



Research Paper

Strategic Planning for Commercialization of Research Findings in Iran: The Case Study of IranDoc

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Abstract

Background and Objectives: Commercialization of research is a process that transforms the knowledge produced in universities and research institutes into marketable products or services. Given its importance in higher education, commercialization of research has recently attracted the attention of policymakers in Iran. This study was thus intended to design effective strategies for commercialization of research in Iranian research institutes by identifying the drivers and barriers to its implementation. Moreover, it was attempted to formulate the commercialization strategies for the Iranian Research Institute for Information Science and Technology (IranDoc) based on the identified drivers and barriers.

Methodology: Based on the data of interviews with 30 IranDoc experts, the drivers and barriers to commercialization in Iranian research institutes were identified and then categorized into internal factors (i.e., strengths and weaknesses) and external factors (i.e., opportunities and threats) using the definitions of strength (S), weakness (W), opportunity (O) and threat (T). In order to complete the list of factors, the researchers asked the IranDoc experts to comment on the strengths, weaknesses, opportunities, and threats of commercialization in IranDoc using a questionnaire. Afterwards, SWOT matrix was used to formulate appropriate strategies for IranDoc.

Findings: Based on the findings, four strategy groups including defensive strategies (WT), competitive strategies (ST), conservative strategies (WO), and aggressive strategies (SO) were identified for the implementation of commercialization in IranDoc. Besides, the analysis of the internal-external factor evaluation (IE) matrix revealed that WT group strategies and ST group strategies were the first and second priorities for the commercialization of research findings in IranDoc, respectively. It is thus recommended that IranDoc apply defensive strategies (WT) in order to decrease the weaknesses and avoid the threats (WT) of commercialization of research findings. These strategies include conducting joint research and development projects, empowering researchers, managing knowledge flow, increasing the motivation of researchers to commercialize their research findings, and also attracting support from the industry sector and other organizations.

Discussion: In order to formulate an effective strategy for commercialization of research findings, it is imperative that the experts and policymakers gain an accurate understanding of the important factors (i.e., drivers and barriers) for research commercialization in research institutes. It is thus suggested that the commercialization strategies of IranDoc be developed based on the list of identified drivers and barriers to research commercialization in Iran. It is hoped that the formulated research commercialization strategies for IranDoc contribute to the commercialization of research products in other similar research centers in Iran.

Introduction

In the era of knowledge-based economy, knowledge is of great economic importance which can lead to added value in societies. In addition to technology, workforce and raw materials, advanced societies take knowledge resulted from commercialization of research findings as the driver of their power, superiority and development (Barclay, 1992). Rooted in the second scientific revolution in the late 20th century, commercialization of research findings enables educational institutions to take part in mutual cooperation with industries (Rasmussen et al., 2006; Abreu and Vadim, 2013; Perkmann, 2013) in order to commercialize their research findings so as to create wealth, enhance economic development and ultimately improve the living standards of societies (Mahoudpour et al., 2012). Research commercialization is indeed defined as a process by which the existing theoretical knowledge of the academic and research centers is transformed into various economic activities (Spilling, 2004). In a similar strand, Downie (2006) defines research commercialization as converting the research findings into products, services, and processes which can be used in commercial trades (Downie, 2005). The commercialization of research findings to the benefit of societies have recently invoked the interest of policymakers and resulted in allocating numerous resources for its true implementation. Among others, Iran has also recognized the important role of commercialization of research findings in its development and thus given it due attention in its scientific policies and programs, though it is not an easy task to truly implement commercialization of research findings as there are several stakeholders involved (Dominguez-Vargas, G., Camacho-Velazquez, 2001). This complex process entails several requirements such as developing appropriate market strategies, managing financial resources and developing products and also evaluating market, etc. There are indeed numerous barriers to commercialization of research findings (Bandarian, 2008).

In Iran, most paradigms of industrial production, consumption, higher education and even research are non-native and imitative and have not been formed based on the real context of the society. Identifying the clue to this complicated issue is not a simple task. This study was thus intended to develop strategies for knowledge commercialization by identifying the drivers and barriers to its implementation in Iranian research centers. Moreover, it was attempted to formulate the commercialization strategies for IranDoc based on the identified drivers and barriers. To that end, the following research questions were formulated: 1) what are the drivers and barriers to research commercialization in Iran? 2) What are the drivers and barriers to research commercialization in IranDoc? 3) What are the research commercialization strategies in IranDoc?

Literature review

Commercialization strategies refer to the options and methods that a company entertains to move its technology/product from concept to the market-place (Gans and Stern, 2003; Mortazavi Ravari et al., 2016). Debackere and Veugelers (2005) categorize knowledge commercialization strategies as (i) establishing economic institutes based on produced technologies by the researchers in research institutes; (ii) conducting joint research studies, e.g., defining and carrying out research and development (R&D) projects with the participation of companies and research centers; (iii) concluding research contracts with industries; (iv) developing an appropriate legal framework for intellectual property rights to support the technology transfer; and (v) exchanging the research staff among the research institutes and universities.

Commercialization strategies have been extensively studied in different contexts. For instance, Goktepe (2008) and Stankeviciene et al. (2017) divided commercialization strategies into specific and generic categories: specific strategies included patent applying, technology licensing, and creating spin-offs. On the other hand, the generic strategies included participating in conferences, seminars and scientific workshops, jointly supervising MA theses and PhD dissertations, recruiting university graduates in the industry, providing advice to industry by faculty members, employing faculty members of the universities in the industry, establishing joint research labs with the industry, concluding contracts to conduct joint R&D

projects, developing common technologies through contracts between the industry and university, and also exchanging the research staff between the industry and university .

In a similar research strand, numerous researchers have highlighted the role of patents filling and licensing in academic research commercialization (Siegel et al., 2004; Rasmussen and Moen, 2006; Jensen and Thorsby, 2001; Henderson et al., 1998). The significance of creating spin-offs in commercializing academic research has been also the focus of some studies (Shane, 2004; O'shea et al., 2005; Di Gregorio and Shane, 2003). Likewise, other studies have focused on the important role of making research contracts with industry (Stuart, 2000; Mortazavi Ravari et al., 2016; Tuncikiene and Drejeris, 2017).

Research commercialization strategies have been also categorized into two formal and informal groups. Formal strategies of commercialization include licensing of academic patents to the existing companies, creating academic spin-offs, while informal strategies refer to such strategies as providing advisory services to industry by university professors (Siegel et al., 2004). However, designing effective strategies for research commercialization entails the identification of the drivers and barriers to true implementation of research commercialization in research institutes. The drivers and barriers to commercialization identified in previous studies are represented in Table 1.

Table 1. Barriers and drivers to research commercialization in the previous studies

Barriers	References	Drivers	References
Behavioral barriers (motivational, attitudinal, and cognitive barriers)	(Samson and Gurdon, 1993; Biemans and Harmsen, 1995; Funk, Tornquist, and Champagne, 1995; Mortazavi Ravari, et al., 2016; Siegel et al., 2004; Tahvanainen and Nikulainen, 2011; Tuncikiene and Drejeris, 2017; Siegel and Phan, 2005; Symeonidou et al., 2017; Kirchberger, and Pohl, 2016; Namdarian& Naimi-Sadigh, 2018b)	Positive personal characteristics (e.g., intellectual independence, self-confidence, hard-working, cooperation and networking).	(Winchell, 1984; Rabie, et al., 2016; Namdarian &Naimi-Sadigh, 2018a; Smith, 2020)
Barriers to research structure (e.g., non-applied research, poor research methodology and poor data collection).	(Biemans and Harmsen, 1995; Namdarian & Naimi-Sadigh, 2018b; Maurseth & Sevansson, 2020)	Creating strategic alliance and networking.	(Braun et al., 2004; Meyer and Kearnes, 2013; Block et al., 2016; Min, et al., 2020)
Infrastructure barriers (e.g., organizational structure, networking and managerial barriers).	(Tahvanainen and Nikulainen, 2011; Bulsara, Gandhi, and Porey, 2010; Pellikka and Colleagues, 2012; Shane, 2004; Kaarela, 2013; Namdarian& Naimi-Sadigh, 2018b; Bakhtiar, et al., 2020)	Creating legal frameworks for intellectual properties.	(Braun et al., 2004; Morricone et al., 2017; Namdarian& Naimi-Sadigh, 2018a; Meijer, et al., 2019)
(Limitation in financial resources and skill).	(Tahvanainen and Nikulainen, 2011; Biemans and Harmsen, 1995; Howells and McKinlay, 1999; Pellikka and Colleagues, 2012; Tuncikiene and Drejeris, 2017; Rank and Brochu, 1999; Block et al., 2016; Namdarian& Naimi-Sadigh, 2018b)	Government's support (Providing supportive infrastructures including financial support and entrepreneurship opportunities for the researchers; developing supportive macro policies).	(Braun et al., 2004; Murtry, 2003, Mortazavi Ravari, et al., 2016; Henrekson &Rosenberg, 2001; O'shea et al., 2005; Kirchberger, and Pohl, 2016; Audretsch, 2012; Namdarian, et al., 2020)
Contextual barriers (cultural, political, legal and business environment barriers).	(Tahvanainen and Nikulainen, 2011; Stankeviciene et al., 2017; Rank and Brochu, 1999; Mortazavi Ravari, et al., 2016; Pellikka, et al., 2012; Al Natsheh, et al., 2015; Kaarela, 2013; Namdarian& Naimi-Sadigh, 2018b; Mahjoom, et al., 2020)	Establishing the disciplines with a focus on problem-solving	(Mortazavi Ravari, et al., 2016; Meijer, et al., 2019)

Research methodology

This descriptive/exploratory study used a mixed-method strategy including the literature review, the interview, and the questionnaire to collect data. Afterwards, based on the collected data, SWOT matrix was used to formulate appropriate strategies for IranDoc.

Step 1. Iranian researchers were interviewed in order to identify the drivers and barriers to research commercialization in Iran. The statistical population for this study included faculty members of the universities, researchers, MA and PhD students in the diverse fields. A non-random purposive sampling procedure was used to select the participants by referring to their résumés. Once identified, they were contacted to make preliminary arrangements for their participation in the study. Accordingly, a list of 30 experts including 26 assistant professors, 4 associate professors was compiled. These experts were specialized in information technology engineering, computer engineering, industrial engineering, management, library and information sciences, philosophy, social sciences, and general linguistics.

Step 2. The drivers and barriers to research commercialization resulting from Step 1 was categorized into two groups of internal (strengths and weaknesses) and external (opportunities and threats) factors using the definitions of strength, weakness, opportunity and threat to research commercialization.

Step 3. A total of 10 assistant professors from IranDoc were interviewed about the obtained factors from Step 2. These experts were specialized in management, industrial engineering, library and information sciences, and general linguistics. They were asked to comment on the factors in the context of IranDoc and also add the factors which were missing.

Step 4. In this step, the research commercialization strategies in IranDoc were formulated by SWOT analysis. 31 experts of IranDoc selected through a purposive sampling procedure were invited to complete a questionnaire. They included 1 associate professor, 17 assistant professors, 6 PhD candidates, 4 lecturers, 2 MA holders, and 1 BA holder. They were specialized in computer engineering, library and information sciences, industrial engineering, general linguistics, management, information technology engineering, social communication, geology, chemistry, physics, psychology.

The strategic analysis of research commercialization in IranDoc is shown in Figure 1.

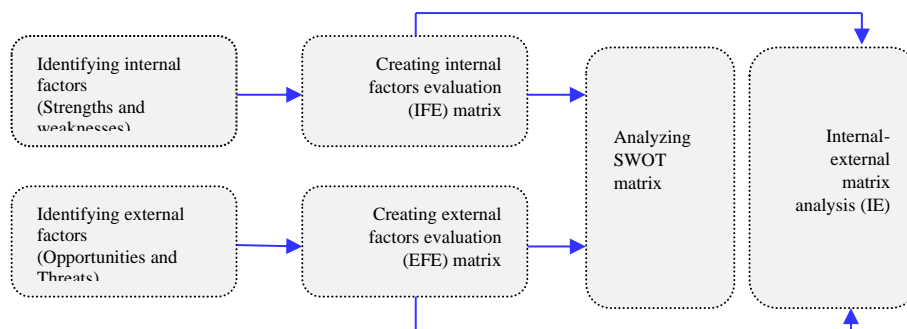


Figure 1. Strategic analysis of research commercialization in IranDoc

Data analysis

The results of each step and its data analysis are presented below according to the research questions.

The drivers and barriers to research commercialization in Iran

Based on the interviews with 30 participants, the drivers and barriers to commercialization in Iran are represented in Table 2.

Table 2. The drivers and barriers to research commercialization in Iran

Drivers	Barriers
Paying attention to knowledge-based economy paradigm in the agendas and programs of universities and research centres.	Lack of commercialization motivation among the researchers.
Developing motivational policy instruments for commercialization of research findings.	Researchers' negative attitudes towards getting involved in business activities.
Evaluating faculty members of universities based on their performance in commercializing their research findings.	Lack of industry' awareness about the results of academic research.
Encouraging the private sector to invest in R&D by considering tax exemption.	Researchers' lack of familiarity with research commercialization process.
Establishing the venture capital funds.	Research projects are not mostly problem-solving and need-oriented research.
Developing the regulations for supporting the knowledge-based companies.	Faculty members of universities are not fully authorized to engage in commercial activities.
Developing the regulations for supporting science and technology parks and incubators	Low cooperation in multi-disciplinary research teams.
Supporting the techno-marts for technologies development	Lack of strategic communication among the research and academic centres and industry.
Increasing the number of postgraduate students.	Lack of a systematic model for attracting the research funding.
	Lack of research commercialization strategies.
	Lack of marketing mechanisms in the research institutes.
	Lack of experience of research institutes to commercialize research results at national and international level.
	Failure of regulations to determine researchers' share of research commercialization revenues.
	Lack of joint R&D project among universities, research centers and industry.
	Lack of exchanging research staff among universities, research centers and industry.
	Poor laws and regulations of intellectual property in the country.
	Not paying attention to the commercialization of research results in the fields of humanities.
	Lack of industry investment in the fundamental research.
	Allocation of research funds only through the government.
	Lack of commercialization courses for students.
	Not supporting for creating spin-offs in the field of humanities.
	Lack of patent applying mechanisms in the field of humanities.
	Inadequate support for creating science and technology parks and incubators in the field of humanities.
	Not accepting research findings by the industry.
	Lack of industry managers' trust to local technologies.
	Bureaucratic process of patent application and technology validation.
	Insufficient attention to the commercialization of research findings in the promotion regulations of universities' faculty members.

The Drivers and barriers to research commercialization in IranDoc

IranDoc started its activities in 1968 as an institute affiliated with the Ministry of Science, Research, and Technology (MSRT) to work in the field of science and technology of Information and Librarianship. In terms of its missions, IranDoc considers information activities, including collecting and disseminating scientific information to meet the information needs and also to develop a scientific information network. In

order to formulate certain strategies for research commercialization in IranDoc, the researchers categorized the obtained checklist of the drivers and barriers to research commercialization in Iran (sections 4.1) into internal drivers and barriers (strengths and weaknesses) and external drivers and barriers (opportunities and threats) through using the definitions of strength, weakness, opportunity and threat. Then, the internal and external factors were analyzed in IranDoc through extracting the experts' viewpoints, and significant factors were accordingly identified for IranDoc (Table 3 and 4). The internal factors evaluation matrix (IFE) and external factors evaluation matrix (EFE) are presented below:

Internal factors evaluation matrix (IFE) of IranDoc: This matrix (Table3) was obtained in five stages as follows:

- **Stage 1:** Having obtained a checklist of the strengths and weaknesses of research commercialization in IranDoc, the researchers ordered these factors from strengths to weaknesses.
- **Stage 2:** IranDoc experts were asked to comment on the significance of each strength and weakness on a five-point Likert scale (5 the highest and 1 the lowest) using the questionnaire. The calculated mean values resulting from a one-sample t-test was considered as the weight of each strength and weakness. Given that the total value of internal factors should equal 1, the calculated mean values were normalized (the mean value of each internal factor was divided by the sum of mean values of the internal factors).
- **Stage 3:** Each internal factor was then given a score of 1 to 4 as 1 indicated fundamental weakness of IranDoc and 2 indicated low weakness of IranDoc considering the given factor. In turn, score of 3 indicates the strength of IranDoc, while score of 4 shows a very high strength of IranDoc considering the given factor, respectively (1 and 2 were related to weaknesses and 3 and 4 were related to strengths). The mode of statistical distribution of scores of each factor was considered as the score of that factor.
- **Stage 4:** The weight of each factor was multiplied by its score in order to obtain its weighted score.
- **Stage 5:** The sum of the weighted scores of internal factors was considered as the final score of IranDoc' internal factors. If the final score was lower than 2.5, it indicated the weakness of IranDoc, while a score higher than 2.5 showed the strength of IranDoc considering the internal factors (David, 2011).

External factors evaluation matrix (EFE) of IranDoc

In order to evaluate the opportunities and threats, the researchers used EFE matrix (Table 4). The stages of creating EFE matrix were similar to those of IFE matrix. However, these two matrices differ only in the meanings of the scores of external and internal factors. In EFE matrix, like IFE matrix, the external factors were given a score of 1 to 4, showing the response of IranDoc to the related factors. Scores 4, 3, 2 and 1 indicated the best, the good, the moderate, and the weak response of IranDoc to the related factors. As such, one of these numbers is assigned to the corresponding opportunity and threat. If the sum of the weighted scores for the external factors was more than 2.5, it meant that IranDoc had an excellent response to the external factors (opportunities and threats). However, if the sum of the weighted scores for the external factors was less than 2.5, it meant that IranDoc could not make use of the existing opportunities or avoid the threats (David, 2011).

Table 3. IFE matrix of IranDoc for research commercialization

Strengths (Si) (i=1-11)	Weight	Score	Weighted score
Senior manager's cooperation and support of commercialization process (S1)	0.0325	4	0.13
Establishing department of knowledge-based services in IranDoc (S2)	0.0333	3	0.099
Providing some solutions for controlling the extent of practicality of research (S3)	0.0289	3	0.0867
Developing a booklet of services, products, and capabilities of IranDoc for industry (S4)	0.0321	3	0.0963
Holding scientific seminars and critical meetings related to research findings (S5)	0.031	3	0.093
Having young, motivated, and well-educated human resources and researchers (S6)	0.0315	4	0.126
Holding seminars and conferences to boost the relationship of IranDoc with industry (S7)	0.0289	3	0.0867
Moving towards transforming research findings into technology, products and services (S8)	0.0278	3	0.0834
Developing accumulative knowledge related to information technology and science, e.g., thesaurus, information databases, bibliography, and information source sharing. (S9)	0.0315	3	0.0945
Holding advanced educational courses (S10)	0.0294	3	0.0882
IranDoc's membership in Iranian science and technology policymaking institutions (S11)	0.0278	3	0.0834
Weaknesses (Wi) (i=1-21)	Weight	Score	Weighted score
Lack of motivation in IranDoc researchers for commercialization (W1)	0.0341	2	0.0682
Researchers' negative attitude towards getting involved in business activities (W2)	0.031	2	0.062
Not distributing IranDoc' research findings to the managers in industry and business sector (W3)	0.036	1	0.036
Lack of services, and financial support of the researchers in order to develop prototypes (W4)	0.0297	2	0.0594
Unfamiliarity of IranDoc researchers with the research commercialization process (W5)	0.0341	1	0.0341
Not conducting problem-solving and need-oriented research projects by IranDoc researchers (W6)	0.0312	1	0.0312
Conflict between the research duties of faculty members and commercialization activities (W7)	0.0289	2	0.0578
Lack of scientific cooperation of multi-disciplinary teams in IranDoc (W8)	0.0331	1	0.0331
Lack of strategic alliance and communication networks between IranDoc and industry (W9)	0.0342	1	0.0342
Lack of a systematic mechanisms for attracting research budget (W10)	0.0297	2	0.0594
Lack of research commercialization strategies (W11)	0.0321	2	0.0642
Inefficient R&D management in the IranDoc (W12)	0.0312	2	0.0624
Lack of research departments in IranDoc (W13)	0.031	1	0.031
Lack of advertising mechanisms for the IranDoc research findings and products (W14)	0.0302	1	0.0302
Insufficient experience of IranDoc in commercializing research findings at the national and international level (W15)	0.0302	2	0.0604
Lack of marketing units in IranDoc (W16)	0.0325	1	0.0325
Unclear distribution of incomes resulting from research commercialization in organizations (W17)	0.0291	2	0.0582
Not defining and conducting R&D projects by the cooperation of research institutes (W18)	0.031	2	0.062
Not exchanging research staff and resources between IranDoc and industry (W19)	0.0336	1	0.0336
Researchers' low willingness to participate in the joint researches (W20)	0.0336	1	0.0336
Not documenting the managerial experiences and R&D projects (W21)	0.0278	1	0.0278
Final score (The sum of the weighted scores)	1	-	2.039
Mean	-	2.06	-
Standard deviation	-	0.94	-

Table 4. EFE matrix of IranDoc for research commercialization

Opportunities (O _i) (i=1-12)	Weight	Score	Weighted score
Popularity of IranDoc in society (O1)	0.0398	3	0.1194
The dominance of knowledge-based economy paradigm in plans and missions of the universities and research centers (O2)	0.0361	2	0.0722
Developing motivational guidelines and policies for commercialization (O3)	0.0371	3	0.1113
Making modifications in the evaluation and promotion system of the university professors (O4)	0.0373	1	0.0373
Government support for applied research (O5)	0.0322	2	0.0644
The government comprehensive plan to support tax exclusion programs for the private sector in order to invest in R&D (O6)	0.0344	2	0.0688
Developing venture capital funds (O7)	0.0344	1	0.0344
The government support for creating knowledge-based companies (O8)	0.0359	3	0.1077
Supporting the techno-marts for technologies development (O9)	0.0328	1	0.0328
Increasing policymakers' demand for scientific and technological information (O10)	0.0334	3	0.1002
Increasing the number of postgraduate students (O11)	0.0327	2	0.0654
The existence of educational and research opportunities in industry for the faculty members (O12)	0.034	1	0.034
Threats (T _i) (i=1-16)	Weight	Score	Weighted score
Weaknesses in regulations related to intellectual property of software technologies (T1)	0.0371	1	0.0371
Not paying attention to the commercialization of research findings in the fields of humanities (T2)	0.0359	1	0.0359
Lack of investment of industry in fundamental research (T3)	0.0349	1	0.0349
Allocating the research funding inappropriately by the government (T4)	0.0337	2	0.0674
Weak entrepreneurial culture, especially in the field of humanities in Iran (T5)	0.0389	2	0.0778
Offering non-applied educational courses to the students (T6)	0.0342	1	0.0342
Not supporting the development of spin-offs in soft technologies and humanities (T7)	0.0334	2	0.0668
Lack of patent application mechanisms in soft technologies and humanities (T8)	0.0349	1	0.0349
Not supporting the development of science and technology parks and business incubators in soft technologies and humanities (T9)	0.0362	1	0.0362
Lack of acceptance of research findings reported in humanities research, especially by industries (T10)	0.0389	2	0.0778
Lack of trust in local technologies by industrial managers (T11)	0.0374	1	0.0374
The small and scattered markets for IranDoc products (T12)	0.0359	2	0.0718
Weak communication between universities and industry (T13)	0.0359	2	0.0718
Inadequate support of research commercialization in the guidelines used for the promotion of university professors (T14)	0.0382	1	0.0382
The existence of a large number of scientific information centers similar to IranDoc (T15)	0.0393	1	0.0393
The availability of more attractive job opportunities for capable researchers of IranDoc (T16)	0.0349	1	0.0349
Final score (The sum of the weighted scores)	1	-	1.644
Mean	-	1.64	-
Standard Deviation	-	0.73	-

According to Table 3, given that the sum of the weighted scores for the internal factors was equal to 2.039, which is lower than 2.5, IranDoc is weak considering its internal factors in research commercialization. Moreover, as Table 4 showed, the sum of the weighted scores for opportunities and threats was equal to 1.644, which is lower than 2.5, indicating that IranDoc could not respond to the external factors.

Findings

Having identified the significance of each factor and its possible influence on research commercialization in IranDoc, the researchers formulated the required strategies as follows.

Aggressive strategies (SO): Organizations use their strengths through aggressive strategies in order to take advantage of external opportunities and maximize their effectiveness. Organizations commonly use WT, WO, and ST to reach such a condition and to be able to use SO strategies (Table 5).

Table 5. Formulating SO strategy in IranDoc

Group	Strategies	Evidences	
SO	Creating knowledge-based companies, business incubators and start-ups in the field of the existing technical knowledge in IranDoc (SO1)	S ₁	O ₁
		S ₆	O ₃
		S ₈	O ₅
SO	Designing and developing new applied training courses and packages for the target group by taking advantage of the experienced professors (SO2)	S ₉	O ₈
		S ₁₀	O ₁₁
		S ₁₁	O ₁₀
SO	Extending IranDoc target group to include science and technology policy makers and also produce scientific and technological information for policy decisions (SO3)	S ₉	O ₁₀
		S ₁₁	O ₁₀

Conservative strategies (WO): These strategies aim to enable the organizations to use the existing opportunities and to decrease the internal weaknesses (Table 6).

Table 6. Formulating WO strategy in IranDoc

Group	Strategies	Evidences		
WO	Moving IranDoc toward attracting research grants from the government, industry, and investors focusing on doing problem-solving and need-oriented research projects (WO1)	W ₆	O ₅	
		W ₁₀	O ₆	
		W ₉	O ₇	
			O ₁₀	
			O ₂	
			O ₃	
			O ₅	
			O ₆	
			O ₇	
			O ₉	
			W ₁₄	
			W ₃	
			W ₁₅	
			W ₁₆	
			W ₁	O ₃
WO	Outsourcing IranDoc advertising activities (WO2)	W ₂	O ₄	
		W ₇	O ₁₂	
		W ₁₇	O ₆	
		W ₉		
		W ₁₉		
		W ₁₈		
		W ₁₂		
		W ₉		
		W ₁₈		
WO	Fostering the participation of IranDoc experts in request-based research to receive financial support from other organizations (WO3)	W ₉		
		W ₁₉		
		W ₁₈		

Competitive strategies (ST): Organizations implement competitive strategies to decrease or remove the influence of the existing threats to research commercialization (Table 7).

Table 7 Formulating ST strategy in IranDoc

Group	Strategies	Evidences
ST	Promoting IranDoc research findings and products to attract support of industry and other organizations (ST1)	S ₂ S ₅ S ₆ S ₈ T ₁₀ T ₁₁ T ₁₂ T ₁₃
	Helping IranDoc increase its superiority over other rival scientific information centers so as to produce extra added value from the scientific and technological information (ST2)	S ₉ S ₁₂ T ₁₅ T ₁₅
	Attracting the attention of scientific community to faculty members and their research findings (ST3)	S ₆ S ₈ T ₅ T ₃ T ₂ T ₁₀
	Promoting IranDoc to suggest policymakers some regulation for intellectual properties, especially in the field of soft technologies and humanities (WT4)	S ₁₄ T ₁

Defensive strategies (WT): These strategies try to decrease the internal weaknesses and avoid the threats of research commercialization (Table 8).

Table 8. Formulating WT strategy in IranDoc

Group	Strategies	Evidences
WT	Carrying out joint R&D projects with information centers similar to IranDoc in order to achieve common goals (WT1)	W ₄ W ₁₈ W ₁₉ W ₂₀ T ₁₅
	Using industry research labs to carry out joint R&D projects with IranDoc (WT2)	W ₄ W ₉ W ₁₈ W ₁₉ W ₂₀ T ₁₃ T ₁₀ T ₄
	Empowering IranDoc researchers in entrepreneurship skills and establishment of Knowledge-based companies (WT3)	W ₅ W ₁₁ T ₆
	Developing multidisciplinary research teams in IranDoc in order to produce creativity and innovation, especially in the field of soft technologies and humanities (WT4)	W ₈ W ₁₃ W ₁₁ T ₇ T ₈ T ₉ T ₁
	Managing inter- and intra-organizational knowledge flow in IranDoc in order to foster learning, creativity and innovation (WT5)	W ₂₁ T ₁₆
	Providing motivational solutions to persuade professors and researchers to commercialize their research (WT6)	W ₁ W ₂ T ₁₄

Having identified the strengths, weaknesses, opportunities, and threats of research commercialization, the researchers created IFE and EFE matrixes, and then analysed internal-external factors evaluation (IE) matrix. The output of this matrix determined which group of strategies (i.e., SO, WO, ST, WT) was prioritized. In IFE matrix, the sum of weighted scores was equal to 2.039, the mean value was equal to 2.06, and the standard deviation was equal to 0.94. In EFE matrix, the sum of weighted

scores was equal to 1.644, the mean value was equal to 1.64, and the standard deviation was equal to 0.73. IE matrix was also formed based on these data (Figure 2). Then, the sum of weighted scores of EFE matrix was spotted on the vertical axis of Figure 2 and the dotted line drawn on it. Besides, the sum of weighted scores of IFE matrix was spotted on the horizontal axis of Figure 2 and the dotted line was drawn on it. The area which these two dotted lines meet indicates priority strategies in IranDoc. The cross section of these two dotted lines displays the WT strategies whose width and length are equal to the standard deviations obtained from mean values of the scores in EFE and IFE matrixes. IE matrix indicates that if IranDoc tends to take up a strategic management of commercialization of research findings, WT strategies, i.e., defensive strategies should be prioritized; weaknesses should be decreased and threats should be accordingly avoided.

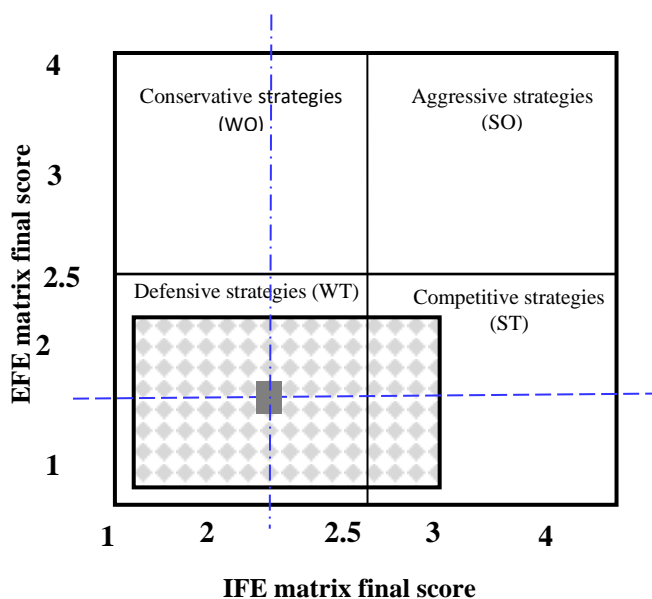


Figure 2. IE matrix for research commercialization in IranDoc

Conclusion

Evaluation of education and research has been currently made possible from an economic point of view. In line with the changes in policy makers' viewpoint, the funding model and management styles of universities have also undergone many changes. As such, in many universities and research centers, offices have been established under the name of technology transfer offices to transfer technology, facilitate the knowledge commercialization, and also strengthen the link among universities, research centers, and industry. In doing so, the universities and research centers have attempted to embark on several commercial activities such as conducting joint R&D projects, and creating intellectual property rights to protect creations and/or inventions resulting from intellectual activity in the industrial, scientific, literary or artistic fields. In order to formulate an effective strategy for commercialization of research findings, it is thus necessary that different stockholders involved gain an accurate understanding of the factors (drivers and barriers) affecting the true implementation of commercialization of research findings. The research commercialization strategies developed for IranDoc can, in turn, help promote commercialization of research findings in other similar research centers in Iran.

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Conflict of interest

No conflict of interest is reported by the authors.

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