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Research paper

University entrepreneurship center identity factors prioritization using TOPSIS method

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Abstract

University Entrepreneurship Center Identity (UECI) is a set of meanings by which a UECI allows itself to be known, and through which it allows people to describe, remember and relate to it. There are many factors stated in many studies related to UECI, but their importance level is not mentioned. In this study, the UECI factors are ranked by using TOPSIS method. A quantitative study was conducted to obtain experts' views on UECI factors. The UECI factors were prioritized and ranked by using the "Technique for order of Preference by Similarity to Ideal Solution" (TOPSIS) from Multi-Criteria Decision Making (MCDM) method. The result of performing TOPSIS is as a novelty which assists UECI presentation. The high priority factors were introduced as "Innovativeness", "Industry Interactions", "Producing Highly Qualified Graduates", "Proactiveness", "Attract Entrepreneurial Faculty", "Teamwork", "Consulting", and "Risk Taking". This study proposes the importance level of UECI factors. At the end, it is recommended to evaluate the effect of UECI perception in different studies which contain university entrepreneurship center identity perception.

Keywords: *Organizational Identity Factors Identification; University Entrepreneurship Center.*

1. Introduction

Organizational identity is a set of meanings by which an organization allows itself to be known and through which it allows people to describe, remember and relate to it [1 - 5]. Organizations identity answers the questions of 'Who am I?', 'Who are we?' and 'How do others know who I am? [6]. Organizational identity plays an important role for organizational image [7 - 8], and consequently organizational attractiveness [9 - 10].
Organizational identity is a relatively new concept in higher education research [7], [11 - 12], and most of studies on university identity and image have the purpose of attracting potential new students [13]. Role of University Entrepreneurship Center (UEC) in universities is very important in order to teach students the initial phases of entrepreneurship, and also universities need to commercialize their students' research outcomes through their entrepreneurship centers [14 - 16]. UECs need to attract students to their activities by presenting their organizational identity to students through their official website as their virtual face, which is the very first source of gaining information for students [17 - 20]. Unfortunately, the literature about University Entrepreneurship Center Identity (UECI) factors' importance level is limited and whatever literature is available are focusing on entrepreneurial orientation of universities and entrepreneurship itself [12], [18], [21 - 22]. This study hoped that by conducting the survey among UEC experts in some Malaysian and international universities, can determine the importance level of UECI factors. The main objective of this study is to identify the importance level of UECI factors from UEC experts' perspective.

2. The problem statement and our contributions

This paper describes an empirical study that we conducted ranking of the possible factors of university entrepreneurship center identity. The questions that have been raised for this study are: (a) what are the significant factors of a university entrepreneurship center identity. (b) What is the importance level of each factor of a university entrepreneurship center identity?
The contributions of this study at hand are two-folded. First, there is limited literature available about university entrepreneurship identity factors, and whatever exists are focusing on entrepreneurial orientation of universities and entrepreneurship itself [12], [18], [21 - 22]. Hence, the current study makes an effort to collect all the possible factors which are related to university entrepreneurship center identity.
Second, this paper evaluates the importance level of university entrepreneurship center identity (UECI) factors. In addition, this study proposes Technique for order of Preference by Similarity to Ideal Solution (TOPSIS), which is originated from Multi-Criteria Decision Making (MCDM) method, to find the importance level of UECI factors. TOPSIS method is adopted in order to determine the importance of UECI factors from UEC experts' point of view. By using TOPSIS, UECI factors are weighted and prioritized by UEC experts, who have plenty of experience and are wholly familiar with university entrepreneurship center identity.

3. Related works

According to [7], University's Entrepreneurship Center Identity (UECI) could be defined and understood as reflecting a 'true' UEC

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character. UECI signals the values and attitudes of the UEC. These values and attitudes are imagined as symbolic representations of the UEC [23]. According to [6], UECI is generally understood to be the collective understanding of members of a UEC of the features that are presumed to be central, distinctive and relatively permanent about the UEC.

[24] states that making university entrepreneurship center more entrepreneurial is the central focus of literature on university entrepreneurship. University Entrepreneurship Centers (UEC) develop and administer entrepreneurship courses, initiate outreach activities, such as business competitions, promote entrepreneurship on campus, and reach out to the university's entrepreneurial ecosystem [14]. The purpose of the Entrepreneurship Center is to facilitate the creation of new businesses by members of the university community – students, faculty, staff, and alumni. The Center has four main functions: to provide entrepreneurship education at the undergraduate, graduate, and community levels; to provide consulting help to entrepreneurs; to provide seed money for start-ups; and to create networks for entrepreneurs to find money, professional services, personnel, and business/technical contacts. Students are trained in entrepreneurship courses on how to write a business plan, raise money, put together a team, and run a startup business [25].

Historically, universities do technology transfer through patenting and licensing the results of university research to be more entrepreneurial [14], [26 - 28]. However, more recently universities have played a direct role in venture start-ups [26], [29 - 30], establishing business incubators [14], [26], [31], [32], and encouraging university-based consulting [27]. Some other researchers like [26], [29], [33] emphasize and support commercialization efforts of universities. Some other researchers like [34], [35] propose research collaboration with practitioners to have more applied education programs. [16] Introduces a model to measure entrepreneurial orientation of different university departments (Entre-U model) which includes four factors of research mobilization, unconventionality or innovativeness, industry collaboration, and university policies. Entre-U has been followed by [15], [30], [36]. [37] Uses a spectrum of entrepreneurial activities such as creation of a technology park, spin-off firm formation, patenting and licensing, contract research, industry training courses, consulting, grantsmanship, publishing academic results, producing highly qualified graduates. Some other entrepreneurial academic activities such as Patents, License agreements, Business activity, Collaboration or Teamwork, Contract research, Industry Interactions, Industry-sponsored workshops and meetings, and applied research are used as the measurement factors by [30].

In the context of entrepreneurial activities of universities, different factors are introduced by different researchers which creates uncertainty about which factors should be used for investigation of the university entrepreneurship center identity. The current study aims to fill this gap in the literature as a starting point for a series of studies relating to university entrepreneurship center identity.

4. TOPSIS technique

In this study, the UECI factors have been ranked based on importance and relevance by using TOPSIS. According to [38, 39] the TOPSIS procedure has five steps. After forming an initial decision matrix, the procedure starts by normalizing the decision matrix. This is followed by building the weighted normalized decision matrix in Step 2, determining the positive and negative ideal solutions in Step 3, and calculating the separation measures for each alternative in Step 4. The procedure ends by computing the relative closeness coefficient. The set of alternatives (or candidates) can be ranked according to the descending order of the closeness coefficient [38], [39] Therefore, the procedure of the TOPSIS method consists of the following steps:

The procedure of the TOPSIS method consists of the following steps [38], [39]:

Step 1: Construct normalized decision matrix:

$$n_{ij} = r_{ij} / \sqrt{\sum_i (r_{ij})^2} \text{ for } i = 1, \dots, n;\ j = 1, \dots, m$$

Where r_{ij} and n_{ij} are original and normalized score of decision matrix respectively with n alternatives and m indicators.

Step 2: Construct the weighted normalized decision matrix: $v_{ij} = w_j r_{ij}$

Where w_j is the weight for j criterion.

Step 3: Determine the positive ideal:

$$A^* = \left\{ \left(\max_i v_{ij} \,\middle|\, j \in J \right), \left(\min_i v_{ij} \,\middle|\, j \in J' \right) \right\}$$

$$A^* = \{ v_1^*, v_2^*, \dots, v_n^* \}$$

And negative ideal solutions:

$$A^- = \left\{ \left(\min_i v_{ij} \,\middle|\, j \in J \right), \left(\max_i v_{ij} \,\middle|\, j \in J' \right) \right\}$$

$$A^- = \{ v_1^-, v_2^-, \dots, v_n^- \}$$

Step 4: Calculate the separation measures for each alternative. The separation from positive ideal alternative is:

$$S_i^+ = \sqrt{\left(\sum_{j=1}^m vij - v_j^+ \right)^2}$$

Similarly, the separation from negative ideal alternative is:

$$S_i^- = \sqrt{\left(\sum_{j=1}^m vij - v_j^- \right)^2}$$

Step 5: Calculate the relative closeness to the ideal solution C_i^*

$$C_i^* = \frac{S_i^-}{S_i^- + S_i^+}$$

Select the Alternative with C_i^* closest to 1.

5. Research methodology

The first step in this study was to identify the UECI factors. In order to identify factors of UECI, 132 articles regarding "entrepreneurial universities" and "university entrepreneurship (UE)" published between 2000 and 2017 were reviewed, then 75 articles concerning to UE were selected, after that, 22 factors have been extracted from them (see Table 1). To extract the relevant factors of UECI, the definition of [11], which has defined a UECI as its shared attitudes, values, goals, and practices, has been adopted and followed. As the result, attitudes, values, goals, and practices of UEC are reviewed and extracted (see Table 1).

Table 1: Description of UECI Factors

	Factors	References
1	**Applied Research** UEC emphasizes applied research.	[26], [40], [41]
2	**Attract Entrepreneurial Faculty** UEC attracts entrepreneurial students and faculty staff.	[26], [29]
3	**Autonomy** UEC motivates students to have independence and freedom from external control or influence.	[26], [29], [42]
4	**Business Activity / Spin-Off Firm Formation**	[26], [29], [30]

	UEC motivates students to have business activity in terms of starting any business based on his/her research results or any kind of personal involvement in a spin-off or start-up business.	
5	**Commercialization** UEC motivates students to manage or run something mainly for financial gain. The commercialization of research generates revenues for the university.	[26], [33], [29]
6	**Competitive Aggressiveness** The tendency to intensely and directly challenge competitors rather than trying to avoid them. This refers to UEC motivates students to value “beating" the competition.	[26], [34]
7	**Consulting** UEC gives expert advice to other professionals, typically in financial and business matters.	[26], [29], [43]
8	**Contract Research** UEC motivate students to engage (more) actively in programs of external financing, outsource their research activities by the corporate sector, and participate in collaborative public–private research partnerships.	[30], [37], [40], [44], [45]
9	**Creation of a Technology Park** UEC supplies a formal site where businesses (normally of a high-tech nature) can locate and interact with the university itself.	[37], [45]
10	**Fun** UEC members value fun and believe it appropriate to have fun at work and with fellow members.	[33], [34], [46]
11	**Funding (Grantsmanship)** UEC provides funding for student enterprises.	[14], [26], [29]
12	**Incubation** UEC often act as business incubators, allowing students and faculty to meet, form teams, and experiment with the idea of bringing technology from research labs to the market.	[14], [26], [31], [32]
13	**Industry Interactions** UEC provides connectivity between academic science and industrial research in terms of (1) public–private co-authored research articles, and (2) references (‘citations’) within corporate research articles to university research articles.	[26], [30], [37], [45], [47]
14	**Industry Training Courses - Workshops and Meetings** UEC provides participation of academics in industry training courses, workshops or meetings	[30], [37], [43], [45], [48]
15	**Innovativeness** UEC provides students with the skill and imagination to create new things	[26], [43], [47]
16	**Proactiveness** UEC motivate students to initiate changes rather than reacting to events. UEC motivate students to create or control a situation by causing something to happen rather than responding to it after it has happened	[15], [16], [26], [30], [34], [49]
17	**Producing Highly Qualified Graduates** UEC provides the workforce with skilled undergraduates and postgraduates.	[26], [37]
18	**Publishing Academic Results** UEC motivates students to publish their academic results through books, chapters and articles.	[26], [33], [30], [37]
19	**Risk Taking** The degree UEC members believe that reasonable risks should be taken by people at all levels of the university, and that failure is a source of learning (rather than a source of shame). Members with Risk-taking characteristic take actions which might have unpleasant or undesirable results for them.	[26], [36], [50], [51]
20	**Teamwork / Collaboration** UEC promotes teamwork and collaboration with practitioners to have more applied education programs	[34], [35]
21	**Technology Transfer – Patenting and Licensing** UEC promotes technology transfer through patenting and licensing of the university research results to increase the benefits of universities to the public.	[14], [26 - 28]
22	**Voice** UEC allows its members to express their dissatisfaction with the UEC in an attempt to improve it, rather than suffering in silence or leaving the UEC.	[34], [40], [52]

Since these are the factors that have been used in various fields, countries and are voluminous, further investigation needed to analyze and prioritize UECI factors. Thus, a decision making technique to select appropriate factors for the scope and purpose of this research was applied. Technique for order of Preference by Similarity to Ideal Solution (TOPSIS) was used. TOPSIS is originated from Multi-Criteria Decision Making (MCDM) method, and it is used to find the importance level of UECI factors. There are several available methods of MCDM such as Analytic Hierarchy Process (AHP), TOPSIS and Fuzzy TOPSIS. However here, TOPSIS is chosen due to its simplicity and ability to consider a non-limited number of alternatives and criteria in the decision-making process [54]. Fig. 1 contains a description of each step in this study.

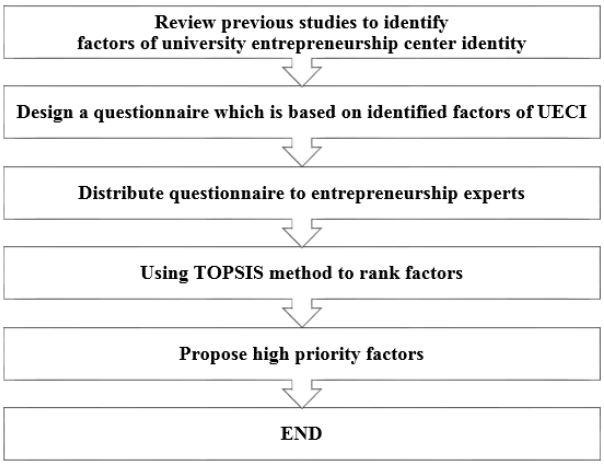


Fig. 1: Research Steps.

Regarding steps to do TOPSIS, the structure stated by [38], [53] were followed and implemented. To perform TOPSIS, a quantitative, survey-based, five-item Likert scaled research study was performed and was analyzed to explain the high priority factors of UECI. Questionnaire was used due to the different country locations of experts, and also its higher speed of data collection process. UEC experts have been asked to rate factors based on Likert scale

of five items (Not at all Important, Somewhat Important, Neither Important nor unimportant, Important, and Very Important). Survey was made available to 185 UEC experts "who are working as UEC's manager or staff" via e-mail, which have been selected as entrepreneurship experts from staff webpage of university's official website. Only 15 experts answered the questionnaire who are senior lecturers or managers in Malaysian and international universities. All the respondents are Ph.D. holders, and most of them (67%) had more than 10 years of experience in entrepreneurship which provide valuable and reliable answers to this study (see Table 2). The experts who have answered the questionnaire are from UTM, UKM, UiTM, USM, UM universities in Malaysia, and Harvard, Texas, and Pennsylvania University in USA. The 15 completed questionnaires are adequate to give a reliable ranking to the UECI factors.
The survey contained number of questions that were designed to capture information about the constructs in the study which are as "Applied Research", "Attract Entrepreneurial Faculty", "Autonomy", "Business activity (Spin-off firm formation)", "Commercialization", "Competitive Aggressiveness", "Consulting", "Contract Research", "Creation of a Technology Park", "Fun", "Funding (Grantsmanship)", "Incubation", "Industry Interactions", "Industry training courses (workshops and meetings)", "Innovativeness", "Proactiveness", "Producing Highly Qualified Graduates", "Publishing Academic Results", "Risk Taking", "Teamwork (Collaboration)", "Technology Transfer (Patenting and licensing)", and "Voice".

6. Data analysis and results

Following [38], [53] guideline, TOPSIS was used to obtain the ranking of these factors. Objective weights were calculated as follows:

w1=0.067, w2=0.133, w3=0.2, w4=0.26, and w5=0.33

Therefore, matrix W can be defined as:

$$W = \begin{bmatrix} 0.067 & 0.000 & 0.000 & 0.000 & 0.000 \\ 0.000 & 0.133 & 0.000 & 0.000 & 0.000 \\ 0.000 & 0.000 & 0.200 & 0.000 & 0.000 \\ 0.000 & 0.000 & 0.000 & 0.267 & 0.000 \\ 0.000 & 0.000 & 0.000 & 0.000 & 0.333 \end{bmatrix}$$ is the set of weights.

The overall viewpoint of experts indicated that "Innovativeness" and "Industry Interactions" are the most important factors of a University Entrepreneurship Center Identity (UECI) with the weight of 0.69 and 0.69. However, "Contract research" and "Creation of a technology park" are the least important factors of a university entrepreneurship center identity with the weight of 0.48 and 0.51. It is clear from the Fig. 2 that the distance between the rank of "Risk Taking" and "Commercialization" is considerable. Thus, there is a break point between the ranks of these two factors ("Risk Taking" and "Commercialization") which categorize the factors into two groups. The first group are high priority factors from the expert's viewpoints (Rank>=0.67) and the second group are low priority factors (Rank=<0.61).
The results of TOPSIS analysis and the break point between "Risk Taking" and "Commercialization", show that eight factors among 22 have higher priority. Innovativeness and Industry Interactions have the most importance in the top priority with the weight of 0.69. Producing Highly Qualified Graduates, Proactiveness, Attract Entrepreneurial Faculty, Teamwork, Consulting, and Risk Taking were in the third to eighth ranks with weights 0.68, 0.68, 0.68, 0.67, 0.67, and 0.67. Furthermore, the conceptual research model was developed based on the UECI high priority factors (see Fig. 3).

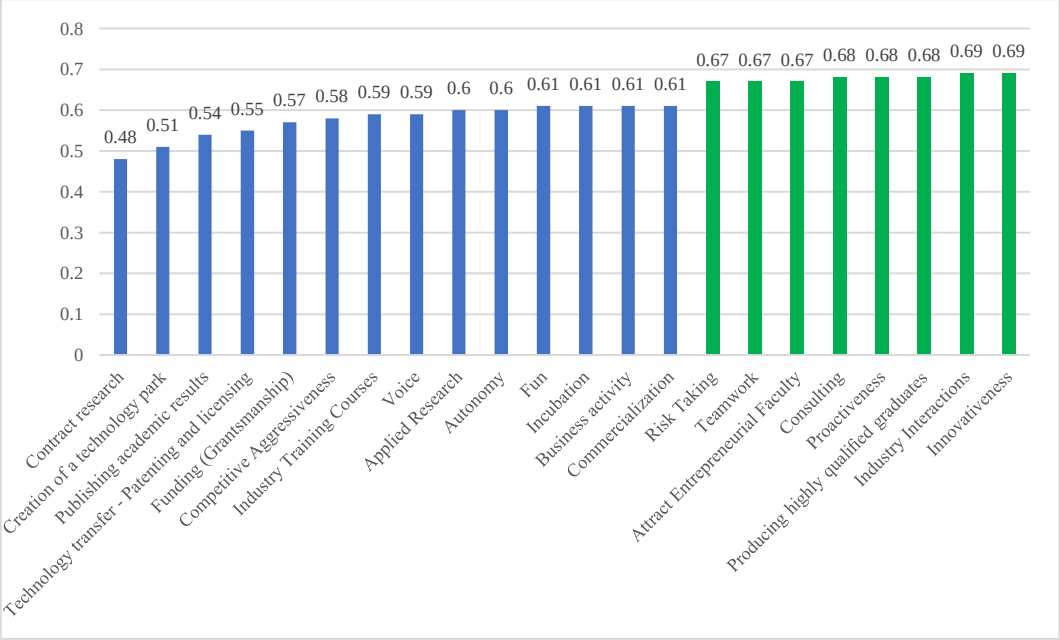


Fig. 2: Ranking of University Entrepreneurship Center Identity (UECI) Factors.

Table 2: Profile of Survey Respondents

Gender %		Age %		Education %		UEC Experience %	
Male	60	24-33	20	Master 0		< 5 years	0
Female 40		34-50	53	Ph.D.	100	5–10 years 33	
		>50	27			> 10 years 67	

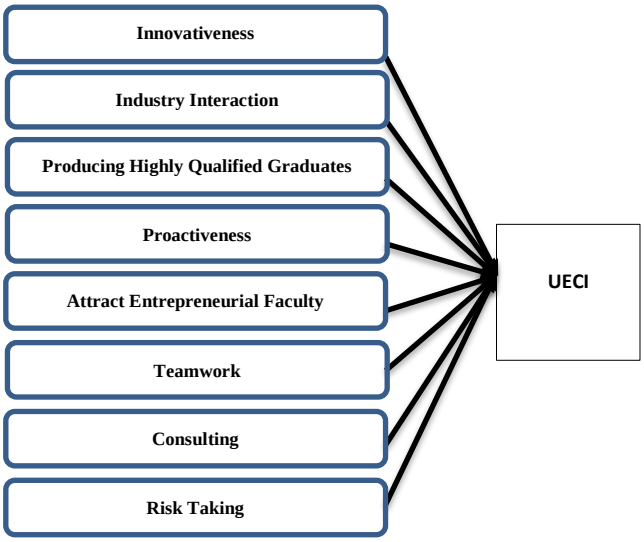


Fig. 3: Research Model.

7. Discussion

While there are different entrepreneurial activities of universities in the literature, little is known about the importance of UECI factors. The research question addressed here is "what is the importance level of UECI factors from UEC experts' perspective". In the context of entrepreneurial activities of universities, different factors are already introduced by other researchers which are listed in Table 2. Using the TOPSIS method for the statistical development of UECI, and based on the data from 15 experts in the context of university entrepreneurship center, we provided evidence that at least there are eight important UECI factors. Based on TOPSIS steps which are followed from [38], [39], Innovativeness and Industry Interaction are the most important factors in the top priority group with the weight of 0.69. In this regard, previous studies such as [26], [43], [47] confirmed "Innovativeness" as an important characteristic of a UEC .In this regard, "Innovativeness" is very important so that UECs provide students with the skills and imaginations to create new things. Studies conducted by [26], [45], [47], [37], [30] confirmed "Industry Interaction" as another important characteristic of a UEC. In this regard, "Industry Interaction" is very important for UECs to provide connectivity between academic science and industrial research in terms of public–private co-authored research articles, and references ('citations') within corporate research articles to university research articles. Importance of "Innovativeness" and "Industry Interaction" as the most important factors mean that they should not be overlooked by UEC managers for their organizational identity presentation and evaluation.

In addition, "Producing Highly Qualified Graduates", "Proactiveness", and "Consulting" are the next most imperative factors of UECI with the weight of 0.68. "Producing Highly Qualified Graduates" echoes the results obtained in the previous studies done by [26], [37], which is an important characteristic of UECs to provide the workforce with skilled undergraduates and postgraduates. Furthermore, "Proactiveness" supports the results of [15], [16], [26], [34], [49], [30] studies. "Proactiveness" means that UECs motivate students to make things happen, instead of waiting for them to happen, in other words, it means to initiate changes rather than reacting to events. Having Proactiveness will make students to create or control a situation by causing something to happen rather than responding to it after it has happened. Additionally, "Consulting" echoes the results obtained in [26], [43], [29] studies, and it is an important characteristic of UECs to give expert advice to other professionals, typically in financial and business matters. Importance of "Producing Highly Qualified Graduates", "Proactiveness", and "Consulting" as the second ranked important factors mean that they should be considered by UEC managers for their organizational identity presentation and evaluation.

Furthermore, "Attract Entrepreneurial Faculty", "Teamwork", and "Risk Taking" have been recognized as the next important factors of UECI with the weight of 0.67. In this regard, studies conducted by [26], [29] have supported "Attract Entrepreneurial Faculty", and [34], [35] have supported "Teamwork", and [26], [36], [50], [51] have supported "Risk Taking". "Attract Entrepreneurial Faculty" means that UEC is consisted of and values entrepreneurial Faculty (including staff and students) which shows a very positive atmosphere in UECs organizational culture and attitudes toward its members. "Teamwork" as an important characteristic in a UEC refers to its staff and students working in a group and having collaboration in doing different activities, and also having research collaboration with practitioners in order to have more applied education programs. "Risk-Taking" characteristic explains that UEC members believe that reasonable risks should be taken by people at all levels of the university, and also that failure is a source of learning rather than a source of shame. UEC members with Risk-taking characteristic take actions which might have unpleasant or undesirable results for them.

Significance of this study is in ranking of UECI factors and introducing the higher priority group of factors which includes eight factors. The important UECI factors are comprised of different types of organizational identity characteristics of UECs which can help researchers to have a better understanding of a 'true' UEC characteristics. The introduced UECI factors signal the values and attitudes of a university entrepreneurship center (UEC), and these values and attitudes are imagined as symbolic representations of the UEC [23]. The current study filled the gap in the literature as a starting point for a series of studies relating to university entrepreneurship center identity. Studies which include "Organizational Identity Perceptions" similar to [9], [35], can use the results of this study to measure their target group perception of UECI. Knowing the important factors of UECI, universities can more properly manage their UECI presentation in their social and virtual activities. This study can lead UECs to some kind of specialization in order to play their expected and needed role in the organizational identity presentation.

8. Conclusion

In this paper, identification and prioritizing of UECI factors took place. The results of TOPSIS revealed that the experts in UECs believe that there are eight high priority factors (Innovativeness, Industry Interactions, Producing Highly Qualified Graduates, Proactiveness, Attract Entrepreneurial Faculty, Teamwork, Consulting, and Risk Taking) for UECI which should not be overlooked in case of UECs' organizational identity presentation and evaluation. This study has theoretical and practical contributions. It suggests a

framework to identify and understand the important factors of university entrepreneurship center identity. By assessing the factors with TOPSIS, importance of each factor has been identified, but the proposed conceptual model needs to be empirically tested for its usefulness and application in the measurement of UEC identity and image in related studies which include "Organizational Identity Perceptions", as it is still in the conceptual stage. The model is open to debate and discussions and further improvements, and expansions may be proposed with inclusion of other suitable variables in the future.

This study can be applied to UEC identity and image studies in all countries through more testing and validating. UEC's organizational identity managers can use the results of this study to have a better identity presentation of their organization, and also on the other hand, they can use the proposed factors to evaluate their organizational identity perception from different target groups. This study suggests that UECs should carefully evaluate the characteristics about themselves which they choose to highlight as part of their identity. This research provides a measurable list of institutional characteristics and resources about which UECs' experts desire to been seen.

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