Research Article

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The impact of evaluation and qualification criteria on Iraqi electromechanical power plants in construction contracts

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Abstract: The Ministry of Electricity (MoE) is one of Iraq's most significant sectoral ministries. Despite massive amount invested in power generation, the country is plagued by power outages for more than three decades. One of the most common sources of the problem and significant impact on the waste of public funds in contractual processes. The Ministry of Planning issued regulations and procedures to facilitate the implementation of power plants by applying the sectorial standard bidding documents (SSBD) of design, supply, and installation of the electromechanical project to support MoE by developing economic projects that lead to raising Iraqi electricity generation field. The research evaluates the government evaluation procedures applied in SSBD and their impact on Iraqi power plant contracts. The study's principal data gathering approaches *via* interviews with consultants resulted in a structured questionnaire that includes 25 criteria delivered to MoE's senior staff. One hundred respondents out of 120. The relative importance index was applied to rank and match respondent consensus on the relevance of the 25 factors. This article's primary conclusion is weak evaluation of SSBD criteria and inadequate bid evaluations, resulting in an ineffective procurement system, and the results aim to encourage MoE's decision-makers to optimize the criteria.

Keywords: sectorial standard bidding document, evaluation and qualification criteria, power plant

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1 Introduction

The successful construction project must pass through two phases (contracting and implementation), requiring the integration of several elements and criteria to accomplish these stages, which include economics, efficiency, accountability, excellent management, transparency, risk prevention and control, and justice in the contracting stage (time, cost, and quality in implementing stage). One of the most difficult challenges that the project may encounter is keeping harmony among the above-mentioned components and criteria; as a consequence, these aspects must be assessed and evaluated for factors to be integrated [1,2] and developed in business responsibility [3]. Electricity is vital to life and, therefore, crucial to the Millennium development goal. No civilization can grow, develop, and succeed in any sectors without it. Creating a sustainable, stable, and affordable energy supply is essential to meet society's basic needs and promote economic activity because it supports the possibility for investment, innovation, and new industries, which are factors that drive employment and growth [4].

Energy is one of the most basic needs of life, and it is also the lifeblood of civilization. It is an essential interaction between nature and society to achieve a higher living standard for human and industrial growth. Energy has been the backbone of technology for decades [5]. Contracts must be tailored to the specific circumstances of a major industrial plant project. However, contract forms that do not meet the participants' (owners' and contractors') competencies and risk capacities are often adopted [6]. Most clients evaluated bids based on cost, and contractors were chosen based on the lowest price. Contractor failure often happens as a consequence of this undivided focus on cost, resulting in significant cost increase and project schedule overrun. Choosing an appropriate contractor for a project has a considerable influence on project performance. The contractors' qualifications must be evaluated before tendering *via* pre-qualification to avoid selecting unqualified contractors. Projects in Iraq suffer from frequent

problems such as going over budget, being delayed, and having poor quality. The fundamental reason is that contracts are awarded based on the lowest price. As a result, different evaluation criteria should be considered to overcome these issues [7], and all contracting entities have agreed that the average annual turnover and financial resources should be considered as the top barriers in Iraq that Ministry of Planning (MoP) should consider to guarantee the success of the standard bidding document (SBD) system in Iraq. In North America, choosing a contractor was nearly entirely dependent on the lowest bid. Qualification and evaluation criteria have caused significant debate in the public sector, where contractors are worried about bidding processes' validity when public funds are used [8,9].

Entities in Egypt are concerned about selecting a suitable bid for construction projects. The project's performance will be harmed if there is no proper and accurate technique for selecting the best bid [10]. Contractors for government refurbishment are chosen *via* competitive bidding. The unique features of these projects, such as complexity, ambiguity, lack of design details, and ambiguous scope, need a thorough approach for assessing bids. These projects have a limited number of bids submitted, significant disparities between submissions, and challenges evaluating the influence of non-price aspects of the bidders. It is vital to change the evaluation criteria requirements and determine the real capabilities and influence of non-price elements of bidders to enhance the bid quality, overall bid evaluation efficiency, and project success [11]. Effective communication is essential for success between design engineers, equipment suppliers, project managers, and owners [12]. Projects are often managed as systems, with the primary goals of meeting completion deadlines and budgets while adhering to quality standards [13–15]. Power plant bidding decision-making was a sophisticated system engineering that required real-time help from information technology. Thus, employing new information technology has become an issue for large power corporations. Soan intelligent decision support system (IDSS) is built based on a multi-agent intelligent decision support system, data warehouse, data mining, and online analytical processing. Compared to previous information management, IDSS has significant benefits in decision support. It might be useful for power plant bidding techniques and other semi-structural and unstructured challenges in the power market [16]. Economic and social progress is hampered by widespread corruption. Public construction projects, in particular, pose a significant risk of corruption since the public construction industry has been rated as the most corrupt for the last few years. However, significant attempts have been made to quantify national corruption [17].

The objective of this study can be summarized by assessing the Ministry of Electricity's (MoE) approach to evaluate bids for the design, supply, and installation of a power plant in Iraq according to the governmental bid evaluation procedures (GBEP) and sectorial standard bidding documents (SSBD).

2 Scope and limitations

The Iraqi prime minister's office claims that billions of dollars were spent on the power industry in previous era, sufficient to develop modern electrical networks. However, corruption, financial waste, and mismanagement have kept Iraq from resolving its electric power issues, resulting in civilians' misery, exacerbated during the summer months. Most Iraqi power plants dated from 1955 until 1986, during the Gulf War of 1991, were not effectively repaired or serviced for almost a decade due to the lack of replacement parts and skilled workforce imposed by economic sanctions, with just a few tiny gas stations operational in 2003 [18,19]. Iraq's other generating capacity flaws include inadequate availability, significant technical losses, and load barriers that affected it from meeting consumption needs. Most existing electricity generation plants are thermal, using crude oil, gas, and fire [20]. Dr. Alanbaki mentioned in the Iraqi economists' network that the government of Iraq was suffering from an electricity crisis while the MoE's overall allocations from 2005 to 2021 reached more than 80 billion dollars, as shown in Table 1 [21].

SSBD of design, supply, and installation of electromechanical works is a new document; there is a limited level of experience with it, developed and issued by MoP to support MoE's general companies in implementing power plant construction projects. The research is limited only to investigating and assessing the impact of evaluation and qualification criteria that influence MoE's decision for SSBD for the procurement of power plants in Iraq.

3 SSBD for plants in Iraq

The public procurement procedures are a key government instrument for boosting and focusing investment and development possibilities, improving the national economy, and enhancing local and federal government planning, budgeting, and monitoring capacities [22,23]. The SSBD has been certified for use in the construction of

Table 1: MoE's allocation budget

Years	Operational	Investment	Total amount
2005	$476,190,476	$670,748,299	$1,146,938,776
2006	$1,190,476,190	$721,088,435	$1,911,564,626
2007	$1,183,673,469	$884,353,741	$2,068,027,211
2008	$3,061,224,490	$2,653,061,224	$5,714,285,714
2009	$952,380,952	$2,428,571,429	$3,380,952,381
2010	$2,925,170,068	$2,585,034,014	$5,510,204,082
2011	$3,537,414,966	$2,591,836,735	$6,129,251,701
2012	$4,625,850,340	$2,476,190,476	$7,102,040,816
2013	$4,557,823,129	$2,176,870,748	$6,734,693,878
2014	$2,653,061,224	$3,605,442,177	$6,258,503,401
2015	$2,448,979,592	$2,040,816,327	$4,489,795,918
2016	$816,326,531	$1,224,489,796	$2,040,816,327
2017	$1,768,707,483	$2,047,619,048	$3,816,326,531
2018	$2,312,925,170	$2,108,843,537	$4,421,768,707
2019	$2,789,115,646	$6,326,530,612	$9,115,646,259
2020	$2,789,115,646	$4,557,823,129	$7,346,938,776
2021	$1,768,707,483	$4,693,877,551	$6,462,585,034
Total	$39,857,142,857	$43,793,197,279	$83,650,340,136

a plant related to the design, supply, installation, and commissioning of specially engineered plants and equipment, as well as the construction of civil works under a single responsibility contract when the value of the plant and equipment represents a major proportion of the contract amount; and when the facility cannot be taken over safely without testing, commissioning, and other extensive procedures before acceptance [24,25]. As a result, contractors are in charge of everything from design to supply to building, testing, and operation to takeover (acceptance) and maintenance by the employer (Contracting Entity) of the facility, and so on according to the SSBD for plants and electromechanical work.

The employer maintains the primary responsibility for contract design engineering. Technical specifications and drawings are provided by the employer to meet the technical and performance requirements. The contractor is responsible for the design, manufacture, supply, installation, and commissioning, or any other activity required to complete the project for its intended function. An electromechanical design, supply, and installation flowchart for a power plant project is shown in Table 2 [22,24,25].

The bids' evaluation stage is the essential step of the procurement process since the selection of the best contractor is dependent on its successful completion [22,26]. The steps of GBEP in Iraq are mainly identified by MoP regulations and according to SSBD's instructions (Sections 1 and 3) of forming a central committee for bid analysis and evaluation with high qualification members for evaluating technical, financial, and legal aspects and their functions as below:

Table 2: SSBD structure flowchart

1	Bidding Document	Issued by MoE
	PART 1 – Procedures for Contracting	
	Section 1 – Instructions to Bidders	
	Section 2 – Data Sheet for Bids	
	Section 3 – Criteria for Evaluation and Qualification	
	Section 4 – Forms for Bidding	
	Section 5 – Eligible Countries	
	PART 2 – Contract Requirements	
	Section 6 – Requirements of MoE	
	PART 3 – Contract Conditions and Documents	
	Section 7 – Contract General Conditions	
	Section 8 – Contract Special Conditions	
	Section 9 – Documents of Contract	
2	The Bid	Submitted by Contractor
	a) Form for submitting a bid	
	b) Completed schedules as required, including Price Schedules	
	c) Bid guarantee	
	d) Alternative bids, if allowed	
	e) Written authorization for confirming bid signature	
	f) Evidence with documentation that the factory and services offered by the bidder in its bid or any alternative bid, if allowed, are eligible	
	g) Evidence with documentation that the bidder's eligibility and qualifications to perform the contract if its bid is accepted	
	h) Evidence with documentation that the Factory and Services offered by the bidder conform to the Bidding Document	
	i) In case the bid is submitted by a joint venture, the joint venture shall be accompanied by the joint venture incorporation agreement (a duly certified partnership contract) unless the contracting entity requests the presentation of this agreement after awarding the tender with specifying the parts of the factory that each partner will be responsible for implementing	
	j) Subcontractors' list	
	k) Contractor's voucher for purchasing the Bidding Document	
	l) Any additional required documents	
3	The contract	Issued by MoE and submitted by contractor
	a) The agreement of the contract and the appendices	
	b) Form for bid submission and the schedules of prices	
	c) Particular conditions	
	d) General conditions	
	e) Specification	
	d) Drawings	
	e) Additional forms that are submitted with the bid	
	f) Any additional documents	
4	Bids Opening Process	By MoE
	1. Bids Opening Committee	
5	Bids Evaluation Process	By MoE
	1. Bids Evaluation Committee	
	2. Central Committee for audit and approve bids' evaluation report to award	

1. Preliminary evaluation of bids,
2. Detailed evaluation of bids, and
3. Determination of bid award.

Table 3: The profile of the respondent

MoE's entities	Distributed	Collected
MoE – Headquarters	20	16
MoE's Middle General Companies (Generation, Distribution, and Transmission)	30	23
MoE's Northern General Companies (Generation, Distribution, and Transmission)	25	21
MoE's Southern General Companies (Generation, Distribution, and Transmission)	20	17
MoE's Middle Euphrates General Companies (Generation, Distribution, and Transmission)	25	23
Total	120	100

The recommendations of the committee for analyzing and evaluating the bids under SSBD shall submit to the endorsement of the central committee for audit and approval to award according to the financial powers entitled.

4 Research methodology

Three primary data gathering approaches were adapted: desk studies, interviews, and questionnaires. A desk study was primarily conducted by studying the public procurement system, such as the regulations of implementing governmental contracts, procurement processes, procurement planning, standard bidding documents, and key performance indicators in procurement issued by the MoP, the desk study's goal was to investigate GBEP to recognize the factors influencing the procurement processes. Interviews were conducted with senior staff from MoP, MoE, private sector representatives, and procurement consultants to validate the consequences of the desk study and to develop and structure a questionnaire for fact collection regarding SSBD application in MoE for the construction of a power plant in Iraq by assessing the critical evaluation and qualification criteria and their impact on project success, collecting and tabulating the responses to calculate the relative importance index (RII) of all factors based on the MoE's professional staff ranking, after which conclusions and support suggestions were developed based on the study's results.

4.1 Assessing factors that influence SSBDs in GBEP (MoE)

The author's listing of discovered criteria was intended to be substantial and thorough. The questionnaire used influencing factors on bid evaluation procedures of power plants to choose the best contractor based on the results of a questionnaire that was produced. Section 3 of SSBD of plants presents either evaluation after pre-qualification completion or the evaluation and qualification option without pre-qualification. This section includes the criteria relevant to determine the substantially responsive lowest evaluated bid and the qualifications of the winning contractor to implement the contract. Evaluation and qualification criteria are divided into three main categories as below:

- Technical evaluation criteria include compliance with the employer's requirement, compulsory spare parts and maintenance services, and additional factors to consider.
- Economic/financial evaluation criteria include the bid price, time schedule, operation and maintenance costs, functional guarantees of the plant, any other services to be provided by the employer, quantifiable deviations and omissions from the contractual obligations, and specific additional criteria.
- Qualification criteria for bidder include eligibility, historical contract non-performance, financial situation, bidder's experience, personnel, equipment, and subcontractors.

A survey of a questionnaire given to MoE's official professional staff in MoE headquarters and all MoE's general companies (generation, transmission, and distribution) included these factors. The RII approach was used to calculate the quality of these factors based on the categorization provided by GBEP. Respondents were asked to rank the impact of each criterion on a 5-point Likert scale, with 5 being the highest rating, with 1 being extremely low, 2 being low, 3 being neutral, 4 being high, and 5 being very high. The formula used to calculate the RII for each factor is shown in the equation below:

$$\text{RII}\ (\%) = \frac{\sum W}{N \star A} \star 100. \tag{1}$$

where W is the weighting as assigned on Likert's scale by each respondent in a range from 1 to 5; 5, representing "highest rating"; 4, representing "high"; 3, representing "neutral"; 2, representing "low"; and 1, representing "very low." A is the highest weight (here it is 5) and N is the total number in the sample.

Table 4: The respondent's profession

Respondent's profession	General director	Consultant engineers	Project managers engineers	Senior legal	Senior financial auditors and economists	Contracts dept.	Bids' analysis committee	Total
	3	20	17	10	9	19	22	100

Table 5: Level of reliability and its coefficient for Cronbach's alpha

Coefficient of Cronbach's alpha	Reliability level
1.00	Very high
0.80–0.99	High
0.60–0.79	Moderate
Less than 0.59	Low

4.2 Sample size and profile of the respondents

A total of 120 questionnaires were distributed into five classes, the profile of the respondent based on their region is given in Table 3; Table 4 presents the respondent's profession. The questionnaires were given and administered to the targeted professionals of MoE, with 100 respondents returning and appropriate for analysis. The questionnaire is structured into four main sections. The first section includes respondents' information in general, the second section related to the general experience of SBD application in Iraq, the third section focuses on the specialized experience with SBBD of the plants, and the fourth section is related to the quality standards, risk management, and any recommendations to enhance the SSBD of power plants in Iraq. Fifty-four detailed questions, some of them required closed answers on 5-Likert scale, and the rest required detailed answers depending on the experience of the respondent. The Cronbach's alpha method was used to conduct a reliability analysis on the study variable data to determine the internal consistency of the data. As seen in Table 5, the maximum reliability coefficient is 1.00; however, when the output has a reliability coefficient of less than 0.6, the questionnaire used in data collection is considered to be unreliable and should be corrected or eliminated from the data collection process. The survey coefficient for Cronbach's alpha was 0.877 and in comparison with Cronbach's Alpha Based on standardized items was 0.851. The findings show that all of the research factors' stability coefficients are highly accepted in engineering.

5 Analysis and results

There are 25 factors that influence SSBDs in GBEP applied by MoE distributed into three categories; three factors in technical evaluation, seven factors in economic and financial evaluation, and 15 factors in bidder qualification. Respondents were asked to rate the impact of each

Table 6: Criteria (factors) arranged according to the significance

No.	Categories		Assessment factors	RII	OR (*N*)
1	Financial/Economic evaluation		The bid price	84.8	6
2			Time schedule	78.4	8
3			Operation and maintenance costs	32.1	16
4			Functional guarantees of the plant	75.2	9
5			Any services to be provided by the employer	21.2	21
6			Quantifiable deviations and omissions	21.1	22
7			Specific additional criteria	13.9	24
8	Technical evaluation		Bid compliance with the employer's requirement	93.2	1
9			Compulsory spare parts and maintenance services	91.8	3
10			Additional criteria to consider	16.3	25
11	Qualification	Eligibility	Nationality	20.9	23
12	of bidder		Conflict of interests	21.5	20
13			Contracting entity ineligibility	22.5	19
14			Government-owned companies	69.4	14
15			Ineligibility depending on a United Nations resolution or the country's law of the employer	26.7	17
16		Historical contract non-performance	Failure to implement previous contracts	70.8	13
17			Pending judicial litigations	65.3	15
18		Financial situation	History of financial performance	72.7	11
19			Average annual turnover	92.1	2
20			Financial resources	89.1	4
21		Experience	General experience	83.6	7
22			Specialized experience	86.3	5
23		Personnel	Leading staff	73.3	10
24		Equipment	Equipment type and characteristics	71.9	12
25		Subcontractor	Subcontractor's qualification	23.3	18

of these factors by scoring on a 5-point Likert scale, with 5 being the highest rating, with 1 being very low, 2 being low, 3 being neutral, 4 being high, and 5 being very high. The RII of each factor is computed by Eq. (1) as mentioned above. Table 6 illustrates the ranking of the 25 factors, which are organized by category, displaying the total ranking of the factors.

5.1 Discussion of results

The author believed that the criteria mentioned in this research were appropriate in the environment of Iraq, and according to the results in Table 6, the essential factors were "Bid Compliance with Employer's Technical Requirement," "Annual Revenues Average," "compulsory spare parts and maintenance services," "Financial Resources," "Specialized Experience," and "The Bid Price"; while other main critical factors have the least importance like the operation and maintenance cost in financial and economic evaluation, which is an essential factor for power plant's life cycle cost and the subcontractor's qualification is also an essential factor in bids' evaluation.

Due to the lack of experience with SSBD of plants, it is recommended that MoP develop a user guide for the SSBD design, supply, and installation of electromechanical work applications to ensure sustainable procurement. The results present that MoE needs to develop the capability building of the MoE's contracting departments and bid analysis committees in general companies to guarantee practical application for the SSBD of power plant construction projects and to give more attention to additional factors to be considered by MoE as environmental, health, and safety management plan.

6 Conclusions

The Iraqi government by MoE owns all of the power plant construction projects funded by Iraq's general federal

budget. Achieving value for money is the most critical aspect of the bid evaluation process, which is carried out to choose a suitable contractor with financial and technical capabilities. In the Iraqi context, bid evaluation for government projects is based on GBEP, which is aligned with the public procurement system by MoP. Achieving value for money rather than focusing on the lowest bid is a critical aspect of the GBEP that must be controlled by the best value selection method based on the price and qualification of the contractor, and this selection requires the proper application of the SSBD of design, supply, and installation of power plant construction project as designed by MoP without neglecting or missing any requirements of the evaluation and qualification criteria to ensure project success, sustainable procurement, and it will eliminate the number and frequency of contractors' claims and disputes. SSBD is also a tool for attracting sober foreign companies that will help in constructing a power plant per approved international standards and specifications, which in turn will contribute to the transfer of knowledge and technology and the development of the capabilities of national companies and staff by applying domestic preference criteria.

The author recommends the following suggestions:

- Early procurement process planning will assist MoE in completing the project successfully.
- Encourage MoE's technical authorities in charge of the project to submit all of the project's requirements, including acceptable technical criteria for a technical evaluation in the early stage of the procurement cycle, with project documentation to support the contractual staff in proper SSBD application to obtain the best bid and to reduce rejection of unresponsive bids.
- Clearly explain each document and its function in the tender document as an employer's technical requirement in Section 6 of the SSBD.
- MoE's contracting entities are accountable for the most effective use of evaluation and qualification criteria, such as considering power plant's life cycle cost by applying net present value calculations when evaluating operation and maintenance costs over the plant's life cycle to ensure that proper contractual processes are followed while also achieving transparency and conserving public funds.

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