International Journal of Occupational and Environmental Safety

Proposing an index to determine the contract level at the pre-contract stage from the viewpoint of Health, Safety, and Environment (HSE)

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Article History

Received 5 April 2018
Accepted 7 November 2018
Published 5 April 2019

Keywords

Contractor
Contract level
HSE

DOI:
10.24840/2184-0954_003.001_0004

ISSN:
2184-0954

Type:
Research Article

Open Access
Peer Reviewed

Abstract

The level of contractor's Health, Safety, and Environment (HSE) is a major concern in outsourcing of the works for large organizations. Contractors with acceptable HSE system and their appropriate performance in this area not only have a considerable impact on employer HSE status but also reduce the cost of outsourcing projects. Moreover, since a large number of contractors HSE activities and their acceptable HSE performance during the contract have directly related to their initial HSE status in pre-contract phase, there seems to be a substantial gap in the study of HSE criteria before inviting contractors to a tender. Therefore, it is essential to determine the level of contract in the pre-contract phase and consequently consider different HSE requirements for each level. The main objective of the present study is to develop an index to evaluate the level of contract based on HSE criteria to reduce the project costs in the pre-contract phase. In this study, by investigating the classification procedure of the contracts available in reliable international manuals and models, 6 main criteria were selected including "contract operational risk level", "length of contract", "number of the contractor workforce", "interference in activities of the contractor and employer", "presence of subcontractors", and "contract cost". Also, an index, called "contract separation" was proposed by weighting the criteria based on four sub-criteria characteristics. Then, by preparing a questionnaire and applying the experts' opinion, the final weight of the criteria was specified for all the contracts of Tehran Oil Refinery Company were divided into four levels, namely (1) advanced, (2) moderate, (3) basic, and (4) exempted from the initial HSE assessment. Results of the study showed that the operational risk level had the highest impact percentage on determining the level of the contract compared with other criteria. Also, the cost of the contract had the lowest weight. Although it is one of the most effective criteria in the contract classification, it cannot by itself represent the magnitude of the contract from the HSE perspective and its impact must be considered along with other criteria associated with HSE to determine the contract level.

1. INTRODUCTION

Selecting a qualified contractor for each project is a critical activity that plays a vital role in the overall success of any project (Palaneeswaran and Kumaraswamy, 2001). While clients strive for making the best decisions regarding selecting right contractors for the right job, a clear understanding of the underlying attributes associated with contractor selection is critical for achieving successful project outcomes (Doloi et al., 2011). A tender procedure should facilitate the selection of a reliable contractor by considering many criteria (Jaskowski et al., 2010). Contractor prequalification procedure makes it possible to admit for tendering only competent contractors (Nieto Morote and Ruz-Vila, 2012). The failure to perform contractor prequalification can lead to large losses, delays, or severe loss of project quality (Movahedian Attar, 2013). Traditionally, one of the most frequent procedures used for selecting contractors has been open

tendering, in which the lowest bidder is awarded the contract. However, the lowest bidder is not always the best economic choice in the long run, since the client runs the risk of poor performance by that contractor during the project life (Nieto Morote and Ruz-Vila, 2012). Nowadays, in more contracts, non-price criteria are often assessed by past performance, and many studies have dealt with the selection phase (Kadefors et al., 2007). To minimize the risk of contractor failure and enhance the performance, clients can apply prequalification procedures before asking for bids (Jaskowski et al., 2011).

One of the most important non-price criteria which has attracted employers' attention and has been regarded as one of the most important criteria for contractor selection is health, safety, and environment (HSE) criteria (Jafari et al., 2013). Because of the variety of works, different working groups, and lack of complete familiarity of contractors with the environment and working conditions, working in the contract environments is associated with high risks of health, safety, and environment accidents (OGP, 1999). Thus, the contractor assessment is critical before signing the contract because of its impact on the HSE situation of the employer (Jafari et al., 2013). Prequalification of contractors' HSE should be involved before signing the contract along with other conditions (price as well as commercial, legal, and quality requirements...), even with greater weight, It also stressed by Mapar et al. (2017) that contractors HSE prequalification is one of the main indicators for achieving sustainable performance. Moreover, finally, the organization should conclude that it is completely satisfied with the contractors applying for the tender and the contractor is able to carry out the job in accordance with the HSE standards required by the employer (ADNOC, 2004). Before inviting the contractors to the tender, the level of the contract should be determined by the employer so that the contractor's work degree is specified and consequently different requirements of the HSE management system would be considered for each level of the contract. Also, determining the level of the contract with a focus on non-price criteria as well as HSE criteria before the start of a tender could prevent the possible deviations in the future which are caused by incorrect selection of the contractor (Palaneeswaran and Kumaraswamy 2001) (Jafari et al., 2013). For example, in large contracts, the employer's expectation is to identify all aspects of hazards in the work environment and to receive an HSE plan with complete details from the contractor. On the other hand, for small contracts and those in which the extent of planning work is much less, the need for such a comprehensive coverage will be correspondingly reduced. However, even for small or short duration contracts, HSE planning must not be ignored or treated superficially (ADNOC, 2004; OGP, 1999).

In 1999, the International Association of Oil and Gas Producers (OGP) proposed Guideline number 291 entitled "HSE management guideline to work in the contract environment" which could be as the first step in HSE management system of contractors and the official entry to the oil industry. This guideline includes eight steps including planning, prerequisites, selection, before providing equipment for the workforce, providing equipment for the workforce, implementation, clearance, and final session by focusing on the phases before the implementation. Also, a method of monitoring contractors and providing HSE criteria for each step was also described (OGP, 1999). In 2002, the Petroleum Development Oman (PDO) Company proposed a 7-step model based on the OGP 291 guideline. In this model, prerequisites and contractor's selection steps are integrated into one step due to the continuity and intersection in the activities of these two steps with each other (PDO, 2002).

NORSOK standard, established in 2003 by the Norwegian Oil Industry recommends a questionnaire to assess the competence of contractors. This standard which is significantly similar to the OGP 291, governs the steps after signing the contract (NORSOK, 2003). In 2004, Abu Dhabi National Oil Company also proposed a guideline similar to OGP 291 utilizing the International Association of Oil and Gas Producers model. According to this guideline, the qualification of the contractors is determined by completing the questionnaires and HSE specific check-lists based on a balanced scorecard (ADNOC, 2009; ADNOC, 2004).

In Shell Oil Company the contractor’s HSE assessment and compiling procedure include five steps. In these steps, the contractor's prequalification, contractor selection, pre-work activities, implementation, and assessment after the work are compiled for further applications. In 2007, Shell Oil Company also proposed the accreditation system for contractors whose generalities are according to OGP 291 guideline. Their accreditation system considered providing equipment and dismantling the workshop too. Oil and gas industry guidance on voluntary sustainability reporting (2015) indicated the need of attention to contractors health and safety participation programs and the role of their programs on promoting the employees’ health and safety management (IPIECA, 2015).

However, the strength of the plan is critical, because it determines the qualification prerequisites of a contractor in three different groups, including high-, medium-, and low-risk contracts and is completed in combination with the OGP model (Shell Canada Limited Resources, 2007).

In the study by Palaneeswaran and Kumaraswamy (2001), it was stated that, apart from securing lower prices, clients would normally prefer to select bidders who are responsive, responsible and competent which safety system such as safety policy, safety audit and occupational health, and environmental concerns can be attributed in “responsibility” category (Palaneeswaran and Kumaraswamy, 2001). Jaskawski et al. (2010) assessed contractor selection criteria weights using fuzzy AHP method in group decision environment (Jaskawski et al., 2010). In Marzouk et al.'s (2013) study, the most important factors influencing the selection of subcontractors were identified. The results showed that one of the important factors in the subcontractor selection process was safety consciousness on the job site (Marzouk et al., 2013). Doloi et al. (2011) assessed the impacts of contractor performance on project success using structural equation model and determined five basic factors including soundness of business and workforce, planning and control, quality performance, past performance, and overall project subject. "Safety initiative's record" and "failure to perform safety requirement" were the indicators of quality performance factor (Doloi et al., 2011).

On the other hand, regarding Li et al. (2015) study, one of the issues for safety management in construction projects in China is a shortage of contractor’s budget that demonstrates the need of increase in investment resources. Also, they indicated the number of subcontractors could also effect on safety management, and therefore Selection of safe contractors and subcontractors suggested as a solution (Li et al., 2015). Detailed information of the contractor's prequalification criteria was presented in the study by Movahedian Attar et al. (2013) using support vector regression. The effective factors of the prequalification process were categorized into nine different criteria, one of which was "safety and health" (Movahedian Attar et al., 2013). As noted by Manu et al. (2013) from the study on mitigating the health and safety influence of subcontracting in construction, contractors were divided based on their size, nature, and scope of operation, the extent of using subcontractors, and designation of interviewees (Manu et al., 2013).

According to the study obtained from the research records, contracts are often separated and classified according to some indicators such as nature of work, type of activity, expertise and experience, financial ability, number of personnel, and risk level of activities (Manu et al., 2013; Shell Canada Limited Resources, 2007; ADNOC, 2004; NORSOK, 2003; Palaneeswaran and Kumaraswamy 2001; OGP, 1999), which are shown in Table 1.

The main objective of the present study is to develop an index to evaluate the level of contract based on HSE criteria to reduce the project costs in the pre-contract phase which means that some criteria can be combined by mathematical formula into an index (Agovino et al., 2018) in response to provide a better assessment and to facilitate the interpretation of criteria (Liu, 2018).

The fundamental hypothesis of the study is that there is a logical relation between assessing the status of contractors HSE system in the pre-contract stage and the desirable level of their HSE performance during the contract period. Therefore in this study, the criteria discussed in the models mentioned above were evaluated to propose an indicator called "contract separation" by combining the weight of each criterion and the score specified for each contract. Then, the contracts were ranked at different levels so that the measures and plans considered in other steps of the contract (including HSE prequalification, HSE assessment, and contract management and implementation) could be considered appropriate to the contract and unnecessary measures and additional costs could be avoided.

Table 1. Contract Classification Methods

Model name	Classification indicator	Categories	Description of categories
Report number 6.64/291, OGP	Based on nature, size of work, and involved risk (focus on risk level)	Small contract	- Under the company's HSE management system - Low-risk activities - A limited number of contractor personnel
		Large contract	- Having their own HSE management system - Large operations - Working with an alliance of contractors or a consortium
Shell Canada Limited Resources	Based on the risk level	Class A	Medium and high risk
		Class B	Low risk
Norsok Standard S-006	Based on HSE risk, number of personnel, and the period	Category I	Large and/or complex
		Category II	Small and/or simple
		Category III	Small and/or simple with limited follow-up
		Category IV	Hire of personnel (limited number of hired personnel over a limited period)
ADNOC	Interfaces between company and contractor (number of contracts), contract schedule, local environment	Small contract	- One-man contract, - Short duration contract - Not having a formalized HSE management system.
		Large contract	- Long duration contract - Engineering/ Procurement/ Construction (EPC) - Already having an HSE management system
Work Bureau, Hong Kong	Based on contract capacity	Group A	Up to HK$20 million
		Group B	Up to HK$50 million
		Group C	Exceeding HK$50 million
Services SA by South Australian Government	Based on the contract value	Category 1	Each category contains sub-categories such as project type, project value, contract type, building type, and project location.
		Category 2	
		Category 3	
		Category 4	
Queensland Government of Australia	Based on the size and complexity of the project	Level 1	-
		Level 2	
		Level 3	
		Level 4	

2. MATERIALS AND METHODS

The studied area in this research was Tehran Oil Refinery Company, located 15 km south away from Tehran, which consisted of southern (Number 1) and northern (Number 2) refineries. The feeds of both refineries were supplied via 24" and 26" pipelines from Maron and Ahvaz oil fields and included distillation units in atmospheric and vacuum pressure, LPG purification, catalytic converter, isomax, hydrogen production, service providers, gas purification, and sulfur recovery. The number of workforce in the refinery was about 4000, 3000 of which were by contract. There were about 10 main active contractor groups in this refinery complex, which included human resources providers (administrative affairs and public relations), security, commodity logistics, project engineering, programming and control, exploitation, safety, health, and firefighting, general engineering, repairs, as well as national and engineering projects with each group having several subcontractors. Supply models at the refinery level could be classified into two main categories. The first category as "supply of goods" included equipment, parts, accessories, etc. which was supervised by the logistics management and the second category as "supply of services" included technology and engineering as well as non-technological services supervised by the contracts management and consisted of three sections, namely counseling, contractor, and public services. The studied area was the "supply of services" category, in particular, its subsidiary: "contractor services."

The methodological research design of this study is shown in Figure 1, and the description of each step is provided in the following section.

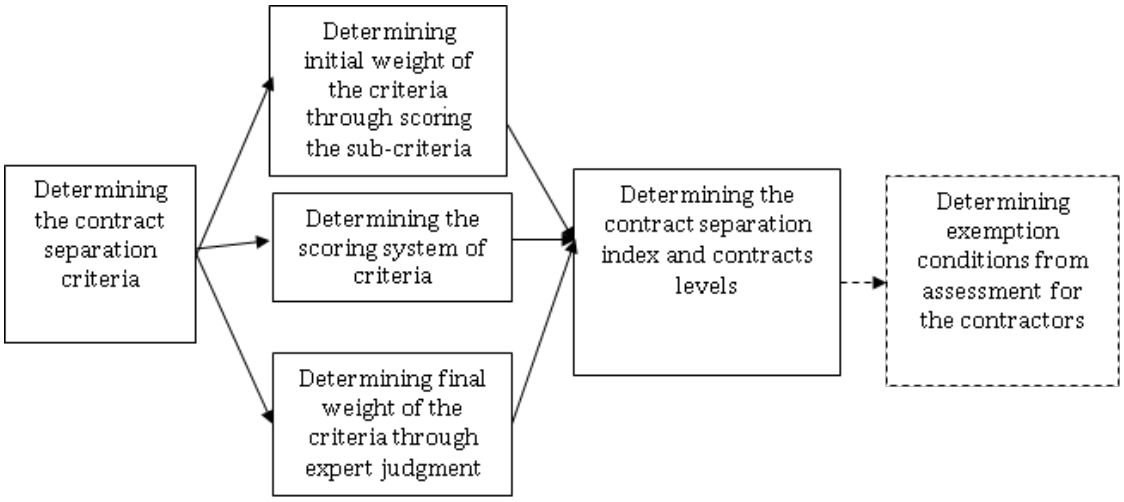

Figure 1. Methodological research design for developing the contract separation Index based on HSE

2.1. Determining the contract separation criteria

In order to separate the contracts of Tehran Oil Refinery Company, using the most common models for the contract separation presented in Table 1 and their combination, the most commonly used contract criteria were identified. Finally, 6 main criteria were specified for determining the contract level, which included 1) contract risk level; 2) length of contract; 3) contract cost; 4) number of contractor workforce; 5) subcontractors (currently working at the site and the surrounding area), and 6) interference in activities of the contractor and employer.

2.2. Determining the initial weight of the criteria

Since the six discussed criteria were not equally important, first, the priority of each criterion was determined in comparison with other criteria. The priority indicates the importance of each criterion in comparison with other contract separation criteria. For this purpose, the two following methods were used to determine the priority of each criterion or its weight:

- First, four sub-criteria were specified, as shown in Table 2, to determine the initial weight of the criteria. Then, the initial scoring was carried out and, finally, the initial weight of each criterion was specified.
- The initial weights were given to the experts as a questionnaire with a Likert scale, and the final weight of each criterion was determined.

Table 2. Contract separation sub-criteria

Number	Sub-criteria	Description
1	Specialized workforce	What kind of experts with what qualifications are required to assess the criteria?
2	Man-day required for meeting the criteria	How many experts and how much time are required to meet the criteria?
3	Required technology	How much technology is required to meet the criteria?
4	Impact of criteria on planning the next steps	To what extent it could lead to the better planning of future steps and decrease contractor's accidents?

Some scores were assigned respectively from 1 (lowest) to 5 (highest) according to the Likert scale (Likert, 1932) for the sub-criteria "specialized workforce," "man-day required for meeting the criteria," and "required technology." For the sub-criterion "impact of the variable on planning the next steps," the scores were considered from 2 (lowest) to 10 (highest) according to the importance of this sub-criterion in other phases of the contract. The scoring method is shown in

Table 3.

Table 3. Scoring table of the sub-criteria

Number	Sub-criteria	Scores				
		5	4	3	2	1
1	Specialized workforce	No need for specialized workforce	BSc; experience < 4 years	BSc; experience ≤ 4 years < 8 years	BSc; experience ≤ 8 years < 12 years	BSc; experience ≥ 12 years
			-	MSc and higher; experience < 4 years	MSc and higher; experience ≤ 4 years < 8 years	MSc and higher; experience ≥ 8 years
2	Man-day required for meeting the criterion	Less than 1 man-day	1 man-day	2 man-day	3 man-day	More than 3 man-day
3	Required technology	No need for technology	Pen and paper	- Simple computer system - Calculator	- Portable computer system - Specialized software	- Sophisticated industrial devices - Modern software packages
4	Impact of criteria on planning next steps	10 - Identifying a considerable portion of risks before starting the work - A significant impact on incidents reduction	8 - Identifying more than half of the risks before starting the work - Favorable impact on incidents reduction	6 - The possibility of relative identification of risks before starting work - Moderate impact on possible incidents reduction	4 Possibility of identifying a small part of risks before starting the work - Slight impact on the possible incidents reduction	2 - Lack of relationship with identifying possible risks before starting the work - Without any impact on possible incidents reduction

Table 2 was completed for each of the six main criteria. Sum of the scores for each sub-criterion provided a number within 5 to 25 for each criterion; accordingly, the initial weight of each criterion was determined through dividing the obtained number by 5 in order to comply with the Likert scale.

2.3. Determining the final weight of the criteria

To determine the accuracy of the initial weighting, method of expert judgment was used. To determine the number of samples (n), Krejcie and Morgan table (Krejcie & Morgan, 1970) was utilized. According to this table, the number of samples is determined based on the number of members of the statistical population (N). The number of members of the statistical population was estimated as 45 partly based on Shaawat et al. (2018) study and the minimum number of 40 samples was achieved according to Morgan table (Krejcie & Morgan, 1970). After that, a questionnaire was prepared and then distributed among industrial professionals, HSE experts, contractors, and university professors. Opinions of the experts were obtained for weight allocation to each criterion according to the Likert scale. The obtained responses form the questionnaires were analyzed by SPSS (Statistical Package for the Social Sciences version 16), and the final weight of each criterion was calculated as an arithmetic mean. To determine the validity of the questionnaire, the opinions of some professors and experts were used to examine the questions of the questionnaire and to resolve the ambiguities, which indicated the acceptable

content validity of the questionnaire. Reliability was also calculated using Cronbach's alpha coefficient by SPSS software, which was equal to 0.949. As recommended by Hussain et al. (2015) and Hou et al. (2014) the Cronbach alpha near or above 0.7 showed that the questionnaire had internal consistency. Therefore, since the achieved number was greater than 7.0, it suggested that the questionnaire is appropriate.

2.4 Determining the score of the criteria

In order to score each criterion, a score was obtained as follows:

Contract operational risk level (X1): For contract operational risk level, five regions were considered in the risk assessment matrix of Tehran Oil Refinery Company, from Low risk to high risk.

Length of the contract (X2): To determine the score for the length of the contract, one score was considered for each "three months" of the contract. Therefore, Equation 1 represents the score for the length of the contract variable. If the length of the contract is less than three months, the score calculated from Equation 2 will become less than 1, and the obtained score would be directly used in the contract separation indicator formula.

$$\text{Length of the contract score X2} = \frac{\text{Total length of the contract per month}}{3} \quad (1)$$

Number of contractor workforce (X3): To determine the score for the required number of contractor workforce for the contract, one score was assigned for every 20 workers. Thus, Equation 2 represents the score for the number of contractor workforce. If the number of the contractor force were less than 20, the score calculated from Equation 2 would become less than 1, and the obtained score would be directly used in the contract separation indicator formula.

$$\text{Score of number of contractor workforce } X3 = \frac{\text{The required number of cthe ontractor workforce}}{20} \quad (2)$$

Subcontractors (X4): "Number of subcontractor groups" and "number of employees per group" working with the contractor within the operating site were used as the basis for the classification, the scoring method of which is shown in Table 5.

Interference in activities of contractor and employer (X5): Percentage of physical interference in the activities of the contractor and employer in the workshop area and during the operation was the basis for the classification, as presented in Table 5.

Contract cost (X6): To determine the score for the contract cost, one score was considered per 100 million Rial. Therefore, Equation 3 represents the score for the contract cost. If the contract cost were less than 100.000.000 Rial, the score calculated from Equation 3 would become less than 1, which can be directly used in the contract separation indicator.

$$\text{Contract cost score } X6 = \frac{\text{Contract cost per Rials}}{100.000.000} \quad (3)$$

2.5 Determining contract separation indicator and contract levels

To determine the contract separation indicator, the final weight of each criterion was multiplied by the score obtained from the assessment of each criterion – based on the balanced scorecard by allocating scores from 1 (lowest) to 5 (highest) for each contract – and the contract separation indicator was determined by the sum of all the weights. Equation 4 shows how "contract separation Index" is calculated.

$$\sum_{i=1}^{i=6} \text{Wi} \times \text{Xi} = \text{Y} \quad (4)$$

Y= Contract separation indicator i = Criteria number X= Result of criteria assessment W= Criteria weight

Finally, in order to determine the position of the contract at each level, the lowest and highest scores for each criterion were obtained. For this purpose, by calculating the sum of the weight of each criterion multiplied by the corresponding lowest and highest scores, the minimum, and maximum scores were respectively determined. Finally, four intervals were determined based on the minimum and maximum scores to specify the levels of the contract.

2.6 Determining conditions of exemption from assessment for the contractors

Although HSE assessment of contractors before signing the contract could improve the process and quality of the work in other steps of the contract, entry of all the contractors into HSE pre-assessment and assessment is not necessary and should be based on the contract's importance, and the score achieved for determining the contract level. For this reason, in order to simplify and accelerate the contract signing process, "conditions of exemption from assessment" were determined for the contractors with the minimum score for the contract separation indictor. Under this circumstance, there is no need for the contractor to enter the HSE prequalification process before signing the contract. Also, in order to ensure about the HSE condition of the contractor and to familiarize the contractor with the organization conditions in terms of HSE, "HSE commitment form" is received from the Contracts Unit and the contractor is introduced to the HSE Unit to attend the required training courses and to be informed of the necessary instructions. HSE Unit will announce the starts of the project or disqualification of the contractor after providing the required training and instructions.

3. RESULTS

Initial and final weights of the criteria are shown in Table 4, based on expert opinion and analysis by SPSS software (ver. 16). The values were rounded to the nearest tenth. Among these criteria, contract risk level had the highest weight, whereas the contract cost had the lowest weight among the others.

Table 4. Initial and final weights of the contract separation criteria

Xn	Variable name	Initial weight	Final weight
1	Contract operational risk level	4	4.5
2	Length of contract	4	3.5
3	Number of the contractor workforce	4	3.4
4	presence of subcontractors	3.6	3.2
5	Interference in activities of contractor and employer	3.4	3.2
6	Contract cost	2.4	2.8

The final results of the scoring system of contractors HSE pre-qualification based on the methodology presented in section 2 are shown in Table 5.

According to Equation 4 and by applying the final weight of the criteria, contract separation indicator (Y) was determined as in Equation 5.

Contract separation indicator = 4.5 X1 + 3.5 X2 + 3.4 X3 + 3.2 X4 + 3.2 X5 + 2.8 X6 (5)

To determine the contract level, the lowest and highest scores of each criterion were specified, the findings of which are presented in Table 6.

If the score calculated form the contract separation variable were less than 20, then the mentioned contract would pose a significant risk within the employer working site. In this case, the contractor would be exempted from conditions of the initial HSE assessment.

Table 5. Scoring the criteria of contractors HSE pre-qualification

Criteria	Final scoring system				
	1	2	3	4	5
Contract operational risk level (X1)	Low risk	Medium risk	ALARP	High risk	High risk with the highest level of severity or probability
Length of contract (X2) (month)	$3 \leq X2 < 6$	$6 \leq X2 < 9$	$9 \leq X2 < 12$	$12 \leq X2 < 15$	$X2 \geq 15$
Number of contractor workforce (X3)	$20 \leq X3 < 40$	$40 \leq X3 < 60$	$60 \leq X3 < 80$	$80 \leq X3 < 100$	$X3 \geq 100$
Presence of subcontractors (X4)	No subcontractor	A subcontractor (less than 20 people)	- A subcontractor (between 20-40 people) - Two subcontractors (less than 20 people)	- A subcontractor (between 40-60 people) - Two subcontractors (between 20-40 people) - Three subcontractors (less than 20 people)	- A subcontractor (more than 60 people) - Two subcontractors (more than 40 people) - More than three subcontractors (more than 20 people)
Interference in activities of contractor and employer (X5)	No interference in the activities	Activity near the employer operational area (physical interference of less than 25%)	Activity in a small part of the employer operational area (Physical interference between 25 and 50%)	Activity in half of the employer operational area (Physical interference between 50 and 75%)	Joint activity in a completely common area (physical interference of more than 75%)
Contract cost (X6)					

Table 6. Contract levels

Number	Score calculated from the contract separation indicator	Contract level
1	y > 60	Level 1 (advanced)
2	40 < Y ≤ 60	Level 2 (moderate)
3	20 < Y ≤ 40	Level 3 (basic)
4	Y ≤ 20	Exemption from the initial HSE assessment of the contractors

4. DISCUSSION

In this study, six criteria were determined for the contract level separation. The highest level of weight (4.5) assigned to contract risk level showed that, even if the contract had limited time and members and there was high risk associated with contract activities, certain provisions should be considered about HSE for the contract and, regardless of other criteria, focus on HSE supervisions in contracts with high levels of risk should receive the highest priority.

The criteria including Length of contract and Number of contractor workforce with little differences between their weights (3.5 and 3.4 respectively) were placed at the second level. These findings are firmly in line with Li et al.'s (2015) study, who indicated that the number of contractors is one of the important factors influencing safety management. Moreover, the short

or long period contract was considered as the secondary important criteria for assessing the prequalification stage of contractors in Shell Company (Shell Canada Limited Resources, 2007). Therefore in this regard, both studies show the same results

Presence of subcontractors and interference in activities of contractor and employer were jointly placed at the third level (3.2). These findings could be also compared with the Manu et al. (2013) from the study on mitigating the health and safety influence of subcontracting. According to the mentioned study, contractors were divided based on their size and extent of using subcontractors, but they indicated that the impact of this criterion should not individually be taken into consideration, but also the influencing of the size and extent of subcontractors should be considered alongside with other criteria such as nature of the work and the scope of the activities. Therefore the findings are approximately similar to the present study.

Moreover, the findings on the “interfaces between company and contractor” criterion are partly against the results found by Abu Dhabi National Oil Company (ADNOC, 2009) which introduces this criterion as one of the most important criteria in the classification of contract in pre-contract stage. In our study, the “interfaces between the company and contractor” criterion were placed at the third level (3.2). Therefore this contradiction is probably because of the differences between the sizes of the companies, as well as the location of operational sites of contractors; e.g., unlike Abu Dhabi National Oil Company, in Tehran Oil Refinery Company, the contractor's sites are located partially far from the own sites of the employee. Therefore the interfaces of contractors and company are not as much highlighted as Abu Dhabi National Oil Company.

Also the lowest weight of criteria (2.8) that is assigned to contract cost shows that although the contract cost could represent the size of the contract, it is not a common issue for all the contracts and sometimes contracts with high costs are signed; but, the contractor activity is conducted outside the site with no interference with the employer activities. Therefore, it does not have a high-risk level.

In addition to the classification, criteria "length of the contract," "number of contractor workforce", and "contract cost" were calculated by considering some other formulas. Since at the beginning of establishing the contractors' HSE management system, no accurate database about contracts time, number of contractors, and the cost of each contract might be available, therefore in order to determine the current scores, the score for these 3 criteria was calculated by holding a seminar meeting with HSE experts and the contract authorities in the refinery. In parallel with the system establishment, it is possible to provide a database of contractors and to modify the 3 mentioned scores by Equations 6, 7, and 8.

$$\text{Length of contract score } X2 = \frac{\text{The total length of contract per month}}{\text{Average of the length of contract in the past two years}} \quad (6)$$

$$\text{Number of contractor workforce score } X3 = \frac{\text{Total number of contract workforce}}{\text{Average number of contract workforce in the past two years}} \quad (7)$$

$$\text{Contract cost score } X6 = \frac{\text{Cost of contract (Rials)}}{\text{Average contract cost in the past two years}} \quad (8)$$

In the contract classification via contract separation indicator, the highest level was related to the advanced contrast (score of greater than 60). At this contract level, due to the operational sensitivity of the work, the contractors themselves must have HSE management system. Although this HSE management system may not necessarily be equal to what the employer has on the mind, it should be applicable and consistent with the HSE management system of the employer and have acceptable performance. In moderate level contracts (scores of 40-60), the contractors could not have an official HSE management system and to use the HSE management system of the employer. However, they should have a basic understanding of HSE management related to its own activities and must be prepared to provide a simple, but effective, model for the HSE management system. Basic level contractors (score of 20-40), which usually involve the small organizational issues in a short period or individual contract, do not need the official HSE management system and should follow some parts of the HSE management system of the employer which are related to their works.

Comparing the results of the current study with those of similar works, presented in Table 1, indicates that contract risk level criteria based on OGP 291, ADNOC, and Shell Corporation

Guidelines (ADNOC, 2009; Shell Canada Limited Resources, 2007; ADNOC, 2004; OGP, 1999) had the greatest impact on the contract separation indicator, while in comparison with the study conducted by Palaneeswaran and Kumaraswamy (2001) on the classification of contractors for Work Burea Company in Hong Kong, although the contract cost is one of the effective criteria in the contract classification, it cannot by itself represent the contract level. Along with the contract cost and even with the greater weight, the presence of other criteria related to HSE has an impact on determining the contract level.

It is noticeable that the proposed model for assessing the contract level at pre-contract level, due to its simple algebraic formula consisting of the algebraic sum of the weighted criteria can be also converted to a continuous model. For instance in the next step, it would be possible to add new sub-criteria to the equation -such as considering the number of accidents and location of project based on unsafe conditions among others- without major changes in the structure of the model and then evaluates the efficiency of the continuous model with the original proposed index.

5. CONCLUSIONS

According to the outsourcing approach and use of contract services in modern organizations, addressing the issues of health, safety, and environment has gained supreme importance. Some of the reasons contributing to the increased importance of this issue include: variety of contract activities such as development projects, improvements, and repairs, interference of contractors with each other in terms of space and work environment, number of contractors in a limited working space, and higher number of contractor employees with respect to official and contract employees in the organization. For this reason, having a systematic mechanism for HSE management of contracts could give rise to many positive consequences for the employer organization and also the contractor.

In this study, a method was designed for contract classification before signing the contract from a proposed HSE perspective. The number of 6 criteria determined and considered in a composite index based on their assigned weights namely “contract separation Index.” In overall, the risk level criterion obtained the first place among others with the highest weight (4.5), whereas the cost of the contract reached the lowest weight (2.8). It is concluded although each criteria are effective in the contract classification, they cannot individually represent the magnitude of the contract from the HSE viewpoint. Therefore it is essential that the impact of each criteria be considered along with other criteria associated with HSE to determine the contract level on pre-qualification stage.

By introducing the mentioned method and determining the contract level before starting the contract steps, it is possible to design programs appropriate with any contract level for the organization. Also, by determining contract level, the importance of the contractor's work is specified, and focus of the HSE activities of the employer is designed based on three levels, namely advanced, moderate, and basic, appropriate to the assessed conditions. Finally, the proposed classification will prevent additional costs imposed on the contractor and employer in other steps of the contract.

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