

SPIN-OFF AND INTERNATIONALIZATION: THE MEDIATING ROLE OF ENTREPRENEURIAL UNIVERSITY

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ABSTRACT

Internationalization is one of the critical indices for universities. Universities are also major players in entrepreneurial ecosystems, whose positive activities in the production and dissemination of knowledge lead to the creation of spin-off. The current study is practical in terms of purpose and is descriptive-correlational in terms of data collection. The statistical population was 325 individuals and 176 individuals were studied by applying Cochran's formula as the sample. Data were collected through a researcher-made questionnaire with a 5-point Likert scale by using a simple random method from the employees of spin-off located in the Science and Technology Park of Tehran, Sharif and Isfahan Universities and also data analysis with structural equation modeling approach using Smart PLS 3 software has been done. Cronbach's alpha for all structures was higher than 0.7 and the AVE was greater than 0.5, based on which the validity and reliability of the structures were confirmed. According to the results, it was found that the components of spin-off have a positive and significant effect on the internationalization of Iranian public universities through the mediating role of entrepreneurial university.

Keywords: Internationalization, Innovation Atmosphere, Entrepreneurial Skills, Spin-off.

INTRODUCTION

Entrepreneurship means activities to create, innovate, or renew within or outside the organization by international players acting independently or as part of a corporate system (Philpott et al., 2011). In this regard, transparency and interaction between industry and universities indicate a great value in knowledge transfer between academic. So, challenges are at the institutional level (promoting career advancement through new investments), organizational (stimulating economic growth through knowledge transfer) and individual (focusing on research as well as education while engaging in entrepreneurial activities) (Miller et al., 2018). Therefore, cooperation among the three sectors of industry, government and university is necessary to promote the national innovation system (Philpott et al., 2011; Ziyae et al., 2019a). With this respect, according to researchers, internationalization is the process of adapting the firm's operations in terms of strategy, structure and resources to international environments (Li, 2015), because competitive advantage is the basis for the development of enterprise capabilities (Tece, 2014). Thus, internationalization can be said to be an effective strategy to meet the diverse needs of the global community (Altbach & Knight, 2007). That is why the internationalization of

universities has now become a momentous strategic priority for many institutions and governments (Mobarki et al., 2021; Zaman & Mohsin, 2014). Thus, internationalization is a bilateral spectrum, at the end of which is limited and symbolic internationalization, which is reflected in the presence of a number of foreign students from several countries on campus, on the one hand. Internationalization is expressed as an invigorating and transformative process in which it affects university courses and activities, on the other hand.

The international level of spin-off due to the tendency to internationalizing the university can be the leading factor for the strong presence of internationalization. This relationship should be found in internationalization variables that can be a new way in future research (Civera et al., 2019). Therefore, it can be concluded that spin-off will have a significant effect on the internationalization of the university. In sum, the main purpose of this study is to investigate the effect of the components of spin-off on the internationalization through the mediating role of entrepreneurial university in Iranian public universities.

LITERATURE REVIEW

Spin-off is an economic phenomenon that has been planned in several research trends including economics, innovation and entrepreneurship (Civera et al., 2019). Spin-off often seeks to internationalize their operations in the early stages (Bjornali & Aspelund, 2012). Abarbanell et al. (2003) refer to the establishment of spin-off as the establishment of new corporations that are markedly different from the parent company (Abarbanell et al., 2003). Taken from the parent university, knowledge transfer should be considered in direct communication between the university, the parent company and away from intermediaries (Cooper, 2001; Hosseini & Tajpour, 2022). Spin-off is the formation of a new company or organization to benefit from the results of academic research (Blair & Hitchens, 2018). Universities are also institutions that bring new ideas and technologies to entrepreneurship through the establishment of spin-off, which have been introduced as a key element in the entrepreneurial ecosystem (Schillo, 2018). For this reason, the term spin-off development refers to a new company based on the findings of members of a research group from the university, which becomes part of a company or organization into an independent company (De Cleyn & Braet, 2007). Meanwhile, small and medium-sized businesses are of great importance in most sectors of the world economy, especially the structures of developed countries (Rowley et al., 2011). Academic spin-off is an important tool for disseminating knowledge and potential for job creation and economic growth (Hayter, 2013). Some recent studies, focusing on their management teams, have examined the internationality of spin-off (Franco-Leal et al., 2016). Spin-off has advanced technologies that are attractive to international markets, thus representing internationalization with these conditions (Kiederich, 2007).

Entrepreneurship is a combination of social, political, economic and cultural elements in an area that support the development and growth of investments based on creativity and innovation (Cunningham et al., 2019). The concept of entrepreneurship is now recognized as a key driving force for the development of innovation as well as an appropriate response to success in highly turbulent and unpredictable markets (Salamzadeh et al., 2022a). However, encouraging the entrepreneurial spirit is so helpful for students in identifying opportunities for personal growth and starting their own business as a career opportunity (Wilson et al., 2009; Ziyae et al., 2019b). Some researchers believe that the entrepreneurial university is a natural incubator, knowledge commercialization and the source of new knowledge and technology (Alexander &

Evgeniy, 2012). Scientific participation in technology transfer, company formation and regional development is indicative of an entrepreneurial university (Etzkowitz, 2014). The organizational structure of the university should be designed to promote and facilitate entrepreneurial behaviors (Gibb & Hannon, 2006). Given that the concept of entrepreneurial university is one of the indicators of internationalization, it can be said that entrepreneurial university is considered as a catalyst to facilitate university entrepreneurship (Centobelli et al., 2019).

Networks are especially important for firms established through the commercialization of academic research, because learning and knowledge development are core tasks for these firms (Styles & Genua, 2008). In fact, academic networks involved in spin-off help to seize early opportunities for internationalization. Spin-off has the significant advantage of resources and networks, brand (Zahra, 2005). Paying attention to human resources, trying to attract financial resources, creating a decentralized structure are some of the things that can lead the university towards entrepreneurship. Given that universities are a factor in economic and social development, most universities have entrepreneurial infrastructure, including entrepreneurship centers and incubators, although schools do not always participate in them, this is related to entrepreneurial activities such as entrepreneurship workshops, workshops for setting up businesses and services, spin-off which are run by universities, but students' contribution is low. It indicates that the activities of universities are centralized (Errasti et al., 2018). Public and private universities facilitate the entrepreneurial process by creating advanced settings according to commercial incubators and science and technology parks. Thus, the role of the entrepreneurial university can be said to support economic growth transmitted to society through increasing the quality of research by means of education and entrepreneurship (Dalmarco et al., 2018).

In recent years, modern knowledge-based economics has played an important role in the third mission of universities in relation to the process of knowledge-transfer as a driving force to facilitate innovation and influence innovation, social and economic development in addition to two traditional missions of education and research (Centobelli et al., 2019). Moreover, if universities, like the entrepreneurial university, do not move towards their goals (e.g., innovation) and, consequently, failed, they will disrupt national and regional development, first and, thereafter, they lose international competition (Arnaut, 2010). Therefore, a university without being international cannot be successful and entrepreneurial, and also a university without being entrepreneurial cannot be considered as an international entity (Bordean & Borza, 2013). Researchers believe that the university should become a dynamic environment because changes in the structure, including the creation and dissemination of new ideas, the first step in this direction is the adoption of a new management law that creates a relationship between managers and universities and, as a result, a new way of managing in universities was formed to be more efficient (Garcia-Morales et al., 2006; Tajpour & Hosseini, 2021). At the same time, network relations can help by providing connections and opportunities in foreign markets by accessing the desired resources for internationalization and receiving the necessary information to enter and compete abroad (Ellis, 2011; Tajpour et al., 2021). However, universities need to use the network effectively. The researchers stated that an intercultural dialogue framework should be considered as part of the overall network and that there should be systems in place to integrate student activities and staff professional development to support these activities (Castro et al., 2016).

In this regard, Teixeira & Coimbra (2014) specifically did research network theory to consider the supportive role of universities in the internationalization of academic corporations. They showed that spin-off that support technology transfer or other scientific and technological

infrastructure tends to be international before that (Teixeira & Coimbra, 2014). The tendency to networking is also one of the main components of organizational culture. Networking influences the creation, development and exploitation of opportunities in an international entrepreneurial enterprise and leads to performance improvement (Dimitratos et al., 2012). Government initiatives encourage the development of innovation infrastructures, and they lead to provide a legal framework for bilateral cooperation between industry-government actors, and universities, and encourage transfers to entrepreneurial universities (Alexander & Evgeniy, 2012). According to studies conducted by Dalmarco et al. (2018), the existence of standards for spin-off indicates the importance of business incubators for entrepreneurial development (Dalmarco et al., 2018). Universities also have to face new challenges to meet expectations for entrepreneurial growth, which is achieved through the interaction between education, research and entrepreneurship (Lahikainen et al., 2019). Researchers have concluded that incubators are the main support network and infrastructure for the formation of spin-off in entrepreneurial universities (Van Cann, 2013). Furthermore, some variables such as multiple licenses, previous experiences of faculty members and joint ventures are effective in the commercialization success of spin-off (Hayter, 2013). Sternberg (2014) considers regional sponsorships, government sponsorships, regional economics, academic specialties, high technologies, university sponsorships, and adequate guarantees as successful factors in achieving spin-off sponsorship (Sternberg, 2014). Other researchers believe that the success of spin-off depends on the development of commercialization policies, economic positioning, the development of a commercialization culture, the creation of spin-off based on regional talent, and performance appraisal (Al Ghabid et al., 2015). According to what mentioned above, the research model is as follows (Figure 1):

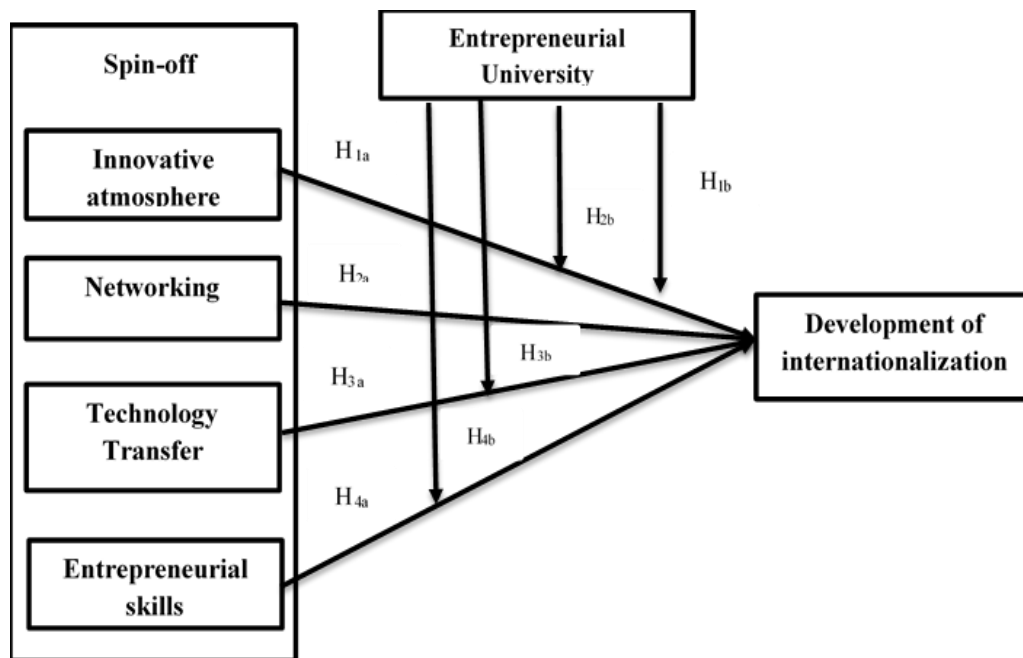


FIGURE 1
CONCEPTUAL MODEL OF RESEARCH

According to the conceptual model, the research hypotheses are as follows:

The Main Hypothesis

H₀: Spin-off has a significant effect on the internationalization mediated by the entrepreneurial university.

Sub-Hypotheses

H_{1a}: Innovative atmosphere has a significant effect on the internationalization.

H_{1b}: Innovative atmosphere has a significant effect on the internationalization mediated by the entrepreneurial university.

H_{2a}: Networking has a significant effect on the internationalization.

H_{2b}: Networking has a significant effect on the internationalization mediated by the entrepreneurial university.

H_{3a}: Technology transfer has a significant effect on the internationalization.

H_{3b}: Technology transfer has a significant effect on the internationalization mediated by the entrepreneurial university.

H_{4a}: Entrepreneurial skills have a significant effect on the internationalization.

H_{4b}: Entrepreneurial skills have a significant effect on the internationalization mediated by the entrepreneurial university.

RESEARCH METHOD

The current study is practical in terms of purpose and is descriptive-correlative in terms of data collection method. The statistical population of the study consists of employees of spin-off set up in the Science and Technology Park of Iran State Universities (Tehran, Sharif, Isfahan) in the February of 2022. The selection of these universities was based on the Times Higher Education Index, which ranked universities based on education, research, and international status. Then, the research data were collected by using a researcher-made questionnaire of 36 propositions with a five-point Likert scale.

Variables	Cronbach's alpha	Composite reliability	Reliability	AVE	R²
Innovative atmosphere	0.845	0.859	0.883	0.557	----
Networking	0.746	0.769	0.827	0.504	-----
Technology Transfer	0.816	0.824	0.870	0.533	----
Entrepreneurial skills	0.831	0.837	0.877	0.545	-----
Entrepreneurial university	0.854	0.857	0.892	0.582	0.830
Internationalization	0.840	0.855	0.883	0.558	0.602

The pilot distribution of the questionnaire revealed that 90% of these businesses were started by university faculty members, staff, students, and graduates. According to the statistical population, 81 spin-off businesses were identified in Iran public universities, and questionnaires were given to the employees of these businesses. The statistical population was 325 individuals and 176 individuals were studied by using Cochran's formula as the sample. Finally, 176

questionnaires were analyzed through PLS3 software. Model analysis with PLS3 software was performed in two parts: evaluation of measurement model and structural model. The adequacy indices of the measurement model are shown in Table 1.

Validity of this study was verified through data collection tools by considering the opinion of expert professors. Also, the validity of the structure using the mean of variance extracted for all structures is higher than 0.5 and the validity of the structures is confirmed. Cronbach's alpha index for structures is higher than 0.7 and composite reliability is higher than 0.7. Accordingly, the reliability of the structures is also confirmed. The results obtained from the divergent validity of the variables are also given in Table 2, which is at an acceptable level.

Variables	1	2	3	4	5	6
Innovative atmosphere	0.746					
Entrepreneurial university	0.513	0.841				
Entrepreneurial skills	0.309	0.763	0.738			
Internationalization	0.549	0.564	0.473	0.747		
Networking	0.507	0.713	0.525	0.705	0.671	
Technology Transfer	0.415	0.678	0.633	0.646	0.660	0.730

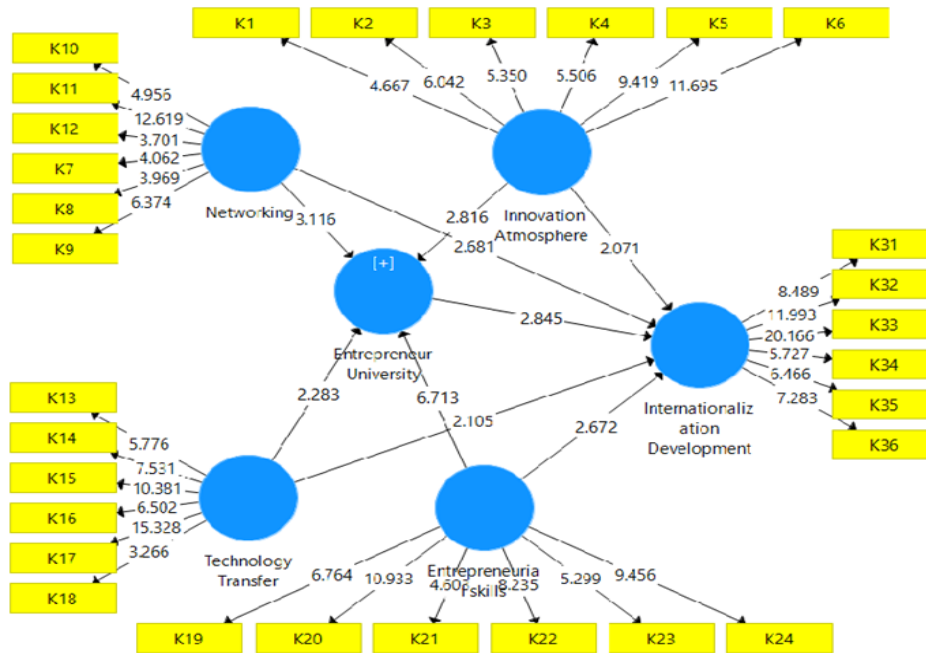
According to the obtained scores and the results derived from the output of Smart PLS 3 software in Tables 1 and 2, the validity models (convergent and divergent) and reliability (reliability, composite reliability coefficient and Cronbach's alpha) are at satisfactory level.

RESULTS

In order to investigate the fit, the model was studied at three levels of measurement, structural and overall. To evaluate the fit of the structural model of the research using the partial least squares method, a number of criteria are applied, the first and most prominent of which are the meaningfulness of significance coefficients or the values of t-statistics. The fit of the structural model using t-coefficients is such that these coefficients must be greater than 1.96 in order to confirm their significance at the 95% confidence level (Thomas, 2003). The results showed that the obtained values that are greater than the critical value (1.96) have been confirmed at the 95% confidence level (Figure 2).

Coefficient of Determination (R^2)

The second criterion for examining the fit of a structural model in a research is the R^2 coefficients related to the hidden endogenous variables of the model. This criterion is applied to examine the intensity of relationship between structures, which only applies to dependent and not independent structures. R^2 is a criterion that indicates shows the effect of exogenous variables on an endogenous variable and 0.19, 0.33 and 0.67 are three values which are weak, medium and strong values of R^2 , respectively (Salamzadeh et al., 2022b). In this study, the criterion for entrepreneurial university is (0.830) and for internationalization is (0.602), so the structural model from the perspective of this criterion has a good fit at a strong level. The results are also shown according to Figure 3.



Source: Authors' Elaboration

FIGURE 2
T-STATISTICS MEDIATED BY ENTREPRENEURIAL UNIVERSITY

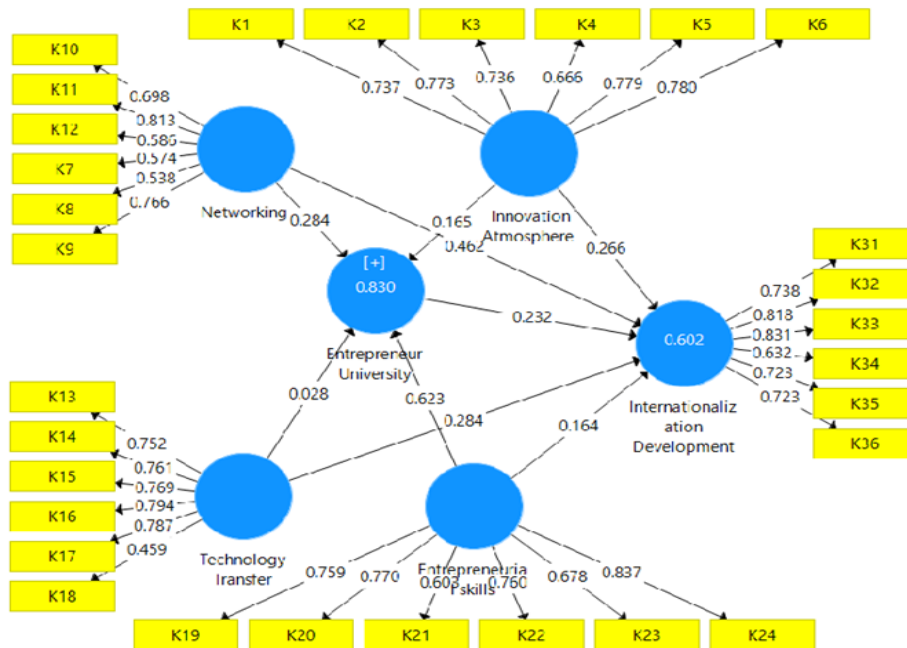
Criterion Q²

The Q2 criterion is estimated for all dependent structures and indicates the product of the combined values of the research structures multiplied by the values of the coefficient of determination related to them. This criterion determines the predictive power of the model in dependent variables. Accordingly, models that have an acceptable structural fit should be able to predict the characteristics of the endogenous structures of the model. This means that if in a model, the relationship between structures is properly defined, the structures will be able to have a sufficient influence on each other's characteristics and thus the hypotheses are appropriately confirmed. The value should be 0.2, 0.15 and 0.35 for all endogenous structures as low, medium and strong predictive power (Tajpour et al., 2022). This criterion in the current study is for entrepreneurial university (0.711) and internationalization (0.515). This result indicates the high appropriateness and acceptable structure of the research model.

Overall Model Fit

The overall model consists of the measurement and structural models; the fit of the model is completed through confirming its fit. Therefore, the overall fit of the model is possible with the help of the GOF criterion. According to the obtained value of 0.790 for GOF, the overall fit of the research model is strongly appropriate and approved. By considering the three values of 0.01, 0.25 and 0.36, which are weak, medium and strong values for GOF, the value of 0.790 for this criterion indicates a strong fit of the overall research model.

$$GOF = \sqrt{\text{average (Commonality)} \times \text{average (R}^2\text{)}}$$



Source: Authors' Elaboration

**FIGURE 3
T-VALUES**

The other index is the Standardized Root Mean Squared Residual index (SRMR). The value of 0.05; 0.08 and the value of SRMR less than 0.10 indicate an acceptable fit of the overall model. Table 3 shows that this index is also at an acceptable threshold, so it can be claimed that the current research model has a very good fit. Also, Normed Fit Index (NFI) has been used to measure fit. The acceptance range of this index should be between 0 and 1 and the NFI should be greater than 0.9 (Kline, 2015). Consequently, according to Table 3, this value is equal to 0.925, which is also confirmed as a result of this index.

	SRMR	NFI
Accepted values	≤ 0.10	≥ 0.9
Calculated values	0.019	0.925

Sobel Test was used to investigate the mediating role of entrepreneurial university:

- (a) The value of the coefficient of the independent and mediating variable was equal to 0.275
- (b) The value of the path coefficient of the mediator and dependent variables was equal to 0.232
- (c) The value of the path coefficient of the independent and dependent variable was equal to 0.294

(sa) Standard error for independent and mediator variable path was equal to 0.081

(sb) Standard error related to mediator and dependent variable path was equal to 0.069

$$VAF = (a \times b) / (a \times b) + c$$

The obtained value of 2.338 in this test, which is higher than the baseline value of 1.96, indicates the mediating role of the university structure. VAF statistics show that the intensity of mediation at entrepreneurial university is 0.178, which means that the mediating effect is partial. Based on the results, the fit of the proposed model in the two sections of measurement and structure is confirmed.

Hypothesis Testing

Finally, t-statistics has been used to investigate hypothetical relationships among the variables. Eight sub-hypotheses have been given to test the main hypothesis and according to Table 4 the t-coefficient of the eight existing relationships was confirmed. To determine the effect of predictor variables on the dependent variables, standardized factor load coefficients related to the paths of each hypothesis were examined. The coefficients indicate that changes in the dependent variables are justified by the independent variables up to a few percent.

No.	Path	t-statistics	Influence Factor	Hypothesis
1	Atmosphere of Innovation - Internationalization	2.071	0.266	Accepted
2	Atmosphere of Innovation - Entrepreneurial university - Internationalization	2.816	0.165	Accepted
3	Networking - Internationalization	2.681	0.462	Accepted
4	Networking - Entrepreneurial university - Internationalization	3.116	0.284	Accepted
5	Technology Transfer - Internationalization	2.105	0.028	Accepted
6	Technology Transfer - Entrepreneurial university - Internationalization	2.283	0.284	Accepted
7	Entrepreneurial Skills - Internationalization	2.672	0.164	Accepted
8	Entrepreneurial Skills - Entrepreneurial University - Internationalization	6.713	0.623	Accepted

According to Table 4, it was found that the path of entrepreneurial skills has the most significant effect on the internationalization through the mediating role of entrepreneurial university.

Today's societies have undergone considerable changes compared to the past, so in order to develop internationalization; universities must pay attention to the factors playing a role in their development. Given that the main research question in this study is to investigate the effect of the components of spin-off on the internationalization mediated by entrepreneurial university, it was investigated in the Science and Technology Park of Iranian public universities. According to the software analysis, it can be concluded that the first hypothesis of innovation on the internationalization of the university with its sub-hypothesis with the mediating role of the entrepreneurial university can be expressed based on the conditions and atmosphere of innovation when team members face with specific issues and problems in the company, they participate very seriously in teamwork and interact with one another to find appropriate solutions (Tsai, 2011). Innovation requires the effect on human capital through strategic human resource actions because it increases employees' willingness and motivation to innovate and paves the

way for the company to identify and apply knowledge and expertise in the organization (Scarborough, 2003). Therefore, the formation of an atmosphere of innovation in spin-off allows people to use new ideas, thoughts and knowledge for development. Thus, in this regard, company managers are advised to pay enough attention to organizational culture and characteristics such as respect, friendly treatment and appropriate social relations among employees and to create such a condition that people can easily present their ideas, and through this they improve the atmosphere of innovation. Managers are also encouraged to consider strategies such as innovative learning in problem solving, preparation for change, self-reliance, and the development of creativity to promote the atmosphere of innovation. By creating a calm and informal work environment for employees, giving appropriate privileges and rewards to innovators, preparing people to change and supporting work bias, they can create an atmosphere of innovation and thus influence the internationalization.

In order to confirm the second hypothesis that networking on the internationalization of the university and by confirming its sub-hypothesis mediated by the entrepreneurial university, it can be said that behaviors and actions within the university reflect the performance of management team members; universities affect themselves through decision-making strategy (Gibb, 2012). Therefore, the weakness of communication processes leads to reduce the effects of well-organized and well-documented information (Abbas et al., 2020). Therefore, the first and most crucial step in knowledge-sharing is to establish communication and networking in the company. Therefore, the support of the management team of internal and external networking is essential for the internationalization of the university (Gibb, 2012). As a result, participation in companies that have high quality networking will be more, which will lead to the growth and interaction required by companies and ultimately organizational learning and gaining a competitive advantage will be accessible (Mohiuddin et al., 2022). Such activities enable companies to expand their resources, offer more value-added products and services, explore emerging opportunities, and thus reap huge benefits in today's highly competitive international environment. Therefore, it is suggested to maintain the levels of trust in social relations between partners can develop and strengthen friendly partnerships, especially when maintaining the conditions maintains a competitive advantage. Knowledge-based trust is created by maintaining relationships and building mutual understanding in such a way that the behavior of the partner is predictable for the other party. At this time, the parties share common values and share tacit and personal knowledge in the field of internationalization.

In order to confirm the third hypothesis that technology transfer on the internationalization of the university and by confirming its sub-hypothesis with the mediation of entrepreneurial university, it can be said that entrepreneurial universities through cooperation with non-university organizations transfer of new technologies to improve internationalization performance and they play a key role (Ahmad et al., 2018). Scientific participation in technology transfer, company formation, and regional development reflects the development of the university's internationalization (Etzkowitz, 2014). Growth and profitability through the innovative network will encourage the university, which in turn it will help to create the necessary culture for the entrepreneurial university, which will facilitate the process of internationalization of the university (Alexander & Evgeniy, 2012). In relation to the entrepreneurial university through technology transfer, networking, innovation as well as entrepreneurship as a facilitator in the process of internationalization of the university through the growth and development of spin-off can be taken into account.

In order to confirm the fourth hypothesis that entrepreneurial skills on the internationalization of the university and by confirming its sub-hypothesis with the mediating role of entrepreneurial university it can be stated that one of the effective factors on the internationalization mediated by the entrepreneurial university in spin-off is manpower. Not only does manpower affect the ability of individuals to discover, evaluate and take advantage of entrepreneurial opportunities, but also affects the entrepreneurial intentions and behavior of individuals. In support of the present hypothesis, Hindle et al. (2009) stated that the process of internationalization of the university is a process formed by manpower (Hindle et al., 2009). Researchers also contended that human resources increase the ability of individuals to discover and take advantage of opportunities in the university and help individuals to acquire new knowledge and skills (Acemoglu, 2012). Therefore, the use of experts and specialists can create a competitive advantage among universities. Moreover, experts have shown that entrepreneurship is a competency that can be acquired or learned (Kuratko, 2005). In this regard, entrepreneurial skills and support for the creation of a work environment based on knowledge technology has increased the success rate of internationalization of the university to a surprising level. In fact, entrepreneurs are the heroes of economic and trade development of countries. It is suggested that given the importance of innovation and entrepreneurship to survive in a changing, complex and fully developed environment, and, accordingly, companies should develop strategies and processes for entrepreneurship and innovation to be able to take advantages of these strategies and the spirit of entrepreneurship and innovation in their organization and employees. Thus, they have to strengthen these components so as to be able to survive and succeed in international competition. Also, for the further research, it can be stated that there may be other influential components for the internationalization of the university through spin-off, all of which have not been studied in this research, and could be a path for other researchers. Additionally, the role of managers as university leaders in the internationalization of the university through spin-off should be examined.

CONCLUSION

Given that this study is new but it is not without limitations. Firstly, the analysis is performed on companies located in the Science and Technology Park of Iranian public universities, so it should be used with caution in generalizations, as it may not be valid for other regional conditions. Secondly, there are aspects of the internationalization that have not been addressed in this study and can be covered by the further research.

Author Contributions

Conceptualization, M.T., M.M., SM.S., and M.Y.; methodology, M.T.; software, M.T.; validation, M.T., and SM.S.; formal analysis, M.T.; investigation, M.T., M.M., SM.S., and M.Y.; resources, M.T., M.M.; data curation, SM.S., M.Y.; writing original draft preparation, M.T., M.M.; writing review and editing, M.M., M.Y.; visualization, M.T.; supervision, M.T.; project administration, M.T. All authors have read and agreed to the published version of the manuscript.

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