An empirical investigation of entrepreneurship intensity in Iranian state universities

Mohammad Mahdavi Mazdeh · Seyed-Mostafa Razavi · Roozbeh Hesamamiri · Mohammad-Reza Zahedi · Behin Elahi

Abstract The purpose of this study is to propose a framework to evaluate the entrepreneurship intensity (EI) of Iranian state universities. In order to determine EI, a hybrid multi-method framework consisting of Delphi, Analytic Network Process (ANP), and VIKOR is proposed. The Delphi method is used to localize and reduce the number of criteria extracted from a deep literature review, according to the social and economic conditions of Iranian state universities by using an expert panel, including sixty-eight country-wide academicians and practitioners. After that, a group approach to ANP was utilized as an evaluation method to derive the weights of each criterion. Next, the evaluation data were gathered through a questionnaire, and, finally, the compromise ranking of universities was calculated using the VIKOR method. Moreover, this study applies weight-variance analysis (WVA) to suggest improvement actions. The paper proposes an evaluation framework for determining the performance of entrepreneurship development initiatives in universities. By using this framework, twenty-two Iranian state universities are evaluated in terms of their EI, and the results are discussed.

Keywords Academic entrepreneurship evaluation · Analytical Network Process (ANP) · Higher-education institutions · Delphi · VIKOR

Introduction

The importance of entrepreneurial behavior in developing countries is currently highlighted by increased competition in the global economy, the need for permanent economic development, and the reported economic benefits arising from the commercialization of...
science and technological knowledge. In these countries, universities play pivotal roles in promoting entrepreneurship by contributing to knowledge and technology development (Owen-Smith and Powell 2001).

As universities adjust to the recent changes in the economic environment and expectations for their contribution to innovation and economic development, research on university entrepreneurship has become a major issue not only for academics, but also for governments, regulators, enterprises, investors, and other stakeholders (Rothaermel et al. 2007). On the other hand, as government funding becomes scarcer, universities are forced to diversify their revenue sources, become more efficient, and shift resources towards greater commercialization of knowledge. As a response, universities are encouraged to become more “entrepreneurial” (Todorovic et al. 2011).

Examining a variety of entrepreneurial university studies shows that three important issues have been considered by different scholars: (1) why some universities are more entrepreneurial than others (Owen-Smith and Powell 2001; Etzkowitz 2003; Friedman and Silberman 2003), (2) what the barriers are to universities’ becoming more entrepreneurial (Feldman and Desrochers 2003; Mowery and Sampat 2005), and (3) how universities can be more successful in entrepreneurial activities (Friedman and Silberman 2003; Powers and McDougall 2005). Although all of these main concerns among different scholars start with the development of entrepreneurship evaluation methods and frameworks for universities, little research has focused on evaluation frameworks for measuring universities’ entrepreneurial intensity.

On the other hand, Iran initiated its entrepreneurship development plan as a developing country back in 2005. In terms of university entrepreneurship, the Ministry of Science, Research, and Technology (MSRT) has started a plan called KARAD1 (which means “University Entrepreneurship” in Persian) since August 30, 2006, as a part of the fourth and fifth “5-year socio-economic development plan” of Iran (2005–2015). The plan’s vision is to establish entrepreneurship centers in universities in order to have a developed and dynamic society consisting of economically self-dependent practitioners with higher education levels. Since 2006, a considerable amount of budget money and effort has been devoted on this plan every year. Today, more than 110 centers for entrepreneurship are established in Iranian universities and twelve different institutes are responsible for KARAD objectives, such as the MSRT and the Ministry of Cooperatives, Labor, and Social Welfare (IDE 2011). However, there has been an atmosphere of vagueness in achieving this policy initiative in Iranian academic environments since the beginning of the plan. In the absence of any systemic evaluation framework, it was not possible to determine which universities are more entrepreneurial than others. The performance of each university’s entrepreneurship development initiative was unclear, however there only existed scattered entrepreneurship reports of some universities. Consequently, the main objective of this research is to develop a framework in order to empirically evaluate the performance of the entrepreneurship development plan in Iranian universities through determining academic EI by conceptualizing, quantifying, and measuring its ingredients as evaluation criteria.

The methodology adopted in this paper is integrated into three main phases. In the first phase, the main elements affecting university EI are identified through previous studies. Then, in accordance with the Iranian state universities’ contingency, the essential criteria and their related sub-criteria are defined and localized using the Delphi method. In the second phase, a group decision-making approach to the Analytic Network Process (ANP) (Saaty 1990, 2006) is used to calculate the weights of each sub-criterion. Consequently, in the third phase, the university rankings are presented based on the gathered data set

through an empirical survey of Iranian state universities using the VIKOR method. The remainder of this paper is organized as follows: Sect. 2 describes university entrepreneurship and categorizes the main criteria and sub-criteria that evaluate the EI. Section 3 addresses any entrepreneurship background in Iranian universities. Section 4 describes the considered methodology and results of the empirical study. Finally, Sect. 5 outlines discussions and concluding remarks.

University entrepreneurship

According to the European Commission, entrepreneurship can be defined as “the mindset and process to create and develop economic activity by blending risk-taking, creativity and/or innovation with sound management, within a new or an existing organization,” and “Entrepreneurs commonly utilize elements of creativity, innovation, problem-solving, risk-taking and pro-activity in the pursuit of their goals” (European Commission 2006). Also, Bolton and Thompson (2004) define entrepreneurs as “individuals who habitually create and innovate to build something of perceived value around opportunities they spot.” Moreover, O’Shea et al. (2005) suggest a definition for the academic entrepreneurship term and state that this term refers to the efforts and activities that universities and their industry partners undertake in hopes of commercializing the outcomes of faculty research.

Universities are currently setting up institutional arrangements, such as Technology Transfer Offices (TTOs), incubators, entrepreneurship centers, and internal seed funds, to increase the commercialization of research (Rasmussen et al. 2006). In particular, many countries and universities have emphasized the creation of university spin-off firms (USOs) as an important tool for the commercialization of research (Shane 2004). Furthermore, universities are the most significant organizational source for knowledge creation in current economy (Slaughter and Rhoades 2004). Universities understand today that new knowledge generated from university research creates opportunities for economic development.

Researchers describe university entrepreneurship differently. Some define it as new companies exploiting intellectual property created in universities considering university spin-offs (Shane 2004). Some have a broader definition and include companies started on the side of university employment. Some address activities such as consulting, specialized research and training, science projects, patenting/licensing, sales, and testing as indicators. TTOs are important elements in university entrepreneurship. Activities such as coordinating hub of commercialization activities ensure that the university’s innovations are disclosed and proper intellectual property protection is secured. These also provide effective situations for facilitating the transfer of the university’s intellectual property to outside partners (Carlsson and Fridh 2002).

Entrepreneurial Intensity (EI) was first introduced by Morris and Sexton (1996) and refers to varying levels of entrepreneurship. EI is viewed as a function, as depicted in Fig. 1. In terms of academic entrepreneurship, the frequency of entrepreneurship is about the quantity of entrepreneurial acts such as developing new science or technology, interactions among universities, training courses, conferences, seminars and workshops, publications, spin-offs, TTOs, and so on. The degree of entrepreneurship refers to the innovativeness, risk-taking, and pro-activeness of universities.

This study considers both the degree and frequency dimensions of the entrepreneurial spirit of universities for entrepreneurship evaluation of universities because it is able to evaluate entrepreneurship at both strategic and practical levels. In terms of EI, the diversity of related university entrepreneurship dimensions is captured in Table 1. These main
perspectives to academic entrepreneurship can be captured via one or both intensity dimensions. For example, university policies are categorized in terms of degree, while science parks represent the frequency of EI. Practical and strategic dimensions should be considered simultaneously in order to have a complete evaluation process (Morris and Sexton 1996).

Iranian academic entrepreneurship background

After the membership of Iran in the largest research consortium of entrepreneurship, Global Entrepreneurship Monitor (GEM), the study, “Monitoring Entrepreneurship in Iran
GEM Based Data” (Razavi et al. 2008), was performed by the Ministry of Labor and Social Affairs and the University of Tehran. As a part of their research, they showed that entrepreneurs who received a higher education are more likely to be more competent in doing business than less-educated entrepreneurs. According to this research, Iran was placed fourth after Egypt, Bosnia, and Denmark with respect to entrepreneurial education at the vocational, professional, college, and university level. Rahmati et al. (2011) analyzed the policy-making system in the university entrepreneurship education in Iran and developed suggestions to fill the gap between the current and an ideal situation. One of these identified shortcomings is the need for designing a system to evaluate the effectiveness of entrepreneurship education. Karimi et al. (2010) investigated the state, trends, challenges, and solutions in entrepreneurship education in Iran and concluded that there is a need for improvement of entrepreneurship education in the Iranian higher education system. Ag-hazamani and Roozikah (2010) explored the different entrepreneurship variables among Iranian and Swedish students to assess their entrepreneurial tendencies. They highlighted the significance of academic entrepreneurship education to students by concluding that motivating students toward entrepreneurial activities seems to be one of the most efficient ways to teach both theoretical and practical courses to students.

Research method

The ANP

ANP is a multi-criteria decision-making (MCDM) method first introduced in Saaty’s book, The Analytic Hierarchy Process (1990). This technique provides a general framework to deal with decisions without making assumptions about the independence of higher-level criteria from lower-level sub-criteria and about the independence of each sub-criterion. Considering that many decision-making problems cannot be considered hierarchical because of dependencies (inner/outer), ANP is very useful in dealing with these kinds of problems. Figure 2 demonstrates the different structures of the ANP and AHP methods (Saaty 1990).

Nodes of the network represent components of the system, and arcs denote interactions between them. Each component consists of various elements. As depicted in Fig. 2, \( X \rightarrow Y \) means that the elements of component Y depend on component X.

In ANP, decision elements of each component are compared pair-wise with respect to their importance towards their control criteria, and components themselves are also compared pair-wise regarding this contribution to the goal. The relative importance values are determined with a scale of 1–9, where a score of 1 represents equal importance between

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**Fig. 2** Different structure of ANP and AHP methods (Saaty 1990)
the two elements, and a score of 9 indicates the extreme importance of one element (row component in the matrix) compared to the other one (column component in the matrix) (Table 2). The super-matrix concept is similar to the Markov chain process. To obtain global priorities in a system with interdependent influences, the local priority vectors are entered in the appropriate columns of a super-matrix. Fundamentally, the ANP method drives weights that account for component and element interactions that are a rich benefit of such a dynamic technique (Saaty 2006).

In order to define the weights of various elements considered for evaluating the entrepreneurship performance of universities, the ANP method is applied in order to take into consideration the interdependency between the components and elements, and group decision making is applied.

The compromise ranking method (VIKOR)

The VIKOR method (Opricovic and Tzeng 2004) ranks the alternatives \( A_i (i = 1, 2, \ldots, n) \) based on the value of three scalar quantities \( (S_i, R_i, \text{ and } Q_i) \) to be calculated for each alternative. For each criterion \( (j = 1, 2, \ldots, m) \), the best \( a_j^+ \) and worst \( a_j^- \) performances among all the alternatives first have to be identified. Consequently, \( S_i, R_i, \text{ and } Q_i \) can be calculated as in Eqs. 1 and 2. The description of \( S^+, S^-, R^+, \text{ and } R^- \) is depicted in Eq. 3. In this method, \( S^+ \) implies the maximum group utility of the majority, and \( R^- \) denotes the minimum of individual maximal regret for the opponent.

\[
S_i = \sum_{j=1}^{m} w_i (a_j^+ - a_{ij}) / a_j^+ - a_j^-; \quad R_j = \max_j \left[ w_i (a_j^+ - a_{ij}) / a_j^+ - a_j^- \right] \tag{1}
\]

\[
Q_i = v \frac{S_i - S^+}{S^+ - S^-} + (1 - v) \frac{R_i - R^-}{R^- - R^+} \tag{2}
\]

\[
S^+ = \min_i S_i; \quad S^- = \max_i S_i; \quad R^+ = \min_i R_i; \quad R^- = \max_i R_i; \tag{3}
\]

The parameter \( v \) is specified by the decision maker in the interval of \([0,1]\) giving a different weight of importance to each addend into the \( Q_i \) expression. If an expert assumes \( v > 0.5 \), he gives more importance of the alternative \( n \) respect to the whole of the criteria. On the other hand, \( v > 0.5 \) indicates more weight to the second term that is related to the magnitude of the worst performances exhibited by the alternatives in respect to each single criterion. \( v > 0.5 \) is used when the two aspects are assumed to be equally relevant. The best
alternatives have the lowest value $S_i$, $R_i$, and $Q_i$, implying that the considered alternatives should be ranked in the increasing order.

The weight variance analysis (WVA)

In this study WVA is introduced to suggest improvement actions. WVA is based on the concept of the importance-performance analysis (IPA) (Martilla and James 1977). However, the ANP weight is substituted for the “importance” and “EI variance rate” replaces the “performance”. WVA provides a more fine-grained analysis focusing on the gaps between an actual solution and an ideal solution according to particular evaluation criteria. In this approach, the EI variance rate is then mapped against the ANP weight to provide a graphic illustration of which evaluation criteria are most in need of enhancement. The “ANP weight” constitutes the vertical axis ($y$-axis), and the “EI variance rate” constitutes the horizontal axis ($x$-axis) of a diagram. This map is then divided into four zones as depicted in Fig. 3. The criteria located in diverse zones have dissimilar management implications, and consequently require different actions for achieving an ideal level of EI performance. These four zones are described as follows:

1. Concentrate here (Zone 1): In this zone, the evaluation criteria are rated as having high importance (ANP weight) and also high EI variance rate. Thus, this zone is a top priority for policy development and future action planning.

2. Keep up the good work (Zone 2): This zone indicates the important criteria of low EI variance rates. Control and monitoring is required to ensure that this condition is going to be maintained.

3. Redeploy resources (Zone 3): This zone contains non-important criteria of high EI variance rate. Thus, it is recommended that the managers or policy-makers should not be excessively concerned about criteria in this zone. Redeploying resources to remedial action is a suggested choice for managers.

4. Low priority (Zone 4): This zone contains evaluation criteria of low importance with a high EI variance rate. Consequently, it is not necessary to focus extra effort and resources to criteria in this zone.

**Fig. 3** The weight versus entrepreneurship intensity variance map

<table>
<thead>
<tr>
<th>ANP Weight</th>
<th>low</th>
<th>high</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Keep Up the Good Work)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zone 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Concentrate Here)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zone 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Redeploy Resources)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zone 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Low Priority)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The evaluation process

**Evaluation criteria and sub-criteria**

In this research, the evaluation criteria and sub-criteria are investigated through semi-structured, convergent, in-depth discussion sessions as stages of two Delphi processes. The communication structure of this Delphi study is presented in Fig. 4.

As depicted in Fig. 4, each Delphi process involved two round table evaluations. Experts from various backgrounds were invited to participate because, as discussed earlier, this field integrates a wide range of dimensions from budgeting to university policies. The research team sent 122 invitations for these experts, and seventy-four experts answered, which showed 60% participation. Among these seventy-four experts, only sixty-eight experts were able to participate in this research. This study’s expert panel is shown in Table 3.

Before each round, the research team communicated with the experts by sending an introduction letter including different aspects of university entrepreneurship literature. All communication was performed via email, ensuring convenience and fast response. These experts were elected based on their profession and their relationship to the academic environment, and they were geographically separated from Iranian north and east state universities to south and west state universities.

The first Delphi process aimed to identify university entrepreneurship evaluation criteria. In this process, the research team concluded a total of ten criteria, including the knowledge of faculty members, alumni association’s activities, extracurricular programs, interactions among universities, journals and publications, workshops, congresses and seminars, facilities and financial supports for entrepreneurial activities, presented courses, training courses, and university strategies. In terms of EI, the captured criteria are depicted in Fig. 5.

The second Delphi process aimed to identify the elements of each evaluation criterion addressed as sub-criteria. Those selected experts ranged from professors and heads of departments or academic units to the Ministry of Science, Research, and Technology executives. The preliminary round produced forty-nine criteria, which were reduced to forty in round two of the Delphi process. Finally, the research team concluded thirty-eight final sub-criteria. This stage of the research was also deemed complete after two rounds.

![Fig. 4 The Delphi method communication structure](image-url)
Evaluation framework and results

In this paper, the authors adopted the VIKOR method for the evaluation of universities based on their entrepreneurship characteristics. The method is improved by introducing the ANP for assigning the weights of relative importance of each sub-criteria and resolving the problems of dependence and feedback among them. The ANP method can be categorized as one of the MCDM techniques that have been widely used in various numbers of publications. For instance, Meade and Presley (2002) utilized this technique for R&D project selection. As the authors suggest, this combination allows the decision maker to assign systematically the values of relative importance to the attributes based on their preferences and allow a wise evaluation of universities. The evaluation process framework for entrepreneurship characteristics of universities is depicted in Fig. 6.

After determining the criteria and sub-criteria, the evaluation process continues with the determination of the weights by using the ANP method in a stepwise format, which is summarized as follows.

**Table 4** depicts the extracted sub-criteria after the second Delphi process and criteria categories.

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**Table 3** University entrepreneurship experts’ panel

<table>
<thead>
<tr>
<th>Category</th>
<th>Participated experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head of academic departments</td>
<td>21</td>
</tr>
<tr>
<td>Chief executives of related firms</td>
<td>20</td>
</tr>
<tr>
<td>Academics (researchers and professors)</td>
<td>23</td>
</tr>
<tr>
<td>Ministry executives</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>68</strong></td>
</tr>
</tbody>
</table>

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**Fig. 5** Categorization of the evaluation criteria in terms of EI

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**Evaluation framework and results**

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<table>
<thead>
<tr>
<th>Criteria</th>
<th>Sub-criteria description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge of faculty members</td>
<td>(A1) The number of faculty members with entrepreneurial experience in various organizations of involved university, such as management experience or institutionalizing new enterprises</td>
</tr>
<tr>
<td></td>
<td>(A2) Mean of conferences, seminars, or workshops to acquaint professors and executive managers with entrepreneurship per year</td>
</tr>
<tr>
<td></td>
<td>(A3) The amount of faculty members’ inventions and patents at the university</td>
</tr>
<tr>
<td>Alumni association activities</td>
<td>(B1) The time since the installation of alumni associations at the university</td>
</tr>
<tr>
<td></td>
<td>(B2) The number of members in alumni associations</td>
</tr>
<tr>
<td></td>
<td>(B3) The number of enterprises and companies set up by alumni and students at the university</td>
</tr>
<tr>
<td></td>
<td>(B4) The time since the university’s alumni associations’ Websites were established</td>
</tr>
<tr>
<td></td>
<td>(B5) The number of students’ and/or alumni’s inventions and patents at the university</td>
</tr>
<tr>
<td></td>
<td>(B6) The number of students or alumni who have participated in national festivals related to extolling entrepreneurs and achieved the top ranks</td>
</tr>
<tr>
<td>Extracurricular programs</td>
<td>(C1) The number of camps held by the university for students per year</td>
</tr>
<tr>
<td></td>
<td>(C2) The number of training courses related to marketing techniques or entrepreneurship festivals held by the university per year</td>
</tr>
<tr>
<td></td>
<td>(C3) The number of visits from industrial centers, such as factories, manufacturers, and national plans and projects, to the university per year</td>
</tr>
<tr>
<td></td>
<td>(C4) The number of competitions related to choosing entrepreneurial students or professors held by the university per year</td>
</tr>
<tr>
<td>Interaction among universities</td>
<td>(D1) The number of projects based on industries’ orders at the university, the number of research contracts and their financial credits (returns) signed between the companies dependent on the university and the university, the number of research contracts and their financial credits (returns) signed between the university research development centers with industries</td>
</tr>
<tr>
<td></td>
<td>(D2) The number of enterprises or companies dependent on the university, the number of research development centers in the university that interact with industries, the number of various research development centers linked with industries located at the university</td>
</tr>
<tr>
<td></td>
<td>(D3) The percent of active staff members or engineers that work in the enterprises and companies dependent to the university and those graduated from the university</td>
</tr>
<tr>
<td>Journals and publications</td>
<td>(E1) The number of managerial journals related to entrepreneurship and published by the university per year</td>
</tr>
<tr>
<td></td>
<td>(E2) The number of books related to entrepreneurship published by faculty members, professors, and students at the university</td>
</tr>
<tr>
<td></td>
<td>(E3) The number of academic, scientific, and applied studies conducted at the university</td>
</tr>
<tr>
<td></td>
<td>(E4) The number of research papers related to entrepreneurship published by the faculty members of the university in ISC or ISI journals</td>
</tr>
<tr>
<td>Criteria</td>
<td>Sub-criteria description</td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------</td>
</tr>
</tbody>
</table>
| Workshops, conferences, and seminars | (F1) The number of conferences, seminars, exhibitions, and speeches related to entrepreneurship held by the university per year  
(F2) The number of successful entrepreneurs invited to share their experiences with students and professors at the university  
(F3) The amount of conferences held by skillful and entrepreneurial managers from within or outside of the university  
(F4) The number of students who utilized financial credits of the university in order to take part in various competitions and international and national exhibitions related to inventions and innovations |
| Facilities and financial support for entrepreneurial activities | (G1) The portion of allocated and invested funds in information technology development  
(G2) The number of books related to entrepreneurship in libraries of the university at the time of evaluation  
(G3) The number of national and international subscriptions related to entrepreneurship paid by the university  
(G4) The number of reports, descriptions, and related materials regarding motivating and attracting students toward entrepreneurship, apart from scientific papers, published in various university journals related to the university management or students  
(G5) The number of financial budgets, such as loans, allotted to professors or students at the university in order to support entrepreneurial activities |
| The content of presented courses | (H1) The mean percent of courses with projects and the percent of students’ scores allocated to the projects regarding entrepreneurship at the university  
(H2) The percent of courses presented by the university in which educational activities are based on teamwork and the number of students’ scores allocated to teamwork activities  
(H3) The number of post-graduate majors for which the university admits the applicants (students) based on a decentralized method and according to their work experience |
| Holding training courses | (I1) The number of formal and informal training course related to an MBA or executive management at the university  
(I2) The number of university majors at the university that include courses related to entrepreneurship presented as optional credits for students  
(I3) The mean of various training workshops, competitions, and festivals related to entrepreneurship, such as workshops for business plans, creativity, principals of instituting companies and enterprises, held at the university per year  
(I4) The mean of various training courses for applicable software, such as CONTREOL PROJECT, LISREL, SPSS, and GIS, required by the market or industry provided by the university per year |
| University strategies | (J1) The amount of time since the university performed strategic planning and since its last revision of strategic planning  
(J2) The role of entrepreneurship is considered as an issue in the vision and mission of the university |
Step 1 The ANP Evaluation team

A team comprised of ten experts and academicians empirically experienced in university entrepreneurship was organized to get their opinions for each level of the evaluation process. This team had particular experience in determining the criteria and sub-criteria.

Step 2 Deriving the weights of each sub-criterion by using ANP

In order to perform this multi-criteria study, the evaluation team was first asked to highlight inter-decencies among various elements. In the next step, the inter-dependencies among the variety of sub-criteria were modeled by using the professional software package, “Super Decisions” (Fig. 7).

Each evaluator was asked to perform pair-wise comparisons based on the interval scale $[1/9, 9]$. The responses were gathered and used to construct the un-weighted and weighted super-matrix. In this study, the geometric mean of final outcomes was taken to integrate results from the evaluation team. Consequently, the final weights of each sub-criterion were calculated as depicted in Table 5.

Step 3 Data gathering

In this stage, based on a literature review and the Delphi results, a questionnaire with fifty-four questions was developed. Among these fifty-four questions, nine were dedicated to query the general specifications of the university, such as name, locations, number of...
The structure of the questionnaire is described in Table 6. In the Delphi method, the research team emphasized measuring criteria elements by developing multiple-choice questions for universities to avoid long answers that slow the analysis time.

Table 5 Weights of sub-criteria being derived by ANP

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Weight</th>
<th>Criterion</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>0.0853</td>
<td>F1</td>
<td>0.0188</td>
</tr>
<tr>
<td>A2</td>
<td>0.0242</td>
<td>F2</td>
<td>0.0177</td>
</tr>
<tr>
<td>A3</td>
<td>0.0174</td>
<td>F3</td>
<td>0.0437</td>
</tr>
<tr>
<td>A4</td>
<td>0.0569</td>
<td>F4</td>
<td>0.0109</td>
</tr>
<tr>
<td>B1</td>
<td>0.0055</td>
<td>G1</td>
<td>0.0211</td>
</tr>
<tr>
<td>B2</td>
<td>0.0080</td>
<td>G2</td>
<td>0.0099</td>
</tr>
<tr>
<td>B3</td>
<td>0.0246</td>
<td>G3</td>
<td>0.0099</td>
</tr>
<tr>
<td>B4</td>
<td>0.0058</td>
<td>G4</td>
<td>0.0099</td>
</tr>
<tr>
<td>B5</td>
<td>0.0089</td>
<td>G5</td>
<td>0.0384</td>
</tr>
<tr>
<td>B6</td>
<td>0.0148</td>
<td>H1</td>
<td>0.0108</td>
</tr>
<tr>
<td>C1</td>
<td>0.0082</td>
<td>H2</td>
<td>0.0133</td>
</tr>
<tr>
<td>C2</td>
<td>0.0086</td>
<td>H3</td>
<td>0.0248</td>
</tr>
<tr>
<td>C3</td>
<td>0.0120</td>
<td>I1</td>
<td>0.0058</td>
</tr>
<tr>
<td>C4</td>
<td>0.0130</td>
<td>I2</td>
<td>0.0109</td>
</tr>
<tr>
<td>D1</td>
<td>0.0526</td>
<td>I3</td>
<td>0.0155</td>
</tr>
<tr>
<td>D2</td>
<td>0.0342</td>
<td>I4</td>
<td>0.0060</td>
</tr>
<tr>
<td>D3</td>
<td>0.0083</td>
<td>J1</td>
<td>0.0618</td>
</tr>
<tr>
<td>E1</td>
<td>0.0032</td>
<td>J2</td>
<td>0.2452</td>
</tr>
<tr>
<td>E2</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>E3</td>
<td>0.0232</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E4</td>
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</tbody>
</table>
Table 6  The questionnaire structure

<table>
<thead>
<tr>
<th>Category code</th>
<th>Criteria name</th>
<th>Number of questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Knowledge of faculty members</td>
<td>3</td>
</tr>
<tr>
<td>B</td>
<td>Alumni association activities</td>
<td>6</td>
</tr>
<tr>
<td>C</td>
<td>Extracurricular programs</td>
<td>4</td>
</tr>
<tr>
<td>D</td>
<td>Interaction among universities</td>
<td>7</td>
</tr>
<tr>
<td>E</td>
<td>Journals and publications</td>
<td>4</td>
</tr>
<tr>
<td>F</td>
<td>Workshops, conferences, and seminars</td>
<td>4</td>
</tr>
<tr>
<td>G</td>
<td>Facilities and financial support for entrepreneurial activities</td>
<td>5</td>
</tr>
<tr>
<td>H</td>
<td>The content of presented courses</td>
<td>5</td>
</tr>
<tr>
<td>I</td>
<td>Holding training courses</td>
<td>4</td>
</tr>
<tr>
<td>J</td>
<td>University strategies</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>45</td>
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</table>

Table 7 The VIKOR results of EI ranking

<table>
<thead>
<tr>
<th>University name</th>
<th>S</th>
<th>R</th>
<th>Q</th>
<th>EI rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shiraz University</td>
<td>0.2323</td>
<td>0.0515</td>
<td>1.0000</td>
<td>1</td>
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<tr>
<td>Imam Sadiq University</td>
<td>0.4053</td>
<td>0.0569</td>
<td>0.8713</td>
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<tr>
<td>Shahrekord University</td>
<td>0.4563</td>
<td>0.0853</td>
<td>0.7641</td>
<td>3</td>
</tr>
<tr>
<td>Shiraz University of Technology</td>
<td>0.5497</td>
<td>0.0853</td>
<td>0.7022</td>
<td>4</td>
</tr>
<tr>
<td>Shahid Bahonar University of Kerman</td>
<td>0.5739</td>
<td>0.0853</td>
<td>0.6861</td>
<td>5</td>
</tr>
<tr>
<td>Birjand University</td>
<td>0.5701</td>
<td>0.0920</td>
<td>0.6715</td>
<td>6</td>
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<tr>
<td>Khorramshahr Marine Science and Technology University</td>
<td>0.6151</td>
<td>0.0853</td>
<td>0.6588</td>
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</tr>
<tr>
<td>Hormozgan University</td>
<td>0.6174</td>
<td>0.0853</td>
<td>0.6573</td>
<td>8</td>
</tr>
<tr>
<td>Maraghe University</td>
<td>0.6434</td>
<td>0.0853</td>
<td>0.6400</td>
<td>9</td>
</tr>
<tr>
<td>Razi University</td>
<td>0.6445</td>
<td>0.0853</td>
<td>0.6393</td>
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</tr>
<tr>
<td>Shahid Chamran University of Ahvaz</td>
<td>0.5196</td>
<td>0.1226</td>
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<tr>
<td>International University of Chabahar</td>
<td>0.6965</td>
<td>0.0853</td>
<td>0.6048</td>
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<tr>
<td>Yasuji University</td>
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<td>0.0853</td>
<td>0.5996</td>
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<tr>
<td>Shahed University</td>
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<td>0.1226</td>
<td>0.5589</td>
<td>14</td>
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<tr>
<td>Isfahan University of Technology</td>
<td>0.6346</td>
<td>0.2452</td>
<td>0.2331</td>
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<tr>
<td>Lorestan University</td>
<td>0.7838</td>
<td>0.2452</td>
<td>0.1341</td>
<td>16</td>
</tr>
<tr>
<td>ValiAsr University of Rafsanjan</td>
<td>0.8134</td>
<td>0.2452</td>
<td>0.1145</td>
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</tr>
<tr>
<td>Shahid-Abaspour University</td>
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</tr>
<tr>
<td>Arak University</td>
<td>0.8555</td>
<td>0.2452</td>
<td>0.0866</td>
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</tr>
<tr>
<td>Mazandaran University of Science and Technology</td>
<td>0.8846</td>
<td>0.2452</td>
<td>0.0673</td>
<td>20</td>
</tr>
<tr>
<td>Zanjan University</td>
<td>0.8892</td>
<td>0.2452</td>
<td>0.0642</td>
<td>21</td>
</tr>
<tr>
<td>University of Malayer</td>
<td>0.9860</td>
<td>0.2452</td>
<td>0.0000</td>
<td>22</td>
</tr>
</tbody>
</table>

Remark: S, R, and Q values are calculated based on $v = 0.5$

$^a$ Represents that the university has acceptable advantage over the next-ranked university.
The questionnaire was sent to twenty-eight Iranian state universities in different cities, and twenty-two questionnaires were filled and gathered by the research team, which showed 78% participation by the universities.

**Step 4  EI ranking using VIKOR**

After determining the criteria and sub-criteria, the weights to be used in the ranking process were determined by using ten experts in a group decision-making approach to ANP. The experts performed pair-wise comparisons to assign each criterion to evaluate the importance of each criterion. In the next step, a questionnaire was designed and was sent out to twenty-eight universities to retrieve required data in order to perform EI evaluations. After receiving the questionnaires, the research team started to analyze data and perform evaluations by using the VIKOR.

In VIKOR method, the acceptable advantage is defined as $Q(A^{(2)}) - Q(A^{(1)}) \geq 1/(n - 1)$, where $A^{(2)}$ is the alternative with the second position in the ranking list by $Q$, and $n$ is the number of universities. The VIKOR method indicates the solution which is acceptable to the decision-makers since it provides the maximum group utility of the majority (represented by $\min S$) and a minimum of individual maximal regret for the opponent (represented by $\min R$). The best alternative, ranking by $Q$, is one with the minimum value of $Q$ (Tzeng et al. 2005).
Fig. 9  Average variance rate of entrepreneurship intensity evaluation criteria

Fig. 10  The map of weight versus average variance of entrepreneurship intensity evaluation criteria. Note XX (Points) represents the criterion of average variance
In this research, min $S$, min $R$, and $Q$ are calculated as depicted in Table 7. Following this calculation, the universities are sorted by $Q$ in an increasing order. Moreover, the acceptable advantage analysis indicates that Shiraz University (rank #1) is the compromise solution and the best alternative with an acceptable advantage over all other universities. Following that is Imam Sadiq University (rank #2) which is the second compromise solution. In the solution, from Shiraz University of Technology (rank #3) to Yasuj University (rank #13), universities have equal advantage and the VIKOR suggests that there is no evidence indicating the advantage of an individual university although their value of $Q$ is not the same. All other acceptable advantages are depicted in Fig. 8.

**Step 5  EI variance analysis**

After applying VIKOR method, EI variance rate is calculated by using the formula:

$$\text{EI variance rate}^{(A,i)} = \frac{\text{positive-ideal EI score}^{(A,i)} - \text{alternative EI score}^{(A,i)}}{\text{positive-ideal EI score}^{(A,i)} - \text{negative-ideal EI score}^{(A,i)}}$$

Where, “alternative EI score” is the value of a criterion $i$ for an alternative $A$. “Positive-ideal EI score” is the best ideal score of $i$, while “negative-ideal EI score” is its worst score among all alternatives. For example, a university’s (alternative’s) score for “A1” (The number of faculty members with entrepreneurial experience) is twenty, “Positive-ideal EI score” is thirty-four, and “negative-ideal EI score” is ten. Thus, the EI variance rate is calculated as $(34-20)/
The EI variance rate is calculated for each criterion and university. Average EI variance rate is defined as the average score of all universities for a specific criterion \( i \). In this study, the Average EI variance rate is calculated and depicted in Fig. 9.

Average EI variance rate is then plotted against the ANP weight to provide a graphic representation of which evaluation criteria are most in need of remedial actions (Fig. 10).

In this figure, different zones and related criteria are identified by using a horizontal line (average ANP weights) and vertical line (average EI variance rates).

**Discussion and conclusion**

Since entrepreneurship has played an important role in economic growth, innovation, and competitiveness, it gradually has become a major success factor for developing countries such as Iran. In the fourth and fifth “5-year socio-economic development plan” of Iran (2005–2015), articles No. 48 and No. 21 insist on the entrepreneurship development of universities in order to improve the efficiency of academicians and graduated students. Therefore, the MSRT initiated a plan called “KARAD,” which in Persian means, “The regulation plan of entrepreneurship development in universities.” Since then, a course was authorized to be included in universities’ educational system, “Introduction to Entrepreneurship”. Additionally, about 110 centers for entrepreneurship were established in universities. Since 2005, a huge effort has been made toward the development of entrepreneurship in Iranian universities. However, no evaluation framework has been introduced and empirically executed to measure the performance of these initiatives.

This study has used a hybrid methodology consisting of Delphi, ANP, VIKOR, and WVA developed to evaluate the EI performance of Iranian universities and to provide some directions to improvements. The goal of this research is to facilitate universities in bridging the gap between actual and desired EI performance. The data were collected from twenty-two Iranian state universities. The thirty-eight sub-criteria were incorporated after their reduction and localization using the Delphi method. The weights of importance for these criteria were obtained from a panel of practitioners and experts by utilizing ANP in order to consider complex inter-dependencies among criteria. The collected data were categorized and classified under the observation of the experts’ panel. The proposed framework provides an evaluation tool for EI investigation across multiple criteria. The major contribution of this research lies in the development of a comprehensive hybrid framework that incorporates various dimensions of entrepreneurship evaluation in Iranian state universities. In addition, the proposed methodology serves as a guideline to the heads of academic departments and ministry executives for making strategic decisions.

The results showed that “Shiraz University” was the best university with an acceptable advantage over other universities under investigation. Furthermore, WVA is introduced in order to identify weakness areas most in need of crucial improvement actions. As depicted in Fig. 10, high-weighted criteria with high EI variance rates are considered as critical (Zone 1). Thus, this zone includes A1 (faculty members with entrepreneurial experience), J1 (strategic planning), G5 (financial budgets), D2 (research development centers), B3 (companies set up by alumni), A2 (conferences, seminars, or workshops), and E3 (academic, scientific, and applied studies). This research highlights the importance of these criteria and suggests that each university should concentrate specially on these aspects. Furthermore, this study suggests the use of the comparative weight versus variance map for the universities in order to provide universities with an instrument to improve their policies and remedial actions. This instrument is depicted in Fig. 11.
Although the proposed model provides a comprehensive framework for the EI evaluation of universities, there are some limitations in this study. Firstly, the Delphi method employed did not consider all possible elements of entrepreneurship. Secondly, the elements are localized corresponding to the social and economic situation of Iran. Thus, the use of same elements (in the ten specified categories) should be done carefully in other countries. Thirdly, the impact or effectiveness of entrepreneurship initiatives of universities is not addressed in this research. Furthermore, financial indicators such as Return on Investment (ROI) for entrepreneurship initiative are not investigated in the proposed model. However, it is a major subject for contribution in future for researchers.

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References


