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Critical Success Factors for Competitiveness of Egyptian Construction Companies

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Abstract: Advancing construction company competitiveness is a tremendous challenge. In approaching this challenge, it is useful to identify the critical success factors (CSFs) that impinge upon company competitiveness. This research aims to determine the CSFs for the competitiveness of Egyptian construction companies. The research deployed the relative importance index (RII) and the fuzzy Delphi method (FDM) to determine the importance of and screen out the success factors for company competitiveness. The results of the two methods are demonstrated and discussed, and then the CSFs are obtained by taking the intersection of the results of the two methods. This research finds that a sustainable organization and leadership structure and governance system; stating a mission, vision and values; key types of suppliers and partners; reporting relationships among the different parts of the organization; and using technology as a support to achieve strategies are the five top-ranked CSFs for company competitiveness in the Egyptian construction market. The least important factors that influence company competitiveness include having indicators to assess the image of the organization and having positive trends for indicators measuring societal performance. The identification of the CSFs is useful for helping contractors to utilize their limited resources more efficiently to improve their competitive advantage.

Keywords: competitiveness; critical success factors; relative importance index; fuzzy Delphi method; construction companies; Egypt

Citation: Mohamed, H.A.E.; Eltohamy, A.I. Critical Success Factors for Competitiveness of Egyptian Construction Companies. *Sustainability* **2022**, *14*, 10460. https://doi.org/10.3390/su141710460

Academic Editors: Albert P. C. Chan, Srinath Perera, Xiaohua Jin, Dilanthi Amaratunga, Makarand Hastak, Patrizia Lombardi, Sepani Senaratne and Anil Sawhney

Received: 12 July 2022
Accepted: 18 August 2022
Published: 23 August 2022

1. Introduction

The construction sector is a comparatively significant sector in both developed and developing economies. In developed economies, the gross domestic product (GDP) contribution of the construction sector amounts to almost 10%, and more than 4% for developing economies [1]. Generally, the construction sector is the vehicle that motivates the growth of a country's economy, especially when the country suffers from stagnation. The construction sector is a major supplier to the Egyptian economy and is considered one of its fastest-growing sectors. Slow economic growth, strong competition, and local and international construction sector restructuring has placed high pressure on construction organizations to constantly improve their productivity and performance to either survive or be more competitive [2].

Competitiveness can be defined as an organization's ability to compete for business in various markets [3]. Competitiveness determines the ability to conquer new markets, to outplay other actors in the market, to attract investment and to grow. Policy makers need to understand how competitive their country is relative to others, and how their competitive position evolves overtime [4].

There are many theories for understanding company competitiveness. The first theory is the competitive advantage [5,6]. In his further works, Porter [6] engaged the value chain to disaggregate a company into many discrete value activities and proposed that the activities for implementing a competitive strategy are ultimately the sources for competitive advantage. The second theory is the resource-based and core-competence theory.

According to Dess et al. [7], strategic management directs the organization toward overall goals and objectives considering the engagement of stakeholders in decision making. The three theories provide the guidelines for identifying the candidate success factors for the competitiveness of a contractor. The success factors for the competitive advantage of an organization should collectively cover the areas of competitive strategies, value activities, and firm-specific resources.

The identification of contractor competitiveness factors has been extensively covered in previous studies. Holt, Olomolaiye [8] classified competitiveness factors under five main groups: the contractor's organization, financial considerations, management resources, past experience, and past performance. Hatush and Skitmore [9] proposed a set of criteria classified under five categories for assessing contractor competitiveness, including financial soundness, technical ability, management capability, health and safety, and reputation. Based on the results of many studies [10–13], Shen and Liu [14] proposed a comprehensive set of contractor competitiveness indicators and a model for calculating a contractor's total competitiveness value. In their research, the contractor competitiveness indicators are grouped into six categories: social influence, technical ability, financing ability and accounting status, marketing ability, management skills, and organizational structure and operations. Hoang [15] and Badawy [16] developed models to assess the competitiveness of Canadian construction companies. However, applications of the competitiveness factors introduced in previous studies are limited as there has been no corresponding relevance of competitiveness factors to different types of environments from one country to another.

The Delphi method is widely applied to filter indicators and factors in many fields, but it requires multiple investigations to achieve the consistency of expert opinions, and experts are required and forced to modify their opinions so as to meet the mean value of all the expert opinions [17]. However, the fuzzy Delphi method (FDM) requires only a small number of samples, and the derived results are objective and reasonable [18]. According to Hsu and Yang [19], the FDM reduces the time and cost required for collecting expert opinions, and the experts' opinions will also be sufficiently expressed without being distorted. The FDM is mostly used for the screening process by employing fuzzy sets to represent opinions from experts. This approach has been employed in various applications, including humanities, management, business, physical science, and engineering. Kuo and Chen [18] applied the FDM to construct key performance appraisal indicators for the mobility of the service industries. Ma, Shao [17] applied two kinds of methods to filter road safety performance indicators, namely the FDM and the grey Delphi method. Tseng, Lim [20] identified the top-ranking features of stakeholders' considerations in sustainable supply-chain management and provided practical suggestions. The study of Elmousalami, Elyamany [21] suggested using fuzzy theory and the Delphi method with the analytic hierarchy process in order to efficiently identify the cost drivers. Bui, Tsai [22] applied the FDM to identify barriers to sustainable solid waste management in practice.

The aim of this paper is to identify CSFs for company competitiveness that are applicable to the Egyptian construction environment. Through the relative importance index (RII) method and the FDM, the importance of factors can be derived and CSFs can be constructed.

The paper is structured as follows. The next section gives a brief overview of competitiveness, its success factors, and models for measuring it. This is followed by a description of the research methodology adopted in carrying out the study. The analysis and discussions of the data collected are then highlighted. Finally, the conclusions of the study are presented.

2. Background

Based on the review of the available literature, the following sections present an overview of competitiveness, success factors for competitiveness of construction organizations in different countries, and models for measuring competitiveness in construction companies.

2.1. Overview of Competitiveness

Competitiveness has become common to describe the economic strength of an entity with respect to its competitors in the global market economy in which goods, services, people, skills, and ideas move freely across geographical borders [23]. Investigations of competitiveness can be conducted at different levels such as nation, industry or enterprise, with each level being significantly different [24].

Scott, Lodge [25] gave the definition of national competitiveness as "a country's ability to create, produce, distribute and/or service products in international trade while earning rising returns on its resources". The national level is considered the highest level where communities such as the World Economic Forum (WEF) and International Institute of Management Development (IMD) publish reports yearly to measure the competitiveness of nations.

The industry level is another level where a detailed analysis of individual industries can be studied. Many studies were conducted to measure the competitiveness performance in construction industries in different countries such as Australia, Finland, Sweden, the UK and the USA [26].

Ivancevich, Lorenzi [27] defined firm competitiveness as "the degree to which a firm can, under free and fair market conditions, produce goods and services that meet the test of international markets while simultaneously maintaining or expanding the real incomes of its employees and owners". The firm or organization level focuses mainly on an individual company's competitiveness. Competitiveness research at the firm level has developed a competitive strategy that helps achieve and sustain competitiveness [6], and has analyzed firms' resources that sustain competitiveness [28,29].

Competitiveness research at the project or product level focuses on the competitiveness of each project such as the bidding strategy for a project [30] and studies factors that affect competitiveness in a project [31].

2.2. Success Factors for Competitiveness of Construction Organizations

The study of competitiveness in the construction industry, including the identification of CSFs for competitiveness, has emerged in many academic journals and technical reports. Researchers in many countries such as the USA, the UK, Chile, and many others have developed CSFs that are, to some degree, suitable for their own national attributes. A summary of the available previous studies on major success factors for company competitiveness is shown in Appendix A, which shows that the CSFs for competitiveness of construction organizations differ from one country to another. Different market situations, policies and strategies, cultures, and competitive environments require different measures [32]. Therefore, a need exists to develop a set of CSFs for company competitiveness that are suitable for the environment in Egypt.

2.3. Models for Measuring Competitiveness in Construction Companies

Evaluating company competitiveness is the first step towards building effective marketing strategies [33]. Shen and Liu [14] developed a decision support system for assessing contractors' total competitiveness value in the context of China's construction industry. In a further study, Shen, Li [34] proposed a model that was adopted to award construction contracts on a multi-criteria basis in China by taking into account both a contractor's competitiveness and the defined project objectives. Tan [35] proposed a competitiveness indicator system for assessing Hong Kong contactors' competitiveness based on six aspects: corporate image, technology and innovation, marketing capability, financing capability, project management skills, and organization and human resources. However, it does not provide criteria to calculate an index or functions to calculate a score.

The research of Elwakil, Ammar [36] proposed nine CSFs that were used in-turn to develop an artificial neural network prediction performance model of construction organizations. The model can be used to predict the performance of a construction organization based on estimated values of its success factors.

Hoang [15] developed a model to assess competitiveness in construction companies in Canada. Later, this study helped to build a model to assess competitiveness in construction at the firm level in Canada using the fuzzy analytic network process and PROMETHEE [16]. The model was generated using 26 factors. The included factors were categorized into three main pillars: external pillar, internal pillar, and financial pillar of the organization and affiliated projects. However, the applications of the competitiveness factors introduced in previous studies are limited as the relevance of competitiveness factors to different types of environments from one country to another do not correspond. There is no research aimed at determining the competitiveness in the Egyptian market.

3. Research Methodology

This study was undertaken through the following major research activities and methods: a literature review, data collection, pilot study, questionnaire survey, reliability of questionnaire, data analysis, results and discussion, and conclusions, as shown in Figure 1.

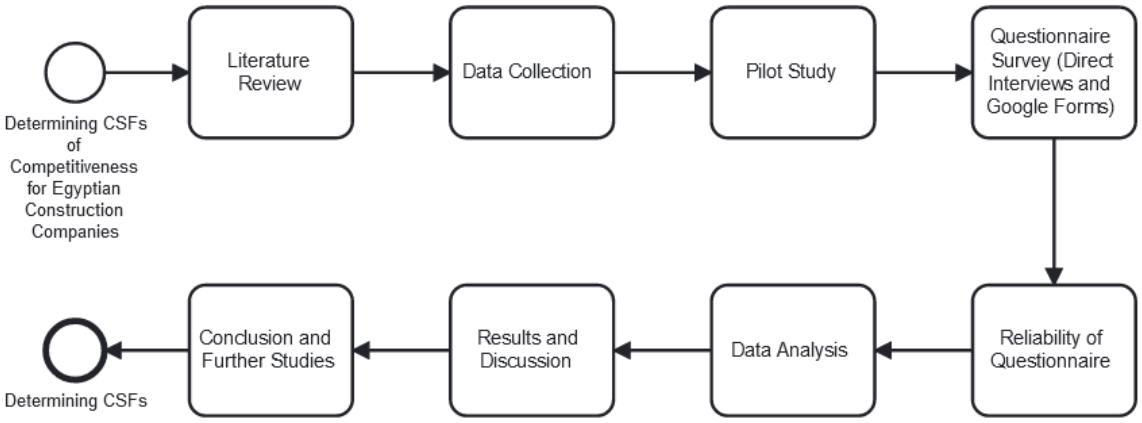

Figure 1. Flow chart of research.

3.1. Data Collection

A list of 83 potential success factors for construction organization competitiveness was derived from an extensive literature review. The 83 factors were divided into three main categories, namely, company profile, enablers, and results. According to Baldrige [37], the company profile sets the context for the company. It serves as the background for all the work it performs. The enablers are the things that the company needs to do to develop and implement its strategy. The results are what the company achieves, in line with its strategic goals.

Because of the large number of factors developed, and more importantly the anticipated overlaps between these factors, a pilot study was conducted. One-on-one interviews with four leading experts and executives working in construction companies in Egypt were conducted. The aim of this first set of interviews was more of a discovery of possible additional factors and a validation of the ones that were developed during the literature reviews. The analysis of the collected data from the pilot study reduced the 83 factors to 49 potential success factors. They were the basis of a questionnaire survey to assess the relative importance of and screen out the success factors. The questionnaire was divided into three main parts. The first part covered the purpose of the questionnaire survey, and the importance of identifying the CSFs for company competitiveness. The second part contained questions about the construction company and the individual filling out the questionnaire, such as the number of years of experience in their current position. In the third part, the respondents were asked to rate each proposed success factor based on their professional experience. A five-point scale on the importance of factor was used to obtain better validity and reliability [38,39]: not important; slightly important, moderately important, important, and very important. The questionnaire was translated into Arabic, the first language of the participants, for their convenience.

The population targeted by the survey was the experts working in construction firms and consulting offices in Egypt. The sample size, which would represent this population, was computed based on the following formula [40]:

$$n = \frac{n'}{[1 + \left(\frac{n'}{N}\right)]} \quad (1)$$

$$n' = \frac{(K^2 \times P \times q)}{V^2} \quad (2)$$

where: n = the required sample size, $n^{'}$ = the first estimate of sample size, n = the population size that is considered ∞ in this research, K is the value for the selected 95% confidence level (K = 1.96 for 95% confidence level), P = the proportion of the characteristic being measured in the target population, $q = 1 - p$, and V = the standard error of the sampling population.

To achieve the maximum sample size, the values of p and q were taken as 0.5. The standard error used in determining the sample size was set equal to 10%, which represents the maximum standard error allowed [41]. By substituting the pre-defined variables in Equations (1) and (2), a sample size of $n = 96.04 \approx 96$ is obtained.

3.2. Reliability of Questionnaire

Before conducting the data analysis, testing the reliability of the questionnaire results is very important. According to [42], Cronbach's alpha (α) [43] can be used to test the reliability of the survey based on the five-point scale. The reliability of the questionnaire results measures the internal consistency among the factors. Using the SPSS 23.00 [44], the Cronbach's alpha value of the test was 0.891. According to Santos and Reynaldo [45], a Cronbach's alpha value greater than 0.7 implies that the five-point scale measurement was reliable. Additionally, the results were tested by the Kaiser–Meyer–Olkin (KMO) and Bartlett tests. The results of the KMO and Bartlett tests guarantee that the initial variables are strongly correlated [46]. The KMO index was 0.911, which was higher than the minimum value of 0.8, indicating that the correlation between variables was satisfactory. The Bartlett test (χ^2 = 4161.783, sig. = 0.00) suggested that the data were appropriate for the results.

3.3. Data Analysis

3.3.1. RII Technique

A relative importance index (RII) can be used for ranking purpose. Ref. [47] explained that many researchers in construction management prefer the RII because of the relative comparison of variables whose indices are lower. A relative importance index (RII) and a mean value can be used for ranking the purpose. This research adopted the RII technique because it is suitable for ranking purposes and recommended for inferential statistical analysis.

The participating respondents shared numerical scores from 1 to 5 (Likert scale), stating their opinions on the degree of importance of each success factor. The relative importance of the success factors was determined using the RII shown in Equation (3) [8].

$$\text{RII} = \frac{\sum_{i=1}^{5} W_i X_i}{A \times n} \quad (3)$$

where: W_i is the weight of the ith response (i = 1, 2, 3), X_i is the frequency of the ith response, A is the highest weight (5 in this study), and n is the number of respondents.

3.3.2. FDM

Ishikawa, Amagasa [48] proposed the FDM, which was extracted from the traditional Delphi method and fuzzy theory. The FDM has many advantages over the traditional Delphi method. It takes into account the uncertainty among the participants' opinions. Moreover, instead of gathering the experts' opinions as deterministic values, the FDM converts the experts' linguistic preferences into fuzzy numbers based on human preferences, allowing high

uncertainty and retaining qualitative characteristics [22]. According to Habibi, Jahantigh [49], only one round can be used for summarizing and obtaining critical factors instead of repetitive surveys to allow forecasting values to converge, which requires much more time and cost. Accordingly, the efficiency and quality of the questionnaires will be improved [50]. Recently, many researchers have used the FDM in the construction management field for such tasks as project risk management [51–54] and procurement [55–57]. These papers suggest that a mixed use of Delphi and fuzzy sets are more appropriate for research topics related to the construction management areas. This study applied the FDM to screen the success factors for company competitiveness. As for the selection of fuzzy membership functions, previous studies were usually based on the triangular fuzzy number, trapezoidal fuzzy number and Gaussian fuzzy number [58]. This study applied the triangular membership functions and fuzzy theory to solve the group decision. The linguistic preferences were converted into triangular fuzzy numbers as illustrated in Table 1 and Figure 2.

Table 1. Transformation table of linguistic terms [22].

Linguistic Terms (Performance/Importance)	Corresponding Triangular Fuzzy Numbers		
	a	**b**	**c**
Not important	0	0	0.25
Slightly important	0	0.25	0.5
Moderately important	0.25	0.5	0.75
Important	0.5	0.75	1
Very important	0.75	1	1

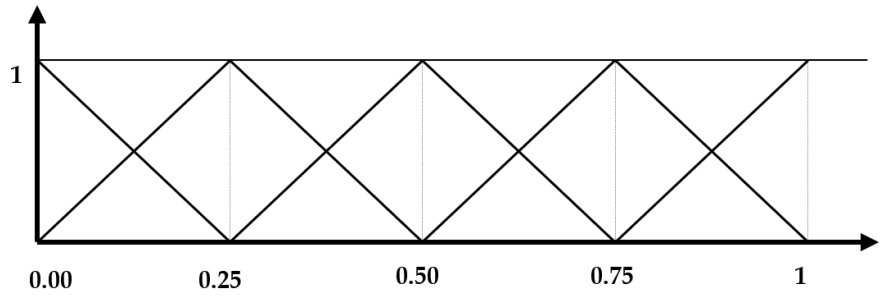

Figure 2. Membership function of the five levels of linguistic variables.

The FDM steps are as follows [58]:

1. Collecting opinions of experts to find the evaluation score of each success factor's significance given by each expert by using linguistic variables in questionnaires.
2. Calculating the evaluation value of the triangular fuzzy number of each success factor given by experts. The computing formula is illustrated as follows:

Assuming the evaluation value of the significance of the no. j factor given by the no. i expert of n experts is $W_{ij} = (a_{ij}, b_{ij}, c_{ij})$, $I = 1, 2, \ldots, n$, $j = 1, 2, \ldots, m$, then the fuzzy weighting w_j of the no. j factor is $w_j = (a_j, b_j, c_j)$, $j = 1, 2, \ldots, m$. Among which

$$a_j = \underset{i}{\text{Min}}\{a_{ij}\},\ b_j = \frac{1}{n}\sum_{i=1}^{n} b_{ij}, c_j = \underset{i}{\text{Max}}\{c_{ij}\} \quad (4)$$

where:

a_{ij}: the minimum of the respondents' common consensuses; b_{ij}: the average of the respondents' common consensuses; c_{ij}: the maximum of the respondents' common consensuses; a_j: mean opinion of the minimum of the respondents' common consensuses (a_{ij}); b_j: mean opinion of the average of the respondents' common consensuses (b_{ij}); c_j: mean opinion of the maximum of the respondents' common consensuses (c_{ij}); W_{ij}: the fuzzy number of all the respondents' opinions.

3. Using a simple center-of-gravity method to defuzzify the fuzzy weight w_j of each factor to develop the value S_j, the following are obtained:

$$S_j = \frac{a_j + b_j + c_j}{3}, \quad j = 1, 2 \ldots m \tag{5}$$

where: S_j is the crisp number after defuzzification where is $0 < S_j < 1$.

4. Screening out factors by setting the threshold α that varies based on the researcher's opinion in different studies [49]. The principle of screening is as follows:

If $S_j \geq \alpha$, then the no. j factor should be selected.
If $S_j < \alpha$, then the no. j factor should be deleted.

4. Results and Discussion

The results and discussion will be presented in four sections. The first section presents the background information of the respondents. The second and third sections handle the ranking of success factors for company competitiveness using the RII and the screening of the factors using the FDM, respectively. The fourth section presents the intersection of the results of the two methods and the discussion of the results.

4.1. Respondent's Profile

As stated earlier, a pilot study was conducted with four leading experts in the construction industry in Egypt in order to discover possible additional factors, validate the ones that were developed during the literature reviews, and reduce the large number of factors. The backgrounds of the experts are shown in Table 2. Based on the experts' recommendations, the factors were reduced to 49 factors. The factors chosen gained the agreement of at least three of the four experts.

Table 2. Backgrounds of the four experts.

No.	Expert's Position	Relevant Work Experience
1	Former Chairman of the Board of Directors of the Arab Contractors Company	38 years
2	Chief Executive Officer	33 years
3	Cost Control Director	32 years
4	Cost Control Director	27 years

The 49 potential success factors were the basis of the questionnaire survey to collect the opinions of construction experts working in construction firms and consulting offices about the importance of the factors for company competitiveness. A total of 150 questionnaires were distributed to engineers working in construction companies and consulting offices, along with a cover letter explaining the objective of the study and assuring them of anonymity. A total of 30 questionnaires were paper-based, and the rest were computer-based in the form of an online survey. A total of 89 surveys were completed and returned; most of them were based on the online form. Out of these 89 participants, 67 were contractors, which is a percentage of about 75%. About 30% of the participants had more than 10 years of experience. Table 3 illustrates the characteristics of the respondents.

Table 3. Backgrounds of respondents.

Respondents' Category	Years of Experiences				Total	Percentage
	5–9	10–15	16–20	>20		
Contractors	45	13	3	6	67	75.28%
Consultants	18	1	1	2	22	24.72%
Total	63	14	4	8	89	100%
Percentage	71%	16%	4%	9%	100%	

4.2. Ranking of Success Factors for Company Competitiveness Using RII

The participating respondents shared their numerical scores, stating their opinions on the degree of importance of each success factor for company competitiveness. The values of the RII for the 49 factors were calculated for each group (consultant and contractor) and for engineers that had more than ten years of experience. Then, the success factors were ranked according to each party's own point of view as shown in Table 4.

Table 4. Ranking of the success factors for company competitiveness using RII.

Category	Proposed Success Factor	RII %	Standard Deviation	Overall Rank	Rank According to Contractors	Rank According to Consultants	Rank According to Respondents with ≥10 Years of Experience
Company Profile	Sustainable organization and leadership structure, and governance system	83.37	1.14	1	1	2	2
Company Profile	Stating mission, vision, and values of the organization	80.00	0.15	2	3	15	13
Company Profile	Key types of suppliers, partners, and collaborators	80.00	0.98	3	2	20	11
Company Profile	Reporting relationships among the governance board, senior leaders, and parent organization	79.55	1.09	4	7	1	8
Enablers	Using technology as a support to achieve strategies	79.10	1.12	5	4	7	9
Company Profile	Relative size and growth of the organization	78.43	1.14	6	10	3	27
Company Profile	Workforce groups and segments, educational requirements for different employee groups and segments, and the key drivers that engage them in achieving the organization's mission and vision	77.98	1.11	7	9	4	4
Company Profile	Key strategic challenges and advantages in the areas of construction services, operations, societal responsibilities, and workforce	77.53	0.95	8	8	16	14
Results	Having indicators measuring financial health, market and sales performance, productivity, overall operational, and innovation performance	77.53	1.12	9	6	21	18
Company Profile	Assets of the organization	77.53	1.19	10	5	34	5
Company Profile	Key elements of organizational performance-improvement system	77.30	1.04	11	11	8	21
Company Profile	Regulatory environment under which the organization operates	77.30	1.17	12	12	9	3
Enablers	Producing, delivering and developing products and services in order to create optimum value for customers	76.85	0.98	13	14	12	15
Enablers	Monitoring, reviewing and promoting internal performance and improvements throughout the organization	76.85	1.00	14	19	5	16
Company Profile	Quantity and types of competitors and key collaborators	76.85	1.09	15	15	13	19
Enablers	Taking care of the health and safety of workforce and providing good working conditions	76.85	1.21	16	13	17	17
Enablers	Identifying external stakeholders and thorough an understanding of their needs and expectations based on the strategy, and managing relationships with them accordingly	76.40	1.09	17	16	22	20
Enablers	Developing and sharing a mission, vision, set of values, and a code of ethics for the organization	76.18	1.06	18	18	23	6
Company Profile	Key market segments, customer groups, and stakeholder groups	75.96	1.09	19	20	24	12
Enablers	Managing and enhancing customer relationships	75.96	1.10	20	21	25	1
Enablers	Designing and managing processes by taking into account stakeholders' needs	75.96	1.10	21	22	10	10
Enablers	Developing workforce knowledge and skills	75.28	1.28	22	26	6	25

Table 4. *Cont.*

Category	Proposed Success Factor	RII %	Standard Deviation	Overall Rank	Rank According to Contractors	Rank According to Consultants	Rank According to Respondents with ≥10 Years of Experience
Company Profile	Key mechanisms for two-way communication with suppliers, partners, and collaborators, and the role they play in contributing and implementing innovations in the organization	75.06	1.05	23	17	38	22
Company Profile	Suppliers' and partners' role in organizational work systems	75.06	1.14	24	27	11	32
Results	Having positive trends over the past three years for the indicators measuring its business results	74.83	0.99	25	25	18	23
Enablers	Assuring that the organization is agile and flexible enough to face changes effectively and create a sustainable organization	73.93	1.09	26	24	35	28
Enablers	Assuring that the workforce understands the mission, vision, values and strategy, and that their evaluation is based on those	73.93	1.14	27	29	26	26
Enablers	Addressing opportunities for innovation in products, operations, and the organizational business model	73.71	1.08	28	30	27	29
Enablers	Managing the organization's finance, buildings, equipment, materials and natural resources in a sustainable way, and continually reducing their impact on the environment	73.48	1.20	29	31	28	33
Results	Defining current levels and indicators of operational performance of key work systems and processes	73.26	1.04	30	23	46	35
Enablers	Sharing and understanding all necessary data and information to optimize decision making	73.26	1.21	31	32	31	24
Results	Holding a regular customer survey, with indicators monitoring their satisfaction, complaints and performance perception	73.03	1.29	32	33	32	34
Enablers	Having a system of rewards and recognition to honor and motivate the workforce via policies, services, and benefits	72.81	1.37	33	28	43	7
Company Profile	Organization's special health and safety requirements	72.58	1.30	34	38	14	36
Enablers	Including a plan on the workforce needs for the future and having a workforce change management	72.36	1.17	35	34	39	37
Company Profile	Key requirements and expectations for services, customer support services, and operations	71.91	0.95	36	37	33	38
Company Profile	Available key sources of comparative and competitive data from within the construction industry	71.46	1.08	37	36	44	45
Enablers	Balancing short- and long-term challenges and opportunities	71.46	1.17	38	44	19	30
Company Profile	Differences in requirements and expectations among market segments, customer groups, and stakeholder groups	71.01	0.87	39	35	47	31
Results	Comparing organization's performance with benchmarks for the indicators measuring business, workforce, customers, and society results	71.01	1.10	40	39	36	40
Enablers	Using market research, customer surveys and other forms of feedback to identify improvements, and effectively promote and market the organization's products and services	70.56	1.07	41	45	29	47
Results	Having and developing indicators to monitor the workforce performance and satisfaction, how they understand the strategy, the quality of internal communication, and the adequacy of individual competitors to the needs of the organization	70.56	1.09	42	41	37	44
Results	Having positive trends over the past three years for the indicators concerning the workforce	70.34	1.11	43	46	30	41

Table 4. *Cont.*

Category	Proposed Success Factor	RII %	Standard Deviation	Overall Rank	Rank According to Contractors	Rank According to Consultants	Rank According to Respondents with ≥10 Years of Experience
Enablers	Leadership communication with the workforce for achieving their strategy	70.11	1.12	44	42	41	46
Company Profile	Key applicable occupational health and safety regulations; accreditation, certification, or registration requirements; industry standards; and environmental, financial, and product regulation	69.89	1.22	45	43	45	43
Results	Having positive trends over the past three years for the indicators in the customer survey	69.66	1.13	46	40	48	42
Results	Understanding the rationale behind the evolution of the indicators concerning its workforce	68.54	1.12	47	47	42	39
Results	Having indicators to assess the image of the organization as being concerned about the environment, the environmental impact of the organization, and employees' social commitment	67.64	1.13	48	49	40	48
Results	Having positive trends over the past three years for the indicators measuring societal performance	66.74	1.11	49	48	49	49

Because too many CSFs may be unmanageable, management must prioritize the appropriate success factors. According to Swan and Kyng [59], the appropriate number of CSFs have to be 8–12. Participant-wise, for the contractor, the most highly rated factor for company competitiveness are sustainable organization and leadership structure, and governance system; key types of suppliers, partners, and collaborators; stating the mission, vision, and values of the organization; using technology as a support to achieve strategies; and the assets of the organization.

Likewise for the consultants, the five top-rated success factors for company competitiveness are reporting relationships among the governance board, senior leaders, and parent organization; sustainable organization and leadership structure, and governance system; relative size and growth of the organization; workforce groups and segments, educational requirements for different employee groups and segments, and key drivers that engage them in achieving the organization's mission and vision; and monitoring, reviewing and promoting internal performance and improvements throughout the organization.

According to respondents with at least ten years of experience, the most highly rated factors for competitiveness are managing and enhancing customer relationships; sustainable organization and leadership structure, and governance system; regulatory environment; workforce groups and segments, educational requirements for different employee groups and segments, and key drivers that engage them in achieving the organization's mission and vision; and the assets of the organization.

All the respondents agreed that the most significant factors for company competitiveness are sustainable organization and leadership structure, and governance system; stating the mission, vision, and values of the organization; key types of suppliers, partners, and collaborators; reporting relationships among the governance board, senior leaders, and parent organization; using technology as a support to achieve strategies. It is interesting to note that factors such as understanding the rationale behind the evolution of the indicators concerning its workforce, having indicators to assess the image of the organization as being concerned about the environment, the environmental impact of the organization and the employees' social commitment, and having positive trends over the past three years for the

indicators measuring societal performance are the least important for helping to improve a contractor's competitiveness in the current Egyptian construction market conditions.

4.3. Screening of Success Factors for Company Competitiveness Using FDM

This study intends to screen the success factors for company competitiveness by applying the FDM. This section handles the results of application of the FDM. The opinions of the experts in the questionnaires are converted to triangular fuzzy numbers (Table 5), and the defuzzified values can be determined after the calculation. In this study the threshold of factors was set as $\alpha = 0.55$.

Table 5. Success factors for company competitiveness after FDM screening.

Category	Success Factor	Triangular Fuzzy Number	Crisp Value (*Sj*)	Result
Company Profile	Sustainable organization and leadership structure, and governance system	(0.00, 0.79, 1.00)	0.597	Select
Company Profile	Stating mission, vision, and values of the organization	(0.50, 0.75, 1.00)	0.75	Select
Company Profile	Key types of suppliers, partners, and collaborators	(0.00, 0.75, 1.00)	0.583	Select
Company Profile	Reporting relationships among the governance board, senior leaders, and parent organization	(0.00, 0.74, 1.00)	0.581	Select
Enablers	Using technology as a support to achieve strategies	(0.00, 0.74, 1.00)	0.556	Select
Company Profile	Relative size and growth of the organization	(0.00, 0.73, 1.00)	0.577	Select
Company Profile	Workforce groups and segments, educational requirements for different employee groups and segments, and the key drivers that engage them in achieving the organization's mission and vision	(0.00, 0.72, 1.00)	0.575	Select
Company Profile	Key strategic challenges and advantages in the areas of construction services, operations, societal responsibilities, and workforce	(0.00, 0.72, 1.00)	0.573	Select
Results	Having indicators measuring financial health, market and sales performance, productivity, overall operational, and innovation performance	(0.00, 0.72, 1.00)	0.573	Select
Company Profile	Assets of the organization	(0.00, 0.72, 1.00)	0.573	Select
Company Profile	Key elements of organizational performance-improvement system	(0.00, 0.72, 1.00)	0.573	Select
Company Profile	Regulatory environment under which the organization operates	(0.00, 0.72, 1.00)	0.573	Select
Enablers	Producing, delivering and developing products and services in order to create optimum value for customers	(0.00, 0.71, 1.00)	0.57	Select
Enablers	Monitoring, reviewing and promoting internal performance and improvements throughout the organization	(0.00, 0.71, 1.00)	0.57	Select
Company Profile	Quantity and types of competitors and key collaborators	(0.00, 0.71, 1.00)	0.57	Select
Enablers	Taking care of the health and safety of workforce and providing good working conditions	(0.00, 0.71, 1.00)	0.57	Select
Enablers	Identifying external stakeholders and thorough an understanding of their needs and expectations based on the strategy, and managing relationships with them accordingly	(0.00, 0.71, 1.00)	0.568	Select
Enablers	Developing and sharing mission, vision, set of values and a code of ethics for the organization	(0.00, 0.70, 1.00)	0.567	Select

Table 5. *Cont.*

Category	Success Factor	Triangular Fuzzy Number	Crisp Value (*Sj*)	Result
Company Profile	Key market segments, customer groups, and stakeholder groups	(0.00, 0.70, 1.00)	0.566	Select
Enablers	Managing and enhancing customer relationships	(0.00, 0.70, 1.00)	0.566	Select
Enablers	Designing and managing processes taking into account stakeholders' needs	(0.00, 0.70, 1.00)	0.566	Select
Enablers	Developing workforce knowledge and skills	(0.00, 0.69, 1.00)	0.564	Select
Company Profile	Key mechanisms for two-way communication with suppliers, partners, and collaborators, and the role they play in contributing and implementing innovations in the organization	(0.00, 0.69, 1.00)	0.563	Select
Company Profile	Suppliers' and partners' role in organizational work systems	(0.00, 0.69, 1.00)	0.563	Select
Results	Having positive trends over the past three years for the indicators measuring its business results	(0.00, 0.69, 1.00)	0.563	Select
Enablers	Assuring that the organization is agile and flexible enough to face changes effectively and create a sustainable organization	(0.00, 0.67, 1.00)	0.558	Select
Enablers	Assuring that workforce understands the mission, vision, values and strategy, and that their evaluation is based on those	(0.00, 0.67, 1.00)	0.558	Select
Enablers	Addressing opportunities for innovation in products, operations, and the organizational business model	(0.00, 0.67, 1.00)	0.557	Select
Enablers	Managing the organization's finance, buildings, equipment, materials and natural resources in a sustainable way, and continually reducing their impact on the environment	(0.00, 0.67, 1.00)	0.555	Select
Results	Defining current levels and indicators of operational performance of key work systems and processes	(0.00, 0.67, 1.00)	0.562	Select
Enablers	Sharing and understanding all necessary data and information to optimize decision making	(0.00, 0.67, 1.00)	0.563	Select
Results	Holding a regular customer survey, with indicators monitoring their satisfaction, complaints and performance perception	(0.00, 0.66, 1.00)	0.553	Select
Enablers	Having a system of rewards and recognition to honor and motivate the workforce via policies, services, and benefits	(0.00, 0.66, 1.00)	0.553	Select
Company Profile	Organization's special health and safety requirements	(0.00, 0.66, 1.00)	0.552	Select
Enablers	Including a plan on the workforce needs for the future and having a workforce change management	(0.00, 0.65, 1.00)	0.551	Select
Company Profile	Key requirements and expectations for services, customer support services, and operations	(0.00, 0.65, 1.00)	0.549	Delete
Company Profile	Available key sources of comparative and competitive data from within the construction industry	(0.00, 0.64, 1.00)	0.546	Delete
Enablers	Balancing short- and long-term challenges and opportunities	(0.00, 0.64, 1.00)	0.546	Delete

Table 5. *Cont.*

Category	Success Factor	Triangular Fuzzy Number	Crisp Value (*Sj*)	Result
Company Profile	Differences in requirements and expectations among market segments, customer groups, and stakeholder groups	(0.00, 0.64, 1.00)	0.546	Delete
Results	Comparing organization's performance with benchmarks for the indicators measuring business, workforce, customers, and society results	(0.00, 0.64, 1.00)	0.544	Delete
Enablers	Using market research, customer surveys and other forms of feedback to identify improvements, and effectively promote and market the organization's products and services	(0.00, 0.63, 1.00)	0.543	Delete
Results	Having and developing indicators to monitor the workforce performance and satisfaction, how they understand the strategy, the quality of internal communication, and the adequacy of individual competitors to the needs of the organization	(0.00, 0.63, 1.00)	0.543	Delete
Results	Having positive trends over the past three years for the indicators concerning the workforce	(0.00, 0.63, 1.00)	0.543	Delete
Enablers	Leadership communication with the workforce for achieving their strategy	(0.00, 0.63, 1.00)	0.542	Delete
Company Profile	Key applicable occupational health and safety regulations; accreditation, certification, or registration requirements; industry standards; and environmental, financial, and product regulation	(0.00, 0.62, 1.00)	0.541	Delete
Results	Having positive trends over the past three years for the indicators in the customer survey	(0.00, 0.62, 1.00)	0.541	Delete
Results	Understanding the rationale behind the evolution of the indicators concerning its workforce	(0.00, 0.61, 1.00)	0.536	Delete
Results	Having indicators to assess the image of the organization as being concerned about the environment, the environmental impact of the organization, and employees' social commitment	(0.00, 0.60, 1.00)	0.533	Delete
Results	Having positive trends over the past three years for the indicators measuring societal performance	(0.00, 0.58, 1.00)	0.532	Delete

If $S_j \geq 0.55$, then the no. j factor should be selected.

If $S_j < 0.55$, then the no. j factor should be deleted.

The success factors after screening are listed in Table 5. It can be seen from Table 5 that 35 factors were selected, and 14 factors were deleted. Fifteen of the selected factors are attributed to the company profile category, which contains 19 factors, while sixteen of the selected factors are attributed to the enablers category, which contains 19 factors. The other four selected factors are attributed to the results category (11 factors).

4.4. CSFs of Company's Competitiveness

In this paper, the RII method was applied to rank the success factors of the company's competitiveness, while the FDM was used to screen out the factors. As mentioned earlier, the number of factors selected using the FDM is 35. Therefore, the CSFs for the competitiveness of the company must be obtained by taking the intersection of the results of two methods, that is, the CSFs for the competitiveness of the company must satisfy two requirements. The first is that it should be one of the factors with the highest rankings

using the RII method, and the second is that it should be selected using the FDM method. The results are shown in Table 6 for only the ten top-ranked success factors. Although it is not practical to discuss the full implications of all the factors, the five top-rated factors will be discussed in-depth.

Table 6. Critical success factors for company competitiveness.

Rank	CSFs Using RII	Success Factor After FDM Screening	Final Results
1	Sustainable organization and leadership structure, and governance system	Selected	Organization and leadership structure, and governance system
2	Stating the mission, vision, and values of the organization	Selected	Stating mission, vision, and values of the organization
3	Key types of suppliers, partners, and collaborators	Selected	Key types of suppliers, partners, and collaborators
4	Reporting relationships among the governance board, senior leaders, and parent organization	Selected	Reporting relationships among the governance board, senior leaders, and parent organization
5	Using technology as a support to achieve strategies	Selected	Using technology as a support to achieve strategies
6	Relative size and growth of the organization	Selected	Relative size and growth of the organization
7	Workforce groups and segments, educational requirements for different employee groups and segments, and the key drivers that engage them in achieving the organization's mission and vision	Selected	Workforce groups and segments, educational requirements for different employee groups and segments, and the key drivers that engage them in achieving the organization's mission and vision
8	Key strategic challenges and advantages in the areas of construction services, operations, societal responsibilities, and workforce	Selected	Key strategic challenges and advantages in the areas of construction services, operations, societal responsibilities, and workforce
9	Having indicators measuring financial health, market and sales performance, productivity, overall operational, and innovation performance	Selected	Having indicators measuring financial health, market and sales performance, productivity, overall operational, and innovation performance
10	Assets of the organization	Selected	Assets of the organization

A sustainable organization and leadership structure, and effective governance system is ranked as the most important CSF for indicating a contractor's competitiveness. The organization structure provides the framework in which a business can operate and strategies can be developed and implemented. The key elements in formulating an organization include making the structure suitable and clearly defined with allocated functions for different departments, and the collaboration and communication between departments [60]. This factor also handles how leaders' personal actions guide and sustain the organization, and how the organization fulfills its legal, ethical, and societal responsibilities [37]. The sustainable organization and leadership structure factor was ranked as one of the important factors in many past studies from countries such as Canada, China, and Hong Kong [33,60,61]. For example, it was ranked sixth in the Canadian market [33] and fourteenth in the Chinese market [60].

Stating the mission, vision, and values of the organization is ranked the second CSF for company competitiveness. Senior leaders set the organization's vision and values and deploy them, through the leadership system, to the workforce, to key suppliers and partners, and to customers and other stakeholders, as appropriate. Moreover, senior leaders' personal actions should reflect a commitment to those values [37]. This factor was ranked as one of the most important factors in past studies in Canada and Switzerland [33,37]. For

example, it was ranked the ninth factor in the Canadian market [33]; however, it was not ranked as one of the important factors in the Chinese Market [60].

The key types of suppliers, partners, and collaborators is ranked as the third important CSF. The types of suppliers, partners, and collaborators are very important for the company to succeed. This result is in line with the findings of previous studies in Canada, Chile and Hong Kong [33,61,62], suggesting that selecting qualified suppliers and partners is vital for contractors in enhancing their competitiveness in an increasingly dynamic construction industry. This factor was ranked as the eighth factor in the Canadian market [33], and was ranked as the twenty-eighth factor in the Chinese market [60].

Reporting relationships among the governance board, senior leaders, and parent organization is ranked as the fourth CSF from the survey. It seems that managers of Egyptian construction companies are fully aware of the importance of the effective implementation of communication and a feedback system in improving competitiveness. Reporting relationships might include relationships with external stakeholders such as a government agency and funding sources. This factor was ranked as the third factor in the Chinese market [60]. In addition, it was ranked as the tenth factor in the Canadian Market [33].

Using technology as a support to achieve strategies is ranked as the fifth CSF. Using technology is a strategic management process that aims to maximize value by achieving a complete integration of a company's IT practices with its structures, processes, decision making, and evolving strategic goals [63]. Technology management is necessary to achieve the strategy required for the company. This factor is ranked as one of the most important factors in previous studies in countries such as Chile and Hong Kong [61,62]. However, technology management was ranked as the least factor of significance to company competitiveness in the Canadian market [33], and was ranked as the nineteenth in the Chinese market [60].

Briefly, the factors in the higher ranks are more critical to a contractor's competitiveness. Those factors should be given priority by the company. The identification of the CSFs provides a vehicle for guiding contractors in utilizing their competitive resources more efficiently to improve their competitive advantage.

5. Conclusions, and Further Work

To advance their competitiveness, increase their productivity, and enhance their performance, it is important for contractors to identify the success factors that have a bearing on their competitiveness in local markets. The main goal of this paper was to identify the CSFs for company competitiveness as perceived by contractors and consultants working in Egypt. In this paper, depending on a review of the national and international literature, there were 83 preliminary factors classified under three main categories that were listed for the identification of competitiveness in construction firms. A pilot study was performed with four experts to reduce the large number of factors to 49 critical factors. A questionnaire form was then designed to collect the opinions of experts working in construction companies and consultant offices in Egypt. A total of 89 surveys were completed and returned. Two kinds of methods were used to rank and screen the success factors for company competitiveness, which were the RII and FDM, respectively. The CSFs for the competitiveness of Egyptian construction companies included a sustainable organization and leadership structure, and governance system; stating the mission, vision, and values of the organization; key types of suppliers, partners, and collaborators; using technology as a support to achieve strategies; relative size and growth of the organization; workforce groups and segments, educational requirements for different employee groups and segments, and key drivers that engage them in achieving the organization's mission and vision; key strategic challenges and advantages in the areas of construction services, operations, societal responsibilities, and workforce; having indicators measuring financial health, market and sales performance, productivity, overall operational, and innovation performance; and the assets of the organization. Understanding the rationale behind the evolution of the indicators concerning its workforce; using indicators to assess the image of the organization

as being concerned about the environment; and having positive trends over the past three years for the indicators measuring societal performance are the lowest-ranked factors for the perception of competitiveness of construction companies.

The results showed that the ranking of the CSFs is different compared to the Canadian and Chinese markets, which emphasizes the importance of this research. The CSFs should be given priority by the company. The identification of the CSFs provides a vehicle for guiding contractors in utilizing their competitive resources more efficiently to improve their competitive advantage. This study was focused on the Egyptian construction market. Therefore, the findings of this research are not applicable to other countries as each market has its own characteristics, but the research methodology can be applied to other countries.

In future studies, the fuzzy analytic hierarchy process (FAHP) can be used as a basis to build a model for measuring/evaluating the competitiveness of the Egyptian construction industry. This model will serve both the contractor and the owner in Egypt.

Author Contributions: Conceptualization, H.A.E.M.; methodology, H.A.E.M.; software, A.I.E.; validation, H.A.E.M. and A.I.E.; formal analysis, A.I.E.; investigation, H.A.E.M.; resources, A.I.E.; data curation, H.A.E.M.; writing—original draft preparation, A.I.E.; writing—review and editing, H.A.E.M.; supervision, H.A.E.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Success factors for company competitiveness summarized in the literature review. The Dot (●) indicates that the factor was used in the selected study.

No.	Success Factors	Reference (Country)										
		El-Diraby, Costa [33] (Canada)	Tan, Shen [62] (Hong Kong)	FIDIC [64] (Switzerland)	Lu, Shen [60] (China)	Elwakil, Ammar [36] (Canada)	Hoang [15] (Canada and other countries)	Orozco, Serpell [61] (Chile)	Ercan and Koksal [65] (USA and Middle East)	EFQM [66] (Europe)	Badawy [16] (Canada)	Baldrige [37] (USA)
1	Company vision, mission, value and ethics	●		●		●	●		●	●		●
2	Leadership communication and performance improvement			●			●		●	●		●
3	Sustainability of organization structure	●	●	●	●	●	●		●	●	●	●
4	Organization and leadership structure			●					●			●
5	Governance system			●					●			●

Table A1. *Cont.*

No.	Success Factors	Reference (Country)										
		El-Diraby, Costa [33] (Canada)	Tan, Shen [62] (Hong Kong)	FIDIC [64] (Switzerland)	Lu, Shen [60] (China)	Elwakil, Ammar [36] (Canada)	Hoang [15] (Canada and other countries)	Orozco, Serpell [61] (Chile)	Ercan and Koksal [65] (USA and Middle East)	EFQM [66] (Europe)	Badawy [16] (Canada)	Baldrige [37] (USA)
6	Organization culture	•		•	•		•	•	•			
7	Image and reputation							•				
8	Litigation and attribution history			•								
9	Organization's credibility	•	•		•							
10	Leaders' personality and capability	•	•		•		•	•				
11	Recognized grade of the company		•									
12	Banking credibility rating		•									
13	Promoting legal and ethical behavior									•	•	•
14	Societal responsibilities and support of key communities											•
15	Communication and coordination among functional departments	•			•			•		•		•
16	Interaction between management and general staff				•							
17	Assets of organization (Major facilities, technologies, and equipment)					•			•			•
18	Company experience	•		•		•	•	•				
19	Relative size and growth of company				•				•		•	
20	Strategy development, implementation, and improvement				•	•	•	•		•	•	•
21	Availability and efficient utilization of company resources	•	•	•	•		•		•	•	•	
22	Healthy and stable financial status		•	•	•			•	•			
23	Financing capacity				•			•	•			
24	Price competitiveness							•	•		•	
25	Capability of gathering and processing information of new projects/contracts				•		•					
26	Value of projects completed in the past three years		•	•			•					
27	Credibility grade certified by relevant financial bodies		•									
28	Capability of loan repayment		•									
29	IT application and Technology management	•	•		•	•	•	•	•		•	•
30	Availability of R&D	•			•	•	•	•			•	
31	Project management knowledge area: integration, scope, schedule, cost, quality, contract, communications, risk, procurement, and stakeholder management	•	•	•	•	•	•	•	•		•	

Table A1. *Cont.*

No.	Success Factors	Reference (Country)										
		El-Diraby, Costa [33] (Canada)	Tan, Shen [62] (Hong Kong)	FIDIC [64] (Switzerland)	Lu, Shen [60] (China)	Elwakil, Ammar [36] (Canada)	Hoang [15] (Canada and other countries)	Orozco, Serpell [61] (Chile)	Ercan and Koksal [65] (USA and Middle East)	EFQM [66] (Europe)	Badawy [16] (Canada)	Baldrige [37] (USA)
32	Proportion of advanced construction equipment and plant		•									
33	Work system management and improvement (design and manage processes)								•	•		
34	Improvement system											•
35	Customer groups and types	•										•
36	Customer relationship and satisfaction	•		•	•		•	•		•	•	•
37	Customer culture challenges			•		•	•					
38	Product offerings and customer support									•		•
39	On the tender list for governmental works		•									
40	Key types of suppliers, partners, and collaborators											•
41	Organization's client and supplier awareness	•					•					
42	Relationship with government departments & with public		•		•		•			•	•	
43	Relationship with partners, subcontractors or suppliers & designers and consultants	•	•		•		•	•	•	•	•	
44	Payment to subcontractors/suppliers on time		•									
45	Supplier environment						•					
46	Effectiveness of co-ordination with subcontractors		•									
47	Logistic and supply-chain management				•							
48	Number and kind of competitors							•				•
49	Workforce capability and capacity	•	•		•	•	•	•		•	•	•
50	Workforce communication and engagement									•		•
51	Workforce satisfaction and motivation	•			•	•	•	•		•		•
52	Workforce union relations	•										
53	Workforce salary						•					
54	Workforce performance						•					•
55	Workforce change management						•	•		•		•
56	Effectiveness of workforce enhancements, training, and education		•		•	•	•	•		•		
57	Retention of core staff		•									
58	Effectiveness of group-working and problem solving		•					•		•		
59	Availability and management of data, information, and knowledge					•						•

Table A1. *Cont.*

No.	Success Factors	Reference (Country)										
		El-Diraby, Costa [33] (Canada)	Tan, Shen [62] (Hong Kong)	FIDIC [64] (Switzerland)	Lu, Shen [60] (China)	Elwakil, Ammar [36] (Canada)	Hoang [15] (Canada and other countries)	Orozco, Serpell [61] (Chile)	Ercan and Koksal [65] (USA and Middle East)	EFQM [66] (Europe)	Badawy [16] (Canada)	Baldrige [37] (USA)
60	Emergency readiness											•
61	Society satisfaction and social conditions	•					•	•				
62	Legal and regulatory environment	•	•		•			•				•
63	Political conditions	•		•		•					•	
64	Construction industry conditions			•			•	•	•		•	
65	Environmental issues	•						•			•	
66	Product maintenance					•						
67	Having indicators measuring financial health, market and sales performance, productivity, overall operational, and innovation performance									•		•
68	Having positive trends over the past three years for the indicators measuring its business results									•		
69	Defining current levels and indicators of operational performance of key work systems and processes									•		
70	Holding a regular customer survey, with indicators monitoring their satisfaction, complaints, and their perception of organization's performance									•		•
71	Comparing organization's performance with benchmarks for the indicators measuring business, workforce, customers, and society results									•		•
72	Having and developing indicators to monitor the workforce performance and satisfaction, how they understand the strategy, the quality of internal communication, and the adequacy of individual competitors to the needs of the organization									•		•
73	Having positive trends over the past three years for the indicators concerning the workforce									•		•
74	Having positive trends over the past three years for the indicators in the customer survey									•		•
75	Understanding the rationale behind the evolution of the indicators concerning its workforce									•		•
76	Having positive trends over the past three years for the indicators in the customer survey									•		•
77	Having indicators measuring market and sales performance and other performance indicators									•		•
78	Having positive trends over the past three years for the indicators measuring its business results									•		•

Table A1. *Cont.*

No.	Success Factors	Reference (Country)										
		El-Diraby, Costa [33] (Canada)	Tan, Shen [62] (Hong Kong)	FIDIC [64] (Switzerland)	Lu, Shen [60] (China)	Elwakil, Ammar [36] (Canada)	Hoang [15] (Canada and other countries)	Orozco, Serpell [61] (Chile)	Ercan and Koksal [65] (USA and Middle East)	EFQM [66] (Europe)	Badawy [16] (Canada)	Baldrige [37] (USA)
79	Defining current levels and indicators of operational performance of key work systems and processes									•		•
80	Having indicators to assess the image of the organization as being concerned about the environment, the environmental impact of the organization, and employees' social commitment									•		•
81	Having positive trends over the past three years for the indicators measuring societal performance									•		•
82	Having indicators measuring sustainable management of building, equipment, material, and rational resources									•		•
83	Having indicators measuring leadership and governance outcomes									•		•

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