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A new approach for evaluation and classification of human resources according to skills and preferences

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***Abstract*—The management of human resources is one of the key points of the competitiveness of the companies. The effective use of their skills is essential to the satisfaction of the performance of the imposed targets. Thus, managers of the enterprises are given a growing interest to the satisfaction of the needs of these resources that allows an improvement of the quality of their training performance and hence an improvement of the business process performance. We seek through this article to provide the leaders of companies with a tool for decision-making in the assessment and classification of human resources according to the skills and preferences. To do this, we propose a new approach consisting of three steps. The first step is the identification and evaluation of the skills acquired by each human resource and required by each task using the 2-tuple method. Thus, the second step is about the calculation of a coefficient of proximity between the required and acquired skills using the multicriteria TOPSIS method (technical for Order by Similarity to Ideal Solution). The third step is the classification of human resources for each task using the SMART method (Simple Multi-Attribute Rating Technique).**

***Keywords*: Evaluation, Classification, Competences, Preferences, 2-tuple, TOPSIS, SMART**

I. INTRODUCTION

Developments, economic constraints and increasingly harsh global competition push companies to seek new solutions to stay efficient and maintain their position in the markets today. Indeed, search for performance requires the enterprise not only flexibility in its organization of work and better control of emerging technologies but also and above all a better consideration of human resources. Thus, several actors, industrial and scientific, agree today that the value creation and the improvement of the performance can be done without the involvement of all the actors of the company. However, several authors have stressed the importance of saving the reservoir of knowledge in the organization. According to Zarifian [1] such recognition has led to the emergence of a new model of the competence model called resource management. It is included as part of the emergence of new forms of organization and productive performance. Thus, the improvement of performance requires a good identification and estimation of the skills of human resources and a better assessment of their levels. Indeed, the best use of human resources is not in the identification of skills. Actually, it affects the need to meet the needs of the resources. Accordingly, the answer to the expectations of the resources has a positive effect on the improvement of the quality of their performance [2].

In addition, taking into account these two human characteristics (skills and preferences) is an effective way of improving the performance of business processes. The goal of the assessment and the classification of human resources is to help leaders of companies to improve performance.

II. LITERATURE REVIEW

In literature, several methods for assessing the skill levels of human resources have been presented. The objective is common. It is the choice of the best candidate for a particular task.

Golec and Kahya [3] presented an assessment process that relies on a good identification of the deducted criteria of the strategic objectives of the organization. At the end of a discussion between the human resources expert and the manager, an assessment in the form of linguistic variables is attributed to each candidate. It reflects its level relative to all flag associated with each criterion.

After translation of the language assessments in Fuzzy numbers, the authors opt for the use of Łukasiewicz fuzzy operator to determine the level of each candidate against each criterion. Each candidate for each criterion defined levels presenting all data entry in the following inference step. Finally, after the application of the rules of inference followed by the process of defuzzing, the skill level of each employee is expressed as a numerical value.

Wi et al. [4] presented an evaluation of the skills of the employees using the keywords required by a well-specified R & D project. The proposed method starts by determining the degree of correspondence between the keywords required by the project in question and those of previous projects carried

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out by the candidates. Then, using the theory of fuzzy logic, it is possible to deduce the levels of personal knowledge (knowledge and know-how) of each employee and the degrees of familiarity among employees. Then, using the theory of fuzzy logic, it is possible to deduce the levels of personal knowledge (knowledge and know-how) of each employee and the degrees of familiarity among employees.

De Andrés et al. [5] proposed an assessment method based on the notion of "computing with words", introduced by Herrera and Martinez [6]. Evaluations of the teamwork of each candidate in linguistic form are obtained by applying the model “of 360” performance evaluation. This model allows the involvement of a set of evaluators who are in contact with the employee concerned (colleagues, employees, customers...).

As all of the obtained assessments are expressed in language values of different granularities, authors are required to unify these multi- granular linguistic information in an area of unique expression [7]. Once this is accomplished the aggregation of all of the obtained uniform assessments can be performed by the application of the model 2-tuple linguistic representation proposed by Herrera and Martinez [6]. Thus Maurice H [8] presented an evaluation approach while taking advantage of the benefits of the previous work. It is based on A good identification of the evaluation criteria surpassing cases of redundancy and ambiguity. The typology of resources of jurisdiction presented by Harzallah and Vernadatbased [9] on the analysis of different aspects considered in the studied field meets this need.

Perfect representation provided by one group of decision-makers ensuring the minimum distortion of information while targeting the objectivity. The qualitative aspect of the chosen criteria dictates the use of a linguistic approach, including the model of representation language 2-tuple to express ratings provided by policymakers. Its ability to close linguistic and digital information and escape from subjectivity by means of assessment aggregation engenders an easy manipulation of information.

III. Proposed approach

Our approach is divided into three stages. The first step is the identification and evaluation of the skills acquired by e ach human resource and required by each task using the method 2-tuple. Thus, the second step represents the calculation of a coefficient of proximity between the acquired and required skills using the multicriteria TOPSIS method. The third step is the classification of human resources for each task using the SMART method. For the determination of the first and the second stage, we will follow the approach proposed by Maurice H, [8].

1) Identification and assessment of skills: Identification is to identify the needs of the duties in terms of the skills required by referring to the entity-relationship model proposed by outgoing and Vernadat (2002). This model offers a topology of resources of competence adapted to the different aspects. It is summarized in the following table.

TABLE I
Typology of resources within the jurisdiction (outgoing and Vernadat, 2002)

	Category of competences		
	Regular	**Bold**	**Italic**
Skills	Theoretical Knowledge (TK)	Procedural Know-How (PK - H)	Relational (R)
	Knowledge of the Existing (KE)	Empirical Know-How (EK - H)	Cognitive Capacity (CC)

Based on this topology we will fill a matrix (resources of competence * task). Thus, we applied our method for the allocation of three teachers to the four modules in the Higher School of Management of the Central University of Tunisia.

TABLE 2

MATRIX (RESOURCES OF COMPETENCE * MODULE)

Cat. Com peten ces	Module 1 (M1)	Module 1 (M2)	Module 1 (M3)	Module 1 (M4)
TK	Computer tools	Production management	Operational research	Statistics
KE	Workplace safety standards	Workplace safety standards	Workplace safety standards	Workplace safety standards
KP	Principles of database management	Performance indicators	Optimization problems	Analyze difficult problems
PK – H	Use Access, SQL.	Use CAPM	Use Ceplex	Using SPSS
EK - H	Creation of new work for better learning situations	Implementation of storage process in workshop	Creation of new work for better learning situations	Creation of new work for better learning situations
R	Know how to communicate with students	Know how to communicate with students	Know how to communicate with students	Know how to communicate with students
CC	Conflict management	Conflict management	Conflict management	Conflict management
B	Curiosity about student behavior	Curiosity about student behavior	Curiosity about student behavior	Curiosity about student behavior

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In order to identify the tasks and the candidates, it is interesting to identify the right people to assign the most possible correct evaluations regarding the required and acquired levels. The more this person is in direct contact with the candidates or tasks, the more credible is his decision.

TABLE 3

AGGREGATE RESOURCE LEVELS OF ACQUIRED AND REQUIRED COMPETENCIES FOR MODULE 1

Category of competences		**Required**	**C1**	**C2**	**C3**
M 1	**(TK)**	(H, 0.33)	(H, 0)	(H,-0.33)	(M, 0)
	(KE)	(H, 0.33)	(H, 0)	(H,-0.33)	(M, 0)
	(KP)	(H, 0.33)	(H,-0.33)	(M, 0)	(L, 0)
	(PK-H)	(H, -0.33)	(H, 0)	(M, 0)	(H,-0.33)
	(EK-H)	(H, 0)	(M, 0)	(M, 0.33)	(M,-0.33)
	(R)	(H, 0.33)	(H,-0.33)	(M, 0)	(M,-0.33)
	(CC)	(H,-0.33)	(H, 0)	(H,-0.33)	(L, 0.33)
	(B)	(H, 0)	(H,-0.33)	(M, 0)	(M, 0.33)

TABLE 4

AGGREGATE RESOURCE LEVELS OF ACQUIRED AND REQUIRED COMPETENCES FOR MODULE 2

Category of competences		**Required**	**C1**	**C2**	**C3**
M 2	**(TK)**	(H, 0.33)	(H,-0.33)	(H,-0.33)	(M, 0)
	(KE)	(H, 0)	(H, 0)	(M, 0.33)	(M, 0.33)
	(KP)	(VH,-0.33)	(H, 0)	(M,-0.33)	(M,-0.33)
	(PK-H)	(H, 0)	(H,-0.33)	(M, 0)	(M,-0.33)
	(EK-H)	(VH, 0)	(H, 0)	(M, 0.33)	(M,-0.33)
	(R)	(H, 0)	(M, 0.33)	(M, 0.33)	(M,-0.33)
	(CC)	(H, 0.33)	(M, 0.33)	(H,-0.33)	(H,-0.33)
	(B)	(H, 0)	(H,-0.33)	(H,-0.33)	(M, 0)

TABLE 5

AGGREGATE RESOURCE LEVELS OF ACQUIRED AND REQUIRED COMPETENCES FOR MODULE 3

Category of competences		**Required**	**C1**	**C2**	**C3**
M 3	**(TK)**	(H, 0)	(H,-0.33)	(H, 0)	(M,-0.33)
	(KE)	(H, 0)	(H,-0.33)	(H, 0)	(M,-0.33)
	(KP)	(H, 0)	(M, 0.33)	(H, 0)	(M, 0.33)
	(PK-H)	(H, 0.33)	(M, 0)	(H, 0.33)	(M, 0)
	(EK-H)	(H,-0.33)	(M,-0.33)	(M, 0.33)	(M, 0)
	(R)	(H, 0.33)	(L, 0.33)	(H,-0.33)	(M,-0.33)
	(CC)	(H, 0.33)	(M,-0.33)	(H, 0.33)	(L, 0.33)
	(B)	(H,-0.33)	(M,-0.33)	(M, 0.33)	(M,-0.33)

TABLE 6

AGGREGATE RESOURCE LEVELS OF ACQUIRED AND REQUIRED COMPETENCES FOR MODULE 4

Category of competences		**Required**	**C1**	**C2**	**C3**
M 4	**(TK)**	(H,0)	(M,-0.33)	(M, 0)	(H, 0)
	(KE)	(H,-0.33)	(M,-0.33)	(H,-0.33)	(H, 0)
	(KP)	(VH,-0.33)	(M,0)	(M, 0)	(H, 0)
	(PK-H)	(H,0)	(M,-0.33)	(M, 0.33)	(H,-0.33)
	(EK-H)	(H,-0.33)	(M,-0.33)	(M, 0.33)	(M, 0.33)
	(R)	(H, 0)	(M, 0.33)	(M, 0.33)	(M, 0.33)
	(CC)	(M, 0.33)	(M,0)	(M,-0.33)	(M, 0)
	(B)	(H, 0.33)	(M,-0.33)	(H, 0.33)	(VH,-0.33)

2) Determination of the coefficient of proximity between acquired and required skills:

- Determination of anti-ideals and ideal solutions for each module

Using TOPSIS method and the results of the evaluations, the aim of this step is to determine for each resource jurisdiction the bad reviews as an anti-ideal solution and the good reviews as an ideal solution among all assessments.

The following tables represent the ideal and anti-ideal solutions for each module.

TABLE 7

IDEAL AND ANTI-IDEAL SOLUTION FOR MODULE 1

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		Ideal solution (Xj^{+})	Anti-ideal solution (Xj^{-})
M 1	*(TK)*	(H,0.33)	(M,0)
	(KE)	(H,0.33)	(M,0)
	(KP)	(H,0.33)	(L, 0)
	(PK - H)	(H,-0.33)	(M,0)
	(EK - H)	(H,0)	(M,-0.33)
	(R)	(H,0.33)	(M,-0.33)
	(CC)	(H,-0.33)	(L,0.33)
	(B)	(H,0)	(M,0.33)

TABLE 8

IDEAL AND ANTI-IDEAL SOLUTION FOR MODULE 2

		Ideal solution (Xj^{+})	Anti-ideal solution (Xj^{-})
M 2	*(TK)*	(H,0.33)	(M,0)
	(KE)	(H,0)	(M,0)
	(KP)	(VH,-0.33)	(L, 0)
	(PK - H)	(H,0)	(M,0)
	(EK - H)	(VH,0)	(M,-0.33)
	(R)	(H,0)	(M,-0.33)
	(CC)	(H,0.33)	(L,0.33)
	(B)	(H,0.33)	(M,0.33)

TABLE 9

IDEAL AND ANTI-IDEAL SOLUTION FOR MODULE 3

		Ideal solution (Xj^{+})	Anti-ideal solution (Xj^{-})
M 3	*(TK)*	(H,0)	(M,-0.33)
	(KE)	(H,0)	(M,-0.33)
	(KP)	(H,0)	(M,0.33)
	(PK - H)	(H,0.33)	(M,0)
	(EK - H)	(H,-0.33)	(M,-0.33)
	(R)	(H,0.33)	(L,0.33)
	(CC)	(H,0.33)	(L,0.33)
	(B)	(H,-0.33)	(M,-0.33)

TABLE 10

IDEAL AND ANTI-IDEAL SOLUTION FOR MODULE 4

		Ideal solution (Xj^{+})	Anti-ideal solution (Xj^{-})
M 4	*(TK)*	(H,0)	(M,-0.33)
	(KE)	(H,0)	(M,-0.33)
	(KP)	(VH,-0.33)	(M, 0)
	(PK - H)	(H,0)	(M,-0.33)
	(EK - H)	(H,-0.33)	(M,-0.33)
	(R)	(H,0)	(M,0.33)
	(CC)	(M,0.33)	(M,-0.33)
	(B)	(VH,-0.33)	(M,-0.33)

- Calculation of the distance between different levels and ideal and anti-ideal solutions

After you have determined the aggregated levels acquired and required as well as the ideal and anti-ideal solutions and the degrees of importance, it is interesting to calculate the Euclidean distances between the different levels and ideal and anti-ideals solutions using the following formulas

-Euclidean distance between the different levels and ideal solutions

$$d_{ij}^{+} = \left(\sum_{r=1}^{8} \frac{wrj[\Delta^{-1}(Ca_{ij}, \propto_{ij}) - \Delta^{-1}(xrj^{+})]^{2}}{\sum_{r=1}^{8} wrj}\right)^{\frac{1}{2}}$$ $\forall$ = {1, 2, 3} i and j = {1, 2, 3, 4}

-Euclidean distance between the different levels and anti-ideal solutions

$$d_{ij}^{-} = \left(\sum_{r=1}^{8} \frac{wrj[\Delta^{-1}(Ca_{ij}, \propto_{ij}) - \Delta^{-1}(xrj^{-})]^{2}}{\sum_{r=1}^{8} wrj}\right)^{1/2}$$ $\forall$ i = {1, 2, 3} and {1, 2, 3, 4} = A j

With:

$\Delta^{-1}(Ca_{ij}, \propto_{ij})$: The aggregate level acquired by the candidate i for task j.

xrj^{+} : The ideal level of the resource for the task j r.

xrj^{-} : The level of anti - ideal for task j r resource.

wrj : The weight of importance of the resource for the task j

The following table represents the Euclidean distances of each candidate against each module

TABLE 11

DISTANCES EUCLIDEAN BETWEEN DIFFERENT LEVELS AND IDEAL AND ANTI-IDEAL SOLUTIONS

		d_{ij}^{+}	$d_{ij}^{-}(Xj^{-})$
M1	C1	0.40	1.15
	C2	0.88	0.64
	C3	1.44	0.22
M2	C1	0.61	1.05
	C2	1.17	0.50
	C3	1.55	0.11
M3	C1	1.20	0.51
	C2	0.29	1.26
	C3	1.34	0.16
M4	C1	1.33	0.74
	C2	0.85	0.78
	C3	0.39	1.14

- Determination of the coefficient of proximity between the skills acquired and required

Relying on TOPSIS technique and the results found in the preceding table, it is interesting to calculate the close coefficient according to the following formula:

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$$CC_{ij} = \frac{d_{ij}^{-}}{d_{ij}^{+} + d_{ij}^{-}} \quad ; \; i = \{1, 2, 3\} \text{ and } j = \{1, 2, 3, 4\}$$

TABLE 12
COEFFICIENT OF PROXIMITY FOR EACH I AND FOR EACH TASK j

CC_{ij}	C1	C2	C3
T1 (M1)	0.74	0.42	0.13
T2 (M2)	0.63	0.29	0.06
T3 (M3)	0.29	0.81	0.10
T4 (M4)	0.35	0.47	0.74

3) Classification of candidates

In the light of the information available, it is possible to get a ranking of candidates for each task and then select the best. We propose a method based on the principle of the SMART methodology where alternatives are classified according to two criteria, the proximity between the competence acquired and required, and the degree of preference for each task.

Step 1: Put the criteria according to the descending order of importance.

Several research studies have indicated that the satisfaction of the needs of the resources for the execution of the tasks leads to improve their yields, and is better than the correct match between the skills acquired and required. Accordingly, we have considered the criterion of preference is more important than the criterion of proximity in our case.

Step 2: Determine the weight of each criterion. A value of 60 is attributed to the criterion of preference and a value of 40 is attributed to the criterion of proximity.

Step 3: Normalize the coefficients of importance.

Preference (C1) = $\frac{60}{60+40}$ = 60%, close = $\frac{60}{60+40}$ = 40%

Step 4: Assessment of the actions on each attribute (uj (have)) for the Task1

The following table represents the degrees of the preferences of the resources for each task

TABLE 13
DEGREES OF PREFERENCES

	C1	C2	C3
T1 (M1)	**VH**	**M**	**L**
T2 (M2)	**L**	**H**	**H**
T3 (M3)	**VH**	**M**	**L**
T4 (M4)	**VH**	**M**	**H**

With:
'L': preferably low level.
"M": preferably average level.
'H': preferably high level.
"VH": very high level of preference.

For levels of preferences, a value of 0.2 has been given to 'low', the value 0.5 was granted medium, to 0.7 to 'high' and 0.9 to 'very high '.

Rating of candidates for the Task 1:

The following table represents the coefficients of the proximity between the skills acquired and required, degrees of preferences, as well as the values that represent the degrees of the preferences of the different candidates for the Task1

Table 14
COEFFICIENTS OF PROXIMITIES AND DEGREES OF PREFERENCES FOR THE TASK1

	Proximity	Preference
Candidate C1	0.74	'VH' 0.9
Candidate C2	0.42	« M » 0.5
Candidate C3	0.13	« L » 0.2

For proximity:
Max = 0.74, Min = 0.13

U1 (IC) = 10. $\frac{(0.74 - \mathrm{Pr}\,oximity)}{(0.74 - 0.13)}$ %

U1 (C1) = 100. (0.74 - 0.74) / (0.74 - 0.13) = 0%
U1 (C2) = 100. (0.74-0.42)/(0.74-0.13) = 52.4%
U1 (C3) = 100. (0.74-0.13) /(0.74-0.13) = 100%

For preference

U2 (C1) = 0 PERCENT, U2 (C2) = 57.1, U2 (C3) = 100%

Step 5: determination of the values of the actions

TABLE 15
DETERMINATION OF THE VALUES OF THE ACTIONS

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	Competence	Preference	U (Ci)
Weight	0.4	0.6	----
C1	0	0	0
C2	52.4	57.1	55.2
C3	100	100	100

Step 6: Classification of the candidates.

Based on the previous table of values of actions, you get the following classification: C3 > C2 > C1

The same approach of ranking of candidates is followed for different tasks. The following table represents the result of the ranking of candidates for different tasks.

Table 16
RANKING RESULTS

Task	Ranking
Task1 (M1)	C3 > C2 > C1
Task 2 (M2)	C1 > C3 > C2
Task3 (M3)	C3 > C2 > C1
Job4 (M4)	C2 > C1 > C3

IV. CONCLUSIONS

This work has allowed us to make contributions in several organization processes, including the assessment of skills and human resources preferences for the fulfilment of the tasks. Indeed, we have proposed a method of decision-making for the management of this process based on skills and human resources preferences. The goal is to help leaders of companies to achieve the objectives of improved performance by respecting the skills and preferences. In this context, our method includes three steps. The first step represents the estimation of the levels of competence acquired by human resources and required by the various tasks through the implementation of the language model 2-tuple. This model allows giving an objective and effective assessment and closing linguistic and digital information.

The assessment is based on a good identification of the components of competence using linguistic values without numerical values that may lead to a loss of information.

In this way, we get the linguistic levels for each component of competence, but these results do not allow determining the best human resource for each task. We used the multi-criteria TOPSIS method to determine the coefficient of proximity between the competence acquired by the human resource and competence required for each task.

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