Original Research

Evaluation of research performance of faculty members of Islamic Azad University, using Fuzzy Delphi method

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Abstract
In the organization of university units, the core of activities is the responsibility of faculty members and educational groups that are at the forefront of educational and research activities. Research performance impacts the sustainability and growth of the higher education system. The current study pursing the goal to represent the dimensions, components and indicators of creativity and initiative in order to evaluate the research performance of the faculty members of Tehran Islamic Azad University. The quantitative stage community consists of the experts of Tehran Islamic Azad University faculty members and 14 members of Higher Education, getting saturated with 10 ones. The qualitative stage data analysis was done using open coding, axial coding and selective coding with interviewing and Delphi technique. The qualitative stage induced results indicated the above dimensions and components consisting of nine dimensions, namely, research literacy, scientific factors, technical and information skills, methodological literacy, environmental factors, organizational factors, management factors, technological factors and personality traits. It is done this manner, in order to identify the dimensions, components and indicators of creativity and initiative, and the innovation of the research performance of the faculty members of the Islamic Azad University of Tehran, 9 dimensions, 25 components and 80 indicators were finally verified on the whole. The fuzzy Delphi analysis revealed that the experts had consensus on the detected dimensions, components and indicators. And the results displayed that the indicators of creativity and initiative are of personality traits components and included in the individual characteristics.

Keywords – Islamic Azad University Faculty Members; Evaluating Research Performance; Performance Indicators of Creativity and Initiative; Thematic Analysis; Fuzzy Delphi analysis

INTRODUCTION

The authorities have outlined five major tasks for universities and higher education institutions at the international level, explaining their role from single-role and single-institution to multi-role and multi-institutional one, where the main tasks and roles encompass educational performance, research performance, service performance, publishing duties, and

staff professional development (Xu, 2020). Research is one of the main missions of universities and higher education centers. Addressing this important issue is the basis for planning policies and formulating micro and macro programs of these scientific institutions. Obviously, if the input of the higher education system in research is accompanied by an appropriate process and appropriate to their perspectives, it will lead to a desirable and efficient output. Research evaluation is considered as one of the functions of higher education management as one of the main trustees of research and the use of this function in universities provides the necessary ground for policy and planning to improve quality. Achieving this goal is one of the main goals of universities. Thus, one of the missions of university system is to promote research performance (Ponomareva et al. 2021). Undoubtedly, of the critical points of this mission is to develop some befitting models compatible with the researchers' conditions that can prove effective in improving the quantity and quality of their scientific activities (Fartash et al. 2020). Consequently, universities and higher education institutions strive to achieve a deserving position in academic rankings at the national and international levels by promoting the research performance of their faculty members (Alemu et al. 2021). It seems that the most significant element influencing the promotion of research performance is the human resource (HR) (faculty members) considered as the heart of any educational system (Al Shobaki et al. 2018). The significance of faculty members in this process is in that they are able to change the position of other variables and elements of higher education (Ford, 2004). Thus, to find some ways to attract, promote and foster hard-working and committed researchers and build a promising research environment is one of the most remarkable goals of universities in every country (Hornstein, 2017). Evaluating faculty members refers to a process which plans to enhance faculty members' performance (Tung, 2018). Then universities as the organizations in charge of training specialized human resources along with producing knowledge require evaluating their own board members' performance more than any organization, since it results in divulging their weaknesses and strengths and paves the ground for scientific development and the realization of the university goals (Zhang et al. 2019).

However, it has to be stated that the asymmetric distribution of knowledge resources, technology and activity requirements in the age of globalization has forced universities to resort to new techniques to promote research activities and thus, increase interaction at the national and international levels so that to achieve such resources and more opportunities have been provided to improve research performance to the global standards levels. In order to move towards a knowledge-based society, the need for retraining of faculty members and continuous improvement of research methods is obvious. Obviously, these issues have challenged the traditional research methods of academic communities. Thus, it appears that the central organization in the Islamic Azad University can also be effective in accelerating the movement to strike a logical balance in the research development and promotion. Creating the research fields for scientometrics, the grounds for more communication among the researchers and for improving the quantity and quality of research performance and eventually, building a competitive environment for conducting various scientific research cases to take a constructive and effective move towards university excellence. Regarding the above cases and the growing importance of research as well as the nature of the university as a research-based institution, the researcher intends to besides filling the existing theoretical gap, to answer this question as to "How is the appropriate model of Islamic Azad University faculty members' research activities performance? And what are its dimensions, indicators and components?

LITERATURE REVIEW

Since the faculty members' activities pursue different goals, so do the evaluation models and criteria. Despite the variety of the existing evaluation models, most of them are not absolutely beneficial and appropriate to evaluate the faculty members' performance under diverse circumstances. The studies demonstrated that the indicators used for evaluating the performance should be possessed with some properties which raise the accuracy, precision and effectiveness of the evaluation process.

Camungao (2020) proposed a decision support system for evaluating the faculty members. For classifying the faculty members, K-means clustering algorithm was employed. The ranking criteria include commitment, knowledge of subject matter, teaching competency, management of learning and etc. The results displayed the proposed model being of sufficient post-implementation performance. Han et al. (2020) dealt with performance of engineering faculty using a weighting approach, where qualitative weighting was utilized. The considered innovation encompasses an expectation-based formula. The criteria taken into account are teaching history and articulation skills. Pursuant to the results, the proposed model can be considered and implemented for other faculty member groups. Jain (2020) evaluated faculty members' performance via data-mining algorithm. Therefore, they employed K-means algorithm for clustering the faculty members. They applied the criteria including: Participating in and submitting articles in foreign forums, domestic and foreign research projects, grants and activities, the awards and gifts received for publishing scientific research articles, participating in and representing

papers in domestic forums, voucher incentives and grants and educational assistant position, complying with safety and protection related issues in projects, research and laboratory work, benefitting from workshops, laboratories and libraries, and communicating with foreign research institutes and citations.

Eslami et al.(2021) identified the factors affecting the evaluation of faculty members' productivity in humanities and social science .The question case study was Tehran University faculty members .The considered criteria included in their research were the participating number of the top dissertations ,the number of the intra-university research projects ,seeking various organizations' research requirements ,cooperating with highly active employers of university research projects , participation in boosting the quality indicators of the university library, electronic publications, electronic content and its updating. Alam et al. (2021) prioritized faculty members using fuzzy numbers. For this purpose, a survey was conducted among the students. Moreover, five components were identified encompassing the individual, influential conditions and factors, organizational circumstances and factors, the activity dimensions and faculty members' performance, the conditions and performance of the ministry and university authorities in research performance. In addition to identifying the development components as three dimensions, i.e., the professional, organizational and individual ones and the research components, Yang et al.(2019) introduced specialized services, scientific publications, training , communication network as the components of professional dimension, organizational communication, documentation, leadership, time management, cost management and team building as the components of organizational dimension and the interpersonal communication, innovation, self-efficacy, independence in practice and professional ethics as the components of individual development. Cao et al. (2021) addressed the research activities indicators of surgery residents' faculty members. They listed the factors influencing prioritization as the following:

Organizing scientific seminars and conferences, book reprinting, judging master and PhD dissertations, designing and launching laboratories and training workshops, the guide of master and PhD dissertations, judging papers and the compilation of a collection of articles, the translation and authorship of books, proposing and implementing research projects, having articles published in the authentic foreign and domestic journals, the capability to use electronic resources and databases.

TABLE 1.
LITERATURE REVIEW SUMMARY

Author(s)	Aim	Results
Eslami et al. (2021)	Identifying the factors affecting the evaluation of faculty members' productivity in humanities and social science	participating number of the top dissertations, the number of the intra-university research projects, seeking various organizations' research requirements ,cooperating with highly active employers of university research projects , participation in boosting the quality indicators of the university library, electronic publications, electronic content and its updating.
Alam et al. (2021)	prioritized faculty members using fuzzy numbers.	individual, influential conditions and factors, organizational circumstances and factors, the activity dimensions and faculty members' performance, the conditions and performance of the ministry and university authorities in research performance
Cao et al. (2021)	the research activities indicators of surgery residents' faculty members.	Organizing scientific seminars and conferences, book reprinting, judging master and PhD dissertations, designing and launching laboratories and training workshops, the guide of master and PhD dissertations, judging papers and the compilation of a collection of articles, the translation and authorship of books, proposing and implementing research projects, having articles published in the authentic foreign and domestic journals, the capability to use electronic resources and databases.
Camungao (2020)	decision support system for evaluating the faculty members	commitment, knowledge of subject matter, teaching competency, management of learning
Han et al. (2020)	performance of engineering faculty using a weighting approach	The considered innovation encompasses an expectation-based formula. The criteria taken into account are teaching history and articulation skills.
Jain (2020)	faculty members' performance via data-mining algorithm	Participating in and submitting articles in foreign forums, domestic and foreign research projects, grants and activities, the awards and gifts received for publishing scientific research articles, participating in and representing papers in domestic forums, voucher incentives and grants and educational assistant position, complying with safety and protection related issues in projects, research and laboratory work, benefitting from workshops, laboratories and libraries, and communicating with foreign research institutes and citations.

Therefore, it should be stated that the university research system is challenging several nuisances making the promotion of research activities tough. The weakness of information system and the inadequacy of the classification system and information management and lack of accessing the nationally and internationally performed research cases accompanied with lack of research budget, lack of transparency, lack of applicability can be mentioned as the distinctive issues and problems which our academic and research system suffers from and consequently, for the

incapability to timely collect, document, organize ,store , share and disseminate information, many research activities have been duplicated and the decisions have been affected by poor or lack of information and no transparency and not timely and appropriately sharing cannot be adopted with sufficient confidence and power .

METHODOLOGY

The current study is qualitative in terms of nature, ad library and field in terms of study type and it's fundamental (basic) based on the study goal, the data collection is cross-sectional and descriptive (as non-experimental in nature) regarding the study implementation method .The study data in this research is mixed because both qualitative and quantitative data are utilized .Since the mixed exploratory method was used, so first off , the study started with the qualitative method and the quantitative method followed .Moreover, the interview data was analyzed by thematic analysis .Sampling the experts was done by purposeful sampling method. That means the samples were selected as being rich in terms of the problem and the study goals. This sampling method is exclusively used for qualitative studies and the number of the individuals interviewed or the same sample size depends on the theoretical saturation of the raised issues, so that in this study, the experts in the field of faculty performance were 10, while the interviews were conducted up to the 14th individual and no new information was acquired in the last 4 interviews and no new code was added. The qualitative data were collected using semi-instructed interviews and during the interview, the researcher controlled the accuracy of their interpretations of the interviewees' statements by posing guiding questions. To get assured of the similar data adequacy and the qualitative data analysis, MAXQDA-12 software was employed for encoding and classification. The present study data were analyzed by thematic analysis and Fuzzy Delphi analysis. Also Fuzzy Delphi technique was applied to investigate the experts' perspective about the proposed performance model's validity and its properties.

The fuzzy Delphi method was proposed by Ishigawa et al. (1993). Delphi technique as a robust group communication structure based process used in the cases is employed among the experts pursuing the goal to come to group consensus when the knowledge at hand is inadequate and uncertain. The fuzzy Delphi method was obtained by combining traditional Delphi and fuzzy set theory. In the classical Delphi method, the opinions of experts are expressed in the form of definite numbers, while experts use their mental competencies to express opinions, and this indicates the possibility of uncertainty prevailing in this situation. The probability of uncertainty is compatible with fuzzy sets. Therefore, it is better to obtain data in the form of natural language from experts and analyze it using fuzzy sets. The implementation steps of this method are a combination of the traditional Delphi method and data analysis of each step using the definitions of fuzzy set theory (figure 1).

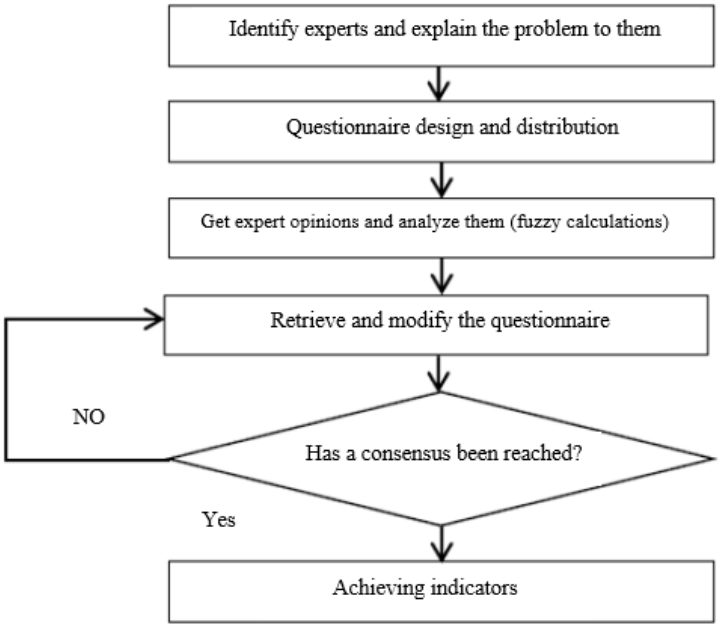

FIGURE 1.
STEPS OF IMPLEMENTING FUZZY DELPHI METHOD

Fuzzy numbers are used to fuzzy expert opinions. Fuzzy numbers are fuzzy sets that are defined in the face of uncertainty about a phenomenon along with numerical data. In this study, triangular fuzzy numbers are used. Triangular fuzzy numbers with three real numbers are displayed as M = (l, m, u). Upper limit of maximum fuzzy number values M, the lower limit (u) of the fuselage is fuzzy number values M and m most probable value of is a fuzzy number. The membership function of a triangular fuzzy number is as follows(Equ.1):

$$u_M(x) = \begin{cases} \dfrac{x-u}{m-u}. & u \ll x \ll m \\ \dfrac{l-x}{l-m}. & m \ll x \ll l \\ 0. & otherwise \end{cases}$$

Steps of implementing fuzzy Delphi method:

1. Gathering the opinions of experts
2. Conversion of verbal variables into triangular fuzzy numbers (Table 2)

TABLE 2.
TRIANGULAR FUZZY NUMBERS CORRESPONDING TO VERBAL VARIABLES

verbal variables	Triangular fuzzy number(l,m,u)	Definite fuzzy numbers
I'm quite successful	(0, 0.25, 1)	0.9375
I agree	(0.15, 0.15, 0.75)	0.75
No idea	(0.25, 0.25, 0.5)	0.5
I disagree	(0.15, 0.15, 0.25)	0.25
I strongly disagree	(0.0,0.25)	0.0625

Thus, triangular fuzzy numbers were given to each expert and the set of triangular fuzzy numbers for each expert was obtained using Equation (2):

$$\tilde{A}^{(i)} = \left(a_1^{(i)}.a_2^{(i)}.a_3^{(i)}\right) \qquad i = 1.2.3.\ldots.n$$

3. Calculate the average of sets $\tilde{A}_m^{(i)}$ from all sets $\tilde{A}^{(i)}$(Equation 3)

$$\tilde{A}_m = (a_{m1}.a_{m2}.a_{m3}) = \left(\frac{1}{n}\sum_{i=1}^{n} a_1^i.\frac{1}{n}\sum_{i=1}^{n} a_2^i.\frac{1}{n}\sum_{i=1}^{n}$$

In the second round of Delphi, in order to check the agreement between the experts, the first round questionnaire, after making the necessary changes, along with the average of the experts' opinions and the previous disagreement of each of them with the average, was sent again to the panel members and asked to answer. Review and revise their opinions and judgments if necessary.

4.After the initial feedback was given to the experts and the second round of Delphi was done, the corrected opinions of the experts are in the form of triangular fuzzy numbers in the form of Equation 4.

$$\tilde{B}^{(i)} = \left(b_1^{(i)}.b_2^{(i)}.b_3^{(i)}\right) \qquad i = 1,2,3,\ldots,n$$

In this stage, as in the second stage, the average of the corrected opinions of the experts ($\tilde{B}_m^{(i)}$) in the second round of Delphi was calculated through Equation (5).

$$\tilde{B}_m = (b_{m1}.b_{m2}.b_{m3}) = \left(\frac{1}{n}\sum_{i=1}^{n} b_1^i.\frac{1}{n}\sum_{i=1}^{n} b_2^i.\frac{1}{n}\sum_{i=1}^{n} b_3^i\right.$$

5.De-fuzzy: Minkowski method was used according to Equation 6.

$$X = m + \frac{\beta - \alpha}{4}$$

For screening and acceptance or non-acceptance of indicators, the intensity of the criterion threshold is considered. In this study, based on the opinion of Habibi et al. (2014), the number 0.7 was considered. If the mean value of the fuzzy number is 0.7 or higher, the index is acceptable, otherwise it is unacceptable.

6.Calculate the amount of disagreement of experts in the second round of Delphi (Equation 7):

$$S\left(\tilde{B}_m.\tilde{A}_m\right) = \left|\frac{1}{3}[(b_{m1}.b_{m2}.b_{m3}) - (a_{m1}.a_{m2}.a_{m3})]\right|$$

The repetition of the Delphi process went so far that the disagreement of the experts between the two polls reached a very low threshold (0.1).

FINDINGS

A: Thematic Analysis Findings

As already pointed out, thematic analysis can be done in three stages of open coding, axial coding and selective coding:

In the open coding stage, first the individual interviews were transcribed by the competent expert. After each interview being transcribed, the text was entered into the software and analyzed. In fact, carefully going through the interview statements line by line, the researcher attributed the descriptive themes to each of the statements and of course, sometimes the statements got various codes from a diverse perspective and the similar data in terms of concept were labeled with proportionate topics. The extracted concepts have been categorized in this section in Table 3. Consequently, 209 referrals to the interviews as 87 codes have been generated and extracted.

TABLE 3
REFERRED OPEN CODES

Employment in institutions	Connections with schools	Screening & employment type
Evaluations & reviews	Link with industry	Book review & correction
Clear-cut organizational goals	Communication with media	Work discipline
Social interactions and social standards	Shared research projects with students	General skills in web and social networks
Familiarity with search methods	Research results branding project	Lectureship skills
Email	Translation authorship and book subscription	Research basic skills
Book translation	Determination and perseverance	Advanced research skills
Research-oriented institution	Awards & grants	Information use skill
Researcher-oriented leader	Establishing & managing research teams	Article in non-specialized journals
Scientific monographs	Participatory decision making	Interpretive articles
Occupational & organizational commitment	Book critical correction	Positive participation
Producing technical knowledge	Identifying required information	Participation in private sector
Sufficient personal motivation	English proficiency	Responsible
Affable & cheerful	Research & researcher's globalization	Control center
Self-efficacy	Organizational climate	Participatory management
Inborn creativity	Judging research projects	Information management
Research creativity	Judging research articles and journals	Public lecturing
Developing specialized curriculum	Ranking in national festivals of research	Jointed foreign research activity
Self-esteem	Decentralized structure	Organizational culture
Lack of pride & arrogance	Executive history in convention	Membership in professional associations/forums
Not centralized in institution	Participatory leadership	Faculty member of research publications
Interacting with professional research networks	Accurate & up-to-date information seeking behaviors	Specialized social networks like ResearchGate / Mendeli / LinkedIn / Academy
Having specialized work related software	Not involving personal prejudice in the research	Designing & launching laboratories and workshops
Number of articles indexed in foreign databases	Potential to use E-resources & databases	Advanced information search, not general search
Promoting novel research technologies use	Number of citations in terms of articles and books	General computer skills
Submitting articles in international forums	Judging Master and PhD dissertations	Thesis Guide & Advisor
Authoring easily understood books for people – e.g., children and adolescents	Analysis, review & scientific editing of books and articles	Holding annual research exhibitions
Focusing on entrepreneurship in all sectors including agriculture, sports and ...	Proposing & implementing inter-& intra-university research projects	Acquaintance with novel advances in science and technology
Familiarity with quantitative & qualitative research methods	Familiarity with statistical & analytical software	Compiled books reprinting & editing

In axial coding stage using constant and multiple comparing descriptive codes produced in the previous stage, the interpretive codes were generated. For generating interpretive codes, several descriptive codes were grouped under one umbrella of interpretive code to form it. These axes are as table 4.

Regarding the previous stage drawn concepts, in the selective coding stage, by repeatedly studying and reviewing and the back-and-forth process between the concepts and the categories, considering the studies specific to each category, the major and basic studies' results related to that category were put together and through checking the factors' roles and their effect on research performance model, the relationship between the categories and the strategies were identified and analyzed.

Eventually, 9 main codes resulted representing the dimensions of the research performance model and 25 axial codes displaying the components of the dimensions. Moreover, 80 open codes were identified, which were reduced to 60 open codes after being integrated. How dimensions, components and indicators were constructed is thoroughly depicted in Table 5.

TABLE 4
AXIAL CODING STAGE

Research	Technical skill	Researching
Industry linking with university	Lecturing	Scientific evaluation & judgement
Communication	Personality traits	Laboratory experience
Participatory Management	Job skills	Information literacy
Leadership characteristics	Organizational culture	Globalization
Software skills	Structural factors	Specialized publications
Methodology skills	Occupational skills	Book writing
IT	Incentive systems	Scientific Articles
Computer literacy	Critical perspective	

TABLE 5
SELECTIVE CODING

Dimensions	Components	Indicators
Environmental factors	Research globalization	Research & researcher's globalization
		Industry & university linking
		Extensive research connections
	Industry & university connection	Research results globalization
		Participation in private & industrial sectors
	Communication	Researchers communicating with media
		Researchers' connection with industry
		Researchers' communication with educational centers & schools
		Social interactions & standards of society
		Connection with professional networks of research
Management factors	Participatory management	Participatory decision making
		Participatory management
	Leadership characteristics	Research-oriented leader
		Participation-oriented leadership
Methodological literacy	Software skills	Familiarity with statistical & qualitative –quantitative research software
	Research method skills	Advanced research skills
		Basic research skills
		Acquaintance with qualitative-quantitative research methods and analysis
Technological factors	IT	Familiarity with novel advances in science & technology
		Promoting novel research technologies
		Specialized social networks like ResearchGate
	Computer literacy	General web & social networks skills
		General computer use skills
		Email and using it
Research literacy	Scientific articles	Submitting articles in international forums
		Article in non-specialized journals
		Indexed articles in foreign databases
		Interpretive articles
		Citations number in terms of articles & books
		Scientific monographs
	Researching	Intra-& inter-university research projects implementation
		Joint research activities with students
		Buililding & managing research teams
		Master & PhD dissertations guide & advisor
		Joint research activity abroad
	Potential for scientific evaluation and judgement	Judging research projects
		Judging research articles and publications
		Judging in conferences & seminars
	Laboratory experience	Launching laboratory & workshop in specialized area
		Research training workshops (methodology)
Information & Technical skills	Information literacy	Recognizing required information
		Using electronic & information databases resources
		Advanced information search , not general search
		Accurate and up-to-date information-seeking behaviors
	Technical literacy	Technical knowledge production
		English proficiency
	Lecturing	Lecturing skills
		Lecturing in public
		Creativity
		Self-efficacy
		Control center

Individual characteristics	Personality traits	Affable & cheerful
		Lack of pride & arrogance
		Sufficient personal potential & motivation
	Professional skills	Responsible
		Discipline at work
		Determination & perseverance
Organizational factors	Organizational culture	Clear-cut organizational goals
		Research-oriented organizational atmosphere
		Research-oriented organizational culture
	Structural factors	Decentralized structure
		Not focusing on transferring research affairs
	Occupational factors	Screening & employment type
		Occupational & organizational commitment
	Incentive systems	Types of awards & grants
		Systems for removing obstacles for researchers
Scientific factors	Critical perspective	Scientific analysis, review, & editing of articles
		Judging students' theses & dissertations
		Book correction & review
		Review and comment on social issues in specialized discipline in newspapers
	Book writing	Authoring & publishing in specialized discipline
		Authored books reprinting & editing
		Specialized up-to-date books translation
	Subscription of journals	Research journals faculty member
		Professional associations' membership
		Ranking in national festivals of research

To analyze the influencing and affected (cause & effect) components in research performance, Fuzzy DEMATEL Method was utilized the results of which are listed in the table 6.

In Table 4, the sum of each row's elements (D) indicates the influencing level of that factor on other system factors. Accordingly, C2 has got the maximum influencing level. The sum of the column elements (R) for each factor depicts the factor being affected from other system factors. Based on this, C7 has been highly affected. The horizontal vector (D + R) shows the influencing and affected (cause & effect) level of the desired factor in the system.

In other words, the higher the factor D+R level, the more interaction that factor has with other factors of the system. Accordingly, C2 has the highest interaction with other study criteria. The vertical vector (D-R) illustrates each factor's influencing power. Generally speaking, if D-R is positive, the variable is considered a causal variable and if it is negative, it is considered an effect.

B: Fuzzy Delphi Findings

In this study, in order to screen the indicators and identify the final indicators, Fuzzy Delphi approach has been applied. For this purpose, the interviewed experts' perspectives about the importance and priority of each of the indicators have been gathered and as a result, the indicators influencing the research performance have been detected and the research model has been developed.

TABLE 6
DEMATEL METHOD RESULTS FOR ANALYZING PATTERN OF CRITERIA'S CAUSAL RELATIONSHIPS

Factor	Symbol	$\widetilde{D}_i$	$\widetilde{R}_i$	$\widetilde{D}_i + \widetilde{R}_i)^{def}$	$(\widetilde{D}_i - \widetilde{R}_i)^{def}$	Status
Scientific factors	C1	2.63	1.931	4.565	1.931	influencing
Personality traits	C2	2.95	2.689	5.639	0.261	influencing
Research knowledge	C3	2.03	2.302	4.337	-0.267	affected
Environmental factors	C4	2.54	2.192	4.735	0.351	influencing
Research literacy	C5	2.18	2.124	4.303	0.054	influencing
Technological factors	C6	2.72	2.132	4.853	0.588	influencing
Management factors	C7	2.66	2.353	5.011	0.305	influencing
Information & technical knowledge	C8	1.89	2.304	4.197	-0.410	affected
Organizational factors	C9	2.47	2.370	4.843	0.103	influencing

TABLE 7
EXPERTS' DEMOGRAPHICS

Demographics		Frequency	%
Gender	Man	6	60%
	Woman	4	40%
Age	Below 35 yrs.	1	10%
	35-45 yrs.	6	60%
	45 yrs. and higher	3	30%
Work history	10-20 yrs.	6	60%
	Over 21 yrs.	4	40%
	Total	10	100%

Concerning this point that using fuzzy sets is more consistent with linguistic and sometimes ambiguous human explanations. Consequently, it's preferred to apply fuzzy sets to deal with long-term predictions and decisions in real world (Caraman et al., 2009). In the current research, triangular fuzzy numbers have been utilized for fuzzification of the experts' perspectives.

TABLE 8
NINE-POINT FUZZY SPECTRUM FOR INDICATORS' EVALUATION

Absolute equivalent	Linguistic variable	Fuzzy number scale
1	Very insignificant	(1,1,1)
2	From very insignificant to insignificant	(1,2,3)
3	Insignificant	(2,3,4)
4	From insignificant to moderately significant	(3,4,5)
5	Moderate	(4,5,6)
6	From moderate to insignificant	(5,6,7)
8	From significant to very significant	(7,8,9)
9	Very significant	(9,9,8)

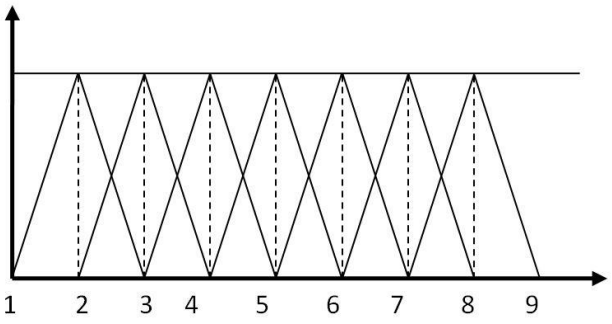

FIG .2
EVALUATION OF INDICATORS RELATIVE TO EACH OTHER USING TRIANGULAR FUZZY NUMBERS

In the next stage, the fuzzy mean of the fuzzy means of individuals' scores is computed. In order to compute the mean of n respondents' views, the fuzzy mean is estimated as the following:

Each triangular fuzzy number for each of the indicators is given in the following equation:

$$\tau_j = (L_j, M_j, U_j) \quad (1)$$

$$L_j = \min(X_{ij}) \quad (2)$$

$$M_j = \sqrt[n]{\prod_{i=1}^{n} X_{ij}} \quad (3)$$

$$U_j = \max(X_{ij}) \quad (4)$$

Index *i* refers to an expert. So that

τ_j: Fuzzy mean of *j*th criterion

x_{ij}: Evaluation value of the *i*th expert of the *j*th criterion

l_j: Min of evaluation values for the *j*th criterion
M_i: Geometric mean of experts' evaluation out of the *i*th criterion's performance
U_j: Max value of evaluations for the *j*th criterion
In fact, these aggregation methods are the experimental ones proposed by various researchers. For example, a conventional method for aggregating a set of triangular fuzzy numbers has considered the minimum *l* and the mean m and the maximum *u*.

$$F_{AGR} = \left(min\{l\}, \left\{ \frac{\sum m}{n} \right\}, max\{u\} \right) \quad (5)$$

In this study, the fuzzy mean method has been used. The fuzzy mean of n triangular fuzzy numbers has been calculated using Eq. 3:

$$\tilde{F}_{AVE} = (\mathrm{L}, \mathrm{M}, \mathrm{U}) = \frac{\sum l_i^k}{n}, \frac{\sum m_i^k}{n}, \frac{\sum u_k^i}{n} \quad (6)$$

Where the triangular fuzzy number $\tilde{f}_i = \left(l_i^k, m_i^k, u_i^k\right)$ equals the Kth expert's perspective fuzzy surrounding ith criterion. The mean fuzzy of exert panel's view for each of the study indicators has been given in the Table. Also for fuzzification, equation 7 has been applied.

$$DF_{ij} = \frac{\left[\left(u_{ij} - l_{ij}\right) + \left(m_{ij} - l_{ij}\right)\right]}{3} + l_{ij} \quad (7)$$

In the Fuzzy Delphi implementation phase, after developing the initial model (extracted from the theoretical references and interviewing the experts), the dimensions and components related questionnaire was developed and was handed to the selected individuals and to measure the validity of the developed model, the 2nd model was developed and re-sent to the experts for the 2nd time and this manner, all experts got aware of the outcome of each other's views. The results indicated that its 9 factors and components influenced the research performance and all experts were unanimous. The fuzzy mean and de-fuzzification output were calculated for the indicators' values. The present study threshold limit has been considered 0.7. The de-fuzzification value more than 0.7

is verified as acceptable and every indicator scored lower than 0.7 is rejected. At the end of the first round, all cases scored lower than 0.7 (two cases) were removed and at the end of the second round, the fuzzy Delphi analysis continued for the remaining indicators. The elements' de-fuzzification derived results in the second round and the difference between the fuzzification values of the first and second rounds are reported in Table 6. It's vivid that because of the high number of the indicators and the components, including the tables of the fuzzification mean to the fuzzification detailed values (*U, M, L*) has been overlooked .In the second round of fuzzy analysis, no items were removed, which signifies the Delphi rounds getting over. However, one approach to terminate Delphi process is to compare the mean scores of the first round and the second round items. If the difference between the two rounds is less than the threshold limit (0.7), then the polling process will terminate.

TABLE 9
FIRST & SECOND PHASES FUZZIFICATION VALUES AND THEIR DIFFERENCE

INDICATORS	1ST ROUND	2ND ROUND	DIFFERENCE
Holding annual research exhibitions	6.09	6.09	0
Research & researcher's globalization	6.09	6.09	0
Participatory decision making	5.96	6.09	-0.13
Participatory management	6.09	5.96	0.13
Potential to use E-resources & databases	5.96	6.09	-0.13
Participatory leadership	6.05	6.09	-0.04
Commercializing research results	6.09	6.09	0
Private sector participation	6.09	6.05	0.04
Awards & grants	6.13	6.09	0.04
Familiarity with statistical and analytical software - qualitative research software	5.96	6.09	-0.13
Self-efficacy	6.09	5.92	0.17
Advanced research skills	6.06	6.09	-0.03
Basic research skills	5.86	6.09	-0.23
Acquaintance with quantitative - qualitative research methods & statistical analysis	5.96	6.53	-0.57
Media connections	6.09	5.97	0.12
Connection with industry	6.15	6.27	-0.12
Research-oriented organization	6.3	5.96	0.34
Links with professional research networks	7	6.96	0.04
Lecturing skills	7.24	6.92	0.32
Lecturing in public circles	6.53	6.09	0.44
Familiarity with novel advances of science & technology	6.31	6.09	0.22
Promoting novel research technologies use	7.41	6.72	0.69
Organizational climate	6.09	5.92	0.17
General web skills & social networks	7.15	6.89	0.26
Decentralized structure	5.91	6.09	-0.18
E-mail	7.15	6.96	0.19
Submitting articles in international forums	6.8	5.92	0.88
Articles to non-specialized journals	6.06	6.09	-0.03
Number of articles indexed in foreign databases	6.17	6.09	0.08
Interpretive articles	2.31	6.09	-3.78
Number of citations in terms of articles and books	6.41	6.09	0.32
Scientific monographs	7.54	6.77	0.77
Submitting & implementing intra-&inter-	6.47	6.89	-0.42

university research projects			
Shared research projects with students	7.31	6.58	0.73
Building & managing research teams	5.96	5.96	0
Book translation	5.92	5.68	0.24
Judging articles & research projects	6.09	6.09	0
Judging articles & research journals	6.09	6.09	0
Executive history in holding conventions	5.72	5.96	-0.24
Designing & lunching laboratory & workshop	5.92	6.09	-0.17
Developing & launching research training laboratories & workshops	5.92	6.09	-0.17
Acquaintance with search methods	6.09	6.09	0
Recognizing required information	6.09	6.05	0.04
Research-oriented leader	6.09	6.09	0
Advanced information search, not general search	5.92	6.09	-0.17
Information management	6.09	6.09	0
Information skill	6.09	6.09	0
English proficiency	6.09	5.97	0.12
Producing technical knowledge	5.28	5.53	0.25
Accurate & up-to-date information-seeking behaviors	6.96	6.09	0.87
Inborn creativity	6.72	6.72	0.45
Creativity and innovation in research	7.15	6.8	0.35
Self-esteem	5.3	5.96	-0.66
Being equipped with specialized	6.09	6.09	0

work related software			
Control center	6.09	6.09	0
Sufficient personal capability & motivation	6.09	6.09	0
Responsible	5.92	5.72	0.2
Job discipline	5.96	5.92	0.04
Determination & perseverance	5.92	6.09	-0.17
Transparent corporate goals	5.92	6.09	-0.17
Social interactions & standards of society	6.09	6.8	-0.71
Specialized social networks such as ResearchGate / Mendeli / LinkedIn / Academy	5.97	5.92	0.05
Organizational culture	6.09	6.09	0
General computer skills	6.27	6.09	0.18
Not concentrating on institution	6.09	6.09	0
Job and organizational commitment	5.68	6.09	-0.41
Evaluations & reviews &	5.92	5.96	-0.04
Book critical correction	5.72	6.09	-0.37
Analysis, review, & scientific editing of books and articles	5.57	5.92	-0.35
Book review & correction	5.92	5.92	0
Authorship of easily understood books for people -e.g, children & adolescents	5.92	5.92	0
Compilation of translation & book convention	5.74	6.09	-0.35
Compiled books reprinting & editing	6.09	5.79	0.3
Jointed foreign research activity	5.92	6.09	-0.17
Judging master & PhD dissertations	5.92	5.72	0.2

Thesis guide & advisor	6.09	5.92	0.17
Developing specialized curriculum	6.09	5.92	0.17
Faculty member of research journals	5.33	5.68	-0.35
Professional associations membership	6.22	6.11	0.11
Raking in national festivals of research	6.55	6.17	0.38

With respect to the presented perspectives in the 1st phase and comparing them with the 2nd phase results, if the difference between the 2nd phase fuzzification mean is less than 0.7, the polling process will stop at this phase. Considering this fact that the fuzzification mean difference of the experts' views in the two phases is lower than 0.7, the experts were unanimous about the dimensions, components and indicators of the faculty members' performance model and the polling was put an end in this stage. That means the question experts had quite similar views about these indicators. As grasped from the results in Table 8, all of the dimensions, components and indicators were confirmed in the 2nd round and out of the 87 indicators, 80 ones were recognized as appropriate and 7 ones were removed in the 1st round.

Discussion and Conclusion

In the current study, a qualitative method (thematic analysis) was employed and 14 experts were interviewed and analyzed via MAXQUDA-12 software. After extracting the initial codes, the components of the qualitative stage's results in the axial coding stage were identified and categorized, and each component or several components were put under one dimension. In this stage, nine dimensions, namely, research literacy, scientific factors, information and technical skills, methodological literacy, environmental factors, organizational factors, management factors, technological factors and individual characteristics with 25 components. The first dimension is research literacy indicating the authorship of scientific articles and researching potential and the capability to evaluate, judge and having laboratory experience. Various laboratories emphasize that the 2nd dimension of the scientific factors, implying the authorship of easily understood books, conventions and translation of books and articles, being the guide and judge of theses and dissertations, and specialized publications and winning national and international awards , the results which are consistent with those found by Lertputtarak, (2008), and Chen et al.(2019), concentrating on the scientific review and editing, judging dissertations and theses, book review and correction, social review and commenting , authoring scientific books in an easily grasped language, reprinting books and translating the up-to-date books worldwide. The third dimension is technical and information skills denoting the information literacy and technical skills and lecturing, the results of which are compatible with those of the studies conducted by Kukko (2013) stressing the required information, the capability to use electronic resources and databases, searching advanced information, the resulted information management, technical knowledge production, English language proficiency, and lecturing and public speaking skills.

The fourth dimension is the literacy of methodology, referring to software skills and research method skills, the results of which are in line with the study findings of Jacob et al. (2016) emphasizing the familiarity with statistical and analytical software, qualitative and quantitative research software, being equipped with specialized software tools in their specialized work area and using them, and basic and advanced research skills. The fifth dimension involves the environmental factors, stating the globalization of research and industry link with the university and extensive communication. The sixth dimension is the corporate factors involving the organizational culture, structural factors (personality traits and individual characteristics), job factors and incentive systems. The seventh dimension includes the management factors referring to participatory management and leadership characteristics, the results of which are in accord with those found by Sanchez (2017) implying participatory decision-making, participatory management, research-oriented leader, and participatory-oriented leadership. The eighth dimension consists of the technological factors namely, computer and IT literacy. The ninth and the critical fundamental dimension encompasses personality traits expressing occupational skills and personality characteristics ,the results of which are consistent with those proposed by Bland et al.(2005) emphasizing the indicators such as having creativity, initiative, innovation, self-esteem, self-efficacy, internal control center, being affable and cheerful , lack of pride and arrogance, sufficient personal potential and motivation besides working skills like responsibility, order and determination and perseverance. As stated in the previously carried out studies ,they are consistent with the present study derived results ,and they differ in that each of them analyzed some dimensions of the current research and no study has been conducted with the present research title and each of them has investigated a variable or separate variables and different dimensions of the research performance and moreover, we have rarely got the chance to access a comprehensive background about identifying the components and indicators of research performance .Therefore, this study has been performed in this regard

considering the significant of the subject as the research performance model and lack of academic studies about this topic.

In general, the components of the results of the qualitative stage included 9 dimensions of research literacy, scientific factors, information and technical skills, methodological literacy, environmental factors, organizational factors, managerial factors, technological factors and individual characteristics with 25 components.

To evaluate the performance of research, quantification of its output alone will not provide accurate results and a more comprehensive approach is needed today. The proposed model in this research helps research managers and other stakeholders to develop and manage their human resources and create a healthy research ecosystem. This article will open a new spectrum for researchers and scholars to exploit and expand current research work in various areas of interest. This study recommends continuous improvement in the performance metrics required by the university for research according to the nature of the work. It is also recommended to benefit from the development of technology and information and improve the performance of faculty members. It is also recommended that transparent measurement of the performance measurement and evaluation process, which is the basic chain of any monitoring system, be done to the performance evaluation process models, a model for each performance, fairness in the performance evaluation and evaluation process and comprehensive evaluation of all faculty members without exception. It is also recommended that the degree of compliance and clarity of the goals that the university seeks with its mission be considered and evaluated, that procedures and administrative systems be followed and reviewed, and that efforts be made to improve them in accordance with the university's missions and goals.

REFERENCES

- Al Shobaki, M. J., Abu-Naser, S. S., Salama, A. A., AlFerjany, A. A. M., & Amuna, Y. M. A. (2018). The Role of Measuring and Evaluating Performance in Achieving Control Objectives-Case Study of" Islamic University". International Journal of Engineering and Information Systems (IJEAIS), 2(1), 106-118.

- Alam, M., Islam, S., & Pandit, M. K. (2020). Faculty Evaluation using Fuzzy Numbers. Journal of Physical Sciences Vol.25, 31-38.

- Alemu, I. D., Abriham, A., & Shuma, S. (2021). Evaluating yield and related trait of Haricot Bean varieties at Dambi Dollo University Research Site, Ethiopia. Plant Science Today, 8(3), 669-673.

- Bland, C J; Center, D A; Finstad, K; Risbey; Staples, J G. (2005). A Theoretical, Practical, Predictive Model of Faculty and Department Research Productivity. Academic Medicine. 80(3). 225-237.

- Camungao, R. (2020). Decision support system framework with k-means algorithm for faculty performance evaluation rating. International Journal of Scientific & Technology Research, 9(03), 4085-4088.

- Chen, G., Yang, G., He, F., & Chen, K. (2019). Exploring the effect of political borders on university-industry collaborative research performance: Evidence from China's Guangdong province. Technovation, 82, 58-69.

- Eslami, Z., Hakimzadeh, R., Saboury, A. A., & Farzad, V. (2021). Identifying Effective Factors in the Assessment of Research Productivity of Faculty Members in the Humanities and Social Sciences (Case Study: University of Tehran). Journal of Management and Planning In Educational System, 13(2), 149-176.

- Fartash, K., Khayyatian Yazdi, M. S., Moradian, M., Saremi, M. S., & Mohseni Kiasari, M. (2020). A Framework for Evaluating Tarbiat Modares University Science and Technology Park Tenants Using Action Research Method. Journal of Technology Development Management, 8(3), 151-184.

- Ford, D. J. (2004). Evaluating performance improvement. Performance Improvement, 43(1), 36-41.

- Han, H. C., Wan, H. D., & Wang, X. (2020). Quantifying Engineering Faculty Performance Based on Expectations on Key Activities and Integration Using Flexible Weighting Factors. Journal of Biomechanical Engineering, 142(11), 1-9.

- Hornstein, H. A. (2017). Student evaluations of teaching are an inadequate assessment tool for evaluating faculty performance. Cogent Education, 4(1), 303-317.

- Jacob, B. A., Rockoff, J. E., Taylor, E. S., Lindy, B., & Rosen, R. (2018). Teacher applicant hiring and teacher performance: Evidence from DC public schools. Journal of Public Economics, 166, 81-97.

- Jain, P. (2020). K-Means Clustering on the Performance Evaluation of Faculty using Data Mining Techniques. International Research Journal on Advanced Science Hub, 2, 36-41.

- Kao, D. S., Appelbaum, N. P., Kates, S. L., & Domson, G. F. (2021). Surgery Resident Perceptions of the Clicker Evaluation System: A Novel Approach to Collecting and Utilizing Clinical Faculty Performance Data. Journal of Surgical Education, 78(1), 113-118.

- Kukko, M. (2013). Knowledge sharing barriers in organic growth: A case study from a software company. The Journal of High Technology Management Research, 24(1), 18-29.

- Lertputtarak, S. (2008). An Investigation of Factors Related to Research Productivity in a Public University in Thailand: A Case Study. Victoria University, Melbourne, Australia: A dissertation submitted in partial fulfilment of the requirements for the Degree of Doctor of Education, School.

-Moeinedini M., Raissi S., Khalili-Damghani K., (2018) A fuzzy fault tree analysis-based risk assessment approach for enterprise resource planning projects: A case study in an Iranian foodservice distributor, International Journal of Quality & Reliability Management 35 (5), 1115-1141.

- Nematkhah F., Raissi S., Ghezavati V.R., (2017), An Integrated Fuzzy DEMATEL-Fuzzy ANP Approach to Nominate Diagnostic Method and Measuring Total Predictive Performance Score, Safety and Reliability, Taylor & Francis, Vol 37, Issue 1, 37-42, https://doi.org/10.1080/09617353.2017.1411676.

- Nourian R. , Meysam Mousavi S., Raissi S., (2019) A fuzzy expert system for mitigation of risks and effective control of gas pressure reduction stations with a real application, Journal of Loss Prevention in the Process Industries, Vol. 59, 77-90.

- Ponomareva, A. M., Zhumanova, M. H., Kolchugina, T. A., Solovieva, I. V., & Puchkova, E. E. (2021). Evaluating the Effectiveness of the University as Intellectual and Creative Organization. In Modern Global Economic System: Evolutional Development vs. Revolutionary Leap 11 (pp. 559-566). Springer International Publishing.

- Sanchez, T. w. (2017). Faculty Performance Evaluation Using Citation Analysis: An Update. Journal of Planning Education and Research (37), 83-94.

- Sharifi Mohamamd Reza, Ghezavati VahidReza, Raissi Sadigh, Makui Ahmad, (2018) Integration of a new MCDM approach based on the DEA, FANP with MONLP for efficiency risk assessment to optimize project portfolio by branch and bound: A real case study, Economic Computation & Economic Cybernetics Studies & Research, Vol. 52, Issue 1.

- Tung, V. W. S., Law, R., & Chon, K. (2018). Changing proxies for evaluating research performance: What matters to university programme heads? Tourism Recreation Research, 43(3), 346-355.

- Xu, C. (2020). Towards a Framework for Evaluating the Research Performance of Chinese Double First-Class Universities. Frontiers of Education in China, 15(3), 369-402.

- Yang, E. B., Lee, T. S., & Cho, M. J. (2019). Current Status and Performance Evaluation Systems of Faculty in Korean Medical Schools. Korean Medical Education Review, 21(1), 41-50.

- Zhang, X., & Shi, W. (2019). Research about the university teaching performance evaluation under the data envelopment method. Cognitive Systems Research, 56, 108-115.