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COMPETITIVE STRATEGIES OF KNOWLEDGE AND INNOVATION COMMERCIALIZATION: A UNIFIED SWOT AND FUZZY AHP APPROACH

ESTRATEGIAS COMPETITIVAS DE CONOCIMIENTO Y COMERCIALIZACIÓN DE LA INNOVACIÓN: UN DOFA UNIFICADO Y UN ENFOQUE DE PROCESO DE ANÁLISIS JERÁRQUICO DIFUSO (FUZZY AHP)

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ABSTRACT

Universities have shown a strong desire to commercialize researches and innovations. As a result, they are increasingly weaning themselves from public budgets. Commercialization has become the gateway for privatization, but the improper selection of commercialization strategies often results in the elimination of resources and time. The correct evaluation and ranking of strategies for the best resources is essential for the competitive performance of a university. The hybrid SWOT and Fuzzy AHP model adopted in this study provides a clear categorization of these university strategies. The first and relevant criteria as well as sub-criteria are identified using SWOT analysis. Fuzzy AHP tool is then used to evaluate and rank the internal and external factors that affect competition in Iranian universities. Based on the IE matrix, the growth and the process of building strategies are important priorities when considering commercializing. The results of this study revealed that academic startups, joint technology, joint research laboratories, strategic alliances, recruiting pundit and contracting with industry are the best strategies for Iranian universities.

KEYWORDS

Knowledge; Innovation; Commercialization; Strategy; FAHP approach; SWOT matrix.

RESUMEN

Las universidades han mostrado un fuerte deseo de comercializar investigaciones e innovación. Como resultado de esto, cada vez más buscan depender menos de los presupuestos públicos. La

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comercialización se ha convertido en la entrada a la privatización, sin embargo, la selección incorrecta de las estrategias de comercialización con frecuencia resulta en la eliminación de recursos y tiempo. La correcta evaluación y ranking de estrategias para los mejores recursos es esencial para el desempeño competitivo de una universidad. El híbrido entre el DOFA y el modelo proceso de análisis jerárquico difuso (Fuzzy AHP) adoptado en este estudio, provee una categorización clara de las estrategias de estas universidades. Los criterios principales y relevantes, al igual que los subcriterios, son identificados utilizando el análisis DOFA. La herramienta Fuzzy AHP se utiliza luego para evaluar y valorar los factores internos y externos que afectan la competencia en las universidades de Irán. Teniendo como base la matriz IE, el crecimiento y el proceso de construcción de las estrategias son prioridades cuando se tiene en cuenta la comercialización. Los resultados de este estudio revelan que los emprendimientos académicos, la tecnología conjunta, los laboratorios de investigación conjunta, las alianzas estratégicas, los expertos en reclutamiento y las contrataciones con la industria son las mejores estrategias para las universidades iraníes.

PALABRAS CLAVE
Conocimiento; innovación; comercialización; estrategia; enfoque AHP; matriz DOFA.

INTRODUCTION
Knowledge and innovation has a direct impact on an economy, especially in fast-growing new startup companies. Knowledge workers are the key towards gaining competitive advantage for innovative organizations (Gonzalez-Perez & Leonard, 2013). Factors such as globalization, along with other factors, have fundamentally changed the relationship between industry and universities.

This is part of a general trend towards the rapid development of knowledge markets. Currently, national policies are focused on the relation between industry players and university. The aim is to facilitate the improvement of entrepreneurship in fast-growing industries (The Organization for Economic Co-operation and Development (OECD), 2002). Hence, universities are considered as important actors in the knowledge-based economy. And the commercialization of research in universities, the innovations that originate from the research and development are considered as important factors for the economic stability of countries (Arora, 2003). Innovation often results in entrepreneurship as new ventures are created (Khajeheian, 2013) and by allowing firms to survive and compete in turbulent markets (Khajeheian, 2016a,b). Innovation also emanates from knowledge and creativity expected to be fostered in universities. The change in the universities' role from a knowledge producer to an entity that commercializes knowledge, has led to an increase in innovative activities in the past two decades. But despite the importance of innovation; little attention has been paid to the successful commercialization of university research in developing countries especially in Iran (Zarea and Salamzadeh, 2012; Guerrero, Urbano, and Salamzadeh, 2014, 2015). With the importance of commercializing research that emanates from universities, and the fact that the selection of a commercialization strategy is the heart of developing innovations, commercialization determines the path through which organizations gains revenue and profit for the products and innovation (Servo, 1998). Therefore, paying attention to the mode of selecting a strategy with its correct mechanism is important for strategic planning in universities.

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Thus, this study provides a comprehensive evaluation of commercialization strategies. The aim is to provide a correct answer to the question, 'what is the appropriate strategy for the commercialization of academic studies in universities and higher educational institutions in Iran?'

RESEARCH BACKGROUND

Universities are increasingly becoming entrepreneurs in most developed countries (Moray and Clarysse, 2004; Siegel, 2006). They are considered as the source and origin of the development of technologies which can be useful for various economic activities (Mowery et al., 2001; Rosenberg and Nelson, 1994). Some researchers believe that universities have a new role in the commercialization of researches' results. And as the significance of a knowledge-based innovation in the development of industrial organizations increases every day, universities can play greater role in the development of societal innovations (Rasmussen, Moen and Gulbrandsen, 2006).

Universities become involved in technology transfer activities for various reasons. The reasons include, recruitment and retention of university professors, the development of a stronger relation between the industry and the university, strengthening the credibility of the university and, for economic, social benefits or regional economics (SBIR Program Reauthorization Act available at http://sbir.gov/about/about-sbir). Overall, the increase in commercialization has led towards the opening of a new gateway to the privatization of scientific joint-cooperation and scientific advances (Chang, Yang and Chen, 2009).

Many researchers have attempted to define the concept of commercialization. For instance, Urabe (1988) defined it as the creation of new idea and its implementation as a product, service, or a new process which leads to the dynamic growth of the national economy thereby increasing the employment rates and net profit of innovative companies. Chang et al., (2009) presents a practical definition for the commercialization of university research. The define commercialization as faculty members who seek to exploit their research results by receiving patent rights, licensing and participating in the ownership of spin-off companies. Also, Siegel et al., (2003a) and Bandarian (2007) defined commercialization as the conversion or transmission of technology towards a profitable field. The commercialization of academic research and technology transfer are synonymous in many research contexts (RAND Corporation, 2003; *Association of University Technology* Managers (AUTM), 2010; Chang et al., 2009). In general, technology transfer implies transferring ideas, methods or research results in an environment which results in a product, service or process in any way (RAND Corporation, 2003). Technology transfer is the official transfer of new discoveries and innovations resulting from scientific research that are carried out by non-profit research institutes and universities with the commercial sectors for public benefits (*AUTM*, 2003). Technology transfer from university to industry is the result of interaction between different actors and organizations such as executives of university, university researchers, research groups, public or private companies, technology transfer offices, venture investors and other financial actors

and different actors in the private sector (Goktepe, 2008). Finally, Kasch and Dowling (2008) mention that technology transfer is a comprehensive term which covers the mechanisms of information transfer to the outside borders and its effective transmission to the acceptor. Commercialization strategy also refers to a series of operations faced by an organization for transferring its product or technology to the market (Servo, 1998; Gans and Stern, 2003).

Technology takeover process and its distribution is an important factor that accelerates growth through productivity factor and the accumulation of capital and promotion of economic and social development in developing economies (Shapira and Wang, 2009; Siegel and Wright, 2015). This process is influenced by numerous external factors. The notable economic factors are the governmental policies and laws, such as Bayh–Dole Actin America (Friedman and Silberman, 2003). Incentive systems, university status, location, culture, intermediary institutions, focus, experience and defined identity, the role of the Scientific Board and nature of the technology which will be commercialized are also internal factors of commercialization (Rothaermel, Agung, and Jiang, 2006).

Universities have shown a strong desire to commercialize knowledge under economic pressure.There is the tendency for universities to become independent by building up their local budgets thus, commercialization has become a new gateway for the privatization of scientific progress (MIT, 2015 Castrogiovanni et al., 2016). The creation and transmission of knowledge by universities have been intensified under economic pressure and tighter public budgets (Brachos et al., 2007; Guzak and Rasheed, 2014). However, evidences show that universities are faced with problems in commercializing successful. One of the main challenges comes from the improper selection of a commercialization strategy. Therefore, the Grant framework was used in this study in the form of mixed exploratory study to identify and develop competitive strategies forcommercialization. Thus, information was collected via a qualitative case study and a quantitative descriptive-survey method (Kasch and Dowling, 2008).

Commercialization typically follows one of three primary strategic paths: (1) sale or licensing of Intellectual Property, (2) external development focused on acquisition, (3) internal development of a startup aimed at an initial public offering (IPO), or a mix of these strategies (Knockaert, Vandenbroucke and Huyghe, 2012; Siegel and Wright, 2015; Gittelman 2006). If the inventor does not want to be involved in the commercialization process, he/she can sell the rights to the innovation to another company (Siegel and Wright, 2015). The inventor may choose to offer the company technical assistance in exchange for a set cost, royalties, or other forms of agreement. Intellectual Property can also be licensed if the inventor wants to maintain ownership of the patent(s) but does not have the commitment or time to be involved in the company (Knockaert, Vandenbroucke and Huyghe, 2012). Although the terms of a licensing agreement vary for each technology, firm, and environment, the defining feature of this arrangement is that both parties remain independent while cooperating in commercialization of the technology (Gans and Stern, 2003).

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Standard license agreements include negotiated financial terms such as annual fees, a royalty on product sales, reimbursement of patent costs, and possibly a minority share of equity in the startup (MIT, 2015). Additionally, license agreements include nonfinancial terms such as the degree of exclusivity (e.g., nonexclusive, exclusive, or restricted by field of use), reservations of the rights for the federal government, and performance (diligence) requirements for having the capability to develop the technology (Rutherford and Holt, 2007; González-Pernía, Kuechle, and Peña-Legazkue, 2013). Another strategy of commercialization is by developing the startup externally with the goal of eventually being acquired by another company (Pettersson and Götsén, 2016; Yetisen et al., 2015). In this strategy, the innovator relinquishes the independent operation of the startup and gives the rights to commercialization and control of the technology to a third party (Brooks, Heffner and Henderson, 2014; Yetisen et al., 2015). In internal development, the innovator must be prepared to commit up to 90% of his/her available assets. The innovator must be able to sustain the development effort through the life cycle of the business with financial returns potentially only being realized after over 5 or more years (Yetisen et al., 2015). However, most startups do not have the available funding to bring the product to the inflection point, where adding a small amount of time and resources results in a significant improvement in performance (Barnes, Pashby, and Gibbons, 2002; Yetisen et al., 2015). Contractual relationships often develop at this stage. i Joint ventures and strategic alliances, and outsourcing may be used to gain access to additional assets (Yetisen et al., 2015). The commercialization strategy of a company is affected primarily by the company's vision, business philosophy, the stage of technological development, market risk, competitive activities and window of opportunity (Plewa, 2005). Ultimately, the optimal commercialization strategy depends on the innovator's background and willingness to invest time and resources to have an independent company and the desire to maximize the commercial availability of the innovation (NIST, 1999).

The main obstacles identified by researchers in the case of research commercialization are disagreements between academics who possess knowledge commercial transmission (Etzkowitz and Leydesdorff, 2000), bureaucracy , lack of flexibility of university management system (Samsom and Gurdon, 1993), lack of freedom of professors to participate in business activities (Plewa, 2005), cultural difference between industrial activists and academic life (Ndonzuau, Pirnay, and Surlemont., 2002), the lack of motivation for the university to commercialize (Debackere and Veugelers, 2005) weak laws protecting intellectual property, university dependence on governmental budgets, lack of identification of the needs and priorities of the business sector by university, different resources for industry activists and academics, lack of financial support for researchers by the university to exploit the knowledge generated by them, insufficient resources dedicated by university to technology transfer, insufficient share for professors (researchers) from the commercialization effort (Ndonzuau et al., 2002; Samsom and Gurdon, 1993).

STRATEGIES FOR COMMERCIALIZATION OF UNIVERSITY RESEARCHES

The background of research related to the commercialization of researches has expanded with the increase in patenting, licensing, corporate venturing, joint venturing business and strategic alliances (Walter, Lechner and Kellermanns, 2008). In the book entitled "Technology Transfer of Federally Funded R & D", Rand Corporation (2003) introduced seven main strategies of technology transfer. These includes licensing, cooperative activities, technical assistance, reimbursable work for nonfederal partner, exchange program, collegial interchange, publications and conferences and use of facilities. Link, Siegel and Bozeman (2007) divided transfer strategies into licensing agreements, joint research ventures, startups and academic companies in other classification. Universities are satisfied from this process because the official transfer of technology can create more revenue and relationships with external stakeholders as well as promote regional economic growth and development (Kelley et al., 2005). Several different strategies can be used to transfer research from universities to industry. These include licensing of university inventions, creation of university spin off companies, contracting with industry to conduct research, counseling university professors to industry and publishing scientific research results in scientific journals, exchange programs, joint cooperation in research and development, joint development agreements, research parks, science parks, technology parks or incubators (Rogers, Takegami and Yin, 2001). Goktepe (2008) also divided commercialization strategies into two categories. These includes general and special strategies. Special strategies include patenting and giving their license to the companies and the formation of university spin off companies. The general strategies include, attending conferences, seminars and workshops, joint supervision of graduate students and doctoral theses, employment of university graduates in the industrial sector, consultation of university professors in industry sector, working of university professors in the industrial sector, joint research laboratory with industry sector, agreements of joint research and development projects, development of joint technology by formal agreements of cooperation with industry sector and mobility of university professors between industry and university.

Universities have other strategies for commercial transmission of knowledge in addition to commercialize-able knowledge production and qualified scientists, such as attracting talented people to the local economy and cooperation with local industries through the provision of formal and informal technical supports (Bramwell and Wolf, 2008). Rogers et al., (2001) consider five different strategies of technology transfer from universities. This includes the creation of spin-off companies, licensing, meetings, papers and other publications as well as joint agreements on research and development. Also, having shares in a company, in return for providing the rights to use the intellectual property of universities, is an emerging strategy and is a good option for many universities. Goldfarb and Henrekson (2003) focuses on two groups of strategies. The first group includes three mechanisms which are generally used in a project with commercial value. They are: sponsored research, consulting (including group activities) and starting a new firm. The second group includes three

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possible mechanisms for compensation of inventor's services which are salaries, royalties and equity. Reamer, Icerman and Youtie (2003) explained five paths of collaborative research and development, licensing or sale of intellectual property, academic companies, technical advice, information exchange and hiring skilled personnel for knowledge transmission in complex environments. Nilsson, Rickne and Bengtsson (2009) classified the knowledge transfer strategies into eight categories of publications and conferences, patents, licenses, academic company, research with funding, informal or pre-formal discussions, common personnel and exchange of employees.

Increasing focus on the commercialization of university research has led to the development of efforts which promote research transfer activities. Some measures are formal while others are informal (Franklin, Wright and Lockett, 2001). Specifically, commercialization strategies of research can be divided into formal and informal mechanisms. The official commercialization strategies are licensing, university patents, the formation of new companies or university spin off companies. The informal strategies incudes consulting for industry players by university professors (Siegel et al., 2004). An informal mechanism for technology transfer involves creating facilitating tool for the flow of knowledge. But this is carried out through informal communication processes, such as technical assistance, consultation and cooperation on research (Link, Siegel and Bozeman, 2007) Cohen, Nelson and Walsh (2000) divided the informal mechanisms of commercialization into three categories. These includes the contribution to the transfer or commercialization of technology, participation in joint papers and consultation. Bercovitz and Feldmann (2006) categorized and presented formal and informal mechanisms of interaction of academic technology transfer in the form of Table (1).

Table 1: Formal and informal mechanisms for commercialization of academic research.

Mechanism	Definition
Research with funding	A contract in which the university receives funding for research.
The copyright	Legal rights to use the intellectual property of university.
Employment of students	Employing university students, especially those who work in sponsored projects.
Spin-off companies	The new concept which is based on academic research or university license.
Chance	Fortune

Source: Bercovitz and Feldmann, 2006.

Studies regarding the density, clustering and boundary spanning imply that joint venture businesses, alliances and distribution companies are useful strategies for technology transfer between companies and non-profit organizations (Siegel, Waldman and Link, 2003b) and licensing agreements between universities and private companies are the most important channel for the commercialization of the university's intellectual property (Kelly, 2004). However, the creation of new venture businesses founded by university researchers have been beneficial via technology transfer in the last two decades (Bercovitz et al., 2001; Shane, 2002; Siegel, Veugelers, and Wright, 2007). Intellectual property licensing and spin-off companies have been considered as key contributions in the creation of new technology-based companies (Feldman, Link, and Siegel, 2002).

RESEARCH METHOD

The analytical structure of our study is illustrated in Figure 1. We have reviewed some factors in literature and used fuzzy set theory to evaluate them. We collected a total number of 32 internal and external factors from previously-conducted researches (Figure 3). For collecting the data, we used fuzzy questionnaire that has 36 key internal and external factors extracted from literature. Questionnaire was created and distributed among relevant experts to elicit their opinions and suggestions about factors. EXPERTCHOICE software was used to analyze data from questionnaire. Due to the limitation in time and distance with respect to conducting interviews, and our main idea being the unification of the FAHP with SWOT, the approach was now to systematically extract strategies from the Internal-Eternal matrix and rank strategies commensurable to their weightiness. To create a SWOT-FAHP based strategic management model, we designed the following four-phase model: the building of the initial model; the confirmation of factors, the running of a ranking model through FAHP and extract strategies.

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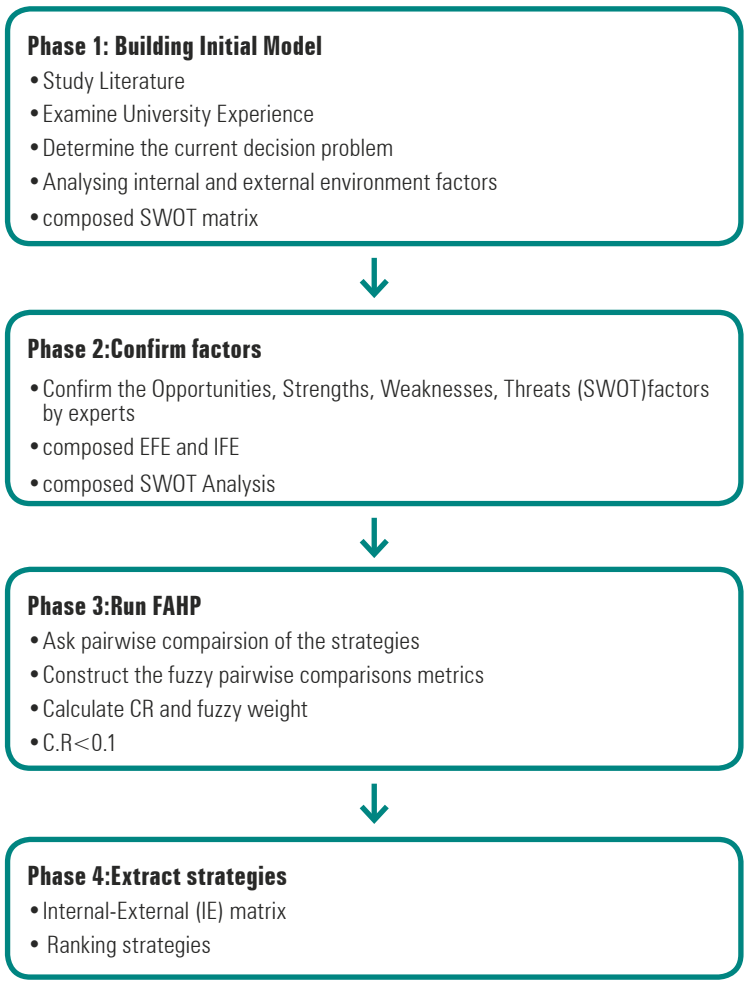
Figure 1: The phase of proposed methodologies.



FAHP Approach: Boutkhoum et al., (2015) noted that: "The Analytic hierarchy Process (AHP), initially introduced by Saaty (1980), has becomes a powerful and flexible methodology in solving problems that require complex decisions. However, the AHP method has some shortcomings due to its ineffectiveness when applied to an ambiguous problem with a high uncertainty. Therefore, several researchers, introduced fuzzy logic into the pairwise comparison of the AHP to compensate and deal with this type of fuzzy decision making technique. Hence, in this paper we prefer to utilize Buckley's methods to evaluate the weight of importance in each selected criterion. The theoretical fundamentals of Buckley's methods on FAHP were defined as follows (Ayhan, 2015):

Step 1: Experts compares the criteria via linguistic terms shown in Table 2. According to the corresponding triangular fuzzy numbers of these linguistic terms.

Table 2. Linguistic terms and the corresponding triangular fuzzy numbers.

Saaty scale	Definition	Fuzzy triangular S
1	Equally important (Eq. Imp.)	(1, 1, 1)
3	Weakly important (W. Imp.)	(2, 3, 4)
5	Fairly important (F. Imp.)	(4, 5, 6)
7	Strongly important (S. Imp.)	(6, 7, 8)
9	Absolutely important (A. Imp.)	(9, 9, 9)
2	The intermittent values between two adjacent scales	(1, 2, 3)
4		(3, 4, 5)
6		(5, 6, 7)
8		(7, 8, 9)

The pairwise contribution matrix is shown in Eq.1, where $\widetilde{d}_{ij}^{k}$ indicates the kth expert's preference of i[th] criterion over j[th] criterion, via fuzzy triangular numbers.

$$\widetilde{A}^{k} = \begin{bmatrix} \widetilde{d}_{11}^{k} & \widetilde{d}_{12}^{k} & \cdots & \widetilde{d}_{1n}^{k} \\ \widetilde{d}_{21}^{k} & \cdots & \cdots & \widetilde{d}_{2n}^{k} \\ \cdots & \cdots & \cdots & \cdots \\ \widetilde{d}_{11}^{k} & \widetilde{d}_{12}^{k} & \cdots & \widetilde{d}_{nn}^{k} \end{bmatrix} \qquad \text{Equation (1)}$$

Step 2: If there is more than one expert, preferences of each decision maker ($\widetilde{d}_{ij}^{k}$) are averaged and ($\widetilde{d}_{ij}$) are calculated as in the Eq. 2.

$$\widetilde{d}_{ij} = \frac{\sum_{k=1}^{k} \widetilde{d}_{ij}^{k}}{K} \qquad \text{Equation (2)}$$

Step 3: According to averaged preferences, pairwise contribution matrices is updated as shown in
Eq. 3.

$$\widetilde{A} = \begin{bmatrix} \widetilde{d_{11}} & \cdots & \widetilde{d_{1n}} \\ \vdots & \ddots & \vdots \\ \widetilde{d_{n1}} & \cdots & \widetilde{d_{nn}} \end{bmatrix} \qquad \text{Equation (3)}$$

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Step 4: According to Buckley, the geometric mean of fuzzy comparison values of each Criterion is calculated as shown in Eq. 4. Here, $\tilde{r}_i$ still represents triangular values.

$$\tilde{r}_i = \left(\prod_{j=1}^{n} \tilde{d}_{ij} \right)^{1/n}, \; i=1, 2,...,n \qquad \text{Equation (4)}$$

Step 5: The fuzzy weights of each criterion can be found with Eq. 5, by incorporating next 3 sub steps.
Step 5a: Find the vector summation of each $\tilde{r}_i$
5b: Find the (-1) power of summation vector. Replace the fuzzy triangular number, to make it in an increasing order.
Step 5c: To find the fuzzy weight of criterion i ($\tilde{w}_i$), multiply each $\tilde{r}_i$ with this reverse vector

$$\tilde{w}_i = \tilde{r}_i \otimes (\tilde{r}_1 \oplus \tilde{r}_2 \oplus \cdots \oplus \tilde{r}_n)^{-1} = (lw_i, mw_i, uw_i) \qquad \text{Equation (5)}$$

Step 6: Since $\tilde{w}_i$ are still fuzzy triangular numbers, they need to de-fuzzified by Centre of area method proposed by Chou and Chang (2008) , via applying the equation 6.

$$M_i = \frac{lw_i, mw_i, uw_i}{3} \qquad \text{Equation (6)}$$

Step 7: M_i is a non-fuzzy number. But it needs to be normalized by following Eq. 7.

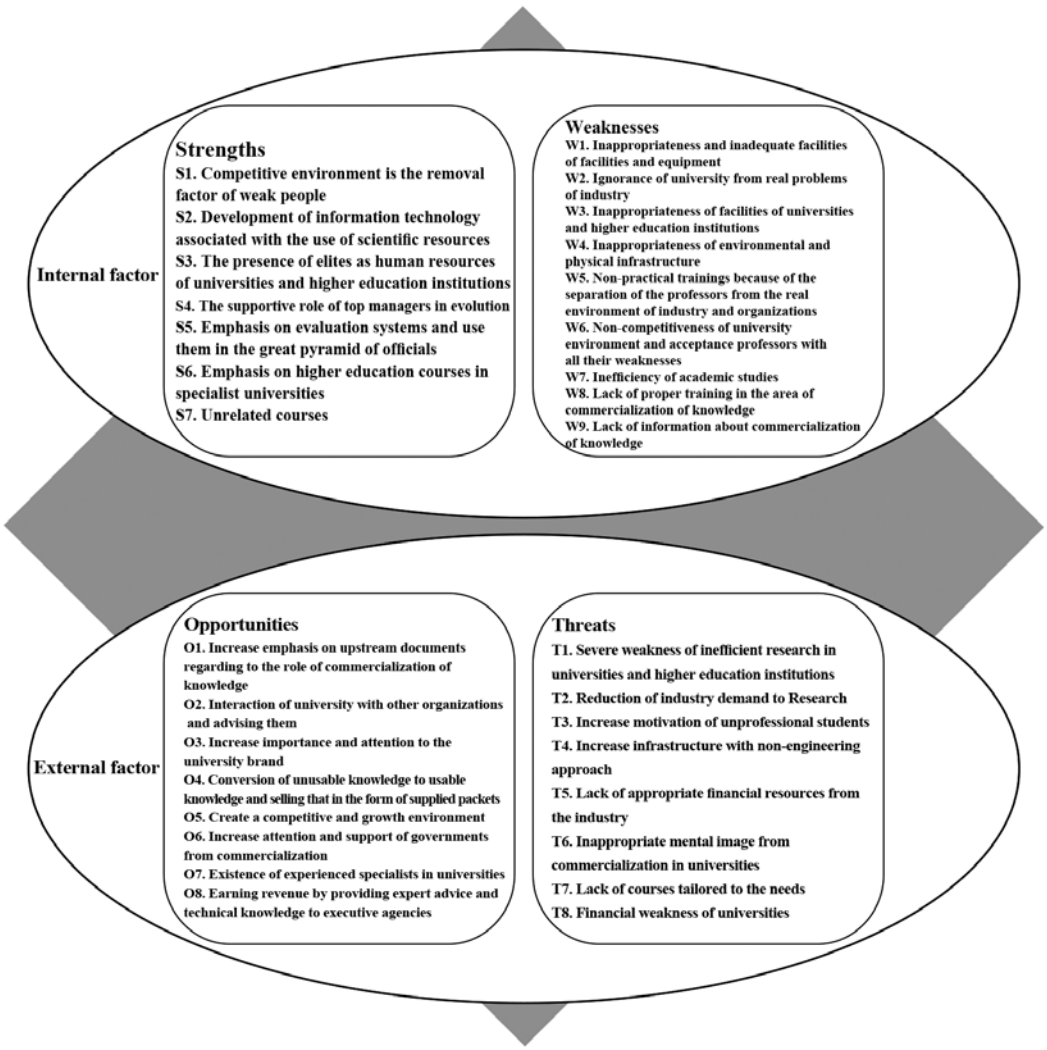
$$N_i = \frac{M_i}{\sum_{i=1}^{n} M_i} \qquad \text{Equation (7)}$$

These 7 steps are performed to find the normalized weights of factors. According to these results, the strategies with the highest score is suggested to the experts.

FINDINGS:

Based on the literature review and interview with academic experts, we developed the internal and external environment factors as shown in Figure 2.

Figure 2. Confirmed internal factors (Strengths, Weaknesses) and Confirmed external factors (Opportunities, Threats).



Source: Authors.

After that, SWOT analysis is carried out and matrix is structured (Table 10). The SWOT framework is a tool for auditing an organization and its environment. The concept of determining strengths, weaknesses, threats, and opportunities in Fig. 3 is the fundamental idea behind the SWOT Analysis Matrix. In Table 3 is an assessment of the appropriate strategies for the commercialization of knowledge in universities. They are separated into four categories according to experts which are: Strengths-

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Opportunities (SO) strategies that use strength to take advantages of opportunities, Threats-Strengths (ST) strategies that use strength to avoid threats, Opportunities-Weaknesses (WO) strategies that overcome weakness by taking advantage of opportunities and Threats- Weaknesses (WT) strategies that minimize weakness and avoid threats.

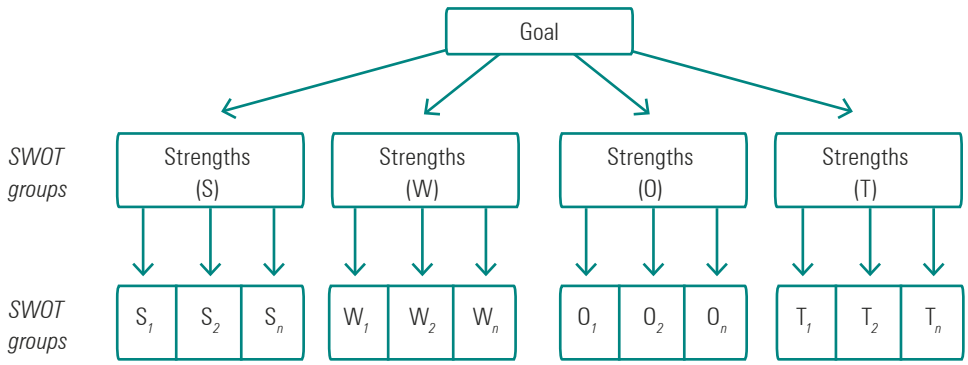
Table 3. Matrix of commercialization strategies of knowledge in universities.

	Strengths (S1, S2, S3, S4, S5, S6, S7)	Weaknesses (W1, W2, W3, W4, W5, W6, W7, W8, W9)
Opportunities (O1, O2, O3, O4, O5, O6, O7, O8)	SO strategies SO1: corporate venture business SO2: contracting with industry to conduct research SO3: academic start-ups SO4: strategic alliances SO5: chance SO6: recruiting skilled personnel for knowledge transfer in complex environments SO7: joint technology development by formal co-operation agreements with the industry sector SO8: joint research laboratories with industry sector	WO strategies WO1: counseling of university professors to industry sector WO2: use of facilities WO3: conducting conference WO4: publishing research results in scientific journals WO5: non-official or pre-official discussions WO6: shareholding hold shares in a company WO7: research joint meetings with industry and organizations WO8: reading and attracting talented people to the local economy and cooperation with local industries through the provision of formal and technical supports WO9: joint supervision of graduate students' dissertations and doctoral theses
Threats (T1, T2, T3, T4, T5, T6, T7, T8)	ST strategies ST1: research parks, science parks, incubators and technology parks ST2: Licensing ST3: patents ST4: Royalty ST5: employment of students ST6: advice to industrial enterprises by university professors ST7: Agreements to conduct R&D projects	WT strategies WT1: joint research and development agreements WT2: Partnership for transfer or commercialization of technology, participation in joint papers and consultation WT3: university interactions WT4: exchange programs WT5: extradition matters for government WT6: Technical Cooperation WT7: Interaction between university and industry WT8: The exchange of personnel and joint staff WT9: Research with sponsorship WT10: Mobility of professors between industry and university

Source: Authors.

Based on the SWOT analysis, the hierarchical structure of the SWOT matrix to develop best strategies for commercialization can be represented as found below: Figure 3.

Figure 3. Hierarchical structure of the SWOT matrix.



In the following stage, the weights of each criteria and sub-criteria are calculated using fuzzy-AHP. According to their preferences, the averaged pairwise comparison of the criteria is represented in Table 4. Due to the limitation of space and the similarity of the other calculations for each comparison matrix, we only provide the evaluation matrices of strengths factors as mentioned in Tables 4 to 7.

Table 4. Comparison matrices for criteria.

Strengths Criteria	S1	S2	S3	S4	S5	S6	S7
S1	(1,1,1)	(3,4,4.5)	(0.222,0.25,0.333)	(3,3.5,4)	(1,2,2)	(0.036,0.038,0.04)	(0.084,0.111,0.117)
S2	(0.222,0.25,0.333)	(1,1,1)	(0.167,0.182,0.2)	(1,2,2)	(1,2,2)	(0.203,0.269,0.456)	(0. 194,0. 356,0. 768
S3	(3,4,4.5)	(5,5.5,6)	(1,1,1)	(5,5.5,6)	(3,4,4.5)	(0.203,0.269,0.282)	(0. 235,0. 353,0. 765)
S4	(0.25,0.286,0.333)	(0.5,0.5,1)	(0.167,0.182,0.2)	(1,1,1)	(3,3.5,4)	(0.036,0.038,0.04)	(0.084,0.111,0.117)
S5	(0.5,0.5,1)	(0.5,0.5,1)	(0.222,0.25,0.333)	(0.25,0.286,0.333)	(1,1,1)	(0. 834,2. 532,3. 176)	(0. 345,0. 765,0. 547)
S6	(0.122,0.131,0.149)	(0.064,0.067,0.093)	(0.056,0.061,0.068)	(0.122,0.131,0.149)	(0.064,0.067,0.093)	(1,1,1)	(0. 325,0. 657,0. 432)
S7	(0.111,0.143,0.2)	(0.111,0.143,0.2)	(0. 346,0. 766,0. 467)	(0.278,0.322,0.35)	(0.203,0.269,0.282)	(0.268,0.311,0.338)	(1,1,1)

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Based on step 4, the geometric means of fuzzy comparison values of all criteria are shown in Table 5. In addition, the total values and the reverse values are also presented. In the last row of Table 5, since the fuzzy triangular number should be in increasing order, the order of the numbers is changed.

Table 5. Geometric means of fuzzy comparison values.

Strengths Criteria	Geometric means ($\widetilde{r}_i$)
S1	(2.51, 2.71, 3.30)
S2	(2.65, 3.10,3.29)
S3	(0.41, 0.54, 0.78)
S4	(0.36, 0.402, 0.439)
S5	(2.552, 2.959, 3.198)
S6	(0.42, 0.54, 0.45)
S7	(1. 42, 1. 24, 2.59)
Total	(10.332, 11.491, 14.47)
Reverse (power of -1)	(0.096, 0.087, 0.069)
Increasing Order	(0.069,0.087, 0.096)

In the fifth step, the fuzzy weight of each criteria ($\widetilde{w}_i$) is found with the help of Eq. 5. Hence the relative fuzzy weights of each criterion are given in Table 6;

Table 6. Relative fuzzy weights of each criterion.

Strengths Criteria	Fuzzy weight ($\widetilde{w}_i$)
S1	(0.178, 0.237,0.316)
S2	(0.188, 0.269, 0.315)
S3	(0.029, 0.046, 0.074)
S4	(0.025, 0.034, 0.042)
S5	(0.181, 0.257, 0.307)
S6	(0.029, 0.046, 0.043)
S7	(0.100, 0.107, 0.24)

In the sixth step, the relative non-fuzzy weight of each criterion (Mi) is calculated by taking the average of fuzzy numbers for each criterion. In the seventh step, by using non fuzzy Mi's, the normalized weights of each criterion are calculated and tabulated in Table 7.

Table 7. Averaged and normalized relative weights of strengths criteria.

Strengths criteria	M_i	N_i
S1	0.243	0.237
S2	0.257	0.251
S3	0.050	0.048
S4	0.034	0.033
S5	0.248	0.242
S6	0.04	0.038
S7	0.152	0.148

In table 8 to 10, we presented averaged and normalized relative weights of Threats, Weaknesses, and Opportunities criteria as well as SWOT groups.

Table 8. Averaged and normalized relative weights of Weaknesses criteria.

Weaknesses criteria	M_i	N_i
W1	0.353	0.247
W2	0.32	0.224
W3	0.243	0.170
W4	0.124	0.086
W5	0.148	0.103
W6	0.044	0.030
W7	0.052	0.036
W8	0.067	0.046
W9	0.075	0.052

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Table 9. Averaged and normalized relative weights of Opportunities criteria.

Opportunities criteria	M_i	N_i
O1	0.143	0.126
O2	0.032	0.028
O3	0.073	0.064
O4	0.004	0.003
O5	0.158	0.140
O6	0.139	0.123
O7	0.282	0.250
O8	0.297	0.263

Table 10. Averaged and normalized relative weights of Threats criteria.

Threats criteria	M_i	N_i
T1	0.166	0.107
T2	0.288	0.187
T3	0.265	0.172
T4	0.314	0.204
T5	0.123	0.079
T6	0.039	0.025
T7	0.182	0.118
T8	0.161	0.104

Finally, the overall priority scores of the SWOT factors are calculated. Overall priorities are shown in Table 11. The FAHP analysis results indicate that earned revenue from providing expert advice and technical knowledge to executive agencies and existence of experienced specialists in universities are the most important issues when considering the commercialization of a universities internal and external environment.

Table 11. Overall Priority Scores of SWOT Factors.

SWOT Group	Group Priority	SWOT Factors	Factor Priority within the Group	Overall Priority of Factor
Strengths	0.355	S1	0.237	0.084
		S2	0.251	0.089
		S3	0.048	0.017
		S4	0.033	0.011
		S5	0.242	0.085
		S6	0.038	0.013
		S7	0.148	0.052
Weaknesses	0.142	W1	0.247	0.035
		W2	0.224	0.031
		W3	0.170	0.024
		W4	0.086	0.012
		W5	0.103	0.014
		W6	0.030	0.004
		W7	0.036	0.005
		W8	0.046	0.006
		W9	0.052	0.007
Opportunities	0.349	O1	0.126	0.044
		O2	0.028	0.009
		O3	0.064	0.022
		O4	0.003	0.001
		O5	0.140	0.048
		O6	0.123	0.043
		O7	0.250	0.087
		O8	0.263	0.091
Threats	0.154	T1	0.107	0.016
		T2	0.187	0.028
		T3	0.172	0.026
		T4	0.204	0.031
		T5	0.079	0.012
		T6	0.025	0.003
		T7	0.118	0.018
		T8	0.104	0.016

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IE matrix: The IE matrix belongs to the group of strategic portfolio management tools; the IE matrix positions an organization into a nine-cell matrix. The IE matrix is based on two criteria: the score from the EFE matrix – this score is plotted on the y-axis and the Score from the IFE matrix – plotted on the x-axis. In the following, we composed EFE and IFE matrix to define and analyze IE matrix.

EFE and IFE Matrix: These matrix is composed of four columns. First column is a list of Internal or External factors that include strengths and weaknesses in IFE matrix or opportunities and threats in EFE matrix. The second column is an assigned normalized fuzzy weights that is calculated in table 11 (normalized overall Priority of factor) and the total value of all weights together should be equal to 1. The third column are the Rate factors that assigns a rating to each factor. The rating should be between 1 and 4. The rating indicates how effective the commercialization of the university's current strategies responds to the factor. 1 = the response is poor. 2 = the response is below average. 3 = above average. 4 = superior. The weights are industry-specific. The ratings are university-specific. And the fourth column calculates the weighted score for each factor. In last row, you sum up all the weighted scores and add all the weighted scores for each factor. This will calculate the total weighted score for the universities. The IE matrix works in a way that it plots the total weighted score from the EFE matrix on the y-axis and draw a horizontal line across the plane. Then the plot take the score calculated in the IFE matrix, plots it on the x-axis, and then draw a vertical line across the plane. The point where your horizontal line meets your vertical line is the determinant of your strategy. This point shows the strategy that a university should follow. On the x-axis of the IE Matrix, an IFE total weighted score of 1.0 to 1.99 represents a weak internal position. A score of 2.0 to 2.99 is considered average. A score of 3.0 to 4.0 is strong. On the y-axis, an EFE total weighted score of 1.0 to 1.99 is considered low. A score of 2.0 to 2.99 is medium. A score of 3.0 to 4.0 is high.

Table 12. Internal Factors Evaluation matrix (IFE), commercialization of knowledge in universities.

Internal factors Evaluation (IFE): strengths (S) and Weaknesses (W)	Fuzzy weight (normalized overall Priority of factor)	Rank	Weighted score
S1	0.171	3	0.515
S2	0.182	3	0.546
S3	0.034	4	0.139
S4	0.022	4	0.089
S5	0.173	4	0.695
S6	0.026	2	0.053
S7	0.106	2	0.212
W1	0.071	4	0.286
W2	0.063	4	0.253
W3	0.049	4	0.196
W4	0.024	3	0.073
W5	0.028	3	0.085
W6	0.008	2	0.016
W7	0.010	2	0.020
W8	0.012	2	0.024
W9	0.014	2	0.028
Total all weighted scores	1		3.237

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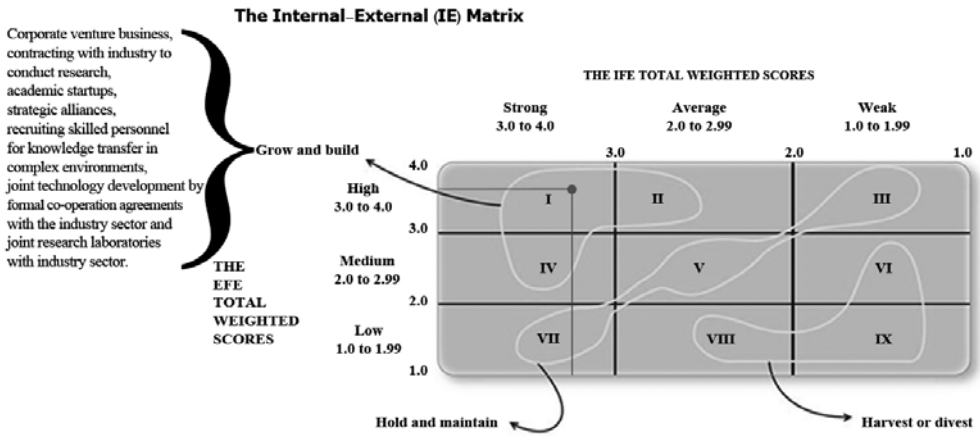
Table 13. External factors Evaluation matrix (EFE), commercialization of knowledge in universities.

External factors Evaluation (EFE): Opportunities (O) and threats (T)	Fuzzy weight (normalized overall Priority of factor)	Rating	Weighted score
O1	0.088	4	0.352
O2	0.018	3	0.054
O3	0.044	3	0.132
O4	0.002	1	0.002
O5	0.096	3	0.288
O6	0.086	3	0.258
O7	0.175	4	0.7
O8	0.183	4	0.732
T1	0.032	3	0.096
T2	0.056	4	0.224
T3	0.052	4	0.208
T4	0.062	4	0.248
T5	0.024	3	0.072
T6	0.006	2	0.012
T7	0.036	3	0.108
T8	0.032	3	0.096
Total all weighted scores	1		3.582

The IE matrix works in a way that you plot the total weighted score from the EFE matrix on the y-axis and draw a horizontal line across the plane. Then you take the score calculated in the IFE matrix, plot it on the x-axis, and draw a vertical line across the plane. The point where your horizontal line meets your vertical line is the determinant of your strategy. This point shows the strategy that your company should follow. On the x-axis of the IE Matrix, an IFE total weighted score of 1.0 to 1.99 represents a weak internal position. A score of 2.0 to 2.99 is considered average. A score of 3.0 to 4.0 is strong. On the y-axis, an EFE total weighted score of 1.0 to 1.99 is considered low. A score of 2.0 to 2.99 is medium. A score of 3.0 to 4.0 is high. We calculated IFE matrix for commercialization in a university. The total weighted score calculated is 3.237 which indicates a university with a strong internal strength. We also calculated the EFE matrix for the university. The total weighted score calculated for the EFE matrix is 3.582 which suggests a strong ability to respond to external factors. Those plots can be represented as following Figure 4:

Figure 4. Internal-External Matrix.



This IE matrix tells us that a university should grow and build its position. This means intensive and aggressive tactical strategies. The University should pursue strategies that will enable market penetration, market development, and product development. From the operational perspective, a backward integration, forward integration, and horizontal integration should be considered. Below strategies that synchronize are corporate ventures, contracting with industry to conduct research, academic startups, strategic alliances, recruiting skilled personnel for knowledge transfer in complex environments, joint technology development by formal co-operation agreements with the industry and joint research laboratories with industry sector.

CONCLUSION

According to Table 3, SO, ST, WO and WT, strategies that minimize weakness and avoid threats strategies were extracted based on the competitive advantage and capabilities of commercialization of academic research. According to this table, academic firms and joint laboratory are examples of the SO strategies. The emphasis on chance as a strategy means that when there are many opportunities and strengths, all chances are seen as a potential strategy. This is because the institution or university can achieve the opportunity based on the competitive advantages. Academic institutions have positioned themselves to serve the industry through consulting, licensing, and university spin-offs. The awareness of commercialization strategies can help academics to efficiently transfer their inventions to the market to achieve the maximum value. Universities are incentivized by the maximization of impact of the research results. Firms that use this knowledge, on the other hand, are typically driven by maximization of profit and commercial measures (Landry, Amara and Ouimet, 2007). Technology entrepreneurs must formulate and implement a commercialization strategy that determines the ultimate performance of the

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business. Optimization of commercialization strategies can enable the inventors and academic institutions to extract the maximum value from inventions and know-how (Yetisen et al., 2015). Emphasis on appropriate speed with conditions and environment to promote commercialization are suitable at the time of using this strategy. Diversification strategy refers to expanded commercialization activities. That is why the tendency is to engage university in the development of their activities. Some of the strategies related to this field include the creation of research parks, growth centers and technology transfer centers.

According to IE Matrix, a university should pursue strategies focused on corporate venture, contracting with industry to conduct research, academic start-ups, strategic alliances, recruiting skilled personnel for knowledge transfer in complex environments, joint technology development by formal co-operation agreements with the industry sector and joint research laboratories with industry sector. The literature review shows that various researchers expressed different strategies for commercialization of knowledge in university. Of course, some researchers have expressed shared items. These strategies changed based on sources, competitive advantages and capabilities of university. The performance of each strategy will be different in different environments. The coercion of labor did not only lead to reduced productivity, and competitiveness; but also its moral and political implications have economic consequences, which are exercised via market forces (Velez-Ocampo; Herrera-Cano, and Gonzalez-Perez, 2016). Scholars agree on the importance of organizations having employees that are adept team players with experience in accomplishing effective virtual projects that require online interaction, managing the dislocation of geographic- and time-based boundaries (Gonzalez-Perez et al., 2014). It is suggested that they pay more attention to the resources, competitive advantages and capabilities of the organization when choosing university strategies and strategies by higher education institutions with the aim of commercializing academic research. This is because choosing a commercialization strategy for research within a university research includes partnerships with industry players in the development of products and services. It also involves providing advisory services, meetings with industry personnel, the creation of an economy based on the university's technology transfer and joint research. These are simple to implement but have mission complexities in different organizations. And selection of all of these strategies will not express the speed, accuracy or tendency towards commercialization.

REFERENCES

Arora, A., and Fosfuri, A. (2003). Licensing in the Presence of Competing Technologies. *Journal of Economic Behavior and Organization*, 52, 277–95.

Association of University Technology Managers (AUTM). (2003). AUTM Licensing Survey FY 2001., *Association of University Technology Managers*.

Association of University Technology Managers (AUTM). (2010). Licensing Activity Survey FY2008. *Association of University Technology Managers*.

Ayhan, M.B.(2015). A Fuzzy Ahp Approach For Supplier Selection Problem: A Case Study In A Gearmotor Company. *International Journal of Managing Value and Supply Chains (IJMVSC), 4*(3). 11-23.

Bandarian, R. (2007). From Idea to Market in RIPI; An agile Frame for NTD Process. *Journal of Technology Management and Innovation, 2*(1), JOTMI Research Group.

Bercovitz, J., and Feldmann, M. (2006). Entrepreneurial universities and technology transfer: a conceptual framework for understanding knowledge-based economic development. *The Journal of Technology Transfer,* 31, 175–188.

Bramwell, A., and Wolf, D. A., (2008). Universities and regional economic development: The entrepreneurial University of Waterloo. *Research Policy,* 37, 1175–1187.

Barnes, T., Pashby, I., and Gibbons, A. (2002). Effective University–Industry Interaction: A Multi-case Evaluation of Collaborative R&D Projects. *European Management Journal,* 20, 272–285.

Bercovitz, J., Feldman, M., Feller, I., and Burton, R. (2001). Organizational Structure as Determinants of Academic Patent and Licensing Behavior: An Exploratory Study of Duke, Johns Hopkins, and Pennsylvania State Universities. *Journal of Technology Transfer* 26, 21–35.

Brachos, D., Konstantinos, K., Soderquist, K.E., Prastacos, G. (2007). Knowledge Effectiveness, Social Context and Innovation. *Journal of Knowledge Management,* 11, 31-44.

Brooks, G., Heffner, A., & Henderson, D. (2014). A SWOT Analysis of Competitive Knowledge from Social Media for A Small Start-Up Business. *Review of Business Information Systems, 18*(1), 23-34.

Boutkhoum, O., Hanine, M., Agouti, T., and Tikniouine, A. (2015). An improved hybrid multi-criteria/ multidimensional model for strategic industrial location selection: Casablanca industrial zones as a case study. *Springerplus.* 4, 628..

Buckley, J. J., (1985). Fuzzy hierarchical analysis. *Fuzzy Sets Systems*, *17* (1), 233–247.

Castrogiovanni, G., Ribeiro-Soriano, D., Mas-Tur, A., and Roig-Tierno, N.(2016). Where to acquire knowledge: Adapting knowledge management to financial institutions. *Journal of Business Research, 69*(5), 1812-1816

Chang, Y., Yang, P., and Chen, M. (2009). The determinants of academic research commercial performance: Towards an organizational ambidexterity perspective. *Research Policy, 38*(6),936-946.

Cohen, W. M., Nelson, R. R., and Walsh, J.P. (2000). Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. *Manufacturing Firms Patent* (or Not). NBER Working Paper No. 7552.

AD-minister Nº. 30 january-june 2017 pp. 45 - 72 · ISSN 1692-0279 · eISSN 2256-4322

Debackere, K. and Veugelers, R. (2005). The Role of Academic Technology Transfer Organizations in Improving Industry Science Links. *Research Policy, 34*(3), 321–342.

Etzkowitz, H. and Leydesdorff, L. (2000). The dynamics of innovation: from National Systems and ''Mode 2'' to a Triple Helix of university–industry–government relations. *Research Policy,* 29, 109-123.

Feldman, M. P., Link, A. N., and Siegel, D. S. (2002). *The economics of science and technology*. Norwell, MA: Kluwer Academic Publishing.

Friedman, J. and Silberman, J. (2003). University Technology Transfer: Do Incentives, Management, and Location Matter?. *Journal of Technology Transfer, 28*(1), 81–85.

Franklin, S., Wright, M., and Lockett, A. (2001). Academic and Surrogate Entrepreneurs in University Spin-out Companies. *Journal of Technology Transfer, 26*(1–2), 127–141.

Guzak, J. R., & Rasheed, A. A. (2014). Governance and growth of professional service firms. *Service Industries Journal, 34*(4), 295-313.

Goktepe, D. (2004). *Investigation of University Industry Technology Transfer Cases: A Conceptual and Methodological Approach. Division of Innovation-LTH Lund University.* Retrieved from www.infra.kth.se/cesis/cesis/conference/Devrim%20Goktepe.pdf.

Gans, J. S., and Stern, S. (2003). The product market and the market for "ideas": commercialization strategies for technology entrepreneurs. *Research Policy,* 32, 333–350

Goldfarb, B. and Henrekson, M. (2003). Bottom-up versus top-down policies towards the commercialization of university intellectual property. *Research Policy,* 32, 639–658.

Gittelman, M. (2008). National institutions, public–private knowledge flows, and innovation performance: A comparative study of the biotechnology industry in the US and France. *Research Policy, 35*(7), 1052-1068.

Guerrero, M., Urbano, D., & Salamzadeh, A. (2014). Evolving Entrepreneurial Universities: Experiences and challenges in the Middle Eastern context. in Fayolle, A. & Redford, D. T. (2014). Handbook of Research in Entrepreneurship Education. *Entrepreneurial University Handbook Volume 4 Cambridge*: Edward Elgar Publishing.

Guerrero, M., Urbano, D., & Salamzadeh, A. (2015). Entrepreneurial Transformation in the Middle East: Experiences from Tehran Universities. *Technics Technologies Education Management*, *10*(4), 533-537.

Götsén, A., Pettersson, B., (2016). *Business Incubators - the savior of startups? - An exploratory study on knowledge acquisition in a business incubator from a startup perspective*. Master's Thesis 30 credits Department of Business Studies Uppsala University.

González-Pernía, J.L., Iñaki, G.K., & Peña-Legazkue. (2013). An Assessment of the Determinants of University Technology Transfer. *Economic Development Quarterly*, *27*(1), 6-17.

Gonzalez-Perez, M.A, Velez-Calle, A., Cathro, V., Caprar, D.V., & Taras, V.(2014). Virtual Teams and International Business Teaching and Learning:The Case of the Global Enterprise Experience (GEE). *Journal of Teaching in International Business*, *25*(3), 200-213.

Gonzalez-Perez, M.A., and Leonard, L. (2013). Principles and strategies to balance ethical, social and environmental concerns with corporate requirements. *Emerald Group Publishing Limited*.

Kasch, S., and Dowling, M. (2008). Commercialization strategies of young biotechnology firms: An empirical analysis of the U.S. industry. *Research Policy,* 37, 1765–1777.

Knockaert, M., Vandenbroucke, E., Huyghe, A. (2012). Unraveling the need for innovation support services in new technology-based firms: The impact of commercialization strategy. *Science and public policy (SPP), 40*(1).

Kelley, D., Neck, H. M., O'Connor, G. C., & Paulson, A. (2005). Corporate entrepreneurship through radical innovation: key organization and initiative level mechanisms. In *Corporate entrepreneurship and venturing* (pp. 23-48). Springer US.

Khajeheian, D. (2013). "New Venture Creation in Social Media Platform; Towards a Framework for Media Entrepreneurship". *In Handbook of Social Media Management* (125-142). Springer Berlin Heidelberg.

Khajeheian, D (2016a), "Telecommunication Policy: Communication Act Update". *Global Media Journal-Canadian Edition, 9*(1) 135-141.

Khajeheian, D. (2016b). "Audience Commodification: A Source of Innovation in Business Models". *Technology Innovation Management Review, 6*(8), 40-47.

Landry, R., Amara, N., and Ouimet, M.(2007). Determinants of knowledge transfer: evidence from the Canadian university researchers in natural sciences and engineering. *Journal of Technology Transfer,* 32, 561–592

Link, A. N., Siegel, D. S., and Bozeman, B.(2007). An Empirical Analysis of the Propensity of Academics to Engage in Informal University Technology Transfer. *Industrial and Corporate Change, 16*(4), 641-655.

Moray, N., & Clarysse, B. (2004). *Institutional Change and the Resource Flows going to Spin off Projects: The case of IMEC* (No. 04/241). Ghent University, Faculty of Economics and Business Administration.

Mowery, D. C., Nelson, R. R., Sampat, B., and Ziedonis, A. A. (2001). The Growth of Patenting and Licensing by U.S. Universities: An Assessment of the Efects of the Bayh-Dole Act of 1980. *Research Policy,* 30, 99–119.

AD-minister Nº. 30 january-june 2017 pp. 45 - 72 · ISSN 1692-0279 · eISSN 2256-4322

MIT. (2015). *An MIT Inventor's Guide to Startups: for Faculty and Students.* Technology Licensing Office.

National Institute of Standards and Technology (NIST). (1999). Commercialization strategies In Commercialization and Business Planning Guide for the Post-Award Period, Dawnbreaker Press, U.S. *Department of Commerce*, 3, 37–46.

Ndonzuau, F. N., Pirnay, F., and Surlemont, B. (2002). A stage model of academic spin-off creation. *Technovation,* 22, 281–289

Nilsson, A. S., Rickne, A., & Bengtsson, L. (2010). Transfer of academic research: uncovering the grey zone. *The Journal of Technology Transfer*, *35*(6), 617-636.

OECD. (2002). *Benchmarking Industry–Science Relationships*. Paris: OECD.

Plewa, C. (2005). Differences in perceived benefits from university-industry relationships. In *ANZMAC2005 Conference: Business Interaction, Relationships an Networks, University of Adelaide, South Australia*.

Rutherford, M.W., & Holt D.T.(2007). Corporate entrepreneurship: An empirical look at the innovativeness dimension and its antecedents. *Journal of Organizational Change Management 20*(3), 429-446

Rand Corporation. (2003). *Technology Transfer of Federally Funded R & D.* Science and Technology Policy Institute.

Rasmussen, E., Moen, Ø., and Gulbrandsen, M. (2006). Initiatives to promote commercialization of university knowledge. *Technovation,* 26, 518–533.

Rothaermel, F. T., Agung, S. D., and Jiang, L.(2006). *University entrepreneurship: a taxonomy of the literature,* in S. Siegel. and M. Wright and A. Lockett (Eds), Special Issue of Industrial and Corporate Change "The Rise of Entrepreneurial Activity at Universities: Organizational and Societal Implications".

Rosenberg, N., and Nelson, R. R. (1994).American Universities and Technical Advance in Industry. *Research Policy, 23*(3), 323–348.

Rogers, E.M., Takegami, S., and Yin, J. (2001). Lessons learned about technology transfer. *Technovation,* 21, 253 – 261.

Reamer, A., Icerman, L., and Youtie, J. (2003). *Technology Transfer and Commercialization: Their Role in Economic Development.* Economic Development Administration, U.S. Department of Commerce, Washington.

Servo, J.C. (1998). *Commercialization and business planning guide for the post award period: design especially for the technology entrepreneur*. Dawn Breaker Press.

Link, A. N., Siegel, D. S., & Wright, M. (Eds.). (2015). *The Chicago handbook of university technology transfer and academic entrepreneurship*. University of Chicago Press.

Siegel, D. S., Waldman, D. A., Atwater, L.E., Link, A. N.(2003a). Commercial knowledge transfers from universities to firms: improving the effectiveness of university–industry collaboration. *Journal of High Technology Management Research,* 14, 111–33.

Siegel, D. S., Waldman, D. A., and Link, A. N.(2003b). Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study. *Research Policy,* 32, 27–48.

Siegel, D. S., Waldman, D. A., Atwater, L.E. and Link, A. N.(2004). Toward a model of the effective transfer of scientific knowledge from academicians to practitioners: qualitative evidence from the commercialization of university technologies. *Journal of engineering and technology managmemt,* 21, 115-142.

Siegel, D. (2006). *University–industry knowledge flows: an overview, in Advancing Measures of Innovation: Knowledge Flows, Business Metrics and Measurement Strategies*. National Science Foundation, Arlington, VA

Siegel, D. S., Veugelers, R., and Wright, M. (2007). Technology Transfer Offices and Commercialization of University Intellectual Property: Performance and Policy Implications. *Oxford Review of Economic Policy. 23*(4), 640–60.

Shapira, P., and Wang, J. (2009). From lab to market? Strategies and issues in the commercialization of nanotechnology in China. *Asian Business and Management, 8*(4), 461-489.

Samsom, K. J. and Gurdon, M. A. (1993). University scientists as entrepreneurs: a specialcase of technology transfer and high-tech venturing. *Technovation, 13*(2), 63-71.

Shane, S.A. (2002). Selling University Technology Patterns from MIT. *Management Science,* 48(1), I22-137

SBIR *Program Reauthorization.* Act retrieved from http://sbir.gov/about/about-sbir.

Urabe, K. (1988). *Innovation and the Japanese management system.* In K. Urabe, J. Child, & T. Kagono (Eds.), Innovation and management international comparisons. Berlin: Walter de Gruyter.

Velez-Ocampo, J.; Herrera-Cano, C., & GonzalezPerez, M.A. (2016). The Peruvian Amazon Company's Death: The Jungle Devoured Them. *Advanced Series in Management,* 15, 35-46.

Yetisen, A.K., Kamrani, E., Volpatti, L.R., Butt, H., Coskun, A.F., Khademhosseini, A., Cho,S., & Yun, S.H. (2015).*Entrepreneurship. Lab Chip,* 15,363

Walter, J., Lechner, C. and Kellermanns, F. (2008).Disentangling alliance management processes: decisionmaking, politicality, and alliance performance. *Journal of Management Studies,* 45, 530-560.

Zarea, H., & Salamzadeh, A. (2012). Identification of Output Performance Indicators in Commercialization of University Research: An AHP based Study of EFQM Model. *Journal of Entrepreneurship Development*, *4*(15), 85-104.