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Investigate the mediating role of knowledge commercialization process intervention on the relationship between companies' selection and exit by Iran's incubators

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Abstract

This paper investigates the mediating role of knowledge commercialization process intervention on the relationship between companies' selection and exit by Iran's incubators. The statistical population consists of 191 approved incubators and the statistical unit with 1337 members of the board of trustees of incubators. Descriptive and inferential statistical methods were used to analyze the collected data. Descriptive statistics methods (tables, graphs) were used to summarize, classify and interpret statistical data, and structural equation methods were used to test research hypotheses. The data collection tool was a questionnaire. The questionnaire's validity and reliability were assessed and approved and then distributed among the sample. The results (based on six factors extracted from ten Grimaldi characteristics) show that the selection method affects the incubators' intervention in Iran. Also, the intervention method affects the exit way by Iran's incubators, confirming the mediating role of the knowledge commercialization process.

Keywords: Incubators, Intervening Method, Removing Method
2020 MSC: 68V30

1 Introduction

Iran has a significant workforce with limited capital. On the other hand, small enterprises get the highest return from each investment unit, and such institutions provide most job opportunities. Despite such strengths, start-ups face high risks. Incubators are key players in the national innovation, entrepreneurship, and employment system. Incubators follow specific models in each country under the threats and opportunities and according to the strengths and weaknesses of the national system of innovation, entrepreneurship, and employment. Given that the Iranian labor market is transitioning from the unemployment period due to population growth of over 40% in the 80s, creating more than one million and two hundred thousand jobs annually is necessary to successfully overcome the unemployment

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crisis. Any action leading to strengthening the formation of private institutions and reducing the risk of their start-up period is a practical step in developing entrepreneurship, tackling unemployment, and a practical step in economic development. The incubators' performance in the start-up companies' exit stage will be affected by the question: "in what stage do the start-up companies offer their services in the incubators." The incubators may offer services based on the needs of the established companies. They provide business units with assistance from the definition of the business concept phase to the final phase of complete independence of the established unit. Some incubators develop specific skills in a particular period of corporate business development. Two features of tangible or intangible incubators' services affect the incubators' performance in the start-up exit phase. The financial and budgetary policies of the incubators are also significant factors in their performance. Suppose the incubators incur higher consumer costs for tangible services; in that case, they will need to adopt a rapid return on investment policy. However, if they put capital expenditures on the agenda, they will not need to adopt a return policy, and such incubators can hope for a return on investment in the long run and at a higher rate. In addition to the above, environmental condition is also an influential factor. The incubators' policy is affected by the stability or instability of the environment as a risky investment policy. A growth center with the financial capacity operating in a stable environment can hope for more long-term profit; otherwise, it is better to hope for a lower profit rate with a shorter payback period. The short-term financing perspective covers superficial ideas requiring tangible services. While, the long-term financing perspective seeks to reduce investment risks.

Research Hypotheses

Hypothesis 1: The selection method affects the intervention method in Iran's incubators.

Hypothesis 2: The intervention method affects the exit method in Iran's incubators.

Hypothesis 3: The knowledge commercialization process method intervenes in the relationship between companies' selection and exit in Iran's incubators.

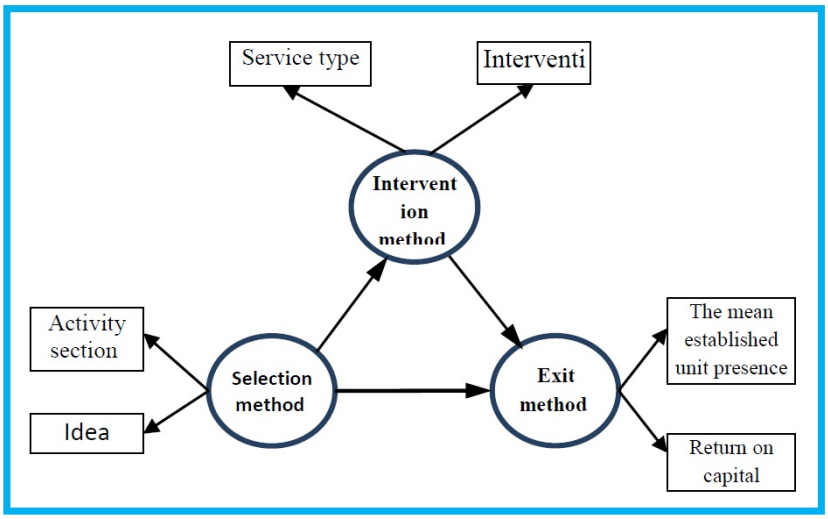

Figure 1: Conceptual model of research [8]

2 Conceptual definitions of research variables

1. Activity section. It means the approach in question is to attract start-up units and focus on a specific industry or a focus on a specific technology [8].
2. Ideas origin. The ideas accepted in the incubators can originate from companies and individuals outside the incubators or companies located in the incubator itself [8].
3. Intervention phase. The incubator decides to provide its services in one or more stages of the development of start-up units [8].
4. Service type. The incubator decides to provide a specific type of service, and includes tangible and intangible services [8].
5. Return on capital. The incubator decides on how to finance the costs of supporting start-ups. It includes receiving service costs from established companies or participating in shares of established companies [8].

6. The mean establishment time. This period is determined according to the product development strategy of the new unit, or its target market, or according to the growth period of technology units located in incubators [8].

Components obtained from combining the main concepts of the research:

- Component 1: Attraction Methods. This component includes the dimensions of activity section, and ideas origion.
- Component 2: Intervention methods. This component includes the dimensions of service type, and intervention phase.
- Component 3: Exit Methods. This component includes the dimensions of return on investment, and the mean of established unit presence time in the incubator.

A litreature review offers more than twenty models of incubators, each scrutinized a dimension. Theories within the scope of the research objectives include the following: [3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 20]. Two experts named "Grimaldi and Grandi" have referred to a list of variables that attributing specific features to the incubators to identify and describe existing models. Empirical evidence of this research was obtained from a case study of eight incubators in Italy. Here, we have selected six of the mentioned variables that specifically affect the performance of incubators. They are combined in the form of three components of attraction methods, intervention methods and exit methods. The ten variables include: mission or strategy, activity section, location, target market, intervention phase, return on investment, provided services, origin of accepted ideas, the mean of established units presence time, and type of management [8].

The first generation of incubators in the 1980s typically provided common workspace and equipment at affordable rates to companies that had complied with the requirements. In the 1990s, it was felt necessary to add services such as consulting, specialized equipment, network communications, and initial capital to the previous services.This led to the emergence of second-generation incubators; although, many incubators in developing countries still operate with the same first-generation structure, with the development of new generation communication and information technology, incubators have grown to take advantage of Communication and Information Technology. Development analysts believe that private sector investment typically forms the third generation of incubators [12]. In total, six perceptions of the incubators are presented:

1. Incubator as a mechanism for creating new businesses;
2. Incubator as a resource allocation mechanism;
3. Incubator as a socio-political game;
4. Incubator as a joint production between the growth center and the unit located in the incubator;
5. Incubator as a result of network behavior;
6. Incubator as a predictable and controllable process.

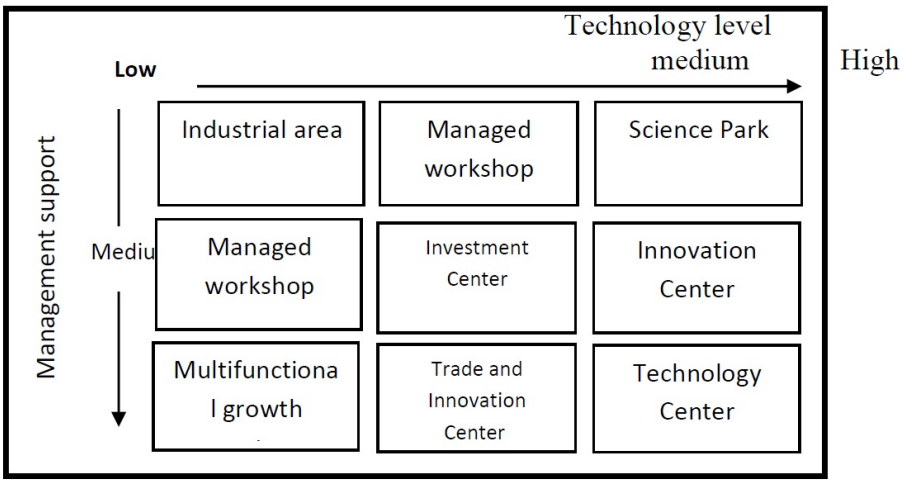

Figure 2: Leveling of support centers for institutions in terms of management support at the technology level

Grimaldi and Grandi [8] classified incubators into four categories:

1. Business Innovation Centers, BICs: They are the most common incubators. They were first established in Europe in 1984 and are related to the European Commission. The BICs are active in providing essential services to established companies, including space allocation, infrastructure, communication channels, information on financial opportunities, and vision.
2. University Business Incubator, UBIs: The importance of a knowledge-based economy is becoming increasingly apparent in societies, and government policymakers increasingly view science as a means of economic empowerment. Although the primary goal of universities is education, they can play a crucial role in local economies. This is possible by directing research to patentable inventions and discoveries and reproductive ideas derived from the talents of academics and the transfer of technology. UBIs are created by universities aiming in to play a direct entrepreneurial role in producing and disseminating technological and scientific knowledge. UBIs are organizations that provide support and services to knowledge-based technology units. Their emphasis is more on transferring scientific knowledge and technology from universities to companies. Furthermore, the primary motive for creating such incubators is that they provide the possibility of links between the university and industry. In other words, the connection of technology, capital, and knowledge is provided for the flourishing of entrepreneurial talents. Available services include shared office services, access to capital, access to business networks, reduction of university-related rental costs including academic advisors, student staff, laboratory services, workshops, CPU computer equipment, research and development activities, technology transfer programs, staff training, and other group activities. The advent of the Internet has led to a dramatic change in the incubators industry and their movement towards expanding online technologies and services. The information technology development in the second half of the 1990s changed many incubators industry rules. Rapid access to capital and the synergistic market of the network are currently the keys to the success of Internet-related technology units. In addition, many entrepreneurial pioneers have realized the lack of managerial and technical expertise.
3. Independent Private Incubators, IPIs: These incubators are created by individuals or a group of individuals. They aim at assisting entrepreneurs in creating and developing their business. They invest in new companies with the risk of capital considerations. They usually do not intervene in the definition phase of the business concept. In fact, they are interested in the started businesses requiring the injection of capital or knowledge.
4. Corporate Private Incubators: These growth centers are affiliated and created by large companies that aim to support the creation of new independent business units. The new business units have originated as spin-offs of research projects carried out by the organizations' resources. In general, these incubators, like the university development centers, intervene during the early stages of business development. The diversity of incubators is rooted in the gradual evolution of the needs and requirements of institutions that encourage these centers to provide a wide range of services. The authors believe that the differences in incubators can be better understood by categorizing them into two general categories. The UBIs are something in between the two models. Their model is similar to the UBIs in they rely on the wages of the growth of government subsidies. Their main objective is to provide knowledge-based units with continuous access to advanced technological knowledge and academic networks. Therefore, they are different from Model 1 incubators [8].
5.

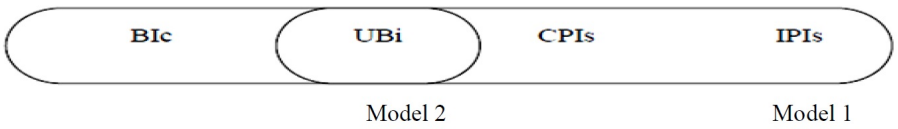

Figure 3: Comparison of growth center models

The difference between the incubators' models indicates their ability to cover various technology units with different goals and demands. The model one incubators focus on a capacity to reduce start-up costs for small entrepreneurs. In addition the model one incubators follow the goal to establish regional markets, provide greater adaptation to the old economy, search for regional market transparency and regional connections with private and public enterprises, set up low capital businesses to allocate logistics assets. The model two incubators focus on capabilities that help entrepreneurs start and grow their businesses by accelerating the start-up process. These entrepreneur assist technology units by attracting risky investments and providing high-value services (access to advanced market technology, management knowledge and capabilities, and operational support). They also grow and develop these units by creating synergies between technology units and a network of partners. The foundation of University business incubators lays between models 1 and 2, related to their capacity to reduce start-up costs and develop the knowledge-based and high-tech entrepreneurs ideas, still in small scale. The technology units related to these centers aim to cover the

regional and national market gaps in a short deployment time and need to acquire technological resources and access to technical knowledge, laboratories and university infrastructure to fully develop their potential [8].

3 Materials and methods

This is a descriptive-analytical survey. The statistical population consists of 1337 members of the board of trustees from 191 approved incubators. According to the statute of establishment of incubators, each unit of the incubators has a board of trustees of seven people and the head of the center is also a member of the said board of trustees. Due to the fact that the incubators are scattered in different parts of the country, the cluster method has been used to select the number of statistical samples. Cochran's general formula was used to determine the sample size and a sample of 320 was selected. This paper uses a mixed field and library method to collect data.

In the field research, a researcher- made questionnaire was used to collect data. The questionnaire included general and specialized items. The structural equation measurement models and path analysis were used to investigate the mediating role of knowledge commercialization process intervention on the relationship between companies' selection and exit by Iran's incubators. Accordingly, to identify and confirm the research conceptual model structure through statistical factors analysis (intervention method, exit method and selection method), we must first confirm the measurement tool validity and reliability; and if necessary apply changes in the model to finalize statistical model. Then, we examine the mediating role of knowledge commercialization process intervention on the relationship between companies' selection and exit by Iran's incubators. Accordingly, we used a path-structural model using the partial least squares method in Smart-PLS software.

4 Findings

We examined the reliability of structures from the perspective of measured internal consistency, composite reliability, subjects reliability, convergent validity and differential validity to evaluate reflective measurement models in path-structural models with partial least squares approach. Thus, we inserted the data into the software to implement the research conceptual model and obtain the outputs. In the following, the explain the process.

The external loads of each structure must be high to evaluate the reliability of subjects in evaluating path-structural measurement models. This indicates that corresponding subjects have a lot in common obtained by the structure. As a rule, all external loads of subjects must be statistically significant. The table below shows each subject's external load values per structure.

Table 1: Values of external loads relevant to each subject

Subjects	**Selection**	**Exit**	**Intervention**
Activity	0.984		
Idea origin	0.983		
The mean established unit presence		0.976	
Intervention phase			0.980
Service type			0.978

The rule of thumb is that external loads of more than 0.4 will be appropriate; however, the best value for external loads is 0.708 or more [7]. The findings of the table show that all the factor loads obtained are greater than 0.7, which indicates the appropriate factor load values in the reliability of the subjects. The table below presents convergent validity indices, composite reliability and compatibility reliability for model components.

Table 2: Validity and reliability indices of the structure

Structure	**Compatibility reliability (Cronbach's alpha)**	**Composite reliability**	**Average Variance Extracted (AVE)**
Selection	0.884	0.915	0.660
Exit	0.851	0.901	0.645
Intervention	0.807	0.895	0.572

Convergent validity is a criterion to determine the extent a measure is correlated with alternative measures of the same structure. Convergent validity assessment is usually based on the Average Variance Extracted (AVE). The

minimum AVE equal to 0.5 indicating sufficient convergent validity; This means that a latent variable can, on average, explain more than half of the scatter of its subjects. According to the table above, the research model convergent validity is confirmed for the AVE is more than 0.5 for each main structures of the model.

Cronbach's alpha is a measure of compatibility control. This criterion is also presented in Smart-PLS software along with other indicators. If Cronbach's alpha of a block is larger than 0.7, the block is a single factor and the measurement model is validated. Findings show that Cronbach's alpha values for all structures are greater than 0.7. Therefore, based on Cronbach's alpha, the one-dimensionality of all structures is confirmed. However, in many studies, alpha greater than 0.6 is also accepted. However, another criterion called composite reliability was used to ensure that all structures are one-dimensional.

In PLS routing models, another index called composite reliability along with Cronbach's alpha is used to evaluate the model. According to the findings presented in the relevant table the composite reliability values for all measurement models are greater than 0.7. Accordingly, the one-dimensionality of all measurement models is reaffirmed. The results of differential validity of structures (Fornell-Larcker criterion) are shown in the table below.

Table 3: Fornell-Larcker criterion values for evaluating the differential validity of main structures

	Transformational leadership	**Customer behavior**	**Organizational commitment**
Selection	0.940		
Exit	0.622	0.872	
Intervention	0.409	0.557	0.934

Differential validity is the extent to which a structure is properly distinguished from other structures by empirical criteria. The Fornell-Larcker criterion is an approach for measuring differential validity. This criterion compares the second root value of AVE with the correlation between latent variables. Specifically, the second root value of AVE structure must be greater than the highest correlation of that structure with other model structures. The logic of this method is based on the assumption that a structure should share more variance with the corresponding subjects than other structures. The results of the above table show that according to the Fornell-Larcker criterion, the second root of each AVE structure is greater than the highest correlation of that structure with other model constructs (the Fornell-Larcker criterion values are shown in color at the intersection of each row and column and the correlation of the variable with other structures is shown below the value of the Fornell-Larcker).

In addition, Figure 4 depicts the structural path pattern report, the estimated coefficients for the structural path pattern.

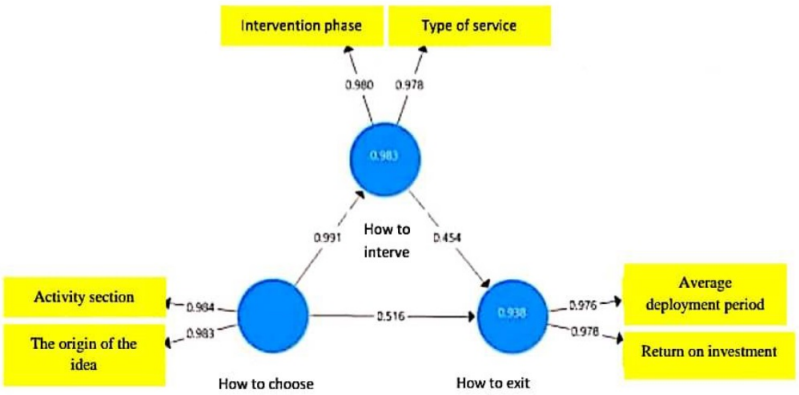

Figure 4: Estimated effect coefficients in the path-structural model

The coefficient of determination and significance test of dependent variables findings are given in the table below.

Table 4: Coefficients of determination and their significance test

	Coefficient of determination	**SD**	**t**	**Sig**
Exit	0.938	0.070	11.769	0.000
Intervention	0.983	0.015	15.902	0.000

The basic criterion for evaluating endogenous latent variables is the coefficient of determination. The values of the coefficient of determination of 0.67, 0.33 and 0.19 in PLS route models are evaluated as significant, moderate and weak, respectively. According the above table, the values of the coefficients of determination for the latent variables are evaluated as moderate and significant (strong). The coefficients of determination indicate the extent to which the changes of each endogenous (dependent) latent variable are explained by the exogenous (independent) latent variable (s) of the model.

In the following, the path coefficients of the model are investigated. Each path coefficient in the structural model can be considered equivalent to a standardized beta coefficient in regressions of the least common squares. The value of path coefficients in the studied model for the structural part of the research in relation to direct and indirect effects is calculated as shown in the table below. According to the table above, the direct and indirect effects of each factor on the other can be identified. Table 5 estimated the effects of total latent variables (direct and indirect) on the structural model:

Table 5: Index of the effects of latent variables (direct and indirect)

	Exit	**Intervention**
Exit	0.115	0.991
Intervention	0.454	–

The following figure presents the values of t-statistic for the estimated coefficients in the path- structural model.

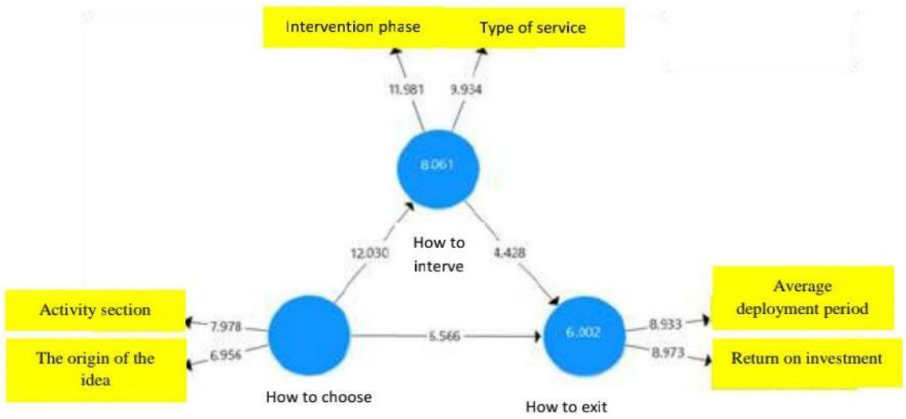

Figure 5: Statistical t values for estimated coefficients in the path-structural model

The table shows test results of the significance of path coefficients in relation to direct effects within the model.

Table 6: Significant test findings of path coefficients in relation to the effect of variables within the model

	SD	**t**	**Sig**	**Results**
Effect of selection on intervention	0.133	12.03	0.000	Confirmed
Effect of selection on exit	0.462	6.566	0.000	Confirmed
Effect of intervention on exit	0.345	4.428	0.000	Confirmed

The results of the above table show that there is a significant relationship for direct effects between all latent variables according to the research model. This is because according to the t value for the study of factor loads that is greater than 1.96 and also the significant level obtained for each of the factor loads that is less than 0.05, so the relationship between them is significant.

In this study, the Sobel test [19] was used to investigate the mediating role of knowledge commercialization process intervention on the relationship between companies' selection and exit by Iran's incubators. Thus, we used Aroian version of the Sobel relation which was first proposed by Baron and Kenny [2] and the index calculated by it, is more accurate and sensitive than the value obtained with the Sobel initial relation. In this test, the value of the Z statistic is obtained by Equation (4.1).

$$Z = \frac{r_1 \times r_2}{\sqrt{(r_2^2 \times S_a^2) + (r_1^2 \times S_b^2) + (S_a^2 \times S_b^2)}} \tag{4.1}$$

In Equation (4.1), r_1 and r_2 are the path coefficients between the independent and mediator variables and the path coefficients between the mediator and dependent variables, respectively. Also, S_a and S_b are the standard error of the path of the independent and mediator variable and the standard error of the path of the mediator and dependent variable, respectively. For the error level $\alpha = 0.05$, if the value of Z statistic calculated from $Z_{\frac{\alpha}{2}} = 1.96$ is greater, the significance of the mediator effect can be confirmed at the 95% level. Accordingly, to investigate the mediating role of knowledge commercialization process intervention on the relationship between companies' selection and exit by Iran's incubators, we can write:

$$Z = \frac{0.991 \times 0.454}{\sqrt{(0.454^2 \times 0.209^2) + (0.991^2 \times 0.182^2) + (0.209^2 \times 0.182^2)}} = 2.17$$

Given that the calculated Z value (2.17) is greater than $Z_{\frac{\alpha}{2}} = 1.96$, the error level $\alpha = 0.05$, so the null statistical assumption based on the absence of the mediating role of knowledge commercialization process intervention on the relationship between companies' selection and exit by companies is rejected. And the opposite assumption is confirmed.

In the structural equation modeling model, the VAF index is used to determine the intensity of the indirect effect of the mediating variable on the dependent variable. This index ranges from zero to one. The general interpretation of the value of VAF is done in such a way that whatever its value is close to one, the effect of the mediating variable on the relationship between the independent and dependent variables is strong; conversely, the closer it is to zero, the weaker the effect of the mediating variable on the relationship between the independent and dependent variables. According to Zhao et al. (2019), VAF values are greater than 0.8 for complete mediation, between 0.2 and 0.8 for partial mediation, and less than 0.2 without mediation. According to the findings, the value of this index to investigate the mediating effect was 0.466. Therefore, the mediating role of knowledge commercialization process intervention on the relationship between companies' selection and exit has been estimated insignificant.

In a summary, the following statements are the research findings expressed separately by research hypotheses:

Hypothesis 1: The selection affects the intervention with an effect of 0.991 and a significance level of 0.000 in Iran business incubators.

Hypothesis 2: The intervention affects the exit with an effect of 0.454 and a significance level of 0.000 in Iran business incubators.

Hypothesis 3: the mediating role of knowledge commercialization process intervention on the relationship between companies' selection and exit by Iran's incubators with an effect of 0.186 and a significant level of 0.000 (at the level of partial effect) can be confirmed.

5 Conclusion

1. Based on the research first hypothesis findings, the selection of start-up institutions to attend incubators has an effect on the intervention of incubators. Given that this effect is at the level of 99%, so regardless of the second independent variable, it is concluded that intervention by incubators is strongly affected under two indicators: the type of service and the phase of intervention. According to [9, 10], the absence of selection strategy prolongs the growth time and also weaken the performance of the incubator.
   They think the most important task in is to hire competent, qualified, educated and cultured people by incubators. This is not only one of the challenges of the incubators but also one of the challenges of the innovation industry, and without it, the incubators can not be expected to launch an entrepreneurial revolution in the region. According to [9, 10], the performance of the incubators is examined based on assumptions, including the performance of the selection. In their view, selections such as the entrance exam raise the expectations of candidates and have a correct evaluation of themselves. It also gives potential entrepreneurs a good understanding of the risks involved in starting a new business [9, 10]. These studies have emphasized the relationship between the performance of incubators and selection and are in line with the claim of the present study based on the relationship between selection methods and intervention methods. Norman and Bergek [3] see entrepreneurs' choice as a variable that can have only two states: Either based on the idea or selected based on the entrepreneur. Idea-based selection requires that the incubator have the dominant technology or business information to be able to assess the feasibility of the ideas. In the entrepreneur-based selection approach, the incubator should be able

to evaluate the personality traits, personal skills, and new business capacities of the entrepreneur [3]. Moreira Business Incubator Model has presented the incubator from the investor's point of view and has dedicated the first two stages of its model to search and selection. In the first stage, which is called search, the growth center should look for companies to establish. In the second stage, which is called selection, the incubator should analyze the businesses of the applicants to select the best ones to enter [15]. Norman and Bergk's findings and the findings of the Moreira Business Development Center are consistent with the findings of the present study.)

2. Based on the research second hypothesis findings, the intervention of incubator has an effect on emerging institutions leaving the incubator. The exit dimensions are: the return on investment and the duration of the presence of start-up institutions in incubator. The growth stages reflect the entrepreneur specific situations. Experts at Del Tachira University have categorized the growth stages into three periods, which include pre-development period, development period, and post-development period [17]. Costa-David, Malan and Lalkaka [6] have also introduced the process in three stages: pre-development, development, and post-development [1]. The goal of the pre-development phase is to potentially commercialize innovative ideas. The output of this step is used as the input of the next step. In countries where the economic structure is more private and the establishment of independent companies is obvious, pre-development courses focus only on educational services. In the development phase, the main support is provided to the activities of entrepreneurs. The post- development period also refers to a set of activities such as identifying the economic development of the institution, the economic effects of the activities of the institution, etc., which typically follows the institution leaving the incubator. The purpose of this phase is to support businesses that have emerged from the incubator and have not yet stabilized. In parallel with the incubation services for the creation of new enterprises, there will be continuous performance of the incubators as well as the performance of the supported enterprises [17]. The separation of the above three stages indicates the difference in their content from each other and based on the contingency approach, it can not be expected that different data or inputs will cause the same output. How to exit shows the different combinations of the limited period of support and how to return on the investment. The exit criteria stipulate that companies must leave the incubator after a certain period of time. Some companies move out of the center sooner because they need more space [1].
3. The mediating role of the intervention of the knowledge commercialization process in the relationship between the selection and the exit of companies in Iran's incubators can be confirmed. The decision made regarding the intervention phase, which will be in one of two ways: in all stages of development - in some stages of development, causes the time range of the establishment of units located in incubator to vary more or less. It seems that in order to reduce the time of establishment of tenant companies, incubators will try to limit their intervention to some stages of development instead of intervening in all phases and stages of development, which is in line with the needs of the unit and thus reduce the duration of presence. This will accelerate the commercialization of ideas and increase the efficiency of incubators. Examples are accelerators, which today are the focus of industrialized countries, especially in the private sector in the field of incubators model. Also, the decision to return the capital can be in one of two ways: - Participation in the shares of established companies will be affected by the question of whether the services of the incubators are tangible or intangible? If the incubators incur more consumption costs in line with tangible services, they will need to adopt a policy of rapid return on investment by those centers, while if they put capital expenditures on the agenda, they will not need to adopt a return on investment policy. Such incubators can hope for a long-term return on investment at a higher rate. However, the financial and budgetary policies of the incubators are a major factor in determining this policy. In addition to the above, environmental conditions are also an influential factor. The policy of the incubators as the policy of a risky investor is affected by the stability or instability of the environment. If the incubators has the financial capacity and operates in a stable environment, it can hope for more profit in the long run, otherwise it is better to hope for a lower profit rate with a shorter payback period. The short-term financing perspective covers superficial ideas that require tangible services, and conversely, the long-term financing perspective seeks to reduce investment risks.

Practical suggestions

1. According to the research objectives findings, it is better that the incubators be organized and distinguished based on different types of intervention methods, ie: type of services and intervention phase.
2. According to the research objectives findings, the duration of the presence of a stable unit for start-up units that receive different services should be different and appropriate. Today, the period of presence of new units is the same for all units.
3. According to the research objectives findings, the period of presence of a stable unit for new units in which the intervention phase of the incubator is not the same is different and appropriate. Today, the period of presence of new units is the same for all units.

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