary et al. (2015a), Arslan (2012),Xia et al. (2015),Zavadskas and Vilutiene (2006), Dowlatshahi et al. (2015)[2], Wong et al. (2001),Palaneeswaran and Kumaraswamy (2000a), Palaneeswaran and Kumaraswamy (2001).
Other categories		
Environmental [1.9%]	Environmental management, environment protection, environment protection records, environmental protection measures, environmental concerns, environmental control policy, environmental effects.	Chen et al. (2008), Cheng et al. (2012), Nassar and Hosny (2013)[2], Ilie-Zudor and Monostori (2009), Padhi and Mohapatra (2010), Safa et al. (2015)[3], Sarkis et al. (2012)[5], Walraven and de Vries (2009), Palaneeswaran and Kumaraswamy (2000a)[2], Palaneeswaran and Kumaraswamy (2001), Rodríguez et al. (2013)[3], Wang et al. (2013), Yang et al. (2012)[2], Yawei et al. (2005), Yilmaz and Ergönül (2011)[2].
Product features [1.6%]	Durability, airworthiness program integrity, air voids, functionality, aviation products design, cutter sensor, durable materials.	Cheng et al. (2012), Chinyio et al. (1998)[2], Elyamany et al. (2012a), Dowlatshahi et al. (2015), Rodríguez et al. (2013)[8], Shahadat (2003), Tsay and Stackhouse (1991)[2], Walraven and de Vries (2009)[5], Zhao and Ren (2012)[2].
Reputation/Image [1.5%]	Company standing (reputation), image, compliance with company image, image of contractor company, contractor image, company image, company reputation, member reputation, reputation.	Abbasianjahromi et al. (2013), Chen and Wang (2009), Darvish et al. (2009), Dowlatshahi et al. (2015), Arslan et al. (2008), Hatush and Skitmore (1998), Holt (1997), Holt et al. (1994a), Holt et al. (1995), Marzouk et al. (2013), Nasab and Ghamsarian (2015), Wang et al. (2013), Nassar and Hosny (2013), Plebankiewicz (2010), Shahadat (2003), Walraven and de Vries (2009), Watt et al. (2009), Yang et al. (2012), Zavadskas et al. (2009), Zavadskas and Vilutiene (2006),Zolfani et al. (2012).
Location [1.3%]	Location of home office, home office location relative to job site location, home office location to project, office location with respect to project, distance.	Azambuja and O'Brien (2012), Holt (1997)[2], Holt (1998), Holt et al. (1993)[2], Holt et al. (1994a)[2], Holt et al. (1994b), Holt et al. (1995)[2], Palaneeswaran and Kumaraswamy (2001), Safa et al. (2015), Wong et al. (2001)[3], Zavadskas and Vilutiene (2006), Zolfani et al. (2012).
Maintenance [1.2%]	Attendance to remedial work, maintains repair service, maintenance services during defects liability periods, major repairs.	Cheng et al. (2011), Dowlatshahi et al. (2015), Hatush and Skitmore (1998)[2], Shahadat (2003), Wang et al. (2013), Yawei et al. (2005), Yilmaz and Ergönül (2011), Zavadskas and Vilutiene (2006)[6], Zavadskas et al. (2009)[3].
Resources [1.2%]	Material/fabrication, availability of resources needed for each project, material escalation, material wastage, self-owned tools, adequacy of material resources, technically acceptable material.	Abbasianjahromi et al. (2013), Alhumaidi (2015), Chen et al. (2008), Aretoulis et al. (2010)[2], Azambuja and O'Brien (2012)[2], Bashiri et al. (2011), Cheng and Li (2004), Cheng et al. (2011)[2], Arslan et al. (2008), Kumaraswamy (1996), Nasab and Ghamsarian (2015), Sarkis et al. (2012), Smith (1973), Yang et al. (2012).
Market [1.1%]	Market share, recommended by other similar organization, turnover, profit, obligations, amounts due, business trends.	Carrera and Mayorga (2008), Chen and Wang (2009), Dowlatshahi et al. (2015), Nasab and Ghamsarian (2015),

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Table A1 (*continued*)

Quality [9.2%]		
Subcategory	Some criteria	Authors [number of citations of each author]
		Plebankiewicz (2010), Safa et al. (2015)[4], Shahadat (2003), Tsay and Stackhouse (1991), Watt et al. (2010), Zavadskas and Vilutiene (2006), Zavadskas et al. (2010)[2].
Warranty [1.0%]	Post construction warranty period quoted by the contractor, warranty, warranty and maintenance, insurance, insurance cover, insurance policy, amount of liquidated damages, better warranties, reimbursement.	Abdelrahman et al. (2008a), Dowlatshahi et al. (2015), Ilie-Zudor and Monostori (2009), Padhi and Mohapatra (2009), Padhi and Mohapatra (2010), Palaneeswaran and Kumaraswamy (2000a), Shahadat (2003), Turskis (2008), Plebankiewicz (2010), Bendaña et al. (2008), Yang et al. (2012)[2], Palaneeswaran and Kumaraswamy (2001), Zavadskas et al. (2009).
Politic, society and regulations [1.0%]	Conformity with rules, legal and other regulations, social, society, other regulations/requirements, legal requirements, policy rate.	Chen et al. (2008), Cheng et al. (2012), Mahdi et al. (2002), Safa et al. (2015)[3], Plebankiewicz (2010), Palaneeswaran and Kumaraswamy (2000a)[3], Sarkis et al. (2012)[2], Walraven and de Vries (2009), Xia et al. (2015), MacKerron et al. (2015).
Communication [0.9%]	Communication level with stakeholders, communications management, complaints in communications with partners.	Dowlatshahi et al. (2015)[3], Sarkis et al. (2012), Wang et al. (2013)[2], Shahadat (2003)[2], Zavadskas and Vilutiene (2006)[2], Yasamis et al. (2002), Zavadskas et al. (2008), Zavadskas et al. (2009).
Transport, delivery and storage [0.9%]	Transportation, traffic control, transportation mode, finished goods storage, handling and packaging capability, expediting.	Abdelrahman et al. (2008a), Abdelrahman et al. (2008b), Azambuja and O'Brien (2012)[4], Carrera and Mayorga (2008), Dowlatshahi et al. (2015)[2], Eshtehardian et al. (2013), Shahadat (2003), Yasamis et al. (2002), Zolfani et al. (2012).
Innovation and design [0.6%]	Creativity and innovation, innovation method, keep up with new innovations, innovation and design process, responsiveness to innovations.	Darvish et al. (2009), Dowlatshahi et al. (2015), Mahdi et al. (2002), Nasab and Ghamsarian (2015), Smith (1973), Sarkis et al. (2012), Safa et al. (2015), Palaneeswaran and Kumaraswamy (2000a), Zavadskas and Vilutiene (2006).
Risk [0.4%]	Political, commercial, and geopolitical risks, risk index, risk management, delivery risk.	Dowlatshahi et al. (2015), Humphreys et al. (2005), Nassar and Hosny (2013), Stegen and Palovic (2014), Turskis (2008), Yasamis et al. (2002).
Other [3.5%]	Prevention of vandalism, project complexity level, benefits, provision/final acceptance, data integrity verification, effort breakdowns by project phases, is a large firm, realism, responsibility, size, size indicators, size of contractor company, contractor size, time of year - weather, construction civilization measures, IT application.	Abbasianjahromi et al. (2013)[2], Arslan (2012)[3], Ben-David et al. (2012), Chen et al. (2008), Chen et al. (2013), Cheng et al. (2012)[2], Dowlatshahi et al. (2015)[3], Arslan et al. (2008), Holt (1997), Holt et al. (1993), Holt et al. (1994a)[2],Holt et al. (1994b),Holt et al. (1995), Mahdi et al. (2002), Nasab and Ghamsarian (2015)[3], Palaneeswaran and Kumaraswamy (2000a)[2], Rodríguez et al. (2013)[2], Safa et al. (2015), Shahadat (2003), Smith (1973)[3], Tsay and Stackhouse (1991)[3],Walraven and de Vries (2009)[4], Wong et al. (2001), Yang et al. (2012),Yasamis et al. (2002), Zavadskas and Vilutiene (2006)[4], Zolfani et al. (2012)[2].

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Table A2
Categories for supplier evaluation.

Company management [14.3%]		
Subcategory	Some criteria related	Authors [number of citations of each author]
Work management [1.4%]	Progress of work, programming of work, labor management.	Ng et al. (2002)[2], Rashvand et al. (2015).
Integration [0.4%]	Management and co-ordination of subcontractors and suppliers.	Soetanto et al. (2001).
Management capability/ability [2.5%]	Management capabilities, management capacity.	Ng et al. (2002),Soetanto et al. (2001), Zhang et al. (2013)[4].
Management Knowledge [0.8%]	Innovation through learning demonstrated.	Butcher and Sheehan (2010), Rashvand et al. (2015).
Management systems and control [1.4%]	Comprehensive system of planning and project control.	Ebrahimi et al. (2015)[2], Rashvand et al. (2015).
Organization [0.4%]	Company internal organizational structure.	Zhang et al. (2013).
Other [7.4%]	Manpower management (number and quality of craftsmen), proactive attitude towards scheme.	Cheng and Carrillo (2012), Ebrahimi et al. (2015)[2], Lee et al. (2009)[2], Maturana et al. (2007), Ng et al. (2002)[2], Rashvand et al. (2015)[5], Soetanto et al. (2001)[3], Xiao and Proverbs (2003), Zhang et al. (2013), MacKerron et al. (2015).
Quality [12.2%]		
Quality control [1.7%]	Quality management, regularity of interim valuations.	Ebrahimi et al. (2015), Ng et al. (2002), Rashvand et al. (2015), Xiao and Proverbs (2002).
Quality failures [0.9%]	Completion of defects.	Soetanto et al. (2001), Xiao and Proverbs (2002).
Quality standards [3.0%]	Adherence to specifications, right first time.	Lam and Gale (2014), Lee et al. (2009), Ng et al. (2002)[4], Xiao and Proverbs (2003), MacKerron et al. (2015).
Other quality criteria [6.6%]	Quality of construction and workmanship, quality of hand-over document (O&M manual, H&S), quality of material.	Butcher and Sheehan (2010),Ebrahimi et al. (2015), Lee et al. (2009), Maturana et al. (2007), Mi et al. (2013),Ng et al. (2002)[3], Soetanto et al. (2001)[2], Straub and Mossel (2007)[2], Xiao and Proverbs (2002), Zhang et al. (2013)[3].
Relationship with stakeholders [12.2%]		
General relations [3.8%]	Relationship with client, relationship of design team.	Butcher and Sheehan (2010), Lee et al. (2009), Ng et al. (2002)[6], Zhang et al. (2013).
Cooperation relations [2.8%]	Cooperation with design team, partnering with subcontractors.	Butcher and Sheehan (2010), Mi et al. (2013), Ng et al. (2002)[3], Xiao and Proverbs (2003)[2].
Problems in relations [2.8%]	Claims & contractual disputes, number of unjustified claims.	Butcher and Sheehan (2010), Ng et al. (2002)[5], Zhang et al. (2013).
Promptness relations [2.8%]	Fair treatment to subcontractors excellent relationships.	Butcher and Sheehan (2010), Lee et al. (2009)[2], Maturana et al. (2007), Ng et al. (2002)[2], Rashvand et al. (2015).
Staff features [7.8%]		
General topics [2.1%]	Enthusiasm, human resource development and management.	Ebrahimi et al. (2015), Lee et al. (2009), Ng et al. (2002)[3].
Team development skill [2.5%]	Supervising undertaken properly, integrity.	Ebrahimi et al. (2015), Ng et al. (2002), Rashvand et al. (2015)[4].
Adequacy of personnel [0.8%]	Adequacy of labor resources, adequacy of supervisory staff.	Ng et al. (2002)[2].
Qualification of personnel [1.6%]	Technical ability of human resource, staff creativity power.	Ebrahimi et al. (2015)[4].
Training [0.8%]	Specialized training of staff.	Ebrahimi et al. (2015), Rashvand et al. (2015).
Time [7.3%]		
Timeliness [3.0%]	Adherence to schedule, ratio of finish on time.	Ip et al. (2004), Lam and Gale (2014)[2], Lee et al. (2009), Ng et al. (2002)[2], Soetanto et al. (2001), MacKerron et al. (2015).
Problems in time [1.3%]	Delay on similar projects, causes of delay.	Cheng and Carrillo (2012), Ng et al. (2002), Xiao and Proverbs (2003).
Other [3.0%]	Defects liability period, days, time performance, minimum project duration.	Aziz (2008), Butcher and Sheehan (2010), Ebrahimi et al. (2015), Lee et al. (2009), Maturana et al. (2007), Rashvand et al. (2015), Xiao and Proverbs (2002).
Financial issues [6.5%]		
Financial capacity/ability [0.8%]	Financial capacity, financial soundness.	Ng et al. (2002), Zhang et al. (2013).
Payments [1.3%]	Ratio of accuracy of payments, subcontractor's payment.	Ebrahimi et al. (2015), Lam and Gale (2014), Ng et al. (2002).
Financial stability [0.8%]	Financial stability.	Ng et al. (2002), Zhang et al. (2013).

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Table A2 (*continued*)

Company management [14.3%]		
Subcategory	Some criteria related	Authors [number of citations of each author]
Financial measures [1.3%]	Financial standards, net profit, gross profit margin.	Straub and Mossel (2007)[2], Cheng and Carrillo (2012), MacKerron et al. (2015).
Other [2.3%]	Financial control.	Ng et al. (2002)[2], Rashvand et al. (2015), Zhang et al. (2013)[2].
Health and safety/environment [5.7%]		
General [3.4%]	Health and safety inspections, health and safety standard, security.	Butcher and Sheehan (2010), Ebrahimi et al. (2015)[3], Lam and Gale (2014), Maturana et al. (2007), Ng et al. (2002)[2], Rashvand et al. (2015).
Environmental [2.3%]	Energy use, observing environmental standards.	Ebrahimi et al. (2015), Lu et al. (2007)[4].
Technical/technology [4.1%]		
Technical [1.5%]	Technical capacity, technical staff qualification.	Ebrahimi et al. (2015), Elyamany et al. (2012b), Zhang et al. (2013)[2].
Technology [1.3%]	Technology application ability.	Ebrahimi et al. (2015), Zhang et al. (2013)[2].
Equipment [1.3%]	Having machinery and equipment and their numbers recorded.	Ebrahimi et al. (2015)[2], Zhang et al. (2013).
Experience [2%]		
Similar works [1.6%]	Average completed number of similar contract projects.	Zhang et al. (2013)[4].
Failures of projects [0.4%]	Experience of past failures.	Zhang et al. (2013).
Other categories		
Site capacity/facilities [3.7%]	Site organization, site organization, site planning.	Lee et al. (2009), Maturana et al. (2007), Ng et al. (2002)[5], Soetanto et al. (2001)[2].
Cost/price [2.8%]	Adherence to budget, cost performance, ratio of actual-to-estimated project costs.	Aziz (2008), Butcher and Sheehan (2010), Ip et al. (2004), Cheng and Carrillo (2012), Ebrahimi et al. (2015), Rashvand et al. (2015), Soetanto et al. (2001).
Communication [2.4%]	Communication with site agent, information and analysis.	Lee et al. (2009)[2], Ng et al. (2002)[2], Rashvand et al. (2015), Xiao and Proverbs (2002).
Maintenance [2.4%]	Any remedial work, any excessive supervision required.	Ebrahimi et al. (2015), Ng et al. (2002)[3], Soetanto et al. (2001), Xiao and Proverbs (2002).
Procurement process [2.4%]	Company bidding ability, documentation.	Ebrahimi et al. (2015), Ng et al. (2002)[4],Zhang et al. (2013).
Product features [1.6%]	Design life of building, asphalt concrete pavement.	Aziz (2008), Elyamany et al. (2012b)[2], Xiao and Proverbs (2002).
Performance [0.8%]	Outcomes of contractors' performance.	Straub and Mossel (2007)[2].
Warranty [0.8%]	Amount of liquidated damages.	Ng et al. (2002)[2].
Flexibility [0.8%]	Responding and flexibility.	Ebrahimi et al. (2015)[2].
Politic, society and regulations [0.8%]	Legal framework, political development.	Rashvand et al. (2015)[2].
Other [9%]	Business results, certifications, completeness, prompt compliance with instructions, delivery ability, factors pertaining to customer, innovation.	Aziz (2008), Ebrahimi et al. (2015)[4], Lee et al. (2009)[3], Lu et al. (2007), Maturana et al. (2007), Mi et al. (2013)[3], Soetanto et al. (2001), Ng et al. (2002)[3], Rashvand et al. (2015)[2], Straub and Mossel (2007), Zhang et al. (2013)[2], MacKerron et al. (2015).

References

Abbasianjahromi, H., Rajaie, H., Shakeri, E., 2013. A framework for subcontractor selection in the construction industry. J. Civ. Eng. Manag. 19 (2):158–168. http://dx.doi.org/10.3846/13923730.2012.743922.

Abdelrahman, M., Zayed, T., Elyamany, A., 2008a. Best-value model based on project specific characteristics. J. Constr. Eng. Manag. 134 (3):179–188. http://dx.doi.org/10.1061/(ASCE)0733-9364(2008)134:3(179).

Abdelrahman, M., Zayed, T., Hietpas, J., Elyamany, A., 2008b. Rational best-value model based on expected performance. Transportation Research Record. J. Transp. Res. Board 2081:46–55. http://dx.doi.org/10.3141/2081-05.

Adhikary, P., Roy, P.K., Mazumdar, A., 2015a. Turbine supplier selection for small hydro project: application of multi-criteria optimization technique. Int. J. Appl. Eng. Res. 10 (5), 13109–13122.

Adhikary, P., Roy, P.K., Mazumdar, A., 2015b. Maintenance contractor selection for small hydropower project: a fuzzy multi-criteria optimization technique approach. Int. Rev. Mech. Eng. 9 (2):174–182. http://dx.doi.org/10.15866/ireme.v9i2.5319.

Alarcón, L.F., Mourgues, C., 2002. Performance modeling for contractor selection. J. Manag. Eng. 18 (2):52–60. http://dx.doi.org/10.1061/(ASCE)0742-597X(2002)18:2(52).

Alhumaidi, H.M., 2015. Construction contractors ranking method using multiple decision-makers and multiattribute fuzzy weighted average. J. Constr. Eng. Manag. 141 (4). http://dx.doi.org/10.1061/(ASCE)CO.1943-7862.0000949.

Alias, R.H., Noor, N.M.M., Selamat, A., Saman, M.Y.M., Abdullah, M.L., 2012. Decision making model for electronic tender evaluation (ETE) using fuzzy AHP with extent analysis method. Int. J. Digit. Content Technol. Appl. 6 (22):79–89. http://dx.doi.org/10.4156/jdcta.vol6.issue22.8.

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AlptekİN, O., 2014. Multi-criteria decision making approach in contractor selection. Int. J. Nat. Eng. Sci. 8 (2), 6–9.

Araújo, M.C.B., Alencar, L.H., 2015. Integrated model for supplier selection and performance evaluation. S. Afr. J. Ind. Eng. 26 (2):41–55. http://dx.doi.org/10.7166/26-2-880.

Aretoulis, G.N., Kalfakakou, G.P., Striagka, F.Z., 2010. Construction material supplier selection under multiple criteria. Oper. Res. 10 (2):209–230. http://dx.doi.org/10.1007/s12351-009-0065-3.

Arslan, G., 2012. Web-based contractor evaluation system for mass-housing projects in Turkey. J. Civ. Eng. Manag. 18 (3):323–334. http://dx.doi.org/10.3846/13923730.2012.698892.

Arslan, G., Kivrak, S., Birgonul, M.T., Dikmen, I., 2008. Improving sub-contractor selection process in construction projects: web-based sub-contractor evaluation system (WEBSES). Autom. Constr. 17 (4):480–488. http://dx.doi.org/10.1016/j.autcon.2007.08.004.

Azambuja, M.M., O'Brien, W.J., 2012. Rapid assessment and selection of engineered equipment suppliers. Autom. Constr. 22:587–596. http://dx.doi.org/10.1016/j.autcon.2011.12.004.

Aziz, A.M.A., 2008. Minimum performance bounds for evaluating contractors performance during construction of highway pavement projects. Constr. Manag. Econ. 26 (5):507–529. http://dx.doi.org/10.1080/01446190801918748.

Bashiri, M., Badri, H., Talebi, J., 2011. A new fuzzy approach for project selection with outsourcing viewpoint. Int. J. Innov. Technol. Manag. 8 (2): 227–251. http://dx.doi.org/10.1142/S0219877011002349.

Bendaña, R., delCaño, A., de la Cruz, M.P., 2008. Contractor selection: fuzzy-control approach. Can. J. Civ. Eng. 35 (5):473–486. http://dx.doi.org/10.1139/L07-127.

Ben-David, A., Gelbard, R., Milstein, I., 2012. Supplier ranking by multi-alternative proposal analysis for agile projects. Int. J. Proj. Manag. 30 (6): 723–730. http://dx.doi.org/10.1016/j.ijproman.2012.01.002.

Butcher, D.C.A., Sheehan, M.J., 2010. Excellent contractor performance in the UK construction industry. Eng. Constr. Archit. Manag. 17 (1):35–45. http://dx.doi.org/10.1108/09699981011011302.

Cao, Q., Wang, Q., 2007. Optimizing vendor selection in a two-stage outsourcing process. Comput. Oper. Res. 34 (12):3757–3768. http://dx.doi.org/10.1016/j.cor.2006.01.013.

Carrera, D.A., Mayorga, R.V., 2008. Supply chain management: a modular fuzzy inference system approach in supplier selection for new product development. J. Intell. Manuf. 19:1–12. http://dx.doi.org/10.1007/s10845-007-0041-9.

Chen, L.Y., Wang, T.C., 2009. Optimizing partners' choice in IS/IT outsourcing projects: the strategic decision of fuzzy VIKOR. Int. J. Prod. Econ. 120 (1):233–242. http://dx.doi.org/10.1016/j.ijpe.2008.07.022.

Chen, Z., Li, H., Ross, A., Khalfan, M.M., Kong, S.C., 2008. Knowledge-driven ANP approach to vendors evaluation for sustainable construction. J. Constr. Eng. Manag. 134 (12):928–941. http://dx.doi.org/10.1061/(ASCE)0733-9364(2008)134:12(928).

Chen, J., Chiang, D.M., Guo, R., 2013. Partner selection model for design chain collaboration. Int. J. Prod. Res. 51 (4):1131–1145. http://dx.doi.org/10.1080/00207543.2012.678404.

Cheng, L.V., Carrillo, E.E., 2012. Assessing supplier performances under partnership in project-type procurement. Ind. Manag. Data Syst. 112 (2): 290–312. http://dx.doi.org/10.1108/02635571211204308.

Cheng, M., Kang, S., 2012. Integrated fuzzy preference relations with decision utilities for construction contractor selection. J. Chin. Inst. Eng. 35 (8): 1051–1063. http://dx.doi.org/10.1080/02533839.2012.708510.

Cheng, E.W.L., Li, H., 2004. Contractor selection using the analytic network process. Constr. Manag. Econ. 22 (10):1021–1032. http://dx.doi.org/10.1080/0144619042000202852.

Cheng, M.Y., Tsai, H.C., Sudjono, E., 2011. Evaluating subcontractor performance using evolutionary fuzzy hybrid neural network. Int. J. Proj. Manag. 29 (3):349–356. http://dx.doi.org/10.1016/j.ijproman.2010.03.005.

Cheng, T., Wang, Y., Sun, Y., 2012. Development and application of tender evaluation decision-making and risk early warning system for water projects based on KDD. Adv. Eng. Softw. 48 (1):58–69. http://dx.doi.org/10.1016/j.advengsoft.2012.02.003.

Chinyio, E.A., Olomolaiye, P.O., Kometa, S.T., Harris, F.C., 1998. A needs-based methodology for classifying construction clients and selecting contractors. Constr. Manag. Econ. 16 (1):91–98. http://dx.doi.org/10.1080/014461998372628.

Cristóbal, J.R.S., 2011. Contractor selection using multicriteria decision-making methods. J. Constr. Eng. Manag. 1:751–758. http://dx.doi.org/10.1061/(ASCE)CO.1943-7862.0000488.

Darvish, M., Yasaei, M., Saeedi, A., 2009. Application of the graph theory and matrix methods to contractor ranking. Int. J. Proj. Manag. 27 (6):610–619. http://dx.doi.org/10.1016/j.ijproman.2008.10.004.

De Almeida, A.T., 2007. Multicriteria decision model for outsourcing contracts selection based on utility function and ELECTRE method. Comput. Oper. Res. 34:3569–3574. http://dx.doi.org/10.1016/j.cor.2006.01.003.

De Almeida, A.T., De Almeida, J.A., Costa, A.P.C.S., De Almeida-Filho, A.T., 2016a. A new method for elicitation of criteria weights in additive models: flexible and interactive tradeoff. Eur. J. Oper. Res. 250:179–191. http://dx.doi.org/10.1016/j.ejor.2015.08.058.

De Almeida, A.T., Alencar, M.H., Garcez, T.V., Ferreira, R.J.P., 2016b. A systematic literature review of multicriteria and multi-objective models applied in risk management. IMA J. Manag. Math. http://dx.doi.org/10.1093/imaman/dpw021.

Dowlatshahi, S., Karimi-Nasab, M., Bahrololum, H., 2015. A group decision-making approach for supplier selection in configuration design: a case study. Int. J. Adv. Manuf. Technol. 81 (5):1139–1154. http://dx.doi.org/10.1007/s00170-015-7242-8.

Du, B., Guo, S., Huang, X., Li, Y., Guo, J., 2015. A Pareto supplier selection algorithm for minimum the life cycle cost of complex product system. Expert Syst. Appl. 42:4253–4264. http://dx.doi.org/10.1016/j.eswa.2015.01.056.

Ebrahimi, A., Alimohammadlou, M., Mohammadi, S., 2015. Identification and prioritization of effective factors in assessment and ranking of contractors using fuzzy multi-criteria techniques. Decis. Sci. Lett. 5:95–108. http://dx.doi.org/10.5267/j.dsl.2015.8.001.

Eckhause, J.M., Hughes, D.R., Gabriel, S.A., 2009. Evaluating real options for mitigating technical risk in public sector R&D acquisitions. Int. J. Proj. Manag. 27 (4):365–377. http://dx.doi.org/10.1016/j.ijproman.2008.05.015.

El-Abbasy, M.S., Zayed, T., Ahmed, M., Alzraiee, H., Abouhamad, M., 2013. Contractor selection model for highway projects using integrated simulation and analytic network process. J. Constr. Eng. Manag. 139 (7):755–767. http://dx.doi.org/10.1061/(ASCE)CO.1943-7862.0000647.

Elyamany, A., Abdelrahman, M., 2010. Contractor performance evaluation for the best value of superpave projects. J. Constr. Eng. Manag. 136 (5): 606–614. http://dx.doi.org/10.1061/(ASCE)CO.1943-7862.0000158.

Elyamany, A., Abdelrahman, M., Cheng, F., Doetkott, C., 2012a. Developing a quality measure for evaluating the contractor performance in asphalt pavement construction. Int. J. Pavement Res. Technol. 6 (1), 22–30.

Elyamany, A.H., Abdelrahman, M., Zayed, T., 2012b. Utilizing random performance records in the best value model. J. Civ. Eng. Manag. 18 (2): 197–208. http://dx.doi.org/10.3846/13923730.2012.671279.

Eshtehardian, E., Ghodousi, P., Bejanpour, A., 2013. Using ANP and AHP for the supplier selection in the construction and civil engineering companies; case study of Iranian company. KSCE J. Civ. Eng. 17 (2):262–270. http://dx.doi.org/10.1007/s12205-013-1141-z.

Figueira, J., Greco, S., Ehrgott, M., 2005. Multiple Criteria Decision Analysis: State of the Art. International Series in Operations Research & Management Science Springer.

Hadidi, L.A., Khater, M.A., 2015. Loss prevention in turnaround maintenance projects by selecting contractors based on safety criteria using the analytic hierarchy process (AHP). J. Loss Prev. Process Ind. 34:115–126. http://dx.doi.org/10.1016/j.jlp.2015.01.028.

Harvey, S., 1997. Successful contractor selection. Eng. Manag. J. 97–100.

Hatush, Z., Skitmore, M., 1998. Contractor selection using multicriteria utility theory: an additive model. Build. Environ. 33 (2–3), 105–115.

Hesping, F.H., Schiele, H., 2015. Purchasing strategy development: a multi-level review. J. Purch. Supply Manag. 21:138–150. http://dx.doi.org/10.1016/j.pursup.2014.12.005.

Holt, G.D., 1997. Classifying construction contractors. Build. Res. Inf. 25 (6): 374–382. http://dx.doi.org/10.1080/096132197370200.

Holt, G.D., 1998. Which contractor selection methodology? Int. J. Proj. Manag. 16 (3), 153–164.

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Holt, G.D., Olomolaiye, P.O., Harris, F.C., 1993. A conceptual alternative to current tendering practice. Build. Res. Inf. 21 (3):167–172. http://dx.doi.org/10.1080/09613219308727284.

Holt, G.D., Olomolaiye, P.O., Harris, F.C., 1994a. Incorporating project specific criteria and client utility into the evaluation of construction tenderers. Build. Res. Inf. 22 (4):214–221. http://dx.doi.org/10.1080/09613219408727384.

Holt, G.D., Olomolaiye, P.O., Harris, F.C., 1994b. Factors influencing U.K. construction clients' choice of contractor. Build. Environ. 29 (2):241–248. http://dx.doi.org/10.1016/0360-1323(94)90074-4.

Holt, G.D., Olomolaiye, P.O., Harris, F.C., 1995. Application of an alternative contractor selection model. Build. Res. Inf. 23 (5):255–264. http://dx.doi.org/10.1080/09613219508727473.

Humphreys, P., Huang, G., Cadden, T., 2005. A web-based supplier evaluation tool for the product development process. Ind. Manag. Data Syst. 105 (2):147–163. http://dx.doi.org/10.1108/02635570510583299.

Idrus, A., Sodangi, M., Amran, M.A., 2011. Decision criteria for selecting main contractors in Malaysia. Built Environ. J. 8 (1), 10–16.

Igarashi, M., de Boer, L., Fet, A.M., 2013. What is required for greener supplier selection? A literature review and conceptual model development. J. Purch. Supply Manag. 19:247–263. http://dx.doi.org/10.1016/j.pursup.2013.06.001.

Ilie-Zudor, E., Monostori, L., 2009. Agent-based framework for pre-contractual evaluation of participants in project-delivery supply-chains. Assem. Autom. 29 (2):137–153. http://dx.doi.org/10.1108/01445150910945598.

Ip, W.H., Yung, K.L., Wang, D., 2004. A branch and bound algorithm for sub-contractor selection in agile manufacturing environment. Int. J. Prod. Econ. 87 (2):195–205. http://dx.doi.org/10.1016/S0925-5273(03)00125-7.

Juan, Y., 2009. A hybrid approach using data envelopment analysis and case-based reasoning for housing refurbishment contractors selection and performance improvement. Expert Syst. Appl. 36 (3):5702–5710. http://dx.doi.org/10.1016/j.eswa.2008.06.053.

Kumaraswamy, M.M., 1996. Contractor evaluation and selection: a Hong Kong perspective. Build. Environ. 31 (3):273–282. http://dx.doi.org/10.1016/0360-1323(95)00044-5.

Kumaraswamy, M.M., Matthews, J.D., 2000. Improved subcontractor selection employing partnering principles. J. Manag. Eng. 4 (6), 209–219.

Lam, T., Gale, K., 2014. Highway maintenance: impact of framework agreements on contractor performance. Eng. Constr. Archit. Manag. 21 (3):336–347. http://dx.doi.org/10.1108/ECAM-02-2013-0016.

Lambropoulos, S., 2007. The use of time and cost utility for construction contract award under European Union Legislation. Build. Environ. 42 (1): 452–463. http://dx.doi.org/10.1016/j.buildenv.2005.08.002.

Lee, D., Lim, T., Arditi, D., 2009. Automated stochastic quality function deployment system for measuring the quality performance of design/build contractors. Autom. Constr. 18 (3):348–356. http://dx.doi.org/10.1016/j.autcon.2008.10.002.

Lesniak, A., Plebankiewicz, E., Zima, K., 2012. Design and build procurement system – contractor selection. Arch. Civ. Eng. 58 (4):463–476. http://dx.doi.org/10.2478/v.10169-012-0025-9.

Li, D.F., Wan, S.P., 2014. A fuzzy in homogenous multiattribute group decision making approach to solve outsourcing provider selection problems. Knowl.-Based Syst. 67:71–89. http://dx.doi.org/10.1016/j.knosys.2014.06.006.

Lin, C., Wang, W., Yang, J., 2007. Evaluating bid item prices to support contractor selection - a case study. J. Chin. Inst. Eng. 30 (4):765–771. http://dx.doi.org/10.1080/02533839.2007.9671303.

Liu, B., Huo, T., Liao, P., Gong, J., Xue, B., 2014. A group decision-making aggregation model for contractor selection in large scale construction projects based on two-stage Partial Least Squares (PLS) path modeling. Group Decis. Negot. 24 (5):855–883. http://dx.doi.org/10.1007/s10726-014-9418-2.

Lu, L.Y.Y., Wu, C.H., Kuo, T.-C., 2007. Environmental principles applicable to green supplier evaluation by using multi-objective decision analysis. Int. J. Prod. Res. 45 (22):5451. http://dx.doi.org/10.1080/00207540701662088.

MacKerron, G., Kumar, M., Benedikt, A., Kumar, V., 2015. Performance management of suppliers in outsourcing project: case analysis from the financial services industry. Prod. Plan. Control 26 (2):150–165. http://dx.doi.org/10.1080/09537287.2013.869702.

Mahdi, I.M., Riley, M.J., Fereig, S.M., Alex, A.P., 2002. A multi-criteria approach to contractor selection. Eng. Constr. Archit. Manag. 9 (1):29–37. http://dx.doi.org/10.1108/eb021204.

Marzouk, M.M., El Kherbawy, A.A., Khalifa, M., 2013. Factors influencing sub-contractors selection in construction projects. HBRC J. 9 (2):150–158. http://dx.doi.org/10.1016/j.hbrcj.2013.05.001.

Masi, D., Micheli, G.J.L., Cagno, E., 2013. A meta-model for choosing a supplier selection technique within an EPC company. J. Purch. Supply Manag. 19 (1):5–15. http://dx.doi.org/10.1016/j.pursup.2012.07.002.

Maturana, S., Alarcón, L.F., Gazmuri, P., Vrsalovic, M., 2007. On-site subcontractor evaluation method based on lean principles and partnering practices. J. Manag. Eng. 23 (2):67–74. http://dx.doi.org/10.1061/(ASCE)0742-597X(2007)23:2(67).

Mi, C., Ma, Z., Ding, Z., 2013. A linguistic evaluation model considering grey information and its application on complex product supplier performance. J. Grey Syst. 25 (3), 34–43.

Micheli, G., 2008. A decision-maker-centred supplier selection approach for critical supplies. Manag. Decis. 46 (6):918–932. http://dx.doi.org/10.1108/00251740810882671.

Micheli, G.J.L., Cagno, E., Di Giulio, A., 2009. Reducing the total cost of supply through risk-efficiency-based supplier selection in the EPC industry. J. Purch. Supply Manag. 15 (3):166–177. http://dx.doi.org/10.1016/j.pursup.2009.05.001.

Nasab, H.H., Ghamsarian, M.M., 2015. A fuzzy multiple-criteria decision-making model for contractor prequalification. J. Decis. Syst. 24 (4): 433–448. http://dx.doi.org/10.1080/12460125.2015.1081048.

Nassar, K., Hosny, O., 2013. Fuzzy clustering validity for contractor performance evaluation: application to UAE contractors. Autom. Constr. 31:158–168. http://dx.doi.org/10.1016/j.autcon.2012.11.013.

Ng, S.T., Palaneeswaran, E., Kumaraswamy, M.M., 2002. A dynamic e-reporting system for contractor's performance appraisal. Adv. Eng. Softw. 33 (6):339–349. http://dx.doi.org/10.1016/S0965-9978(02)00042-X.

Padhi, S.S., Mohapatra, P.K.J., 2009. Centralized construction contractor selection considering past performance of contractors: a case of India. Oper. Res. 9 (2):199–224. http://dx.doi.org/10.1007/s12351-009-0044-8.

Padhi, S.S., Mohapatra, P.K.J., 2010. Centralized bid evaluation for awarding of construction projects – a case of India government. Int. J. Proj. Manag. 28 (3):275–284. http://dx.doi.org/10.1016/j.ijproman.2009.06.001.

Palaneeswaran, E., Kumaraswamy, M.M., 2000a. Contractor selection for design/build projects. J. Constr. Eng. Manag. 126, 331–339.

Palaneeswaran, E., Kumaraswamy, M.M., 2000b. Benchmarking contractor selection practices in public-sector construction — a proposed model. Eng. Constr. Archit. Manag. 7 (3):285–299. http://dx.doi.org/10.1108/eb021153.

Palaneeswaran, E., Kumaraswamy, M.M., 2001. Reinforcing design-build contractor selection: a Hong Kong perspective. HKIE Trans. 8 (1), 7–12.

Plebankiewicz, E., 2010. Construction contractor prequalification from polish clients' perspective. J. Civ. Eng. Manag. 16 (1):57–64. http://dx.doi.org/10.3846/jcem.2010.05.

Rashvand, P., Majid, M.Z.A., Pinto, J.K., 2015. Contractor management performance evaluation model at prequalification stage. Expert Syst. Appl. 42 (12):5087–5101. http://dx.doi.org/10.1016/j.eswa.2015.02.043.

Rodríguez, A., Ortega, F., Concepción, R., 2013. A method for the selection of customized equipment suppliers. Expert Syst. Appl. 40 (4):1170–1176. http://dx.doi.org/10.1016/j.eswa.2012.08.021.

Safa, M., Shahi, A., Haas, C.T., Hipel, K.W., 2014. Supplier selection process in an integrated construction materials management model. Autom. Constr. 48:64–73. http://dx.doi.org/10.1016/j.autcon.2014.08.008.

Safa, M., Shahi, A., Haas, C.T., Fiander-mccann, D., Safa, M., Hipel, K., Macgillivray, S., 2015. Automation in construction competitive intelligence (CI) for evaluation of construction contractors. Autom. Constr. 59:149–157. http://dx.doi.org/10.1016/j.autcon.2015.02.009.

Sarkis, J., Meade, L.M., Presley, A.R., 2012. Incorporating sustainability into contractor evaluation and team formation in the built environment. J. Clean. Prod. 31:40–53. http://dx.doi.org/10.1016/j.jclepro.2012.02.029.

Sartor, M., Orzes, G., Nassimbeni, G., Jia, F., Lamming, R., 2014. International purchasing offices: literature review and research directions. J. Purch. Supply Manag. 20:1–17. http://dx.doi.org/10.1016/j.pursup.2013.09.002.

Please cite this article as: M.C.B. de Araújo, et al., 2017. Project procurement management: A structured literature review, Int. J. Proj. Manag. http://dx.doi.org/10.1016/j.ijproman.2017.01.008

Seuring, S., Müller, M., 2008. From a literature review to a conceptual framework for sustainable supply chain management. J. Clean. Prod. 16: 1699–1710. http://dx.doi.org/10.1016/j.jclepro.2008.04.020.

Shahadat, K., 2003. Supplier choice criteria of executing agencies in developing countries. Int. J. Public Sect. Manag. 16 (4):261–285. http://dx.doi.org/10.1108/09513550310480033.

Singh, D., Tiong, R.L.K., 2005. A fuzzy decision framework for contractor selection. J. Constr. Eng. Manag. 131 (1):62–70. http://dx.doi.org/10.1061/(ASCE)0733-9364(2005)131:1(62).

Singh, D., Tiong, R.L.K., 2006. Contractor selection criteria: investigation of opinions of Singapore construction practitioners. J. Constr. Eng. Manag. 132 (9): 998–1008. http://dx.doi.org/10.1061/(ASCE)0733-9364(2006)132:9(998).

Smith, A.W., 1973. An information model and evaluation tool for R&D projects and contractor selections — PRECEPT. Ind. Mark. Manag. 2 (2): 163–175. http://dx.doi.org/10.1016/0019-8501(73)90076-X.

Soetanto, R., Proverbs, D.G., Holt, G.D., 2001. Achieving quality construction projects based on harmonious working relationships - clients' and architects' perceptions of contractor performance. Int. J. Qual. Reliab. Manag. 18 (5):528–548. http://dx.doi.org/10.1108/02656710110392836.

Stegen, K.S., Palovic, M., 2014. Decision-making for supplying energy projects: a four-dimensional model. Energy Convers. Manag. 86:644–652. http://dx.doi.org/10.1016/j.enconman.2014.06.020.

Straub, A., Mossel, H.J.V., 2007. Contractor selection for performance-based maintenance partnerships. Int. J. Strateg. Prop. Manag. 11 (2):65–76. http://dx.doi.org/10.1080/1648715X.2007.9637561.

Topcu, Y.I., 2004. A decision model proposal for construction contractor selection in Turkey. Build. Environ. 39 (4):469–481. http://dx.doi.org/10.1016/j.buildenv.2003.09.009.

Tsay, B., Stackhouse, J.R., 1991. Developing a management information system for a hospital: a case study on vendor selection. J. Med. Syst. 15 (5/6), 345–358.

Turskis, Z., 2008. Multi-attribute contractors ranking method by applying ordering of feasible alternatives of solutions in terms of preferability technique. Technol. Econ. Dev. Econ. 14 (2):224–239. http://dx.doi.org/10.3846/1392-8619.2008.14.224-239.

Walraven, A., de Vries, B., 2009. From demand driven contractor selection towards value driven contractor selection. Constr. Manag. Econ. 27 (6): 597–604. http://dx.doi.org/10.1080/01446190902933356.

Wang, W., Yu, W., Yang, I., Lin, C., Lee, M., Cheng, Y., 2013. Applying the AHP to support the best-value contractor selection – lessons learned from two case studies in Taiwan. J. Civ. Eng. Manag. 19 (1):24–36. http://dx.doi.org/10.3846/13923730.2012.734851.

Watt, D.J., Kayis, B., Willey, K., 2009. Identifying key factors in the evaluation of tenders for projects and services. Int. J. Proj. Manag. 27 (3):250–260. http://dx.doi.org/10.1016/j.ijproman.2008.03.002.

Watt, D.J., Kayis, B., Willey, K., 2010. The relative importance of tender evaluation and contractor selection criteria. Int. J. Proj. Manag. 28 (1): 51–60. http://dx.doi.org/10.1016/j.ijproman.2009.04.003.

Wong, C.H., Holt, G.D., Harris, P., 2001. Multi-criteria selection or lowest price? Investigation of UK construction clients' tender evaluation preferences. Eng. Constr. Archit. Manag. 8 (4):257–271. http://dx.doi.org/10.1108/eb021187.

Xia, B., Chen, Q., Xu, Y., Li, M., Jin, X., 2015. Design-build contractor selection for public sustainable buildings. J. Manag. Eng. 31 (5). http://dx.doi.org/10.1061/(ASCE)ME.1943-5479.0000295.

Xiao, H., Proverbs, D., 2002. The performance of contractors in Japan, the UK and the USA. Int. J. Qual. Reliab. Manag. 19 (6):672–687. http://dx.doi.org/10.1108/02656710210429564.

Xiao, H., Proverbs, D., 2003. Factors influencing contractor performance: an international investigation. Eng. Constr. Archit. Manag. 10 (5):322–332. http://dx.doi.org/10.1108/09699980310502937.

Xu, J., Yan, F., 2011. A multi-objective decision making model for the vendor selection problem in a bifuzzy environment. Expert Syst. Appl. 38 (8): 9684–9695. http://dx.doi.org/10.1016/j.eswa.2011.01.168.

Yang, I.T., Wang, W.C., Yang, T.I., 2012. Automatic repair of inconsistent pairwise weighting matrices in analytic hierarchy process. Autom. Constr. 22:290–297. http://dx.doi.org/10.1016/j.autcon.2011.09.004.

Yasamis, F., Arditi, D., Mohammadi, J., 2002. Assessing contractor quality performance. Constr. Manag. Econ. 20 (3):211–223. http://dx.doi.org/10.1080/01446190110113693.

Yawei, L., Shouyu, C., Xiangtian, N., 2005. Fuzzy pattern recognition approach to construction contractor selection. Fuzzy Optim. Decis. Making 4: 103–118. http://dx.doi.org/10.1007/s10700-004-5867-4.

Yilmaz, A., Ergönül, S., 2011. Selection of contractors for middle-sized projects in Turkey. Gazi Univ. J. Sci. 24 (3), 477–485.

Yu, W., Wang, K., 2012. Best value or lowest bid? A quantitative perspective. J. Constr. Eng. Manag. 138 (1):128–134. http://dx.doi.org/10.1061/(ASCE)CO.1943-7862.0000414.

Zavadskas, E.K., Vilutiene, T., 2006. A multiple criteria evaluation of multi-family apartment block's maintenance contractors: I - model for maintenance contractor evaluation and the determination of its selection criteria. Build. Environ. 41 (5):621–632. http://dx.doi.org/10.1016/j.buildenv.2005.02.019.

Zavadskas, E.K., Turskis, Z., Tamošaitiene, J., 2008. Contractor selection of construction in a competitive environment. J. Bus. Econ. Manag. 9 (3): 181–187. http://dx.doi.org/10.3846/1611-1699.2008.9.181-187.

Zavadskas, E.K., Kaklauskas, A., Turskis, Z., Tamošaitien, J., 2009. Multi-attribute decision-making model by applying Grey numbers. Informatica 20 (3), 305–320.

Zavadskas, E.K., Vilutiene, T., Turskis, Z., Tamosaitiene, J., 2010. Contractor selection for construction works by applying SAW-G and TOPSIS grey techniques. J. Bus. Econ. Manag. 11 (1):34–55. http://dx.doi.org/10.3846/jbem.2010.03.

Zhang, W., Yang, Y., Liu, W., 2013. Contractor evaluation model for large project based on grey relevancy. Appl. Mech. Mater. 357-360:2384–2387. http://dx.doi.org/10.4028/www.scientific.net/AMM.357-360.2384.

Zhao, M., Ren, R., 2012. The decision-making model for aviation project's supplier selection based on entropy method. Adv. Inf. Sci. Serv. Sci. 23 (4): 459–465. http://dx.doi.org/10.4156/aiss.vol4.issue23.57.

Zolfani, S.H., Chen, I., Rezaeiniya, N., Tamošaitienė, J., 2012. A hybrid MCDM model encompassing AHP and COPRAS-G methods for selecting company supplier in Iran. Technol. Econ. Dev. Econ. 18 (3):529–543. http://dx.doi.org/10.3846/20294913.2012.709472.

Zolghadri, M., Amrani, A., Zouggar, S., Girard, P., 2011a. Power assessment as a high-level partner selection criterion for new product development projects. Int. J. Comput. Integr. Manuf. 24 (4):312–327. http://dx.doi.org/10.1080/0951192X.2011.554872.

Zolghadri, M., Eckert, C., Zouggar, S., Girard, P., 2011b. Power-based supplier selection in product development projects. Comput. Ind. 62 (5):487–500. http://dx.doi.org/10.1016/j.compind.2010.12.001.

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