PRIORITIZATION OF EFFECTIVE FACTORS ON SELECTION OF CONTRACTORS OF MUNICIPALITIES USING HIERARCHICAL ANALYSIS METHOD

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Abstract. In this research, priority has been given to the factors affecting the selection of contractors in the municipality. The statistical population in this study is the managers, experts and experts in the field of logistics, technical and shopping for the municipalities and selected our sample from the experts of this group. Regarding qualification and factors affecting contractor selection, the indicators that are most effective in contracting contractors' competence are extracted from library studies and evaluated by Delphi method and distribution of questionnaires. Delphi group was considered as 51 individuals. Using hierarchical analysis technique, ranking of factors influencing the prioritization of the contractors of the municipality was investigated. According to the results, the components of financial power and support price and proposed price of financial-economic factors, components of good previous projects, creativity and innovation in previous projects, documentation and experience of design and construction teams (human resources), continuous communication with the employer and the consultant in the previous projects, from the point of view of the empirical factors, components of the various competencies of the organizations and the official organs, availability of ready-made equipment and machinery from the point of view of technical-equipment factors, effective management components and proper management system, observance of predicted scheduling, observance of safety and security guidelines, observance of environmental laws and social security from the point of view of management factors had the most impact on the prioritization of municipal contractors from the point of view of experts.

Keywords: Prioritization of Contractors, Municipalities, Hierarchical Analysis Method.

1. Introduction

In today's competitive world, companies are looking for ways to improve their market position. For this, many companies use the services of other companies (contractors) to improve their performance and, at the same time, reduce their costs (Suhang et al., 2015). Organizations need to work hard to grow and sustain and to use the right strategy to maintain their survival. Strategies that have the power to overcome the challenges ahead and have good flexibility. Organizations have a responsibility to manage costs, make profits and realize long-term plans, increase productivity and efficiency, and meet customer needs in the community (Kim, 2014). Increasing competition between manufacturing and service organizations to produce products and provide quality services and customer satisfaction requires a new perspective among all manufacturers and manufacturers (Mianabadi, 2010). The environment around organizations is changing rapidly, including these variations in demand and customer needs. The relationship between supplier and consumer in manufacturing companies has been considered seriously. When there are long-term relationships between the two, the supply chain will be a serious and strong impediment to competitors (Jafarinejad et al., 2007). The other major constraint that put organizations at a disadvantage is scarcity and resource constraints that challenge decision makers and decision makers so that they are not always easy to make decisions (Yatag et al. , 2007). Issues such as determining optimal strategy, the best combination of production, optimal production line scheduling, identifying risks and their importance, as well as supply chain issues and the process of purchasing and storing all require optimal and systematic decisions. It promotes timely and efficient decisions of managers to promote the organization. Throughout recent years, with the development and development of scientific and practical methods at the organization level, even in small cases, messaging has been satisfactory and satisfactory. With the increasing importance of purchasing activity, purchasing decision making is more important, and since today organizations are more dependent on suppliers, the direct and indirect consequences of poor decision making seem to be worse (Montser et al., 2001).

Choosing suppliers is one of the most vital activities of the organization and a strategic purchasing decision that results in a significant reduction in the total cost of the product (40-80%). (Agarwal et al., 2007). Instead, there have been organizations that have led to the disintegration of the organization by adopting inaccurate and ineffective policies and decisions by some managers. Therefore, considering the problems and shortcomings in all affairs, we find that one of the main roots of the problem is the weakness of decision-making and with a glance at the fundamental tasks of management such as planning, organizing, leadership, control and human resources, we will conclude that the common elements in all these tasks are decision-making. The science of decision making today has a significant share in the production of papers and research and management. In fact, the knowledge necessary to select an optimal method is among several different options. Perhaps it can be said that the basis of human life is the adoption of a series of reasonable decisions in certain circumstances and of

varying degrees of importance (Ling Choso et al., 2013). Purchasing and procurement management is one of the areas that are less addressed than other areas of management. The growing consumer demand, recent advances in communications technology and information systems, international competition, and increased awareness of the environment are all factors that have led companies to focus on the management of the supply chain (Sang et al., 2007). Supply chain management has been in use for over twenty years, referring to the integrated activities of the material supply chain, their conversion into intermediate and final goods, distribution of goods and delivery to final customers. In today's global markets, companies are not unique brand names that can operate independently, but rather an important part of a supply chain. The ultimate goal of these companies is to manage their suppliers across the supply chain, deliver faster, reduce production time, reduce costs, and increase quality (Chuan Li, 2010). Since suppliers now have a major impact on the success or failure of a company, the purchase, which was previously considered as a pure tactical tool, is now known as a strategic task. Today, companies have found that their purchasing and supplying sectors can be increasingly effective in increasing their efficiency and effectiveness, and experts believe that purchasing in all respects and relationships with suppliers, in particular, provide a good case for improvement. As a result of the increasing importance of the purchase problem, the importance of purchasing-related decisions has increased (Karbasian et al., 2011).

In response to increased competition, shortening product lifecycle and rapidly changing customer tastes, many companies have been focusing on developing long-term vendors' capabilities. This highlights the importance of evaluating and selecting suppliers. In such a situation, the purchasing department can play a key role in the efficiency and effectiveness of the organization and has a direct impact on reducing costs, profitability and flexibility of a company (Mousavi et al., 2011). Choosing the right suppliers can greatly reduce the cost of purchasing, increasing the competitiveness of the organization, as many experts believe that choosing the right supplier is the most important part of the buying activity. Basically, for selecting the supplier, in most cases, the resource assessment system is used (Lee et al., 2012).

The optimal choice of contractors, which plays an important role in safeguarding the economy of the community, has a major responsibility in terms of optimal communication with suppliers and contractors as an integral part of the organization that is constantly associated with them. Deciding on contractors, reviewing their performance and their history, discussing their cooperation and lack of cooperation are issues that many organizations today, both in Iran and internationally, have done articles, researches and publications about it (Mazaheri et al., 2016). The main objective of the contractor is to select the optimal contractor that provides the best service to provide the customer and is in fact part of the supply chain of the organization. In the present study, the organization's needs require that experienced, qualified and qualified contractors be measured using a scientific methodology to further enhance the organization's efficiency. For this reason, in this research, we first identify the criteria for measuring suppliers. Then, by using the Structural Interpretation Model method, the leveling of these factors and their categorization are discussed. Then, using the decision method, determine the key factors and effective features and explain the variables on the selection of contractors of municipalities. With regard to indicators such as price, quality, and after-sales service, we will propose suggestions for better choices so that the organization can take steps to improve its goals and service more efficiently by making better use of these factors. According to the basics in this study, we do not need statistical analysis and sampling, and experts are used in this regard.

1.1 Theoretical Foundations of Research

Supply Chain (SC): A network of organizations that deal with downstream communication in processes and activities, and value in the form of products and services provided to the final customer (Ed. Et al., 2013). In fact, a supply chain consists of two or more entities that are legally separate, but are linked by the flows of materials, information, and finance. These organizations can be companies that produce components, components and end products, and even service providers (logistics) and the customer itself (final) (Jafarinejad et al., 2007).

Optimal Economic Order: The order quantity of the goods in the specified period, in which the cost of maintenance and order reaches its optimum value (Isfahani, 2009).

Customer service: The ultimate goal of a company is profit, and to achieve it, the most important factor is customer satisfaction, because it is he who brings a profit to a company (Shakeriyan, 2012). To enhance customer satisfaction, two important points are: One product access, which means that the customer must be able to deliver the product exactly and at an orderly rate, another is the response time and the delivery of the product to the customer, that is, the customer must be able to achieve the product in the shortest possible time and time (Talib et al., 2011).

Financial Valuation: The financial value is defined as the ratio of income to the total cost. A company and supply chain can achieve more financial value by reducing its costs and increasing its market share (Aghilinejad, 2012).

Exchange of information and knowledge: Another important issue is the information exchange in the supply chain, in this way, many of the components of the chain are connected and can coordinate their activities. If chains can create a good communication link between their components, so that the information can be directly and immediately distributed to different parts of the chain, it is a major step towards success (Rahman Seresht et al., 2008).

Multi-criteria decision making: In most cases, decisions are made when decisions are made on the basis of several criteria or indicators. Criteria may be quantitative or qualitative. In multi-criteria decision-making methods, instead of using a

multi-criteria metric, the measure is used (Kozazi et al., 2010). Multi-criteria decision making models are divided into two major categories of multi-objective models and multi-index models. In general, multi-objective models are used to design and multi-criteria models to select the best option. The main difference between multi-objective decision-making models and multi-criteria decision-making models are that the former are defined in the continuous decision making space, and the latter are defined on the discrete decision-making space (Asgharpour, 2011).

Hierarchical Analytic Method: The hierarchical analysis method is a mathematical tool in the process of hierarchical analysis. This method was originally developed by Professor Thomas Al Claire. The basis of the hierarchical analysis method is based on a completely natural logic. The main issue, as far as possible, is to compare the elements (these elements are the same quantitative and qualitative determinants of decision making). Elements are categorized as their importance and are selected by known mathematical methods based on the highest scores calculated (Saati, 1988) and (Ghodsipour, 2005).

2. History of research

- Mazaheri et al. (2017) found in an article entitled "Identification and Prioritization of Supply Chain Risk in Manufacturing Organizations Using Multi-Criteria Decision Making": The existence of uncertainties and increasing factors affecting the supply chain and the complexity of production systems have made it difficult for managers to achieve their goals. Depending on the type of activity and the sensitivity of its assets, each organization faces a different level of risk and risk, and the risk management process must be implemented and preventive to the problems and risks affecting the management chain.

- Nazari et al. (2017) examined the fuzzy AHP model for qualitative assessment of engineering consultants in Iran's public procurement system. This study shows that (1) the work culture of industry employees affects their judgments on the level of importance of the intangible and tangible criteria used for qualitative assessment processes, (2) Shortlist consultants should be avoided to collect long-term information and to be divided into national registers or qualitative project evaluations and (3) Researchers should test FAHP models with different fuzzy values, since the success of a wide-scale analysis of fuzzy size is strongly dependent on the scale of fuzzy functions and judgment of decision makers.

- Plebankiewicz & Kubek (2016) conducted a multi-criteria selection of building material suppliers using Fuzzy AHP and AHP. The results show that the real determinants require methods similar to those of human reasoning, which is often characterized by uncertainty and an evaluation mentality. The real problem presented in the paper proves that the FAHP method may be practical.

- Yan Tu and colleagues (2017) in an attempt to optimize the hierarchical supplier selection with numerous cases in large-scale construction projects. In this paper, a multi-objective multi-objective programming model with fuzzy random coefficient is proposed for a multi-item supplier selection problem (SSP-MI) in a large-scale construction project. The high-level problem is related to the contractor who chooses suppliers to minimize the total cost, maximum service, and item quality. The lower the problem with the suppliers is to provide the supply items to maximize their overall profit. To solve this non-linear two-level (two-stage) complex with uncertainty, first the expected operational method was used to deal with the indeterminate variables and then Karush–Kuhn–Tucker (KKT) conditions and a hybrid algorithm with a logical fuzzy logic (flc-SGA) algorithm and a balanced (WSM) based on a satisfactory level (SD) as flc-SGA with SD-based WSM.

3. Research Methodology

This research is a descriptive survey research. Also, since the results of this research can be used effectively, a case study is an applied research.

Research objectives

1- Prioritizing contractors for received projects.

2- Determine the importance and weight of the indicators for assessing contractors for received projects.

This research is applied in terms of the purpose and, on the other hand, is an analytical-field study. It is applicable in that it uses the theory and previous research for a new study to be applied.

Research question

How is the evaluation and ranking of factors influencing the prioritization of municipal contractors?

Society and statistical sample

The statistical population in this study is the managers, experts and experts in the field of logistics, technical and shopping for the municipalities and selected our sample from the experts of this group. Regarding qualification and factors affecting contractor selection, the indicators that are most effective in contracting contractors' competence are extracted from library studies and evaluated by Delphi method and distribution of questionnaires. Delphi group was considered as 51 individuals.

Data collection method

To collect data in this research, a four-way data tool: reference documents, interviews, and questionnaires were used.

A. Library Studies: Library methods (Internet, books, articles, theses, and reports) have been used to obtain information on the subject and background of the research.

B. Field method: In the field method, a pairwise questionnaire was used to collect data.

Information analysis method

In this research, using the information obtained from the questionnaire, firstly, the quantitative and qualitative analysis (in terms of type of indicators and options) is composed of harmonic matrices and then using the Expert Choice software, the results are calculated and evaluated for the conclusion in the research in the hierarchical analysis method.

4. Data analysis results

4.1 Descriptive findings

According to the results, 21.27% of samples were between 30 and 39 years old, 40 to 49% were between 40 to 49 years old and 27.45% were 50 years and older. 9.8% of sample were female and 90.20% of samples were male. 11.76% of the sample had a diploma, 56.86% of the samples were bachelor and 31.37% of the samples were masters and higher. 17.65% of sample people under 10 years of work experience, 50.98% of sample 10 to 20 years of work experience and 31.37% of sample people have more than 20 years of work experience.

4.2 Inferential Findings

Analytical hierarchy analysis is used to prioritize the components of the municipal contractors in order to prioritize the components.

❖ Results related to prioritizing factors affecting the prioritization of municipal contractors from experts' point of view

Table 1 shows the average answers of experts to prioritize factors affecting the prioritization of municipal contractors. According to the results of the hierarchical analysis of the factors influencing the prioritization of the municipal contractors in Table 1, the value obtained for the incompatibility criterion is 0.09 and, given that this value is less than 0.1, hence the incompatibility of this table is very appropriate and acceptable. Also, the components of financial-economical factors, technical-equipment factors, management factors and empirical factors had the most impact on the prioritization of municipal contractors from the point of view of experts.

Table 1: Geometric mean of expert answers on prioritizing factors influencing the prioritization of municipal contractors

	Financial-economical	Empirical	Technical-equipment	Management
Financial-economical	1.000	2.15	0.854	1.85
Empirical	0.465	1.000	0.526	1.14
Technical-equipment	1.17	1.90	1.000	0.578
Management	0.540	0.877	1.73	1.000
Prioritization results	0.323	0.174	0.262	0.241
Incompatibility criterion	0.09			

Research findings

In the following, we examine the sub-components of each of the main factors affecting the prioritization of the municipal contractors using hierarchical analysis.

❖ Results of prioritizing financial-economic factors affecting the prioritization of municipal contractors from the viewpoint of experts

Table 2 shows the average expert responses to prioritizing financially-economic factors affecting the prioritization of municipal contractors.

Table 2: Geometric mean of expert answers on prioritizing financially-economical factors affecting the prioritization of contractors

	Proposed price	Financial support
Proposed price	1.000	0.235
Financial support	4.25	1.000
Prioritization results	0.810	0.190
Incompatibility criterion	0.00	

Research findings

According to the results of the hierarchical analysis of financial-economic factors affecting the prioritization of municipal contractors in Table 2, the value obtained for the incompatibility criterion is 0.00 and, given that this value is less than 0.1, the incompatibility of this table is very appropriate and acceptable. Also, the components of financial strength, support and bid price have the most impact from the perspective of financial-economic factors on the prioritization of municipal contractors from the point of view of experts.

❖ Results of prioritizing the empirical factors affecting the prioritization of municipal contractors from the experts' point of view

Table 3 shows the average expert responses to prioritizing the empirical factors affecting the prioritization of municipal contractors. According to the results of the hierarchical analysis of the empirical factors affecting the prioritization of the municipal contractors in Table 3, the value obtained for the incompatibility criterion is 0.08 and, given that this value is less than 0.1, the incompatibility of this table is very appropriate and acceptable. Also, good components of previous projects, creativity and innovation in previous projects, documentation and experience of design teams (human resources), continuous communication with the employer and consultant in the previous projects has had the most impact from the experimental point of view on the prioritization of the contractors of the municipality from the point of view of experts.

Table 3: Geometric mean of expert answers on prioritizing empirical factors affecting the prioritization of municipal contractors

	Good history	Creativity and innovation	Evidence and experience	Continuous contact
Good history in previous projects	1.000	0.363	2.32	2.70
Creativity and innovation in previous projects	2.75	1.000	2.41	2.76
Evidence and experience of design and construction teams (human resources)	0.431	0.414	1.000	2.46
Continuous contact with the employer and consultant in previous projects	0.370	0.362	0.406	1.000
Prioritization results	0.448	0.272	0.175	0.105
Incompatibility criterion	0.08			

Research findings

❖ Results related to the prioritization of technical-equipment factors affecting the prioritization of municipal contractors from the perspective of experts

Table 4 shows the average expert responses to the prioritization of technical-equipment factors affecting t on the prioritization of municipal contractors.

Table 4: Geometric mean of expert answers on prioritizing technical-equipment factors affecting the prioritization of municipal contractors

	Having equipment	Qualification
Availability of ready-made and accessible equipment and machinery	1.000	5.45
Qualifications of different organizations and organizations	0.183	1.000
Prioritization results	0.845	0.155
Incompatibility criterion	0.00	

Research findings

According to the results of the hierarchical analysis of the technical factors - the equipment that influences the prioritization of the municipal contractors in Table 4, the value obtained for the incompatibility criterion is 0.00 and, given that this value is less than 0.1, the incompatibility of this table is very appropriate and acceptable. Also, the components of different competencies from official organizations and organizations, availability of ready-made equipment and machinery have the most impact from the technical-equipment aspects on the prioritization of municipal contractors from the point of view of experts.

❖ Results of prioritizing effective management factors on prioritizing municipal contractors from experts' point of view

Table 5 shows the average expert responses to prioritize effective management factors on the prioritization of municipal contractors.

Table 5: Geometric mean of expert answers on prioritizing effective management factors on the prioritization of municipal contractors

	Efficient management	Observe the timing	Follow the instructions	Observe the rules
Efficient management and proper management system	1.000	2.19	2.75	2.65
Observe the scheduled timing	0.456	1.000	2.75	2.14
Observe safety and protection instructions	0.363	0.363	1.000	2.45
Observe environmental laws and social security	0.377	0.467	0.408	1.000
Prioritization results	0.434	0.283	0.116	0.114
Incompatibility criterion	0.07			

Research findings

Considering the results of the hierarchical analysis of the effective management factors affecting the prioritization of the municipal contractors in Table 5, the value obtained for the incompatibility criterion is 0.07 and, given that this value is less than 0.1, the incompatibility of this table is very appropriate and acceptable. Also, efficient management components and proper management system, observance of predicted scheduling, observance of safety and security guidelines, observance of environmental laws and social security have the most impact from the aspect of management factors on the prioritization of municipal contractors from the perspective of experts.

5. Discussion and conclusion

In this research, identification of factors affecting the prioritization of the contractors of the municipality was considered. The Delphi technique was used to identify the factors influencing the prioritization of the contractors of the municipality. The financial-economic factors, empirical factors, technical factors, and management factors were identified as factors influencing the prioritization of the contractors of the municipalities. Then, using hierarchical analysis technique, ranking factors influencing the priorities of the contractors of the municipality were studied. According to the results, the components of financial power and support price and proposed price of financial-economic factors, components of good previous projects, creativity and innovation in previous projects, documentation and experience of design and construction teams (human resources), continuous communication with the employer and the consultant in the previous projects, from the point of view of the empirical factors, components of the various competencies of the organizations and the official organs, availability of ready-made equipment and machinery from the point of view of technical-equipment factors, effective management components and proper management system, observance of predicted scheduling, observance of safety and security guidelines, observance of environmental laws and social security from the point of view of management factors had the most impact on the prioritization of municipal contractors from the point of view of experts. A review of previous studies is the same on the subject of research has shown that the results of this study are based on the results of Ramon and Cristobal (2012), Mohammad al-Abbasi et al. (2013), Plebankiewicz & Kubek (2016) and Yang Tu and colleagues (2017).

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