A Multi-Criteria Decision-Making Model for ERP Selection in Moroccan SMEs Using Fuzzy AHP

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Abstract—Today, selecting an Enterprise Resource Planning (ERP) system has become a strategic decision for Small and Medium-sized Enterprises (SMEs) seeking to improve their operational efficiency, modernize their information systems, and strengthen their competitiveness in an increasingly digitalized environment. In this context, identifying the most relevant ERP selection criteria is essential to support decision-makers in choosing the solution that best fits their organizational and strategic needs. However, previous studies have generally examined ERP selection criteria from a broad perspective, without prioritizing their relative importance according to the specific context of SMEs. The objective of this study is therefore to identify and prioritize the ERP selection criteria that are most critical for Moroccan SMEs, as well as to propose a decision-making model that supports ERP evaluation and selection. To achieve this objective, a mixed-methods approach was adopted. Semi-structured interviews with ERP professionals and practitioners were conducted to identify the most relevant criteria in the Moroccan SME context. In addition, the Fuzzy Analytic Hierarchy Process (Fuzzy AHP) method was used to evaluate and weight these criteria under conditions of uncertainty and subjective judgment. The results reveal that functional scope is the most critical criterion in ERP selection, followed by ease of use and total cost. Technical criteria such as compatibility and security are considered moderately important, whereas scalability appears to have less influence on the selection decision. Based on these findings, a decision-making model is proposed to help SMEs evaluate ERP alternatives more effectively and reduce the risks associated with ERP selection. This research contributes to the existing ERP literature by providing a structured and prioritized analysis of ERP selection criteria specifically adapted to Moroccan SMEs. It also offers ERP consultants and decision-makers a practical framework for assessing ERP solutions and improving the quality and reliability of ERP selection decisions.

Keywords—ERP selection; Fuzzy AHP; Moroccan SMEs; multi-criteria decision-making; information systems; decision framework; digital transformation

I. Introduction

In an ERP, the business processes related to procurement, sales, finance, inventory, and customer relationships can be managed in an efficient way by centralizing and integrating them into one information system. However, implementing an ERP within SMEs represents a significant investment and requires time before it can be fully integrated into the business.

In order to improve their productivity, increase their efficiency, and make themselves better prepared to tackle the challenges in the highly competitive environment, some companies, including Moroccan SMEs, have opted for ERP adoption within their IS.

Consequently, choosing an ERP should not be a hasty decision. It requires a very thorough analysis of several factors, including organizational structure, business processes, business objectives, and user expectations. Given the wide variety of ERP solutions available, selecting the most suitable ERP is a major strategic decision [1].

This decision depends largely on the definition of selection criteria and their prioritization. Indeed, the selected criteria have a direct influence on the success of the ERP implementation within the company. Clearly ranking these criteria by priority helps effectively guide the selection process and accelerate decision-making.

Given the high costs associated with ERP implementation, it is essential to ensure that the chosen solution effectively meets the company's needs [2]. Companies that succeed in this choice are often those that have a strong grasp of their business processes as well as the needs of their employees.

Research has been conducted to assist companies in their selection process [3,4,5,6,7]. However, there is a lack of research aimed at identifying the criteria for selecting an ERP as well as a decision-making model for ERP selection, particularly in the context of Moroccan SMEs.

In this context, this study aims to identify and prioritize ERP selection criteria, as well as to propose a decision-making model for ERP selection in Moroccan SMEs.

II. Literature Review

Numerous studies have proposed decision-making models and methods—particularly those based on multi-criteria approaches—to structure the ERP selection process. Table I provides an overview of the key studies identified in the literature regarding the selection of ERP.

After reviewing the literature, we found that there is no multi-criteria decision-making model for selecting an ERP within Moroccan SMEs. The studies were conducted in contexts different from that of Moroccan SMEs, which limits their applicability to this context.

TABLE I. SUMMARY OF STUDIES ON ERP SÉLECTION

Authors	Country	Abstract
[3]	United Arab Emirates	Identifies and ranks the critical factors for ERP selection in UAE ports using FDM and RII, highlighting cybersecurity and stakeholder integration as priorities.
[8]	Turkey	Proposes a hybrid method combining hesitant fuzzy cross-entropy and probabilistic hesitant fuzzy COPRAS for ERP selection, improving the ranking of alternatives based on multiple criteria.
[9]	Indonesia	Proposes a hybrid Fuzzy AHP–TOPSIS method for selecting an open-source ERP for SMEs in Indonesia, emphasizing system quality (security, reliability) as a key criterion.
[4]	India	Uses Fuzzy AHP to select ERP systems and ERP consultants. Identifies the following as key criteria: reputation, ERP experience, and cost.
[5]	India	Analyzes the factors influencing ERP selection using Fuzzy AHP. Cost is the primary criterion, followed by usability and business requirements.
[10]	Portugal	Develops a hybrid MCDM model combining MMASSI/IT and AHP to evaluate and select an ERP, validated in an industrial setting.
[6]	Turkey	Proposes a multi-criteria decision-making (MCDM) approach that combines fuzzy ANP and GRA to select an ERP while accounting for uncertainty, thereby improving the ranking of alternatives.
[11]	India	Proposes a framework that incorporates critical success factors (CSFs) into ERP selection and introduces a Fuzzy TOPSIS approach to improve decision-making.

III. RESEARCH QUESTIONS

Given this gap in the literature, this study aims to answer the following question:

What are the most relevant criteria for selecting an ERP in Moroccan SMEs, and how can these criteria be organized to develop a decision-making model for ERP selection tailored to their specific context?

We will attempt to answer this central question through the following sub-questions:

1) What are the key criteria to consider when selecting an ERP for Moroccan SMEs?

2) Which criteria have the greatest influence on the selection of an ERP for Moroccan SMEs?

3) How can we develop a decision-making model for ERP selection that is relevant, practical, and tailored to Moroccan SMEs?

IV. RESEARCH METHODOLOGY

To answer these research questions, we adopted a mixed research method.

A. Qualitative Research Method

To answer the first question, we adopted a qualitative research method to identify the criteria for selecting an ERP within Moroccan SMEs. To this effect, semi-structured interviews were conducted among employees working for SMEs of Morocco, including IT managers, financial specialists, and key users, alongside experts. Such an interviewing technique would enable us to adopt both functional and specialist views. The respondents have been carefully chosen based on a targeted sampling technique, where preference was given to those with past experience in ERP systems' usage and selection.

37 participants were interviewed for a period ranging from 30 to 45 minutes. The number of interviewees used was decided upon using the concept of theoretical saturation, meaning that additional interviews were stopped once they no longer yielded significantly new information.

Analysis of the obtained data helped determine the most prevalent and significant criteria. This enabled the creation of a structured list of ERP selection criteria within Moroccan SMEs, which was subsequently used in a quantitative analysis to evaluate and prioritize them.

B. Fuzzy Analytic Hierarchy Process

To answer the second question, we adopted a multi-criteria approach using the Fuzzy AHP.

AHP is a methodology for multi-criteria decision making. It allows structuring any complicated decision by hierarchically organizing decision criteria and assigning weights to them according to expert evaluations [12]. Expert evaluations could sometimes include some degree of vagueness. Therefore, a modification of AHP that includes fuzziness in the process was developed [13].

Data for this section of the research were collected from employees of SMEs operating in Morocco, including companies that have introduced an ERP solution and others who haven't yet used any similar software solutions. Participants were asked to make pairwise comparisons between the various identified criteria in order to assess their relative importance in the ERP selection process.

The method applied consists of five main steps: constructing the fuzzy comparison matrix, calculating fuzzy sums, determining synthetic values, defuzzifying weights, and final normalization.

1) Construction of the fuzzy comparison matrix

a) Define the criteria

List the criteria:

$$C_1, C_2, \ldots, C_N$$

b) Pairwise Comparison (Question for employees): The criteria are compared in pairs by employees in order to assess their relative importance in the ERP selection process.

For each pair C_i, C_j, participants are asked to indicate which criterion is more important and to what extent.

c) Conversion to a Triangular Fuzzy Number (TFN): Each response is converted to a Triangular Fuzzy Number:

$$\tilde{a}_{\{ij\}} = \left(l_{\{ij\}}, m_{\{ij\}}, u_{\{ij\}}\right)$$

Interpretation:

- l = lowest possible value
- m = most likely value

- u = highest possible value

Linguistic judgments are converted into fuzzy numbers according to the scale shown in Table II.

TABLE II. CONVERTING LINGUISTIC JUDGMENTS INTO TRIANGULAR FUZZY NUMBERS

Linguistic variables	Fuzzy scale	Corresponding fuzzy scale
Equally important	(1, 1, 1)	(1, 1, 1)
Moderately important	(1/2, 1, 3/2)	(2/3, 1, 2)
Important	(3/2, 2, 5/2)	(2/5, 1/2, 2/3)
Very important	(5/2, 3, 7/2)	(2/7, 1/3, 2/5)
Extremely important	(7/2, 4, 9/2)	(2/9, 1/4, 2/7)

d) Aggregation (average) when there are multiple consultants: When multiple employees participate in the evaluation, and each provides (l_k, m_k, u_k), then the final cell is:

$$l_{\{ij\}} = \frac{1}{K}\sum_{k=1}^{k} l_{i,j}^{(K)}$$

$$m_{\{ij\}} = \frac{1}{K}\sum_{k=1}^{k} m_{i,j}^{(K)}$$

$$u_{\{ij\}} = \frac{1}{K}\sum_{k=1}^{k} u_{i,j}^{(K)}$$

where, K represents the number of employees.

Therefore:

$$\tilde{a}_{\{ij\}} = \left(\frac{1}{K}\sum_{k=1}^{k} l_{i,j}^{(K)}, \frac{1}{K}\sum_{k=1}^{k} m_{i,j}^{(K)}, \frac{1}{K}\sum_{k=1}^{k} u_{i,j}^{(K)}\right)$$

e) Consistency rules for the matrix

Diagonal

A criterion compared to itself is equal to:

$$\tilde{a}_{\{ii\}} = (1,1,1)$$

Reciprocal (inverse)

If:

$$\tilde{a}_{\{ij\}} = (l, m, u)$$

So:

$$\tilde{a}_{\{ji\}} = \tilde{a}_{\{ij\}}^{\{-1\}} = \left(\frac{1}{u}, \frac{1}{m}, \frac{1}{l}\right)$$

f) Result of this step

We obtain the fuzzy comparison matrix:

$$\tilde{A} = \begin{bmatrix} 1,1,1 & \tilde{a}_{\{12\}} & \tilde{a}_{\{13\}} & \tilde{a}_{\{14\}} & \tilde{a}_{\{15\}} & \tilde{a}_{\{16\}} \\ \tilde{a}_{\{21\}} & 1,1,1 & \tilde{a}_{\{23\}} & \tilde{a}_{\{24\}} & \tilde{a}_{\{25\}} & \tilde{a}_{\{25\}} \\ \tilde{a}_{\{31\}} & \tilde{a}_{\{32\}} & 1,1,1 & \tilde{a}_{\{34\}} & \tilde{a}_{\{35\}} & \tilde{a}_{\{36\}} \\ \tilde{a}_{\{41\}} & \tilde{a}_{\{42\}} & \tilde{a}_{\{43\}} & 1,1,1 & \tilde{a}_{\{45\}} & \tilde{a}_{\{46\}} \\ \tilde{a}_{\{51\}} & \tilde{a}_{\{52\}} & \tilde{a}_{\{53\}} & \tilde{a}_{\{54\}} & 1,1,1 & \tilde{a}_{\{56\}} \\ \tilde{a}_{\{61\}} & \tilde{a}_{\{62\}} & \tilde{a}_{\{63\}} & \tilde{a}_{\{64\}} & \tilde{a}_{\{65\}} & 1,1,1 \end{bmatrix}$$

2) Calculation of fuzzy sums by criterion: For each criterion, the sum of the fuzzy values in the corresponding row is calculated:

$$\Sigma l_i = \sum_{j=1}^{n} l_{i,j}$$

$$\Sigma m_i = \sum_{j=1}^{n} m_{i,j}$$

$$\Sigma u_i = \sum_{j=1}^{n} u_{i,j}$$

These values represent the cumulative weight of each criterion relative to the others.

The total sums are then calculated:

$$\Sigma l_{tot} = \sum_{i=1}^{n} \Sigma l_i$$

$$\Sigma m_{tot} = \sum_{i=1}^{n} \Sigma m_i$$

$$\Sigma u_{tot} = \sum_{i=1}^{n} \Sigma u_i$$

3) Calculation of fuzzy synthetic values: Fuzzy synthetic values are obtained through normalization:

$$S_{\{l,i\}} = \Sigma l_i \times \frac{1}{\Sigma u_{tot}}$$

$$S_{\{m,i\}} = \Sigma m_i \times \frac{1}{\Sigma m_{tot}}$$

$$S_{\{u,i\}} = \Sigma u_i \times \frac{1}{\Sigma l_{tot}}$$

These values represent the relative importance of the criteria in a fuzzy manner.

4) Defuzzification of weights: To obtain a single usable weight, fuzzy values are converted into simple numerical values using the center-of-gravity method:

$$W_i = \frac{S_{\{l,i\}} + S_{\{m,i\}} + S_{\{u,i\}}}{3}$$

This step provides a numerical value representing the significance of each criterion.

5) Normalization of weights: The weights obtained are then normalized so that their sum equals 1:

$$w_i = \frac{W_i}{\sum_{k=1}^{n} W_k}$$

The weights can then be expressed as a percentage:

$$Weight_i(\%) = 100 * w_i$$

These values correspond to the final relative importance of each criterion.

V. ERP Selection Criteria

Data collected from 37 participants was analyzed to identify the most common and relevant criteria. Table III given below presents a structured list of ERP selection criteria within Moroccan SMEs.

TABLE III. List of ERP Selection Criteria Within Moroccan SMEs

Criteria code	Main criteria	Sub-criteria	Criteria code
C1	Functional scope of the ERP system	Accounting and Financial Management	C1.1
		Purchasing and Sales Management	C1.2
		Inventory and Logistics Management	C1.3
		Production and Project Management	C1.4
C2	System Usability	Intuitive user interface	C2.1
		Ease of learning the system	C2.2
		Ease of navigation	C2.3
		Availability of documentation and user support	C2.4
C3	Total Cost of the ERP System	Cost of ERP licenses	C3.1
		Implementation cost	C3.2
		Annual maintenance cost	C3.3
		User training cost	C3.4
C4	Compatibility and Technical Integration	Compatibility with existing systems	C4.1
		Ease of data migration	C4.2
		Integration with other software	C4.3
		Compatibility with hardware infrastructure	C4.4
C5	System Security and Reliability	Data Protection and Confidentiality	C5.1
		User Access Rights Management	C5.2
		Data Backup and Restoration	C5.3
		System Stability	C5.4
C6	Scalability of the ERP System	Ability to add new modules	C6.1
		Adaptability to business growth	C6.2
		Ability to customize the system	C6.3
		Availability of future functional enhancements	C6.4

VI. Findings: Prioritization of Criteria and Sub-Criteria for Selecting an ERP

In this study, we identified six main criteria for selecting ERP among Moroccan SMEs, and for each of these criteria, we defined four sub-criteria. We will begin by determining the priority of each criterion, and then the priority of each sub-criterion associated with each of them.

A. Prioritization of Criteria

For the purpose of decision-making using the Fuzzy AHP approach, the criteria were assigned the following codes: C1, C2, C3, C4, C5, and C6 (see Table IV). The criteria and their respective codes are detailed below:

C1: Functional scope of the ERP system

C2: System Usability

C3: Total Cost of the ERP System

C4: Compatibility and Technical Integration

C5: System Security and Reliability

C6: Scalability of the ERP System

TABLE IV. FUZZY PAIRWISE COMPARISON MATRIX OF CRITERIA

	C1			C2			C3			C4			C5			C6		
	l	m	u	l	m	u	l	m	u	l	m	u	l	m	u	l	m	u
C1	1	1	1	1,129	1,227	1,325	1,38	1,5	1,62	1,774	1,929	2,083	2,258	2,455	2,651	3,105	3,375	3,645
C2	0,754	0,814	0,885	1	1	1	1,124	1,222	1,32	1,446	1,571	1,697	1,84	2	2,16	2,53	2,75	2,97
C3	0,613	0,667	0,72	0,753	0,818	0,884	1	1	1	1,183	1,286	1,389	1,505	1,636	1,767	2,07	2,25	2,43
C4	0,477	0,519	0,56	0,585	0,636	0,687	0,716	0,778	0,84	1	1	1	1,171	1,273	1,375	1,61	1,75	1,89
C5	0,375	0,407	0,44	0,46	0,5	0,54	0,562	0,611	0,66	0,723	0,786	0,849	1	1	1	1,265	1,375	1,485
C6	0,273	0,296	0,32	0,335	0,364	0,393	0,409	0,444	0,48	0,526	0,571	0,617	0,669	0,727	0,785	1	1	1

TABLE V. FUZZY VALUES FOR SYNTHETIC EXTENT AND RELATIVE IMPORTANCE WEIGHTS OF THE CRITERIA

	Σl	Σm	Σu	1/Σu	1/Σm	1/Σl	S_l	S_m	S_u	W	%
C1	10,646	11,486	12,324	0,022	0,024	0,025	0,234	0,276	0,308	0,27	27
C2	8,694	9,357	10,032	0,022	0,024	0,025	0,191	0,225	0,251	0,22	22
C3	7,124	7,657	8,19	0,022	0,024	0,025	0,157	0,184	0,205	0,18	18
C4	5,559	5,956	6,352	0,022	0,024	0,025	0,122	0,143	0,159	0,14	14
C5	4,385	4,679	4,974	0,022	0,024	0,025	0,096	0,112	0,124	0,11	11
C6	3,212	3,402	3,595	0,022	0,024	0,025	0,071	0,082	0,09	0,08	8
Sum	39,62	42,54	45,47								

The findings demonstrate that the criterion C1 (Functional scope of the ERP system) is ranked first with the weight of 27%. Such a finding shows how crucial the issue of the functional scope of the ERP system is; it should have the capability of handling all business activities within the organization. With such a functional scope of the ERP system, an integrative approach can be adopted to address the operations without adopting other solutions.

The second most important criterion is C2 (System Usability), which accounts for 22% of the total. It shows that usability is one of the key elements in adopting the system. A user-friendly ERP system will be less resistant to change and will increase efficiency as well.

Criterion C3 (Total Cost of the ERP System) ranks third, each at 18%. This finding demonstrates that the total cost of the system in the course of its installation and maintenance is an important criterion in selection, especially in view of the SME sector.

Criterion C4 (Compatibility and Technical Integration) comes next and accounts for 14% of the score, as the integration of the ERP system with other systems must be taken into account to ensure continuity.

Criterion C5 (System Security and Reliability) accounts for 11% of the total score. While it does not receive the same level of emphasis as the criteria mentioned above, it cannot be discounted for its value in ensuring the continuity of operations and safeguarding confidential data.

Finally, criterion C6 (Scalability of the ERP System) has the lowest weight at 8%. This implies that the scalability aspect of the ERP system is not highly valued for the short term but will be an important aspect in the long run (see Table V).

B. Prioritization of Sub-Criteria

1) Functional Scope of the ERP System: During the decision-making process, where the criterion "Functional scope of the ERP system" will be assessed through the fuzzy AHP method, the following sub-criteria codes will be applied: C1.1, C1.2, C1.3, and C1.4 (see Table VI). Listed below are the sub-criteria codes together with the sub-criteria themselves:

C1.1: Accounting and Financial Management

C1.2: Purchasing and Sales Management

C1.3: Inventory and Logistics Management

C1.4: Production and Project Management

TABLE VI. FUZZY PAIRWISE COMPARISON MATRIX OF SUB-CRITERIA FOR THE FUNCTIONAL SCOPE CRITERION

	C1.1			C1.2			C1.3			C1.4		
	l	m	u	l	m	u	l	m	u	l	m	u
C1.1	1	1	1	0,90	1,05	1,20	1,05	1,20	1,35	1,90	2,10	2,30
C1.2	0,83	0,95	1,11	1	1	1	1,05	1,15	1,30	1,70	1,90	2,10
C1.3	0,74	0,83	0,95	0,77	0,87	0,95	1	1	1	1,55	1,70	1,90
C1.4	0,43	0,48	0,53	0,48	0,53	0,59	0,53	0,59	0,65	1	1	1

TABLE VII. FUZZY WEIGHTS AND NORMALIZED PRIORITIES OF FUNCTIONAL SCOPE SUB-CRITERIA

	Σl	Σm	Σu	1/Σu	1/Σm	1/Σl	S_l	S_m	S_u	W	%
C1.1	4,85	5,35	5,85	0,052	0,057	0,062	0,252	0,305	0,363	0,31	31
C1.2	4,58	5	5,51	0,052	0,057	0,062	0,238	0,285	0,342	0,29	29
C1.3	4,06	4,4	4,8	0,052	0,057	0,062	0,211	0,251	0,298	0,25	25
C1.4	2,44	2,6	2,77	0,052	0,057	0,062	0,127	0,148	0,172	0,15	15
Sum	15,93	17,35	18,93								

As for the criterion C1 that covers the scope of functionality of the ERP system, it should be mentioned that the sub-criterion C1.1 (Accounting and Financial Management) occupies the first place with a weight of 31%. It is important to point out that the highest importance is attached to accounting and financial management functions because accounting is the basic component of information systems of SMEs.

Sub-criterion C1.2 (Purchasing and Sales Management) holds the second position in terms of weight with 29%. This indicates the significance of purchasing and sales management as they affect the efficiency of operations and customer-supplier relationships.

Following this, the sub-criteria C1.3 (Inventory and Logistics Management) comprises 25% weightage. The reason behind assigning a weightage of 25% to inventory and logistics management lies in its significance in ensuring effective physical flow while being less crucial compared to finance and sales functions.

Lastly, sub-criterion C1.4 (Production and Project Management) has the least weight with 15% importance. The reason behind this is that in relation to the SMEs involved in the study, production/project management might not be an urgent need or could be simpler compared to other processes (see Table VII).

2) System Usability: During the decision-making process, where the criterion 'System Usability' will be assessed through the fuzzy AHP method, the following sub-criteria codes will be applied: C2.1, C2.2, C2.3, and C2.4 (see Table VIII). Below are listed the sub-criteria codes together with the sub-criteria themselves:

C2.1: Intuitive user interface

C2.2: Ease of learning the system

C2.3: Ease of navigation

C2.4: Availability of documentation and user support

TABLE VIII. FUZZY PAIRWISE COMPARISON MATRIX OF SUB-CRITERIA FOR THE SYSTEM USABILITY CRITERION

	C2.1			C2.2			C2.3			C2.4		
	l	m	u	l	m	u	l	m	u	l	m	u
C2.1	1	1	1	1,05	1,15	1,30	1,15	1,30	1,45	1,55	1,70	1,90
C2.2	0,77	0,87	0,95	1	1	1	1,05	1,15	1,30	1,45	1,60	1,80
C2.3	0,69	0,77	0,87	0,77	0,87	0,95	1	1	1	1,20	1,35	1,50
C2.4	0,53	0,59	0,65	0,56	0,63	0,69	0,67	0,74	0,83	1	1	1

TABLE IX. FUZZY WEIGHTS AND NORMALIZED PRIORITIES OF SYSTEM USABILITY SUB-CRITERIA

	Σl	Σm	Σu	1/Σu	1/Σm	1/Σl	S_l	S_m	S_u	W	%
C2.1	4,75	5,15	5,65	0,054	0,06	0,065	0,257	0,309	0,367	0,31	31
C2.2	4,27	4,62	5,05	0,054	0,06	0,065	0,231	0,277	0,328	0,28	28
C2.3	3,66	3,99	4,32	0,054	0,06	0,065	0,198	0,239	0,281	0,24	24
C2.4	2,76	2,96	3,17	0,054	0,06	0,065	0,149	0,178	0,206	0,17	17
Sum	15,44	16,72	18,19								

In regard to the criterion C2 concerning the system usability, it is evident that the highest weight belongs to the criterion C2.1 (Intuitive user interface). Such a conclusion implies the relevance of the intuitive interface that will allow users to get acquainted with the system and work with it more easily and quickly.

Sub-criteria C2.2 (Ease of learning the system) has the second highest weight of 28%. This highlights that the system's ease of learning is an important criterion, especially within the framework of SMEs, whereby training budgets might be inadequate. It helps that if the ERP system is easier to learn, users can get proficient faster.

Following this, sub-criterion C2.3 (ease of navigation) makes up 24%. It is evident that smooth navigation in the system is significant because it affects the ease with which users can conduct their activities.

Finally, sub-criterion C2.4 (Availability of documentation and user support) is assigned the least weight at 17%, which

can be attributed to the preference by users for a system that is intuitive and easy to operate, thereby minimizing their need for documentation or assistance (see Table IX).

3) Total Cost of the ERP System: During the decision-making process, where the criterion 'Total Cost of the ERP System' will be assessed through the fuzzy AHP method, the following subcriteria codes will be applied: C3.1, C3.2, C3.3, and C3.4 (see Table X). Below are listed the subcriteria codes together with the subcriteria themselves:

C3.1: Cost of ERP licenses

C3.2: Implementation cost

C3.3: Annual maintenance cost

C3.4: User training cost

Regarding criterion C3, dealing with the total cost of the ERP system, the findings reveal that sub-criterion C3.1 (Cost of ERP licenses) occupies the first place with a weight of 32%. The significance attached to the acquisition cost of the software is brought into light from this finding since cost is the major consideration for any SME when choosing an ERP system.

TABLE X. FUZZY PAIRWISE COMPARISON MATRIX OF SUB-CRITERIA FOR THE TOTAL COST OF THE ERP SYSTEM CRITERION

	C3.1			C3.2			C3.3			C3.4		
	l	m	u	l	m	u	l	m	u	l	m	u
C3.1	1	1	1	1,05	1,15	1,3	1,25	1,4	1,55	1,7	1,9	2,1
C3.2	0,77	0,87	0,95	1	1	1	1,15	1,3	1,45	1,6	1,8	2
C3.3	0,65	0,71	0,8	0,69	0,77	0,87	1	1	1	1,15	1,3	1,45
C3.4	0,48	0,53	0,59	0,5	0,56	0,63	0,69	0,77	0,87	1	1	1

TABLE XI. FUZZY WEIGHTS AND NORMALIZED PRIORITIES OF TOTAL COST OF THE ERP SYSTEM SUB-CRITERIA

	Σl	Σm	Σu	1/Σu	1/Σm	1/Σl	S_l	S_m	S_u	W	%
C3.1	5	5,45	5,95	0,054	0,059	0,064	0,27	0,322	0,381	0,32	32
C3.2	4,52	4,97	5,4	0,054	0,059	0,064	0,244	0,293	0,346	0,28	28
C3.3	3,49	3,78	4,12	0,054	0,059	0,064	0,188	0,223	0,264	0,23	23
C3.4	2,67	2,86	3,09	0,054	0,059	0,064	0,144	0,169	0,198	0,17	17
Sum	15,68	17,06	18,56								

Sub-criterion C3.2 (Implementation Cost) is the second most important with a weighting factor of 28%. It clearly indicates that the costs related to the implementation process are equally important considerations in selecting an ERP system.

Subsequently, sub-criterion C3.3 (Annual maintenance cost) takes up 23%. This proves that recurring costs are important but usually taken into consideration after initial costs during decision-making.

Lastly, the criterion C3.4 (User training cost) gets the smallest weight, which is 17%. It is because the cost of training users does not seem significant, especially when the system is viewed as an easy-to-use system (see Table XI).

4) Compatibility and Technical Integration: During the decision-making process, where the criterion 'Compatibility and Technical Integration' will be assessed through the fuzzy AHP method, the following subcriteria codes will be applied: C4.1, C4.2, C4.3, and C4.4 (see Table XII). Below are listed the subcriteria codes together with the subcriteria themselves:

C4.1: Compatibility with existing systems

C4.2: Ease of data migration

C4.3: Integration with other software

C4.4: Compatibility with hardware infrastructure

In terms of criterion C4 relating to compatibility and integration, the findings reveal that sub-criterion C4.1 (Compatibility with existing systems) comes first with a weightage of 30%. It indicates the significance of ERP compatibility with the existing systems in the enterprise. High compatibility would help to avoid interruptions, cut down costs, and ensure operational continuity.

TABLE XII. FUZZY PAIRWISE COMPARISON MATRIX OF SUB-CRITERIA FOR THE COMPATIBILITY AND TECHNICAL INTEGRATION CRITERION

	C4.1			C4.2			C4.3			C4.4		
	l	m	u	l	m	u	l	m	u	l	m	u
C4.1	1	1	1	1,05	1,15	1,3	1,1	1,25	1,4	1,45	1,6	1,8
C4.2	0,77	0,87	0,95	1	1	1	1,05	1,15	1,3	1,35	1,5	1,7
C4.3	0,71	0,8	0,91	0,77	0,87	0,95	1	1	1	1,2	1,35	1,5
C4.4	0,56	0,63	0,69	0,59	0,67	0,74	0,67	0,74	0,83	1	1	1

TABLE XIII. FUZZY WEIGHTS AND NORMALIZED PRIORITIES OF COMPATIBILITY AND TECHNICAL INTEGRATION SUB-CRITERIA

	Σl	Σm	Σu	1/Σu	1/Σm	1/Σl	S_l	S_m	S_u	W	%
C4.1	4,6	5	5,5	0,055	0,06	0,065	0,253	0,3	0,358	0,3	30
C4.2	4,17	4,52	4,95	0,055	0,06	0,065	0,229	0,271	0,322	0,27	27
C4.3	3,68	4,02	4,36	0,055	0,06	0,065	0,202	0,241	0,283	0,24	24
C4.4	2,82	3,04	3,26	0,055	0,06	0,065	0,155	0,182	0,212	0,18	18
Sum	15,27	16,58	18,07								

Sub-criterion C4.2 (Ease of data migration) comes second with a weight of 27%. The above outcome indicates that one of the difficulties of implementing an ERP solution is related to the ease of data migration.

Thirdly, sub-criterion C4.3 (Integration with other software) takes 24%. From the above outcome, one may understand that the ERP system integration capacity with other software available in the company is also important.

Finally, sub-criterion C4.4 (Compatibility with hardware infrastructure) is assigned the lowest weight – 18%. One explanation could be the adaptability of organizations in the sphere, especially when new technologies are considered (see Table XIII).

5) System Security and Reliability: During the decision-making process, where the criterion 'System Security and Reliability' will be assessed through the fuzzy AHP method, the following subcriteria codes will be applied: C5.1, C5.2, C5.3, and C5.4 (see Table XIV). Below are listed the subcriteria codes together with the subcriteria themselves:

C5.1: Data Protection and Confidentiality

C5.2: User Access Rights Management

C5.3: Data Backup and Restoration

C5.4: System Stability

TABLE XIV. FUZZY PAIRWISE COMPARISON MATRIX OF SUB-CRITERIA FOR THE SYSTEM SECURITY AND RELIABILITY CRITERION

	C5.1			C5.2			C5.3			C5.4		
	l	m	u	l	m	u	l	m	u	l	m	u
C5.1	1	1	1	1,1	1,25	1,4	1,2	1,35	1,5	1,2	1,3	1,45
C5.2	0,71	0,8	0,91	1	1	1	1,05	1,15	1,3	1,05	1,15	1,3
C5.3	0,67	0,74	0,83	0,77	0,87	0,95	1	1	1	1	1,1	1,2
C5.4	0,69	0,77	0,83	0,77	0,87	0,95	0,83	0,91	1	1	1	1

TABLE XV. FUZZY WEIGHTS AND NORMALIZED PRIORITIES OF SYSTEM SECURITY AND RELIABILITY SUB-CRITERIA

	Σl	Σm	Σu	1/Σu	1/Σm	1/Σl	S_l	S_m	S_u	W	%
C5.1	4,5	4,9	5,35	0,057	0,061	0,066	0,257	0,299	0,353	0,3	30
C5.2	3,81	4,1	4,51	0,057	0,061	0,066	0,217	0,25	0,298	0,25	25
C5.3	3,44	3,71	3,98	0,057	0,061	0,066	0,196	0,226	0,263	0,23	23
C5.4	3,29	3,55	3,78	0,057	0,061	0,066	0,188	0,217	0,249	0,22	22
Sum	15,04	16,26	17,62								

As for the fifth criterion relating to the system security and reliability, the findings indicate that sub-criterion C5.1 (Data Protection and Confidentiality) has received the highest weight of 30%. This indicates the significance attached to the protection of confidential data and information confidentiality given that the target organizations deal with sensitive information.

The sub-criterion C5.2 (User Access Rights Management), coming in second place with the weight of 25%, reflects the importance of the access rights management in terms of information access control and the enhancement of security.

Thirdly, sub-criterion C5.3 (Data Backup and Restoration) has 23% weight, demonstrating that the mechanisms of data restoration are crucial in order to ensure the business continuity in case of incidents.

Finally, the sub-criterion C5.4 (System Stability), which is of low importance, has 22% weight. Despite being significant as well, the issue is less prioritized than others as it is usually considered one of the basics of the ERP system (see Table XV).

6) Scalability of the ERP system: During the decision-making process, where the criterion 'Scalability of the ERP System' will be assessed through the fuzzy AHP method, the following sub-criteria codes will be applied: C6.1, C6.2, C6.3, and C6.4 (see Table XVI). Below are listed the sub-criteria codes together with the sub-criteria themselves:

C6.1: Ability to add new modules

C6.2: Adaptability to business growth

C6.3: Ability to customize the system

C6.4: Availability of future functional enhancements

TABLE XVI. FUZZY PAIRWISE COMPARISON MATRIX OF SUB-CRITERIA FOR THE SCALABILITY OF THE ERP SYSTEM CRITERION

	C6.1			C6.2			C6.3			C6.4		
	l	m	u	l	m	u	l	m	u	l	m	u
C6.1	1	1	1	1,05	1,15	1,3	1,1	1,25	1,4	1,2	1,35	1,5
C6.2	0,77	0,87	0,95	1	1	1	1,05	1,15	1,3	1,1	1,25	1,4
C6.3	0,71	0,8	0,91	0,77	0,87	0,95	1	1	1	1,05	1,15	1,3
C6.4	0,67	0,74	0,83	0,71	0,8	0,91	0,77	0,87	0,95	1	1	1

TABLE XVII. FUZZY WEIGHTS AND NORMALIZED PRIORITIES OF SCALABILITY OF THE ERP SYSTEM SUB-CRITERIA

	Σl	Σm	Σu	1/Σu	1/Σm	1/Σl	S_l	S_m	S_u	W	%
C6.1	4,35	4,75	5,2	0,056	0,061	0,067	0,244	0,29	0,348	0,29	29
C6.2	3,92	4,27	4,65	0,056	0,061	0,067	0,22	0,26	0,312	0,26	26
C6.3	3,53	3,82	4,16	0,056	0,061	0,067	0,198	0,233	0,279	0,24	24
C6.4	3,15	3,41	3,69	0,056	0,061	0,067	0,176	0,208	0,247	0,21	21
Sum	14,95	16,25	17,7								

With regard to criterion C6 concerning the scalability of the ERP system, sub-criterion C6.1 (Ability to add new modules) ranks first and is assigned the highest weighting among all other sub-criteria: 29%. The implication is that it is crucial for the system to develop incrementally and be able to incorporate more modules when required by the organization.

The sub-criterion C6.2 (Adaptability to business growth), with a weightage of 26% of the total evaluation criteria, means the ability of the system to adapt and aid in the growth of the business is an important factor in the current scenario.

Sub-criterion C6.3 (Ability to customize the system) carries 24% weightage. The fact that the customization ability of the system based on the company's requirements is an important criterion but not as critical as scalability-related criteria is evident from the above result.

Last, criterion C6.4 (Availability of future functional enhancements) has the least weight with 21%. This may be attributed to the fact that future improvements are considered less urgent or less important in the early stages of decision-making (see Table XVII).

VII. PROPOSED MODEL FOR SELECTING ERP FOR MOROCCAN SMES

A. General Principle of the Model

As the basis of transformation of findings acquired using the Fuzzy AHP method into something tangible and practically usable by organizations, the study puts forward a decision model that makes possible objective comparison of various ERP solutions available to Moroccan SMEs. It is a hierarchically structured model composed of a decision goal, main selection criteria, and operational sub-criteria, which allow for a realistic assessment of ERP solutions. Main criteria are the general aspects affecting the decision about the adoption of an ERP application, while operational sub-criteria are more tangible and observable functional features of ERP applications.

B. Mathematical Formulation of the Model

Let C_i be a selection criterion, where $i = 1, \ldots, 6$, and SC_{ij} a sub-criterion belonging to criterion C_i, where $j = 1, \ldots, 4$.

Fuzzy AHP analysis allows us to obtain the relative weight of each criterion, denoted w_i, reflecting its importance in the overall decision. Within each criterion, the sub-criteria have local weights denoted v_{ij}, such that:

$$\sum_{j=1}^{4} v_{i,j} = 1$$

To determine the actual weight of each sub-criterion in the final decision, an overall weight is calculated as follows:

$$g_{i,j} = w_i \times v_{i,j}$$

The consistency of the model is ensured by:

$$\sum_{i=1}^{6} \sum_{j=1}^{4} g_{i,j} = 1$$

C. Evaluation of the ERP Solutions

Each candidate ERP solution is evaluated by the company's experts or users using a score between 0 and 10 for each sub-criterion, denoted as $(s_{i,j}^{(p)})$, where (p) represents the ERP solution being analyzed.

The overall score for an ERP solution is calculated as follows:

$$Score\left(ERP^{(p)}\right) = \sum_{i=1}^{6} \sum_{j=1}^{4} g_{i,j} \times s_{i,j}^{(p)}$$

The selected solution is the one that achieved the highest score:

$$ERP^{*} = arg\ max\ Score(ERP)$$

This mechanism thus makes it possible to convert decision-makers' qualitative assessments into a quantitative metric, making it easier to compare ERP solutions.

D. Operational Evaluation Table for ERP

Table XVIII shows the operational approach for comparing ERP solutions based on the proposed model. The rows of the table indicate the sub-criteria that need to be considered for evaluating the ERP. These sub-criteria include aspects like accounting management, sales management, data security, and technical compatibility.

The Weight (g) column indicates the relative importance of each sub-criterion in the final decision, as determined by the Fuzzy AHP analysis. These weights reflect the priorities of Moroccan SMEs when selecting an ERP.

The columns (ERP_1 Note), (ERP_2 Note) allow you to assign notes to each ERP solution on a scale of 0 to 10.

The columns (ERP_1 Score) and (ERP_2 Score) show the weighted scores calculated for each ERP solution by multiplying the Weight (g) by the corresponding note.

The table below thus serves as the primary calculation tool for converting the qualitative assessment of ERP solutions into a comparable quantitative score.

TABLE XVIII. OPERATIONAL EVALUATION TABLE FOR ERP

Code	Sub-criteria	Weight (g)	ERP_1 Note	ERP_2 Note	ERP_1 Score	ERP_2 Score
C1.1	Accounting and Financial Management	0,083				
C1.2	Purchasing and Sales Management	0,078				
C1.3	Inventory and Logistics Management	0,068				
C1.4	Production and Project Management	0,04				
C2.1	Intuitive user interface	0,068				
C2.2	Ease of learning the system	0,061				
C2.3	Ease of navigation	0,053				
C2.4	Availability of documentation and user support	0,039				
C3.1	Cost of ERP licenses	0,058				
C3.2	Implementation cost	0,053				
C3.3	Annual maintenance cost	0,041				
C3.4	User training cost	0,031				
C4.1	Compatibility with existing systems	0,043				
C4.2	Ease of data migration	0,038				
C4.3	Integration with other software	0,034				
C4.4	Compatibility with hardware infrastructure	0,026				
C5.1	Data Protection and Confidentiality	0,033				
C5.2	User Access Rights Management	0,028				
C5.3	Data Backup and Restoration	0,02				
C5.4	System Stability	0,024				
C6.1	Ability to add new modules	0,024				
C6.2	Adaptability to business growth	0,021				
C6.3	Ability to customize the system	0,019				
C6.4	Availability of future functional enhancements	0,017				
	Total score	1				

E. Procedure for Using the Table

1) Assign an ERP Note between 0 and 10 to each ERP solution for each sub-criterion.

2) Calculate the ERP Score for each sub-criterion using the following formula:

$$ERP\ Score = \text{Weight (g)} * ERP\ Note$$

3) Add the weighted scores to obtain the total score for each ERP solution.

4) Compare the scores and select the solution with the highest score.

F. Contribution of the Proposed Model

The model maintains the scientific rigor of multiple criteria decision-making without becoming difficult to use in a business setting. In this way, Moroccan SMEs are ensured an

appropriate methodology for the comparison of ERP systems and reducing the likelihood of a bad choice.

VIII. Discussion

The results obtained through the application of the Fuzzy AHP method reveal a clear hierarchy of selection criteria for ERP systems in the context of Moroccan SMEs. The analysis reveals that criteria related to the system's functional scope rank first, followed by ease of use and the overall cost of the system. This prioritization reflects a marked preference among SMEs for solutions that are immediately operational, capable of effectively meeting business needs while remaining simple to use.

These results are consistent with several studies in the literature. For example, [3] demonstrated that critical factors related to ERP selection, particularly system performance and integration, play a decisive role in the decision-making process. Similarly, [8] emphasize the importance of hybrid multi-criteria approaches for improving the ranking of ERP solutions by taking multiple dimensions into account.

The emphasis placed on ease of use in our study which confirms that user adoption is a key factor for success. This finding aligns with the conclusions of [9], which highlight the central role of system quality, particularly in terms of usability and reliability. Similarly, [6] shows that incorporating multiple criteria, including user-related aspects, improves the relevance of decisions.

Furthermore, the total cost of the system emerges as a determining criterion in our study, reflecting the budget constraints specific to SMEs. This finding is also confirmed by [4], who identify cost as a key factor in the evaluation of ERP solutions, particularly in industrial environments.

In contrast, criteria related to scalability and future developments appear to be of lower priority in our study. This finding may be interpreted as reflecting SMEs' focus on immediate needs rather than long-term prospects. This trend differs in part from certain studies, such as [11], which place greater emphasis on long-term strategic and organizational factors in ERP selection.

Finally, the model proposed in this study serves as a relevant decision-making tool, helping to structure the ERP selection process and reduce the subjectivity of choices. This approach builds on the work of [10], who highlight the value of multi-criteria methods for improving the quality of decisions in complex contexts.

IX. Conclusion

The objective of this study was to identify and prioritize the selection criteria for ERP systems in the context of Moroccan SMEs, as well as to propose a decision-making model tailored to their needs. To achieve this, an approach combining qualitative interviews and the Fuzzy AHP method was adopted, allowing for both the experience of professionals and a structured evaluation of the criteria to be taken into account.

This research aimed at defining and prioritizing selection criteria for ERP systems within the context of SMEs in Morocco and developing a decision model based on the needs of such companies. In order to reach these objectives, the choice was made to use a mixed methodology, including interviews and application of the fuzzy AHP method, which takes into consideration both professional experience and criteria evaluation.

The results highlight the top priority of the ERP system's functional scope, followed by ease of use and the overall cost of the system. These results reflect a clear preference among SMEs for practical, accessible, and immediately operational solutions. Furthermore, technical criteria, such as compatibility and integration, as well as system security, remain important but are considered secondary to immediate functional needs. Finally, system scalability appears to be the lowest priority, suggesting that SMEs prioritize solutions that meet their current needs rather than a long-term vision.

A detailed analysis of the sub-criteria confirms this trend, highlighting the importance of financial management features, system usability, and initial costs. These factors reflect the specific constraints faced by SMEs, particularly in terms of limited resources, the need for simplicity, and the need for rapid implementation.

Based on these results, a decision-support model has been proposed to objectively evaluate and compare different ERP solutions by weighting the criteria and sub-criteria. This model transforms qualitative judgments into a quantitative assessment, thereby facilitating the selection process. It serves as an operational tool accessible to SMEs, enabling them to reduce the risks associated with choosing an unsuitable system and to improve the quality of their decision-making.

In conclusion, this research makes both a theoretical and practical contribution. On the one hand, it enriches existing work on ERP selection by incorporating the specific context of Moroccan SMEs. On the other hand, it offers a practical tool that companies can use to structure their selection process. However, certain limitations should be noted, particularly the sample size and the contextual nature of the results. Future research could expand the study to include a larger number of companies or incorporate other multi-criteria methods to strengthen the robustness of the proposed model.

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