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The Choice of the Best Proposal in Tendering with AHP Method: Case of Procurement of IT Master Plan's Realization

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***Abstract*—**The computer system has become one of the centerpieces in the functioning of organizations hence the importance of an IT (Information Technology) master plan to manage its development. To find a provider for the IT master plan's realization, organizations are increasingly using tendering as the mode of awarding contracts.

This article focuses on the use of multi-criteria decision-making method AHP for analysis and evaluation of tenders during the awarding of contracts of IT master plan's realization. To achieve this goal, a painstaking work was realized, on the one hand, for making an inventory of criteria and sub-criteria involved in the evaluation of bids and on the other hand for specifying the degrees of preference for each pair of criteria and each pair of sub-criteria. Finally, a test was performed by using fictitious tenders.

The goals of this work are to make available to members of tenders committee a decision support tool for evaluating tenders of IT master plan's realization submitted by bidders and endow the organizations with effective IT master plans in order to increase the performance of their information systems.

***Index Terms*—**Tendering, Procurement, IT Master Plan, AHP, Multi Criteria Decision Making, Artificial Intelligence, Decision Support.

I. INTRODUCTION

Public and private organizations increasingly use IT master plan for leading the development of the computer system which is an essential element for their operations[1]. Thus, public and private procurement of IT master plans' realization are becoming more frequent.

Organizations in order to ensure their tasks need to purchase goods or services or to execute works. These purchases designated by the term "procurement" play a considerable economic role and have a significant economic weight [2] estimated at about 20% of global GDP [3].

The award of contracts is a sensitive area as the economic interests at stake are huge[3,4]. There are several modes for the awarding of contracts including tendering [5] which can be defined as a process that allows to emit a request for works, services and goods to businesses and then choose the provider after analysis of proposals according to predetermined criteria without negotiation [6]. There are two main types of tendering: the open tendering (any business can submit a bid) and restricted tendering (only businesses which have been authorized after pre-selection can submit tenders)[7].

To satisfy stakeholders, the open tendering is used as a natural mode of the award of contracts [4] for many reasons such as the opportunity that it gives to all businesses to win the contract and the competition between bidders which improves the quality of the deliveries. The use of restricted tendering or other contracts' awarding modes must be justified [8].

However, many problems exist in the tendering process [9]. The most important of them remains corruption [2,9-11] which often occurs during the most crucial step namely the step of analysis and evaluation of tenders [4]. Apart from corruption, the inefficiency of the methods of analysis and evaluation of tenders may favor the selection of another tender to the detriment of the best[8].

The analysis and evaluation of tenders is a decisive step in the tendering process because tenders badly analyzed and evaluated compromise the choice of the best tender and this has harmful consequences on the service quality but worse, it creates a confidence crisis between providers and the contracting authorities [12, 13]. The principle established to analyze and evaluate tenders is based on the use of awarding criteria [14]. These criteria must be designed so as be non-discriminatory and linked to the object of the contract. Thus, the selection of the best tender can be characterized as a multiple criteria decision-making (MCDM) problem. A major part of decision-making involves the analysis of a set of alternatives described in terms of evaluative criteria. In order to find the most suitable alternative or determine the relative priority of each alternative, they must be ranked [15].

A frequently used method to solve the multi-criteria decision-making problem is AHP (Analytic hierarchy process) method [16-19]. The AHP method has been developed by the mathematician Thomas Saaty Lorie[20, 21]. It is a powerful and flexible method of decision support applied for solving simple and complex problems in many situations [22, 23].

One of the main advantages of AHP method is its simplicity compared to many decision support methods[24-25]. Also, one of its key strengths is its ability to handle quantitative and qualitative criteria in the same decision-making problem [26, 27]. AHP method provides, moreover, the possibility of establishing a hierarchical structure of the criteria allowing the decision makers to define specific criteria and sub-criteria to facilitate the phase of definition of preference degrees[28].

The aim of this work is to propose a decision making tool that allows selecting the best tender during the award of contracts of IT master plan's realization. To achieve that, the AHP method has been used for its performance and its great success in published works.

The remainder of this paper is structured as follows. Section 2 provides a related work with regard to artificial intelligence methods particularly MCDM methods used for the selection of the best proposal in tendering. Section 3 gives a description of IT master plan. Section 4 provides the theory of AHP method. The results of the AHP method's implementation in awarding of contracts of IT master plan's realization are described in section 5. The paper ends with concluding remarks and avenues for future research in section 6.

II. Related Work

To improve the process of selecting the best tender, many solutions based on artificial intelligence methods particularly on multi-criteria decision making methods have been proposed[29-32].

Tsai and Chou have worked on the establishment of a fuzzy system for online contracts award which allows bidders to submit tenders online. The tenders will be evaluated online by the fuzzy system according the awarding criteria [33].

Diabagaté, Azmani and EL Harzli have proposed a new method of analysis and evaluation of tenders based on the use of fuzzy logic and rule of proportion [34].

For contracts of construction works, Yang, Qu and Zu have, firstly, introduced a new evaluation index system which uses quantitative analysis in order to avoid error induced by the subjectivity of the qualitative analysis. Secondly, they proposed an improved back-propagation neural network as an evaluation method of tenders. These results permit to obtain a simple and practical process of evaluation[35].

Regarding the multi-criteria decision making methods, there are two main approaches in published research related to the selection of the best tender. The approach which proposes a decision support tool based on a MCDM method for all types of contracts and the approach which addresses a specific type of contracts. For the first approach, Han-Chen Huang has proposed a weighted analysis on evaluation criteria of the most advantageous bid [36] for all types of contracts by using FAHP method. The disadvantage of this approach is its inability to take into account all specificities of the contracts. Indeed, there are several types of contracts and each type presents some particular specificities. This disadvantage explains the fact that most of the published researches adopt the second approach by addressing a specific type of contract.

There are several MCDM methods. Among these methods, AHP seems to be a very popular method and has been widely applied to deal with various complex decision-making problems mainly in the problem of selecting of the best tender [15].

Priya, Iyakutti and Devi have developed a decision support system in the context of the dematerialization of public procurement for the choice of the best tender among which proposed by auto manufacturing companies. They integrated AHP method in this E-procurement system for the selection of the best proposal [37].

Akarte et al. developed a web-based AHP system to evaluate the casting suppliers with respect to eighteen criteria. In the system, suppliers had to register, and then input their casting specifications. To evaluate the suppliers, buyers had to determine the relative importance weightings for the criteria based on the casting specifications, and then assigned the performance rating for each criterion using a pairwise comparison [38].

Atanasova-Pacemska, Lapevski and Timovski proposed a decision making tool for the choice of the best economic offer for purchase of computer equipment, especially purchase of desktop computers. In this research, the selection criteria according to which the selection of the best tender will be made is in accordance with the Law on Public Procurement of the Republic of Macedonia[39].

Chan et al. developed an AHP-based decision making approach to solve the supplier selection problem. Potential suppliers were evaluated based on fourteen criteria. A sensitivity analysis using Expert Choice was performed to examine the response of alternatives when the relative importance rating of each criterion was changed [16].

Dang and Zhiguo have proposed a method to quantify the relationship between object and factors in bidding universities procurement of materials, based on the AHP method and the analysis of the representative factors in bidding decision[40].

In the literature, we have not found the published research which address the selection of the best tender during awarding of contracts of IT master plan's realization. This fact reflects the great importance of this work which can be considered as a reference by organizations during the calls for tenders for the realization of IT master plans.

III. IT Master Plan

The IT master plan is a strategic plan intended for piloting the development of IT in an organization. It allows having a computer system that meets the strategic options of the Directorate General. Its starting point is the strategy of an organization to reach the definition of a target in terms of IT and information system. The realization of an IT master plan aims at many objectives such as:

- the urbanization of the computer system
- the modernization of IT infrastructures (hardware and software)
- the reduction of IT costs
- the accompaniment of the launch of strategic projects
- the creation of monitoring indicators
- the multi-sites deployment of the computer system

Many organizations are implementing IT master plan given its importance for the planning and development of their information systems[41]. The main steps in the implementation of an IT master plan are to:

- take cognizance of the strategy
- carry out an overview of the existing
- express the needs
- set the priorities
- develop scenarios to reach the targets
- define an action plan to achieve the chosen target

After its realization, the IT master plan is a document which generally includes:

- a description of the business processes of the organization
- a mapping of the computer system and its functional architecture
- a description of the IT processes
- the application architecture of the computer system
- the technical architecture of the computer system
- an inventory of technologies (hardware and software) and IT assets
- a technical and economic analysis of the opportunity to computerize all or part of every business process
- a assessment of the budgetary aspects of projects (technology costs, implementation costs, costs related to change)
- a plan of deployment and control

IV. Theory of AHP Method

The implementation of AHP method is based , firstly, on the construction of the matrices of judgment, the determination of the priority vectors containing the weights of criteria and sub-criteria, the study of the consistency of judgment matrices and secondly on a comparative study of alternatives in order to choose the best[20,42]. The mathematical theory of the step of the comparative study of alternatives is similar to that of the determination of the priority vectors.

A. Construction of Matrices of Judgment

In the matrix of judgment, the decision maker sets the preferences he has with respect to each pair of criteria and each pair of sub-criteria[20,43-44]. These preferences, which are expressed as verbal forms are converted to digital forms according to the table (1) [47-49].

Table 1. Table of preferences' equivalency

Linguistic scale	Digital scale
The two criteria A and B are equal	1
The criterion A moderately dominates the criterion B	3
The criterion A strongly dominates the criterion B	5
The criterion A very strongly dominates the criterion B	7
The criterion A is absolutely dominant	9
Intermediate values to refine judgments	2, 4, 6, 8

Let $(C_j)_{1\le j\le p}$ and A be respectively the set of criteria and the matrix of judgment. A is defined as follows:

$$A = \begin{pmatrix} c_{11} & c_{12} & \cdots & \cdots & c_{1p} \\ c_{21} & c_{22} & \cdots & \cdots & \cdots \\ \cdots & \cdots & \ddots & \cdots & \cdots \\ \cdots & \cdots & \cdots & \ddots & \cdots \\ c_{p1} & \cdots & \cdots & \cdots & c_{pp} \end{pmatrix} = (c_{jm})_{1\le j,m\le p} \quad (1)$$

Where:

- c_{jm} is the preference degree of criterion C_j on the criterion C_m
- $c_{jm} = 1\ \forall\ j = m\ \ and\ \ c_{jm} = {}^{1}/_{c_{mj}}\ \forall\ j, m$

B. Determination of Weight Vector (Priority Vector)

For synthesizing the judgment matrix of criteria [28], two quantities S_m and t_{jm} are defined as follows:

$$S_m = \sum_{j=1}^{p} c_{jm} \quad \forall\ m = 1 \quad (2)$$

$$t_{jm} = {}^{c_{jm}}/_{S_m} \quad \forall\ j, m = 1, \dots, p \quad (3)$$

To classify criteria in order of priority, the priority degree P_j of each criterion C_j is obtained as follows:

$$P_j = \frac{1}{p} * \tilde{P}_j \;\; \forall j = 1, \dots, p \quad where \quad \tilde{P}_j = \sum_{m=1}^{p} t_{jm} \tag{4}$$

The most important criterion C_M is the criterion which priority degree P_M is such that:

$$P_M = \frac{1}{p}\sum_{m=1}^{p} t_{Mm} > P_j = \frac{1}{p}\sum_{m=1}^{p} t_{jm} \quad \forall j \neq M$$

C. Study of Consistency of Judgment Matrix

After the construction of judgment matrices and determination of priority vectors, the consistency of each matrix must be studied[20,42,48]. To achieve this, a ratio is calculated to reflect the degree of consistency. A radio more than 0.1 indicates a too high level of inconsistency [45,47,50].

Suppose T, T_R and λ_{max} defined as follows:

$$T = (T_j)_{1\le j\le p} = P_1 * \begin{pmatrix} c_{11} \\ c_{21} \\ \vdots \\ \vdots \\ c_{p1} \end{pmatrix} + \cdots + P_p * \begin{pmatrix} c_{1p} \\ c_{2p} \\ \vdots \\ \vdots \\ c_{pp} \end{pmatrix} \tag{5}$$

$$T = \sum_{j=m=1}^{p} P_j * C_m \quad where\; C_m = \begin{pmatrix} c_{1m} \\ c_{2m} \\ \vdots \\ \vdots \\ c_{pm} \end{pmatrix} \tag{6}$$

$$T_R = \begin{pmatrix} T_{R_1} \\ T_{R_2} \\ \vdots \\ \vdots \\ T_{R_p} \end{pmatrix} = \begin{pmatrix} T_1/P_1 \\ T_2/P_2 \\ \vdots \\ \vdots \\ T_p/P_p \end{pmatrix} \tag{7}$$

$$\lambda_{max} = \frac{1}{p}\sum_{j=1}^{p} T_{R_j} \tag{8}$$

The consistency index IC and the ratio of coherence RC are defined respectively as follows:

$$IC = \frac{\lambda_{max} - p}{p-1} \tag{9}$$

$$RC = \frac{IC}{IA} \tag{10}$$

The index IA varies according to the number of criteria and it is given by the table (2) [47,50-52]:

Table 2. Table of indices IA

Number of criteria	3	4	5	6	7	8	9	10
IA	0,58	0,90	1,12	1,24	1,32	1,41	1,45	1,49

V. Application of AHP Method in Contracts Award of IT Master Plan's Realization

This section describes the different steps and results of the application of AHP method for the evaluation of tenders of IT master plan's realization.

A. Identification of Criteria, Sub-Criteria and Preference Degrees

The identification of criteria, sub-criteria and their weights is a crucial step toward the implementation of the AHP method. In this study, the approach adopted has been to consult several tender documents gathering expertise from many experts about criteria, sub-criteria and weighting. Tender documents about IT master plan realization from different countries have been consulted.

The process of identification of criteria has been done in two main phases. In the first phase, the expertise of experts who have participated in the drafting of the several consulted tender documents allowed identifying criteria, sub-criteria and weights.

A similar work has been done in the second phase to consolidate the results of the first phase and establish the definitive list of criteria, sub-criteria and their weights.

The table 3 contains some of the many tender documents that have been consulted.

Table 3. Some tender documents consulted

Contracts	**Country**
Tender documents of the IT master plan's realization of ANAPEC (National Agency for Promotion of Employment and Skills)	Morocco
Tender documents of the realization of an IT master plan for the period 2013-2017 of Loire-Bretagne water Agency	France
Tender documents of the realization of an IT master plan for the ministry of higher education, training of managers and scientific research for the period of 2012-2016	Morocco
Tender documents of the realization of an IT Master Plan for Mauritania Central Bank	Mauritania
Tender documents of the realization of an IT master plan dedicated to the health surveillance of Saint-Maurice	Guyana
Tender documents of the realization of an IT Master Plan for the city of Pessac	France
Tender documents of the IT Master Plan's realization of MDJS (Moroccan Company of Games and Sports)	Morocco

This approach allowed, on the one hand, to identify all criteria and sub-criteria and on the other hand to have a good appreciation of preference degrees of each pair of criteria and each pair of sub-criteria.

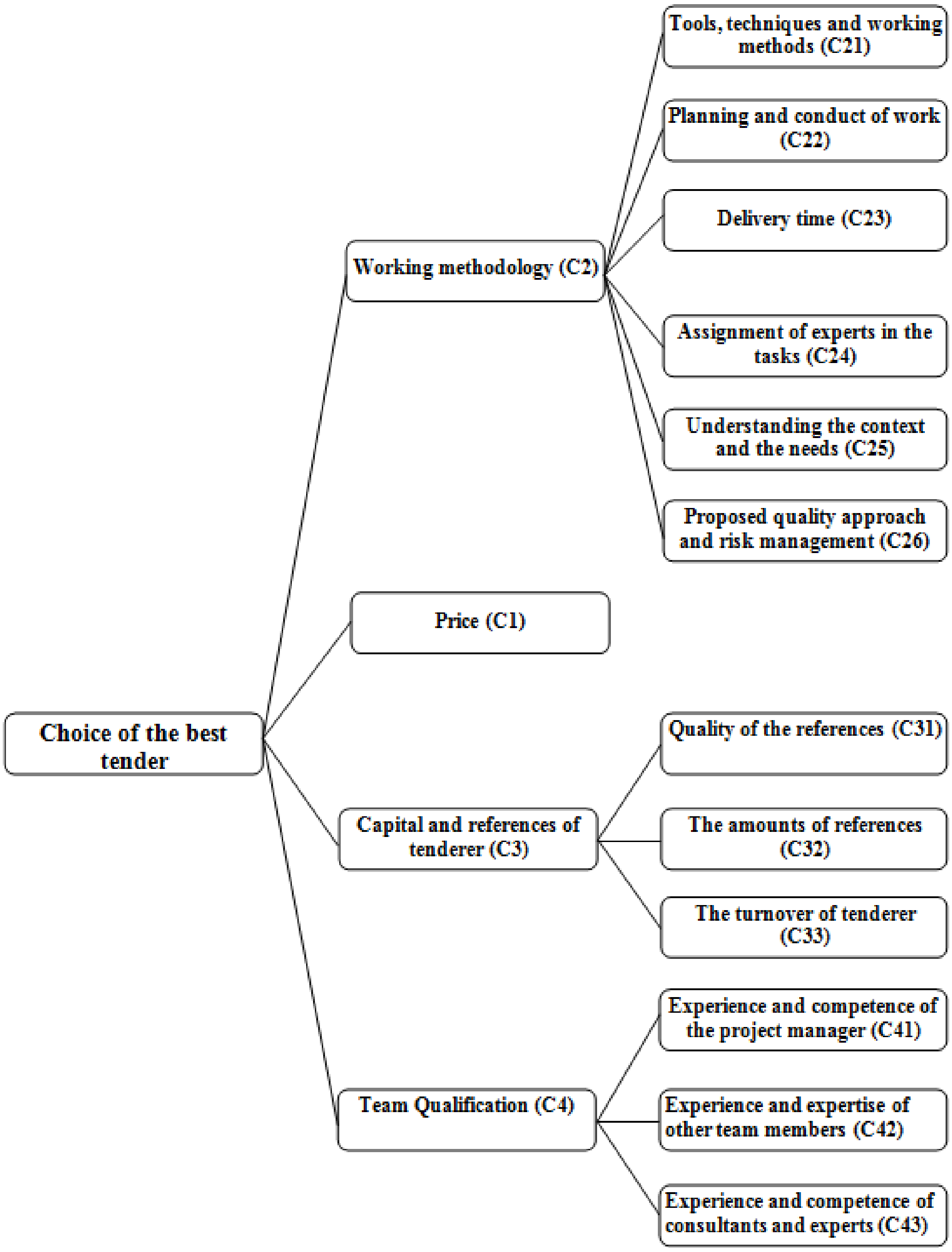

Fig. 1. Hierarchy of criteria and sub-criteria for evaluation of tenders

The Fig.1 presents in a hierarchical structure all criteria and sub-criteria for the implementation of AHP method.

B. Construction of Judgment Matrix of Criteria and Determination of the Priority Vector

The tables 4 and 5 contain respectively the judgment matrix of criteria and the calculations of the priority vector. The most important criterion is the criterion "Price" with a weight of 0.61. It is followed by the criteria "Team Qualifications" and "Working methodology" having respectively weight of 0.199 and 0.121.

Table 4. Judgment Matrix of criteria

	Price	Working methodology	Capital and references	Team Qualification
Price	1	5	7	4
Working methodology	1/5	1	2	1/2
Capital and references	1/7	1/2	1	1/3
Team Qualification	1/4	2	3	1

Table 5. Calculation of criteria's priority vector

Criteria	t_{j1}	t_{j2}	t_{j3}	t_{j4}	$\tilde{P}_j$	**Weight** (P_j)
Price	0,63	0,59	0,54	0,69	2,44	0,610
Working methodology	0,13	0,12	0,15	0,09	0,48	0,121
Capital and references	0,09	0,09	0,08	0,06	0,28	0,071
Team Qualification	0,157	0,26	0,23	0,17	0,79	0,199

Table 6. Study of consistency of judgment matrix

$P_1 * C_1$	$P_2 * C_2$	$P_3 * C_3$	$P_4 * C_4$	T_j	T_{R_j}
0,61	0,60	0,49	0,79	2,50	4,10
0,12	0,12	0,14	0,1	0,48	4,00
0,09	0,06	0,07	0,07	0,28	4,03
0,15	0,24	0,21	0,2	0,80	4,05
$\lambda_{max} = \frac{1}{4}\sum_{j=1}^{4} T_{R_j} = 4{,}04544494$; $IC = \frac{\lambda_{max}-4}{4-1} = 0{,}01514831$					
$IA = 0{,}9$ and $RC = \frac{IC}{IA} = 0{,}01683146$					

Table 6 displays the results about the study of judgment matrix's consistency. The ratio of coherence RC is much lower than 0,1 therefore the degree of consistency is very satisfying.

C. Construction of Judgment Matrices of Sub-Criteria and Determination of the Priority Vectors

The tables 7, 8 and 9 present respectively the judgment matrix of sub-criteria of criterion "Work Methodology (C2)", the calculations of the associated priority vector and the results of the study of judgment matrix's consistency.

Table 7. Judgment matrix of sub-criteria of criterion "Working Methodology"

	C21	**C22**	**C23**	**C24**	**C25**	**C26**
C21	1	5	8	6	2	8
C22	1/5	1	2	3	1/3	2
C23	1/8	½	1	1/2	1/5	1/2
C24	1/6	1/3	2	1	1/6	2
C25	1/2	3	5	6	1	5
C26	1/8	½	2	1/2	1/5	1

Table 8. Calculation of priority vector for sub-criteria of criterion "Working Methodology"

	t_{j1}	t_{j2}	t_{j3}	t_{j4}	t_{j5}	t_{j6}	$\tilde{P}_j$	**Weight (P_j)**
C21	0,47	0,48	0,40	0,35	0,51	0,43	2,66	0,442
C22	0,09	0,1	0,10	0,18	0,09	0,11	0,66	0,110
C23	0,06	0,05	0,05	0,03	0,05	0,03	0,27	0,044
C24	0,08	0,03	0,10	0,06	0,04	0,10	0,42	0,070
C25	0,24	0,29	0,25	0,35	0,26	0,27	1,66	0,276
C26	0,06	0,05	0,10	0,03	0,05	0,05	0,34	0,057

Table 9. Study of judgment matrix consistency

$P_1 * C_1$	$P_2 * C_2$	$P_3 * C_3$	$P_4 * C_4$	$P_5 * C_5$	$P_6 * C_6$	T_j	T_{R_j}
0,44	0,55	0,46	0,42	0,55	0,46	2,88	6,51
0,09	0,11	0,11	0,21	0,09	0,11	0,73	6,62
0,06	0,06	0,06	0,04	0,06	0,029	0,29	6,48
0,07	0,04	0,11	0,07	0,05	0,11	0,45	6,49
0,22	0,33	0,29	0,42	0,28	0,29	1,82	6,6
0,06	0,06	0,11	0,04	0,06	0,06	0,37	6,52
$\lambda_{max} = \frac{1}{6}\sum_{j=1}^{6} T_{R_j} = 6{,}53212604$; $IC = \frac{\lambda_{max}-6}{6-1} = 0{,}10642521$							
$IA = 1{,}24$, on a $RC = \frac{IC}{IA} = 0{,}08582678$							
RC is very less than 0,1 so the degree of consistency is very satisfying.							

The tables 10, 11 and 12 display respectively the judgment matrix of sub-criteria of criterion "Capital and References (C3)", the calculations of the associated priority vector and the results of the study of judgment matrix's consistency.

Table 10. Judgment matrix of sub-criteria of criterion "Capital and references"

	C31	**C32**	**C33**
C31	1	6	3
C32	1/6	1	1/3
C33	1/3	3	1

Table 11. Calculation of priority vector for sub-criteria of criterion "Capital and references"

	t_{j1}	t_{j2}	t_{j3}	$\tilde{P}_j$	**Weight (P_j)**
C31	0,67	0,6	0,69	1,96	0,65
C32	0,11	0,1	0,08	0,29	0,1
C33	0,22	0,3	0,23	0,75	0,25

Table 12. Study of consistency of judgment matrix

$P_1 * C_1$	$P_2 * C_2$	$P_3 * C_3$	T_j	T_{R_j}
0,65	0,58	0,75	1,98	3,04
0,19	0,1	0,08	0,29	3,00
0,22	0,29	0,26	0,76	3,01
$\lambda_{max} = \frac{1}{3}\sum_{j=1}^{3} T_{R_j} = 3{,}01834729; IC = \frac{\lambda_{max}-3}{3-1} = 0{,}00917365$				
$IA = 0{,}58$, on a $RC = \frac{IC}{IA} = 0{,}01581663$				
RC is much lower than 0,1 therefore the degree of consistency is very satisfying.				

The tables 13, 14 and 15 present respectively the judgment matrix of sub-criteria of criterion "Team Qualification (C4)", the calculations of the associated priority vector and the results of the study of judgment matrix's consistency.

Table 13. Judgment matrix of sub-criteria of criterion "Team qualification"

	C41	**C42**	**C43**
C41	1	1/5	3
C42	5	1	7
C43	1/3	1/7	1

Table 14. Calculation of priority vector for sub-criteria of criterion "Team qualification"

	t_{j1}	t_{j2}	t_{j3}	$\tilde{P}_j$	**Weight (P_j)**
C41	0,16	0,15	0,27	0,58	0,19
C42	0,79	0,74	0,64	2,17	0,72
C43	0,05	0,15	0,09	0,25	0,083

t_{j1}	t_{j2}	t_{j3}	$\tilde{P}_j$	**Priorit é (P_j)**	t_{j1}
0,16	0,15	0,27	0,58	0,19	0,16
0,79	0,74	0,64	2,17	0,72	0,79
0,05	0,15	0,09	0,25	0,083	0,05

Table 15. Study of consistency of judgment matrix

$P_1 * C_1$	$P_2 * C_2$	$P_3 * C_3$	T_j	T_{R_j}
0,19	0,14	0,25	0,59	3,04
0,97	0,72	0,58	2,27	3,14
0,064	0,10	0,08	0,25	3,01
$\lambda_{max} = \frac{1}{3}\sum_{j=1}^{3} T_{R_j} = 3{,}06581867; IC = \frac{\lambda_{max}-3}{3-1} = 0{,}03290934$				
$IA = 0{,}58$, on a $RC = \frac{IC}{IA} = 0{,}05674023$				
RC is much lower than 0,1 therefore the degree of consistency is very satisfying.				

The table 16 shows the weights of the sub-criteria of each criterion. The criterion "Price" has no sub-criterion therefore it doesn't appear in the table.

Table 16. Summary table of sub-criteria's weights

Criterion Working methodology (C2)						
Sub-criterion	C21	C22	C23	C24	C25	C26
Weight of sub-criterion	0,442	0,110	0,044	0,070	0,276	0,057
Criterion Capital et References (C3)						
Sub-criterion	C31	C32	C33			
Weight of sub-criterion	0,653	0,096	0,251			
Criterion Team Qualification (C4)						
Sub-criterion	C41	C42	C43			
Weight of sub-criterion	0,193	0,724	0,083			

D. Comparison of Tenders and Determination of the Best

This section consists in doing a test with three tenders O_1, O_2, O_3. The table 17 gives the comparison matrix of the three tenders for the criterion "Price" and the weights of tenders.

For the criteria which have sub-criteria, the table 18 contains the weights of the tenders according to sub-criteria of each criterion. The weights of tenders according criteria that have sub-criteria are calculated by the weighted sum of the weights of sub-criteria and the weights of tenders according sub-criteria [52].

Table 18. The weights of tenders at sub-criteria level

Criterion "Working methodology (C2)"							
Sub-criterion	C21	C22	C23	C24	C25	C26	
Weight of sub-criterion	0,442	0,110	0,044	0,070	0,276	0,057	
Tender	**Weights of tenders at sub-criteria level**						**Weight of tender**
O_1	0,68156288	0,7504068	0,0824043	0,6	0,16759411	0,6267081	0,5119552
O_2	0,23644689	0,1622026	0,3151245	0,3	0,73797054	0,1099379	0,3674159
O_3	0,08199023	0,0873906	0,6024712	0,1	0,09443535	0,263354	0,1206289
Criterion "Capital et References (C3)"							
Sub-criterion	C31	C32	C33				
Weight of sub-criterion	0,653	0,096	0,251				
Tender	**Weights of tenders at sub-criteria level**						**Weight of tender**
O_1	0,7272727	0,5812636	0,0819902				0,5512901
O_2	0,1818182	0,3091503	0,2364469				0,2077552
O_3	0,0909091	0,1095861	0,6815629				0,2409547
Criterion "Team Qualification (C4)"							
Sub-criterion	C41	C42	C43				
Weight of sub-criterion	0,193	0,724	0,083				
Tender	**Weights of tenders at sub-criteria level**						**Weight of tender**
O_1	0,0926219	0,5812636	0,6666667				0,4939796
O_2	0,6150198	0,3091503	0,2222222				0,3609982
O_3	0,2923584	0,1095861	0,1111111				0,1450222

Table 17. Comparison matrix of tenders according the criterion "Price" and the associated weight vector

$C1$	O_1	O_2	O_3	W_{C1}
O_1	1	2	5	0,59
O_2	1/2	1	2	0,28
O_3	1/5	½	1	0,13

The final results of comparison of tenders according to criteria are displayed in the table 19. The tender $\boldsymbol{O_1}$ is the best with a score of 0.56.

Table 19. Results of comparison of tenders at criteria level

	$\boldsymbol{O_1}$	$\boldsymbol{O_2}$	$\boldsymbol{O_3}$	**Weights of criteria**
C1	0,59488796	0,27661064	0,1285014	0,61005345
C2	0,51195524	0,36741589	0,12062886	0,12069201
C3	0,55129012	0,20775517	0,24095471	0,07064389
C4	0,49397959	0,36099824	0,14502217	0,19861065
Scores of tenders	**0,56175724**	**0,29946617**	**0,13877659**	

VI. Conclusion and Perspectives

The IT master plan that allows planning and managing the development of the computer systems derives its importance in the central role of the computer systems in the functioning of organizations. Aware the importance of the IT master plan, many organizations are working on the establishment of an IT master plan and they increasingly use tendering to find a provider able to put in place an effective IT Master plan. This allows them to create a competition between several providers with a view to choosing the one that proposes the best proposal.

However, as others public and private contracts, the awarding of contracts IT master plan's realization by using tendering faces the problematic of choosing the best tender among those proposed by the bidders.

The present work is a response to this problematic by proposing a decision support tool that has been thoughtfully designed for facilitating the choice of the best tender. This tool was built by using the multi-criteria decision-making method AHP after making an inventory of criteria and sub-criteria involved in the evaluation of tenders of IT master plan's realization and after specifying the degrees of preference for each pair of criteria and each pair of sub-criteria.

Such work aims to improve the step of the evaluation of tenders of IT master plan's realization and endow the organizations with effective IT Master Plan for a strategic steering of the development of their information systems.

In terms of perspective, we are working to integrate the principles of fuzzy set with FAHP method to overcome the limits of classical logic in order to make the proposed tool more effective.

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