SELECTING DECISION SUPPORT SYSTEM TECHNIQUE TO CHOOSE BEST SUPPLIER IN PROCUREMENT OF IRAQI PUBLIC SECTOR

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ABSTRACT:

Iraqi procurement of public sector suffering from several problems in taking the right and honest decision in short time to selecting best supplier due to, heavy and manual work that will make administrative corruption is possible, decision support system DSS technique has used to help manager to take fast and accurate decision. Multi-criteria DSS techniques CDMA are the appropriate techniques with procurement decisions, this research study will review CDMA techniques (LGP, MAUT and AHP) and compared it with the Iraqi procurement rules and criteria of the public sector, as finding for this study Analytical hierarchy process AHP is the more method agree with Iraq procurement process to select the best supplier. The research attempts to integrating multiple information sources to boosts the procurement decision making process through theoretical and empirical results on the mutuality that describe the relations between information fusion and management decision making. The outcome of this research can be used in all systems related to decision making processes regarding public procurement.

Key words: decision support systems; decision making process; MCDA; AHP; MAUT; LGP; selecting supplier, procurement; Iraq, information.

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1. INTRODUCTION

Iraq is one of the Arab Gulf countries that have specialize high budget for developing the country since ending the economic restriction after 2003 that made Iraq has stopped and backward from the world development, Iraq has begun to overcome this gap by purchasing different needs, according to World Bank Group Report,(2015), Iraq has spent about “$1000000000” (20% from country total products) and this rapid high purchase caused big lost due to weakness in planning, administrative corruption, manual work, and miss use of advances technology made the decisions is incorrect due to multi-criteria that should be apply in taking procurement decisions (Rahman et al.,2015).

Edvard et al. (2009), stressed that procurement is a process of gathering materials and services at lowest prices and also to maximize quality and quantity, which should be get order within period and place that ensure high benefits in work and business process. Patrick and Sonny (2008) argued that procurement goals are influenced by internal and external forces. Thus, interactions between different elements, professionalism, budget resources, procurement organisational structure whether it is centralized or decentralized, rules, and guidance, procurement regulations and internal control policies, all need attention and effect the performance of the procurement function.

Many researchers have defined procurement system, Masterman (2002) defined the procurement system as an organisational structure that should be adopted by user to perform the operation, and sometimes in the end of the project, Rameezdeen and Ratnasabapathy (2006) emphasize that the procurement system is an essential means by which customers create the preconditions for the success of achieving the specific objectives of the project. Walker and Rowlinson (2008) also have stress that it is getting the project resources to achieve a facility constructed.

Leadra, et al, (2006) and K. N. Kadhim and Ghufran A.(2016) emphasis that the procurement systems should agree with the procurement strategy also they emphasis the although the terminologies that used in the characterization of procurement systems differ with different countries, the essential way for choosing of the procurement systems is always the same in all countries.

Watson and Wixom, (2007) regard the Information systems (IS) that use DSS technique which support decision making is a decision support system. Xuezhong et al. (2008) argued that it is important to deploy the decision support systems in any business organizations that need accurate summaries and aggregations in taking decisions which are easy to use. Meanwhile, DSS have the advantage in posing various requirements on data-base technology, which is best than the applications of traditional online transaction processing “OLTP” that need to be automated from day to day to clerical data processing tasks, (Chaudhuri et al., 2001).

This research has divided into three phases: studying Iraqi procurement of the public sector, studying MCDA techniques that has used with procurement process, then matching between them to select the best technique which is more agree with Iraqi procurement.

2. METHODOLOGY

This research methodology concentrating of two phases focus on aspects that determine the matching between DSS method of the public procurement sector context and the operational requirements, These two aspects are compared to each other to identify suitable DSS method for the procurement, as explained in Figure 1.
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Figure 1 Research Design

First phase is to specify the operational criteria needed to identify the DSS requirement is gathered by interview, since this study deals with the decisions in Iraqi procurement and this decisions is taken according to government rules. The purpose of the interview questions that asked to procurement and financial staff, and technical experts, is to understand the current procurement system, the system requirements, and how these requirements can be filtered into the proposed DSS method, the questions type used is open ended.

In the second phase, a literature review common methods , identifying a DSS technique to model a certain complex decision the principles of the technique selected should be understood, and they should be comply for the characteristics of the decision itself (Lewis, 2004).

Finally, a third phase involved a criteria based evaluation of the DSS methods compared with the operational requirements. This evaluation aims to analysis and check DSS methods matching with procurement operational requirements and could be implemented to building a new DSS for Iraqi public sector’s Procurement.

Phase 1:

1.1. Iraqi Selecting Supplier process Analysis

To propose DSS method, the government regulations and the criteria of selecting process decision should be identify first (Rahman et al., 2013). Therefore, in each step, the interview is the appropriated method that is used to collect data and information. The process development methods are explained in these steps:

- Forming a project team is the first stage in the procurement decision making process, this importance comes from diversity in procurement tender specifications, and therefore it’s important to form different teams according to these tender specifications. Team members are combinations from procurement unit and experts, the roles for this team are:
- Determine the criteria and sub-criteria: - staffs of the procurement unit which is responsible to identify project team from procurement unit and experts who have enough experience in tender specifications.
- Determining vendors’ bids: - project teams are responsible to analyse the vendors’ bids specifications with respect to criteria and doing the relative comparisons between these bids.
- Determine the manufacturing source: By using the government updated list for good manufacturers that are stored in the procurement unit database.
- Initial estimation of prices: Procurement unit is referred to the last procurements in the unit and ask in some suppliers to estimate initial prices.
Phase 2: Decision Support System Review

2.1. Decision Support Systems
DSS has three important characteristics of Power (2008). The first important characteristic of decision support systems is that it is specially designed to support decision processes. Secondly, decision support systems are not used to cancel managerial judgment. Rather, decision support systems are designed to support the decision maker by providing information that needed in managerial judgment. Finally, decision support systems should have continuous dynamic ability to interact with the all requirements of decision makers. Also, decision support systems should be provide the accurate information for managers at the right time, in the required format, and with factual cost.

2. 2. Development in Decision Support System Applications
Building and studying decision support systems began in about 1980 in organizations that led to deploy the range of use decision support system applications (Power, 2008). This deployment is also extended in the area of application of DSS to go further than the domain of management application and initial business. Decision Support System’s name is the default name for diverse systems. Since the first time, DSS’s were developed to support decision-makers at various levels of the organization. Also, decision support systems could support operations of decision making, strategic decision-making, and financial management (Power, 2008).

Many researchers like Eom and Lee (1990), Alavi and Joachimsthaler (1992), Arnott & Pervan (2005), and Eom (2002) suggested that the major applications for decision support systems emphasized accessing and analysing large data bases, manipulating quantitative models, and supporting group decision making. Much of the model-driven decision support system researches emphasized the use of these systems by the individuals / personal decision support systems, while data driven decision support system were usually for institutions or organizations. Group decision support system researches emphasized the factors that affect the structure of decision process, especially brainstorming. Therefore, the decision support system applications needs to be the model-driven and data driven decision support systems and executive information systems to be considered as one of the DSS applications.

2.3. Criteria in Decision Support Systems
Zeleny (1981) defined Criteria as a logical group of rules, standards, and measures that will guide decision making process by selecting various attributes, objectives, or goals which will support decision makers to control relevant decision in a given situation. Thus optimising the multiple attributes, objectives, and goals are involved by the team multiple criteria decision making.

Criteria can be either identified or quantitatively measurable of specifications, price, time, size, etc., or they can be qualitative and difficult to measure aesthetics, satisfaction, etc. Even when criteria are measurable, conflicts emerge between decision-makers over each of the priority and significance.

2.4. Multiple Criteria Decision Making Techniques MCDM
Min (1994) argued six common traditional techniques for decision making in supplier selection and stressed that if the number of criteria, attributes, and alternatives is large and not able to measure both quantitative and quantitative criteria and complex problems.

MCDM help to make rational decisions by providing the mechanisms to utilize and integrate the different criteria. Narasimhan (1983) and Nydick and Hill (1992), used the
Analytical hericury process AHP to overcome these shortcomings. At the same time, goal-programming technique (GP) developed by Buffà and Jackson (1983) to organizing and procurement orders and supplement under the buying firm's quality, demand, time, and inventory regulations. Non-linear goal-programming technique has developed by Likewise, Sharma et al. (1989) for procurement plan in the general industrial sector. Then, multi-objective programming (MGP) model proposed by Weber and Ellram (1996) to compiling the accepted solutions to identify the best supplier. Due to this, the MGP technique was successful in solving problems of the supplier selection and volume allocation and also helped the buyer to evaluate offers.

After these development and deployment of multi types and use of decision support systems, M. Ashari et al. (2008) reviewed 133 articles published in 2008 about MCDM application and found that 79 articles concerned management, 26 articles concerned manufacturing and the others; in construction 4 articles, 3 articles for education, medical and logistic. Heinemann (2010) argued that decision support system uses one or more methods in its operation which must be based on the nature of the application in the processes. Thus, the techniques of DSS are many, as will be discussed below.

The analysis of decisions requirement of special case of data can forms an important base in selection DSS technique. It is well known that different researchers are depended on different models, and that leading to large set of distinct solutions. The judgement and experience considers the most way in choosing the appropriated technique for each research case (Englund, 1990).

Chai (2005) studied many DSS techniques that related procurement process and found the most common and suitable three techniques are the (LGP), MAUT, and AHP. To choose the best technique that is suitable with requirements for Iraqi procurement decision, the explanation for these techniques presented in the followed sub sections.

2.4.1. Linear Goal Programming LGP
LGP decision-making techniques technique, it is one of mathematical programming. It identifies functions for the objective of each criterion, that stresses quantitatively what is to be accomplished regarding any regulation pressures such as; economic, political, or social that affects the project. Forgionne (1990) emphased that decision problem can be solved using goal programming that can accomplish various goals levels rather than focus on maximizing all objectives. The objective functions are important in government procurement in selection suppliers because of its consideration for political, economic, financial, and social. The best vendors’ bid represent the best offer that can increase the benefits of the objective functions with respect to regulation pressure. The LGP technique has been dispraised because of its difficulty in drawing the format of functions and constraints. Liberatore (1987) mentioned that LGP is a not professional level technique because it uses mathematical programming.

Decision makers of the public sector severed from problems from quantifying objective functions and constraints that cannot be properly measured, for example, social benefits or losses

2.4.2. Multi-Attributes Utility Theory “MAUT”
Selecting Supplier regarded as a complex decision, especially in strategic procurement. Min (1994) proposed that selecting a supplier and making multi-offers are affected by the complexity which comes from increasing factors of quantitative and qualitative. MAUT is a technique that can help decision maker to simplify a problem by structuring a simple hierarchy form and to enable typical evaluation for multitude qualitative and quantitative factors either, there is a risk or/and uncertainty. Zionts (1992) mentioned that the important
characteristic of MAUT is its capability in dealing with both stochastic and deterministic decision environments. In most financial purchases, the decision of choosing the best supplier is not easy as it includes a multitude of close entire decisions related to negotiations, financing, allocation, and assurance of product. Due to large numbers of factors that are acted upon decision, it should be referred to organized steps. Therefore, complex problem should be divided into multi-level problems in decision hierarchy form, this constraint should not be a precondition of the technique and is not committed to all applications (Zahedi, 1986).

The main disadvantage of this method is regard as unfriendliness method, and difficult to apply, high level approach, high cost, needs long time, and depressing in implementation (Forgionne, 1990)

2.4.3. The Analytical Hierarchy Process “AHP”

Saaty (1980) founded AHP technique to support decision making in different fields. Today, AHP is the common method and used by more than 200 applications in finance, marketing, industry, medicine, academic, corporate planning, sports, military, and government administration around the worldwide, (Yang and Lee, 1997). In the field of procurement, Khoramshahgol et al. (1998), Liberatore (1987), Lotfi et al. (1992), Paek et al. (1992), Min (1994), and Al-Araimi (1993), considered that “AHP” is a strong method for selecting the best supplier. AHP has the ability to exceed the limitations of other MTCDM methods.

Many characteristics of “AHP” are stared by Saaty (1994a) as:

- Easy to construct.
- Flexible for either individuals or groups.
- A process is natural to predict and default thinking.
- Promote settlement and consensus-building.
- Simple to manage, not need to professionals in order to manage or communicate.

Springer (2004) illustrate an AHP generic hierarchic structure as shown in Figure 2.

![Figure 2 Generic hierarchic structure (Springer, 2004)](image)

When the decision has taken, Saaty (1980) has identified other advantages of “AHP”,

- Easy technique for an unstructured problem.
- Easy to review and recorrecting the judgments.
- The method does not need to be a consensus but results must represent benefits from various judgements.
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- Simulating the normal direction of the human thinking to arrange elements of a system.
- Depends on the logical consistency of judgements.

2.5. Summarization MCDM Techniques
After studying these MCDM techniques, Table 1 shows the summarization for the characteristics, problem analysis, advantages, and disadvantages:

<table>
<thead>
<tr>
<th>Technique specifications</th>
<th>LGP</th>
<th>MAUT</th>
<th>AHP</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is mathematical programming method can deal with regulation pressures such as; economic, political, or social that affects the project</td>
<td>Used solve complex decision, used with Supplier selection, especially in strategic procurement.</td>
<td>solve the complex decisions by structuring, and mathematical methods, so it used with complex procurement decisions, it has powerful method to select suppliers.</td>
<td></td>
</tr>
<tr>
<td>identifies functions for the objective of each criterion</td>
<td>use organized steps in analysing the complex problem by dividing it into multi-level problems in decision hierarchy form</td>
<td>The method divide a complex problem, dividing it into many levels. Arrange these levels into a hierarchy</td>
<td></td>
</tr>
<tr>
<td>that can accomplishes various goals levels rather than focus on maximizing all objectives</td>
<td>the important characteristic of MAUT is its capability in dealing with both stochastic and deterministic decision environments</td>
<td>Easy to construct and flexible for individuals and groups. A process is natural to predict and default thinking, Easy to manage, and does not need to experts to manage and communicate.</td>
<td></td>
</tr>
<tr>
<td>It is has difficulty in drawing the format of functions and constraints. It is a not professional level technique because it uses mathematical programming</td>
<td>It is unfriendly, i.e. difficult to apply, high level approach and needs long time, high cost, and is depressing to implement</td>
<td>Very high alternatives and criteria may cause some errors due to limited number of judgment in AHP method (from 1 to 9).</td>
<td></td>
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</table>

Phase 3:

3.1. Identifying DSS Technique
The most procurement characteristics that should be available in DSS technique. AHP, Multi utility Attribute theory and linear goal programming LGP as the most multi-criteria decision-making techniques that are related with the Iraqi procurement system characteristics. A comparison study of the major procurement features for these three techniques with capabilities and strengths is presented in Table 2.
Table 2 A Comparison between DSS Techniques with Respect to Iraqi supplier selection process.

<table>
<thead>
<tr>
<th>Characteristic of Supplier Selection Process</th>
<th>AHP</th>
<th>MAUT</th>
<th>LGP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large number of criteria and alternatives</td>
<td>suitable</td>
<td>suitable</td>
<td>suitable</td>
</tr>
<tr>
<td>Multi criteria decision making environment</td>
<td>suitable</td>
<td>suitable</td>
<td>suitable</td>
</tr>
<tr>
<td>Quantitative and qualitative criteria</td>
<td>suitable</td>
<td>suitable</td>
<td>suitable</td>
</tr>
<tr>
<td>Re-buy and one time buy</td>
<td>suitable</td>
<td>suitable</td>
<td>suitable</td>
</tr>
<tr>
<td>High accountability to stockholders</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Quick and simple evaluation process</td>
<td>Relatively simple</td>
<td>complex/ slow</td>
<td>Mathematical/ slow</td>
</tr>
<tr>
<td>Cheap evaluation process</td>
<td>Relatively fast/cheap</td>
<td>Hi cost/time consuming</td>
<td>Hi cost/time consuming</td>
</tr>
<tr>
<td>Widely used in selecting supplier</td>
<td>Very popular</td>
<td>Relatively popular</td>
<td>Rare</td>
</tr>
</tbody>
</table>

Although Linear Goal Programming (LGP) and have wide used in many other areas, particularly in scientific research, however, with consideration to experts’ requirement definition of the problem, the AHP is the most decision technique has used for complex decisions to select best supplier. The AHP strengths come from its core characteristics that are its flexibility, simplicity, its balance, and its comprehensiveness. Fung (1999) emphasized the flexibility as very important point because the purchasing occurs in a dynamic, economic, political, technological and social environments and all these make the purchasing into a complex process. AHP appears as the best tool when compared with MAUT and linear goal programming in the following aspects for evaluating complex system:

- Its ability in handling qualitative criteria.
- Its ability to operate under different criteria environment effectively,
- Use simple theory with easy mathematics calculation,
- Relatively easy to apply and very interactive to ordinary procurement bids,
- Has proven records in government, academic, and industrial applications.
- Can organize wide number of criteria, sub-criteria and alternatives.
- It has built-in consistency checking mechanism.

Table 3 shows some capabilities of the Analytic Hierarchy process and its capability to match the supplier selection process characteristics, the important point in selecting “AHP” technique because to its capability to match and handle the characteristics of procurement as large numbers of quantitative and qualitative criteria and alternatives. In addition to its capability, simplicity, and flexibility in adapting with financial and technical, either
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separately or collectively, by a one or different evaluation teams and in a one or multiple sites to provide the high degree of transparency.

**Table 3** Matching between Characteristic of Iraqi Supplier Selection Process and Ability to Match AHP

<table>
<thead>
<tr>
<th>Characteristic of Selecting Supplier Process</th>
<th>AHP Matching Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large number of criteria and alternatives.</td>
<td>Able to handle with large numbers.</td>
</tr>
<tr>
<td>Multi criteria decision making environment</td>
<td>Able to handle multi criteria</td>
</tr>
<tr>
<td>Quantitative and qualitative criteria</td>
<td>Able to handle Quantitative and qualitative criteria</td>
</tr>
<tr>
<td>Re-buy and one time buy</td>
<td>Flexible</td>
</tr>
<tr>
<td>High accountability to stockholders</td>
<td>Able to provide audit trails clearly</td>
</tr>
<tr>
<td>Quick and simple evaluation process</td>
<td>Quick and simple</td>
</tr>
<tr>
<td>High degree of transparency</td>
<td>Process centric and group consensus on all decisions</td>
</tr>
</tbody>
</table>

4. CONCLUSIONS:
The research analysing the Iraqi procurement and compared it with decision making techniques, finally research finding proved that AHP is the best technique, as it easy, flexible, quick, its ability to handle multi-criteria and high number of alternatives. The adoption of the proposed DSS technique in Iraqi institutions has the potential to solve a large component of the problems caused by financial and administrative corruption.

**Future Works**
Selecting appropriate method to select the best supplier will open new idea to develop this work to draw new framework and application to simplify and manage procurement supplier selection decision making process in Iraq.

**REFERENCES**


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