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Identifying and Ranking Development Drivers of Knowledge-based Technology-Driven Companies (Case study: Fars Province Science and Technology Park)

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Abstract

The purpose of this Study study is to identify and rank the development drivers of knowledge-based, technology-driven businesses. This work is conducted as a case study in Fars Province Science and Technology Park. It is a descriptive survey in terms of purpose since a part of its data is collected through questionnaires and is of surveying type because it describes the existing conditions. The population of the study includes all the knowledge-based, technology-driven companies located in the mentioned Science and Technology Park. At the stage of identifying the drivers, 201 employees were randomly assigned by stratified sampling. For the prioritization of these drivers, 30 of the senior managers of those companies were deliberately consulted and the collected data were analyzed using exploratory and confirmatory factor analysis as well as fuzzy hierarchy process analysis. The findings showed 37 drivers in five economic and legal, marketing and foreign relations, technological, cultural and human relationships and, ultimately, structural and informational dimensions. Drivers of communication with the world market, the world web as a factor for enhancing the world knowledge and a means for knowledge-driven development; ease of access to the technology and technical consulting; ease of access to the suppliers and providing public subsidies to knowledge-based companies while taking note of regional policy were considered as the most important drivers in the development of knowledge-based, technology-driven companies. Also, the dimensions of marketing and foreign relations, technological, economic and legal dimensions were identified as the most important dimensions respectively.

Keywords: Knowledge-based, technology-driven businesses, science and technology parks, explorative and confirmatory factor analysis, fuzzy hierarchical analysis process

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1. Introduction

Complex and rapid developments in recent decades and acceleration in the process of globalization have led to a situation, in which different communities increasingly try to prepare themselves for embracing development (Rao, 1979). During the recent 50 years, developing economies have undergone a type of change so that knowledge has been at the top of those developments (Rahman Seresht and Simar Asl, 2009). In the knowledge-driven economy, knowledge is the main capital of knowledge-based businesses and, generally, the main capital for the communities (Samadi et al., 2008). Such knowledge could have a technological origin or the other way round (Mahdavi et al, 2011) and a significant portion of the value added of economic activities is gained through activities based on knowledge (Ansari and Soltanzadeh, 2012).

The knowledge-based economy is an economy in which production, distribution and use of knowledge are the main sources for development and wealth-making. Such economy is the dominant form among the economies in the 21st century for designing the policy-making systems, in which the governments play an important and strategic role. The required technical, social and cultural backgrounds for the production, application and promotion of knowledge and shaping of innovation waves in the community for participation in the knowledge-driven economy are the instructions which must be considered by the 21st century policy makers (Monavarian and Askari, 2004). In the knowledge-driven economy which is associated with intense and cruel world competition, reduction in resources and increase in restrictions, one could no longer satisfy him/herself with having financial resources and tangible assets. Here, as claimed by the authorities, for easing those restrictions, the miracles coming out of knowledge-based businesses should be expected, which could create new competitive advantages via their ideas (Mahmoodi Sefidgar and Nasiri, 2013). Now, it is necessary to have a short review of the What ness of knowledge-based businesses (Akbarzadeh and Shafizadeh, 2012). There is no agreed-upon definition for knowledge-based industries or businesses although it seems that there is an agreement on the fact that knowledge-based businesses possess a high proportion of intangible assets and are extremely dependent on innovation as a competitive source. Though there is little in the definition of knowledge-based business, according to Morgan and Mc Carthy, most banks and public organizations have agreed that knowledge-based businesses have

some of the following features in common: high skill, higher education, labor, high level of research and development, high tendency to exporting, high proportion of intangible assets, products and services with a short life curve and high gross profit margin. In addition, it is likely that knowledge-based businesses use more of advanced technologies or innovative processes in their products, services or processes (Gorman and Mccarthy, 2006).

In knowledge-based businesses, one should attempt to explain and model knowledge production (research and development of new knowledge), enrich the knowledge (education, training and development of the manpower) and transfer knowledge (publication and promotion of knowledge and innovation). In such a business, knowledge is divided into different types based on the type of knowledge and those who learn them (Hamidizadeh, 2008). In fact, a knowledge-based business is based on publication, promotion and use of information, science, wisdom and knowledge as well as their creation (Alibino et al., 2014) and the purpose of establishing such a business is to assist in the enhancement of knowledge and wealth, development of knowledge-driven economy, extension of inventions and innovations and their application for commercializing and operationalizing the findings of research and development of inventions (Ghazinoori and Azadeganmehr, 2008).

Knowledge-based companies are the firms that employ university graduates and specialists who constitute their main body and the main factor of creating income in them is knowledge rather than natural resources, capital or unskilled labor. Today, knowledge-based companies have paved the way for the attraction and enhancement of entrepreneurship talents (Salajegheh and Kazemi, 2014). According to the bill on the protection of Iranian knowledge-based companies, one could divide them into 3 categories: 1) Technology units affiliated to Science and Technology Centers and Parks or incubators; 2) Businesses approved by High Council of Science, Research and Technology; 3) businesses belonging to universities or university knowledge-based companies (Safaei Ghadiklaei et al., 2013).

On the other hand, knowledge-based, technology-driven companies play an important role in national and international economies. That is due to the activity of technology in modern sectors and the ability in innovation and rapid commercialization. These companies work in a more complex environment, in which there is also a need for enjoying more

complex marketing measures. Thy operate in a more complex environment that requires the use of more sophisticated marketing efforts; however, due to their limited ability to market and identify customers' needs (Rezvani et al., 2011), most of the investments in these companies are wasted because their products and services rarely attract customers.

The importance of these companies is because, in addition to their advantages such as being small- and medium-sized, they are also becoming increasingly important because of the activity in the field of modern technology.

2. Literature Review

2.1. Knowledge-based, technology-driven businesses

One of the basic concepts concerning knowledge-based companies is the technology-driven companies that have been widely studied on theoretical foundations. Different concepts used in the literature lead to increased ambiguity and confusion. In other words, it is difficult to know what the authors mean while analyzing the results of different studies.

Also, in some cases, it is challenging to make a comparison between them since a multitude of statements has been used to refer to the concept of technology-driven companies (Storey & Tether, 1998). Therefore, it is necessary to provide a precise definition for technology-driven companies in the framework of this study and to state what features are associated with this particular group of companies. One of the first definitions found in the literature on technology-driven companies is Cooper's definition: "A company that focuses on research and development or its major emphasis is on exploiting new technical knowledge." On the theoretical foundations, the concept of technology-driven companies uses widespread definitions, as well as limited definitions. One of the widespread definitions of application is that all the new companies operating in high-tech sectors can be considered as technology-based companies (Butchart, 1987).

Accordingly, high-tech sectors, which is more than other sectors, comprise all the sectors where the average cost of investing in research and development, such as cost of using scientists, professional engineers, etc., is high (Butchart, 1987). In Table 1, some of the most important definitions presented by various authors are expressed.

Table (1)- Definitions of technology-driven companies

Studies	Definitions	Key Concepts
Cooper (1971)	A company that focuses on the research, development and utilization of new technical know-how	*Focus on research and development *Emphasis on the exploitation of new technical know-how
Little (1977)	An independent business that has not lived for more than 25 years and is based on inventions or technological innovations	*Independent business *Referring to the company's age (25 years) *Established on the basis of inventions or technological innovations
Bollinger et al. (1983)	New and independent companies that are associated with a small group of founders and have a great incentive to discover innovative technological ideas	*New and independent companies *Discovering innovative technological ideas
Butchart (1987)	Small and medium-sized enterprises active in high-tech sectors	*Small and medium-sized businesses *Activities in high-tech sectors
Shearman & Burrell (1988)	New independent companies developed in the new industries	*Independent companies *Developed in the new industries
Storey & Tether (1998)	All new companies operating in high-tech sectors	*Focus on the scope of the company (high-tech)
Rickne & Jacobsson (1999)	Companies whose strength and competitive advantage are from their knowledge and skills of employees in the natural sciences, engineering or medicine and those employees transfer their knowledge to the products and services they provide to the market	*Focus on the scientific and professional background of the staff
Fontes & Coombs (2001)	New, young and independent companies involved in the development and use of new technologies	*Companies being new *Developing new technologies
Chamanski & Waag (2001)	Companies that provide and develop the knowledge and technology focused on products and services	*New companies
Maine et al. (2010)	Young and small companies operating in research and development	*Companies being new and small *Focus on research and development

Technology-driven companies are often defined as small and medium enterprises or companies set up by a small group (Maine et al., 2010). Although there is little agreement on the definition of knowledge-based, technology-driven businesses, most banks and government agencies have agreed that knowledge-based, technology-driven businesses have some, but not all, of the following characteristics:

– High skill
– Workforce with higher education
– High level of research and development
– High tendency to exporting
– High percentage of intangible assets and products
– Services with short life expectancy and gross margins

In addition, knowledge-based businesses may use more of the advanced technology or innovative processes in their products, services or processes (Gorman & McCarthy, 2006). In general, in this study, the knowledge-based, technology- driven enterprise is meant to be small and medium-sized enterprises whose main focus is on high technology.

By reviewing the research background, a comprehensive set of development drivers of knowledge-based, technology-driven business was found, as described in Table 2.

Table (2)- Drivers extracted from the research background

R	dDiver	Reference
1	Legislation and proper enforcement of insurance and tax laws and customs as well as export laws of knowledge-based companies	Siegel et al. (2007); Lofstrom et al. (2014); jalalpour et al. (2016); Karpak & Topcu (2010); Tari, Moradi & Ebrahimpour (2015)
2	Funds, including venture investors, investment funds, foreign investment and government budgets	Almus & Nerlinger (1999); Zhang (2009)
3	Educated, skilled, creative and innovative workforce	Tari, Moradi & Ebrahimpour (2015) ; Azar, Sadeghi & Kordnaaeij (2012))
4	The World Wide Web as a collaborative component of global knowledge and knowledge-based development tools	Tari, Moradi & Ebrahimpour (2015))
5	Economic conditions, including inflation rate, economic growth rate, emphasis on resilient economy and sanctions	Tari, Moradi & Ebrahimpour (2015); Babakhaniani (2013)
6	Existence and proper implementation of intellectual property laws and support by the state	O Shea et al. (2008); Siegel et al. (2007); Stankiewicz (1994); Azar, Sadeghi & Kordnaeij (2012)
7	Communication with the global market	Azar, Sadeghi & Kordnaeij (2012)
8	Proper transfer of international technologies and enhancement of the quality of knowledge-based products	Azar, Sadeghi & Kordnaeij (2012)
9	International exchange of human resources	Azar, Sadeghi & Kordnaeij (2012)
10	Ease of access to suppliers	Azar, Sadeghi & Kordnaeij (2012)

R	dDiver	Reference
11	Applying demand-creation policies to knowledge-based products in domestic markets	Zhang (2009); Waarts et al. (2002); Siegel et al. (2007)
12	Providing facility to buyers of knowledge-based products	Siegel et al. (2007); Azar, Sadeghi & Kordnaeij (2012); Nazarian & Haddadi;Moghaddam (2013)
13	Proximity of companies to the supply and demand market for knowledge-based products	Man & Chan (2002)
14	Providing government subsidies to knowledge-based companies with regard to regional policy	Storey (2003); Ali Ahmadi & Ghazinouri (2008); Amin Bidokhti & Zargar (2010)
15	Having marketing skills by the founders of knowledge-based companies and their constituent teams	Zahra et al. (2007); zhang et al. (2009); Nazarian & Haddadi Moghaddam (2013); Azar, Sadeghi and Kordnaeij (2012)
16	Having a business plan by the team constituting the knowledge-based companies	Vohora et al. (2004)
17	Recruiting university instructors and full-time, and even part-time ,academic entrepreneurs in knowledge-based businesses	Zhang (2009); Lockett et al. (2003)
18	Promoting in-person competencies in the teams that make up knowledge-based companies	Czarnitzki et al. (2014); Zahra et al. (2007)
19	Existence of informal networks parallel to the official networks, as appropriate information flows	Donckels & Lambrecht (1995)
20	Creating diverse, transparent and less-complex capital markets for financing the knowledge-based companies	Stankiewicz (1994)
21	Applying policies to increase the presence of risk investment funds	Moore & Garnsey (1993)
22	Applying policies and programs to create a community environment for policymakers, government officials, industry and business executives, university instructors, college students and university graduates	Grimaldi et al. (2011)
23	Professional consultancy in organizations and centers related to knowledge-based companies and the existence of sufficient programs to inform and familiarize companies with the market and modern management and business systems as much as possible	Donckels & Lambrecht (1995); Storey (2003)
24	Presence of specialized committees for evaluating raw materials and products of the company	Czarnitzki et al. (2014); Zahra et al. (2007)
25	Presence of a flexible and dynamic organizational structure tailored to the development of the relevant technology	Tari, Moradi & Ebrahimpour (2015)
26	Teaching soft and psychological skills (topics such as stress, self-esteem, leadership and conflict management)	Zahra et al. (2007); zhang et al. (2009)
27	The technology being immutable by other companies	Azar, Sadeghi & Kordnanij (2012)
28	Pricing the products based on the value expected by the customer	Donckels & Lambrecht (1995); Storey (2003)
29	The interaction between knowledge-based, technology-driven companies and interacting with other science and technology parks	Rashidinejad & Sharifzadeh Kermani (2006)

R	dDiver	Reference
30	Facilitating access to technology and technical advice	Ghazinouri & Azadegan Mehr (2008)
31	Quantitative development and quality improvement of marketing services	Ghazinouri & Azadegan Mehr (2008)
32	Reengineering of advanced foreign technology	Azar, Sadeghi & Kordnanij (2012)
33	Access to distribution channels and ability to timely deliver product or service to the market	Azar, Sadeghi & Kordnanij (2012)
34	Supportive culture stimulating innovation	Nazariyan & Haddadi Moghaddam (2013); Hafezian & colleagues (2014); Asadpour & Kargar (2015); Tari, Moradi & Ebrahimpour (2015)
35	Increased risk-taking power of individuals	Nazaryan & Haddadi Moghaddam (2013)
36	Increasing rate of residence in centers related to knowledge-based companies	Ghazinouri & Azadegan Mehr (2008)
37	Space and location suitable for loading equipment	Jalalpur et al. (2016)

3. Research methodology

This research was a descriptive survey in term of purpose. it was considered a survey due to the fact that a part of the research data was collected through a questionnaire and it was descriptive for its description of the circumstances. In essence, this research was applied and had a quantitative approach. The statistical population of this research was all the knowledge-based, technology-driven companies located in Fars Science and Technology Park. In order to evaluate the extracted drivers (identification and modeling), stratified random sampling method was used. Stratified random sampling, as its name implies, requires categorization and, then, random selection of subjects from each class. In stratified random sampling, the statistical community is first divided into incompatible groups that are relevant, fit and significant in the research context (Hafeznia, 2015). Since the population studied in this study was composed of different groups, the stratified sampling method was used; to divide the sample size among the classes of population according to the size of each, a class of suitable assignment was used and random selection was made for the selection of sample individuals. The total number of knowledge-based, technology-driven companies in Fars Science and Technology Park was 32 companies operating in four areas, as shown in Table 3. The total number of employees was 424, which was equal to Morgan's table; the sample size was 201, which was calculated as the statistical sample in terms of the number of employees in each area. In order to prioritize the effective drivers in the development of technology-driven, knowledge-based businesses, 30 of the senior managers of these companies were deliberately consulted.

Table (3)- Fields of activity of knowledge-based technology-driven companies and the number of knowledge worker

Field	Number of companies	Number of people (population)	Percentage	Sample size
Comprehensive Technology Development Center	7	80	8.18	38
Center for Oil, Gas and Petrochemical Development	15	218	4.51	103
Center for Agricultural and Natural Resource Development	1	21	5	10
Center for Information and Communication Technology Development	9	105	8.24	50
Total	32	424	100	201

In this research, to identify the effective drivers in the development of knowledge-based, technology-driven businesses from exploratory factor analysis and to reduce the probable number of these propellers and ensure the correct placement of drivers in the dimensions, the confirmatory factor analysis method was used. Finally, the fuzzy hierarchy process analysis method was employed for weighting the developmental drivers. Lisrel, SPSS and Excel were utilized to process the data.

4. Research findings

4.1. Exploratory factor analysis

In performing the factor analysis, first, it must be ensured that the available data can be used for the analysis. Using Bartlett test, you can ensure that the sampling is complete. This index is in the range of 0 to 1. If the value of the index is close to 1, the desired ones are suitable for the factor analysis; otherwise, the results of the factor analysis for the given data are not appropriate (Momeni, 2007: 193). First, we examine the appropriateness of the data for factor analysis: there are several methods for doing so, which include one that can be tested (KMO) with the value always fluctuating between 0 and 1. If the KMO value is less than 0.50, then the data are not suitable for factor analysis; if the value is between 0.50 and 0.69, then you can be more cautious with factor analysis; but if the value is greater than 0.70, the correlations between the data will be appropriate for factor analysis. On the other hand, to ensure that the data are appropriate, the correlation matrix, which is the basis of the analysis, is not zero in population and Bartlett's test is employed. In other words, using this test, you can ensure that sampling is adequate. The results of the tests are shown in Table 4.

Table (4)- Final results of the KMO test and Bartlett's sphericity test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.868
Bartlett's sphericity test	Approx. Chi-Square	3541.309
	df	664
	Sig.	0.000

Factor analysis is in fact a theoretical test model. In this way, the analysis begins with a previous hypothesis. This model, which is empirical-basis and has strong theory, specifies which variables are correlated with which factors and which factors are associated with which other factors. Different methods of factor analysis first help extract a set of factors from a set of variables. The results of exploratory factor analysis through varimax rotation and principal components method are shown in Table 3. It can be seen that Factors 1 to 5, respectively, yielded variances of 271.23, 14.340, 13.309, 12.886 and 9.666, respectively. The total number of variances explained by five factors was also 447.73.

Table (5)- Results of varimax rotation and number of variances explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	19.602	52.980	52.980	19.602	52.980	52.980	8.610	23.271	23.271
2	3.524	9.525	62.505	3.524	9.525	62.505	5.306	14.340	37.611
3	1.766	4.772	67.277	1.766	4.772	67.277	4.924	13.309	50.919
4	1.238	3.346	70.624	1.238	3.346	70.624	4.761	12.867	63.787
5	1.045	2.824	73.447	1.045	2.824	73.447	3.575	9.661	73.447
6	.878	2.374	75.821						
7	.659	1.781	77.602						
8	.623	1.683	79.285						
9	.603	1.629	80.914						
10	.534	1.442	82.356						
11	.485	1.310	83.666						
12	.466	1.258	84.924						
13	.407	1.100	86.024						
14	.380	1.028	87.052						

15	.370	1.000	88.052						
16	.350	.946	88.998						
17	.343	.926	89.924						
18	.323	.873	90.797						
19	.298	.806	91.603						
20	.288	.779	92.381						
21	.260	.703	93.085						
22	.239	.646	93.731						
23	.234	.631	94.363						
24	.226	.612	94.975						
25	.201	.543	95.518						
26	.183	.496	96.013						
27	.181	.490	96.503						
28	.171	.461	96.964						
29	.160	.433	97.398						
30	.156	.422	97.819						
31	.140	.377	98.196						
32	.132	.357	98.554						
33	.126	.342	98.895						
34	.121	.327	99.222						
35	.109	.293	99.515						
36	.091	.247	99.762						
37	.088	.238	100.000						

Extraction Method: Principal Component Analysis.

In addition, the Scribble Kettle diagram, shown in Figure 1, also demonstrates five dimensions.

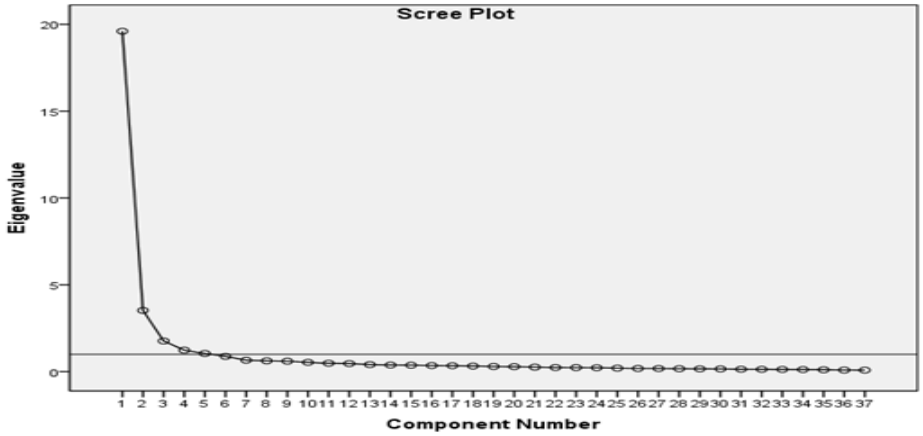

Figure (1)- Scribble plot

Table 6 shows the high correlation of indicators with their related dimensions and their lower correlation with other dimensions (divergent validity).

Table (6)- Rotated factor matrix in a varimax method

R	Driver	Factor				
		1	2	3	4	5
1	Legislation and proper enforcement of insurance and tax laws and customs as well as export laws of knowledge-based companies	0.523	0.106	0.022	0.229	0.048
2	Funds, including venture investors, investment funds, foreign investment and government budgets	0.455	0.132	0.167	0.217	0.159
3	Educated, skilled, creative and innovative workforce	0.235	0.277	0.122	0.501	0.107
4	The World Wide Web as a collaborative component of global knowledge and knowledge-based development tools	-0.038	0.402	0.561	0.215	-0.083
5	Economic conditions, including inflation rate, economic growth rate, emphasis on resilient economy and sanctions	0.552	0.264	0.318	-0.012	0.011
6	Existence and proper implementation of intellectual property laws and support by the state	0.635	0.064	0.058	-0.031	0.297
7	Communication with the global market	0.134	0.521	0.026	0.032	0.250
8	Proper transfer of international technologies and enhancement of the quality of knowledge-based products	0.159	0.212	0.505	0.273	0.201
9	International exchange of human resources	0.098	-0.085	-0.101	0.754	0.154
10	Ease of access to suppliers	0.245	0.586	-0.096	0.155	0.064
11	Applying demand-creation policies to knowledge-based products in domestic markets	0.077	0.507	0.357	0.046	0.120
12	Providing facility to buyers of knowledge-	0.128	0.656	0.244	-0.011	0.297

R	Driver	Factor				
		1	2	3	4	5
	based products					
13	Proximity of companies to the supply and demand market for knowledge-based products	0.339	0.435	0.079	0.326	0.102
14	Providing government subsidies to knowledge-based companies with regard to regional policy	0.716	-0.010	0.042	0.033	0.158
15	Having marketing skills by the founders of knowledge-based companies and their constituent teams	0.015	0.597	0.362	0.267	0.046
16	Having a business plan by the team constituting the knowledge-based companies	0.316	0.303	0.120	-0.007	0.669
17	Recruiting university instructors and full-time, and even part-time, academic entrepreneurs in knowledge-based businesses	0.403	-0.020	0.019	0.494	0.315
18	Promoting in-person competencies in the teams that make up knowledge-based companies	-0.080	0.268	0.341	0.478	-0.094
19	Existence of informal networks parallel to the official networks, as appropriate information flows	0.208	0.213	0.267	0.046	0.493
20	Creating diverse, transparent and less-complex capital markets for financing knowledge-based companies	0.642	0.070	0.010	0.214	0.192
21	Applying policies to increase the presence of risk investment funds	0.749	0.273	-0.170	0.016	0.028
22	Applying policies and programs to create a community environment for policymakers, government officials, industry and business executives, university instructors, college students and university graduates	0.045	0.317	0.285	0.561	-0.003
23	Professional consultancy in organizations and centers related to knowledge-based companies and the existence of sufficient programs to inform and familiarize companies with the market and modern management and business systems as much as possible	0.203	0.005	0.059	0.278	0.588
24	Presence of specialized committees for evaluating raw materials and products of the company	0.283	-0.061	0.015	-0.075	0.567
25	Presence of a flexible and dynamic organizational structure tailored to the development of the relevant technology	0.145	0.291	0.055	0.049	0.544
26	Teaching soft and psychological skills (topics such as stress, self-esteem, leadership and conflict management)	0.137	0.177	0.358	0.522	0.030
27	Technology being immutable by other companies	0.091	0.161	0.714	-0.017	-0.057
28	Pricing the products based on the value expected by the customer	0.221	0.617	0.237	-0.060	0.205
29	Interaction between knowledge-based, technology-driven companies and interacting with other science and technology parks	0.085	0.074	0.184	0.163	0.634
30	Facilitating access to technology and technical	0.359	-0.296	0.522	-0.071	0.223

R	Driver	Factor				
		1	2	3	4	5
	advice					
31	Quantitative development and quality improvement of marketing services	-0.040	0.665	0.213	0.127	0.063
32	Reengineering of advanced foreign technology	0.036	0.121	0.707	0.060	0.158
33	Access to distribution channels and ability to timely deliver product or service to the market	0.324	0.412	-0.043	0.226	0.213
34	Supportive culture stimulating innovation	0.098	0.154	-0.063	0.642	0.252
35	Increased risk-taking power of individuals	0.238	0.455	0.208	0.626	-0.073
36	Increasing the rate of residence in centers related to knowledge-based companies	0.108	0.048	0.159	0.009	0.619
37	Space and location suitable for loading equipment	0.251	0.149	0.003	-0.293	0.593

Also, by referring to the text of the questionnaire and extractive indicators, dimensions were named as economic and legal drivers, marketing and foreign, technological, cultural and human relations and, finally, structural and informational drives.

To ensure the reliability of the model, Cronbach's alpha coefficient was used, which is shown in Table 7. Cronbach's alpha index of above 0.7 represents appropriate reliability which, according to the table, can be considered as acceptable for the model reliability.

Table (7)- Results of the measurement model analysis

Cod	Dimension	Number of questions	Cronbach's alpha
ECLW	Economic and legal	7	0.838
MARK	Marketing and foreign relations	9	0.828
TECH	Technological	5	0.775
CAHU	Cultural and human	8	0.756
STIN	Structural and informational	8	0.874

4.2. Confirmatory factor analysis

In order to test the proposed model, we used the structured equations and Liserl 8.80 software. Confirmatory factor analysis is one of the oldest statistical methods, which is used to examine the relationship between the variables (dimensions) and the observed variables (indicators) and represents the measurement model. In this type of analysis, the main components of the research are measured and whether the main variable is properly measured by sub-factors (dimensions and indicators)?
Its results are reported in Fig. 1 and Table 8.

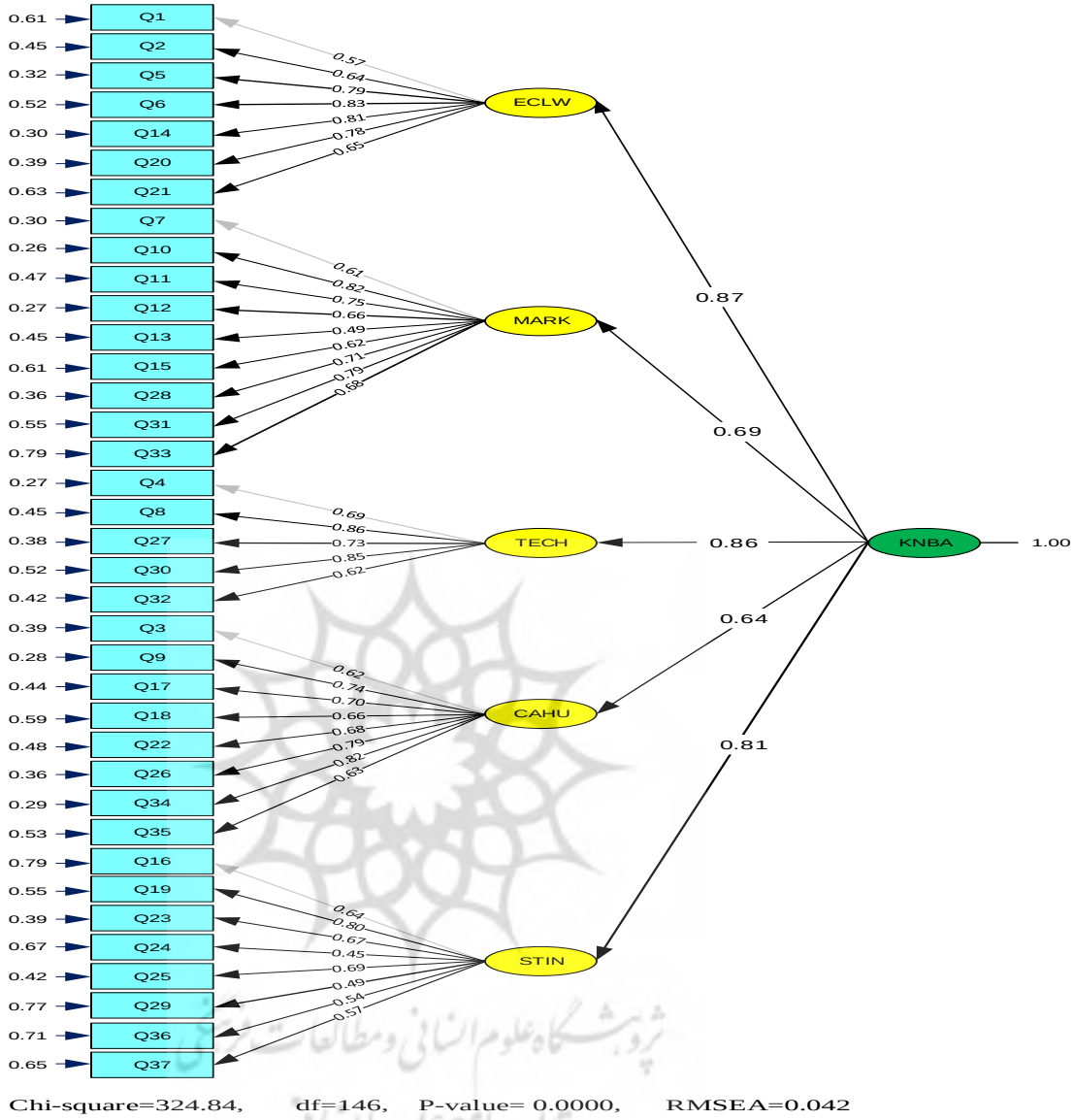

Figure (1)- Standard coefficients of development drivers of knowledge-based, technology-driven businesses in factor analysis

As shown in Fig. 1, the observed variables can well explain the latent variable. Because the factor load of all observed variables (indexes) was greater than 0.3, it had a good relationship with hidden variables. To determine the fitting of the model, the indicators that can be presented in soft parts of Liserl were used, which are presented in Table 6.

Accordingly, the modeling proponents of the model were suitable criteria because the pattern fit of the pattern in the confirmatory factor analysis confirmed the fitting of the model.

Table (8)- Model fitting indicators with acceptable levels

Index	Allowed Amount	Amount
Chi-square (X^2)	-	324.84
Chi-square Divided Freedom to Degree of	3 ـه	2.224
Significance Level (P-Value)	0.05 ـه	0.000
Root Mean Square Error of Approximation (RMSEA)	0.08 ـه	0.042
Root Mean Square Residual (RMR)	0.08 ـه	0.065
Normed Fit Index (NFI)	0.9 ـه	0.93
Comparative Fit Index (CFI)	0.9 ـه	0.98
Incremental Fit Index (IFI)	0.9 ـه	0.99
Relative Fit Index (RFI)	0.9 ـه	0.91
Goodness of Fit Index (GFI)	0.9 ـه	0.90

After identifying the drivers of business development of technology-driven businesses, the importance of each of the drivers was also identified by using the fuzzy hierarchy analysis method. To do so, a pairwise comparison questionnaire designed for this purpose was distributed among 30 experts (senior managers of the companies). Then, these data were analyzed by triangular fuzzy numbers. To this end, the expertise of the experts was integrated into a general matrix. Thus, in this matrix, the first fuzzy number of the least amount of response of the experts, the second fuzzy number, the geometric mean of the response of the experts and the third fuzzy number represented the highest response value of the experts.

Then, the final geometric mean of triangular fuzzy numbers (Z) as well as sum of Z and its inverse values was calculated. The results for the dimensions are shown in Table 9.

Table (9)- Definite geometric mean meometry of triangular fuzzy numbers for model dimensions

R	Dimension	First Fuzzy Number	Second Fuzzy Number	Third Fuzzy Number
1	Economic and legal	0.7348	1.7775	3.3935
2	Marketing and foreign relations	0.8152	1.6458	4.5993
3	Technological	0.8706	2.0108	4.0428
4	Cultural and human	0.3432	0.4677	0.6988
5	Structural and informational	0.2449	0.3635	0.5173
Total Z values		0.0088	6.2653	13.2517
Z inverse		0.0755	0.1596	0.3324

Below, the weight of the dimensions was calculated individually, the results of which are shown in Table 10. As can be found in this table, the dimensions of marketing and foreign relations (0.2090), technological (0.3073), and economic and legal (0.2605), respectively, had the highest importance among the dimensions of business development drivers of technology-driven businesses located in Fars Science and Technology Park. Then, the structural and informational (0.0441), cultural and human (0.591) had the least importance.

Table (10)- Final weight of model dimensions

R	Dimension	Fuzzy Number			Defuzzy	Final Weight
		1	2	3		
1	Economic and legal	0.0555	0.2837	1.1279	0.4890	0.2605
2	Marketing and foreign relations	0.0615	0.2627	1.5286	0.6176	0.3290
3	Technological	0.0657	0.3209	1.3437	0.5768	0.3073
4	Cultural and human	0.0259	0.0746	0.2323	0.1109	0.0591
5	Structural and informational	0.0185	0.0580	0.1719	0.0828	0.0441

Ultimately, the final weight of all dimensions and drivers is shown in Table 11. As can be observed in this table, among the drivers, "Connection to the global market", " Global Internet network as an add-on to global knowledge and knowledge-based development tools", "Facilitating access to technology and technical advice "," Ease of access to suppliers "and" Provision of government subsidies to the participation of businesses in the context of regional politics" were, respectively, the most important drivers for the development of knowledge-based, technology-driven businesses.

Table (11)- Final weights of technology-driven business development drivers

R	Dimension	Final Weight	Driver	Relative Weight	Final Weight
1	Economic and legal	0.260	Legislation and proper enforcement of insurance and tax laws and customs as well as export laws of knowledge-based companies	0.048	0.012
2			Funds, including venture investors, investment funds, foreign investment and government budgets	0.167	0.043
3			Educated, skilled, creative and innovative workforce	0.151	0.039
4			The World Wide Web as a collaborative component of global knowledge and knowledge-based development tools	0.074	0.019
5			Economic conditions, including inflation rate, economic growth rate, emphasis on resilient economy and sanctions	0.236	0.061
6			Existence and proper implementation of intellectual property laws and support by the state	0.162	0.042
7			Communication with the global market	0.159	0.041
8	marketing and foreign relations	0.329	Proper transfer of international technologies and enhancement of the quality of knowledge-based products	0.288	0.094
9			International exchange of human resources	0.209	0.069
10			Ease of access to suppliers	0.087	0.028
11			Applying demand-creation policies to knowledge-based products in domestic markets	0.060	0.019
12			Providing facility to buyers of knowledge-based products	0.066	0.021
13			Proximity of companies to the supply and demand market for knowledge-based products	0.168	0.055
14			Providing government subsidies to knowledge-based companies with regard to regional policy	0.046	0.015
15			Having marketing skills by the founders of knowledge-based companies and their constituent teams	0.039	0.012
16			Having a business plan by the team constituting the knowledge-based companies	0.035	0.011
17	Technological	0.307	Recruiting university instructors and full-time, and even part-time, academic entrepreneurs in knowledge-based businesses	0.305	0.093
18			Promoting in-person competencies in the teams that make up knowledge-based companies	0.194	0.059
19			Existence of informal networks parallel to the official networks, as appropriate information flows	0.137	0.042
20			Creating diverse, transparent and less-complex capital markets for financing the knowledge-based companies	0.257	0.079
21			Applying policies to increase the presence of risk investment funds	0.105	0.032
22	cultural and human	0.059	Applying policies and programs to create a community environment for policymakers, government officials, industry and business executives, university instructors, college students and university graduates	0.263	0.015
23			Professional consultancy in organizations and centers related to knowledge-based companies and the existence of sufficient programs to inform and familiarize companies with the market and modern management and business systems as much as possible	0.101	0.006

R	Dimension	Final Weight	Driver	Relative Weight	Final Weight
24			Presence of specialized committees for evaluating raw materials and products of the company	0.123	0.007
25			Presence of a flexible and dynamic organizational structure tailored to the development of the relevant technology	0.143	0.008
26			Teaching soft and psychological skills (topics such as stress, self-esteem, leadership and conflict management)	0.104	0.006
27			Technology being immutable by other companies	0.091	0.005
28			Pricing the products based on the value expected by the customer	0.098	0.005
29			Interaction between knowledge-based, technology-driven companies and interacting with other science and technology parks	0073	0.004
30	Structural and informational	0.044	Facilitating access to technology and technical advice	0.315	0.014
31			Quantitative development and quality improvement of marketing services	0.119	0.005
32			Reengineering of advanced foreign technology	0.107	0.004
33			Access to distribution channels and ability to timely deliver product or service to the market	0.102	0.004
34			Supportive culture stimulating innovation	0.151	0.006
35			Increased risk-taking power of individuals	0.082	0.003
36			Increasing the rate of residence in centers related to knowledge-based companies	0.077	0.003
37			Space and location suitable for loading equipment and equipment	0.043	0.002

5. Conclusions and suggestions

The purpose of this study was to identify and rank the drivers of knowledge-based, technology-driven businesses. One of the results of this research was the marketing dimension and foreign relations in the highest priority, to which many scholars refer along with the drivers (Table 2). In the industries with new technologies that operate in more complex environments, there is a need for more complex marketing efforts. Nevertheless, because of their limited ability to market and identify customers' needs, most investments in these companies are wasted because their products and services rarely attract customers. In fact, the managers of these businesses believe that having the latest technology and the most up-to-date product is not enough to having high sales. It should be noted that although technology development is very important, marketing is also needed to turn advanced technology into a competitive advantage. The type of student products and the length of the process to produce ideas are

the concerns faced by many businesses while trying to build their own products. In the meantime, lack of access to global markets and lack of proper domestic market for knowledge-based business products, along with absence of knowledge in science, commerce and marketing among these businesses, are among the challenges facing growth and development of business assets.

In short, the rate of failure in all types of knowledge-based, technology-driven businesses is generally high. An important factor in such failure is lack of marketing. Although the executives of these companies have strong technical knowledge, their focus is on the product and they give less importance to marketing activities. For the same reason, the main weakness of the technology companies is lack of suitable marketing, and, subsequently, because of their small market, mistakes in the marketing of modern products have a high failure rate. Knowledge-based and innovative products require special marketing efforts to cross the initial market- consisting of innovation seeking people- and reach a solid market. As noted, the domestic market of knowledge-based products is relatively limited and small. Therefore, it is imperative that every knowledge company should enter the international arena for growth and development. There are numerous problems with this in the way of knowledge-based businesses. Knowledge-based businesses generally do not have the high financial ability to provide financial guarantees in international businesses. Even some of them do not have the ability to offer their products at international technology exhibitions. Among the requirements for entry into international arena and supply of knowledge-based products is obtaining international standards. These standards include industrial and technical standards as well as management and business ones. It takes a great deal of time and, indeed, cost, with its knowledge and financial capital basically lacking in many knowledge-based businesses. On the other hand, knowledge-based businesses have numerous foreign competitors, both in entering the domestic markets and entering the international markets. Unfortunately, many of the knowledge-based products, even inside the country, cannot be sold due to the presence of famous foreign competitors. In addition, many of the knowledge-based businesses, although possess high technical and scientific capabilities at the start of their establishment, they lack the knowledge of knowledge-based business and knowledge-based marketing. The proper recognition of the need for the knowledge-based market and correct supply of the product

along with the proper appropriation of capital is the prerequisite for any knowledge-based company, which must be pursued scientifically and in principle.

Another finding of this research is the importance of the technological dimension in the development of knowledge-based, technology-driven businesses. In the meantime, the World Wide Web and the facilitation of access to new technology are more important. This fact has been proven in various studies (Table 2). Today, the Internet is considered as the most important global phenomenon since the Industrial Revolution. The role of the Internet in creating convergence and the proximity of human communication with different types encompass and provide broad possibilities for eliminating geographical distances and accelerating the communication function between different human beings regarding economic, cultural, social, ethical, religious and political levels. Together, all of these components will undoubtedly provide the appropriate background for expanding information interactions.

When we upgrade the exchange of information from the individual to organizational levels, we will have new windows, needs and structures. The Internet as a communication bridge across the globe provides the opportunity for all organizations to follow their communications and interactions in a common context. Hence, creating a fundamental change in the attitude of organization managements to the Internet and paying attention to the useable growing capacities of this important tool can have an extraordinary impact on the organization's exit from static structures and becoming a dynamic organization.

In addition to the discussed topics, one of the most important dimensions of knowledge-based, technology-driven business development referred to in various research is the economic and legal dimensions and the indicator of subsidies and government aid is of greater importance to such companies (Table 2). In our country, due to macro policies and government operational plans, there is a special consideration of the knowledge-based economy; this concern can be felt well by reference to the set of regulations and attention to the commercialization and industrialization of the technologies needed in the country. The country's comprehensive science map document explicitly supports the creation of knowledge-based businesses and it is designated as a way of directing the cycle of science and technology as well as innovation to play a more effective role in the economy. In the fifth development plan of the country,

various policies have been considered to support commercialization. One of the most important of these policies is financial support and facilitation of the formation and development of small and medium-sized private companies and cooperatives engaged in the commercialization of knowledge-based, technology-driven business activities, especially the production of products based on advanced technologies and export of technical and engineering services. In the case of financial support of the knowledge-based business and taking the driving risk of these companies, in the short- or long-term planning, they can produce other valuable products such as technology for the industry plus their products, which, in addition to satisfying the needs and bottlenecks of the country, can be considered as an arm of entrepreneurship in the country. Besides, the wealth of manpower in the country itself is used and, in case of the prosperity of technology business of such companies, the general level of welfare of the community is also improved.

According to the findings and identification of the most important development drivers of knowledge-based, technology-driven businesses, the following suggestions are provided for the use of these drivers and, ultimately, development of the companies in question.

In view of the fact that the indicator of "Communication with the world market" was identified as the most significant indicator (0.0949), it is suggested, by creating platforms for financial support of knowledge-based, technology-driven businesses, these companies are assisted to enter the international arena and international exhibitions. Also, familiarizing the knowledge-based, technology-driven businesses with global standards and quality management systems to compete in global markets can be effective in that regard. Collaboration with other domestic and international institutions that are active in the field of developing knowledge-based, technology-driven businesses and taking models from successful countries in the field of knowledge-based, technology-driven businesses development can also be a solution to improve communication with the world market.

In this research, the indicator "World Wide Web as a contribution to enhancement of global knowledge" and "Knowledge-based development tool" ranked second with the significance level of 0.0938. Therefore, it is suggested that the government, by investing in telecommunications, information and communication technologies and scientific networks, as

the most important infrastructures, help develop the knowledge-based, technology-driven businesses.

The indicator "Facilitation of the access to technology and technical advice" with the significance value of 0.0792 in this study was ranked third. In this way, the development of the university's communication with companies through the creation and expansion of knowledge-based businesses in the private sector and companies derived from universities and research centers can be a useful solution. At the moment, many businesses operate in science and technology development parks and centers that process different stages of their technology development. The creation and expansion of these companies under direct supervision of universities and research centers are the effective step in accessing technical advice. Contributing to the creation of non-governmental organizations supporting the knowledge-based businesses, such as development centers, contracting institutions, consulting institutes and the bank for the development of knowledge-based enterprises, can also be a way to facilitate access to technical know-how.

The indicator "Ease of access to suppliers" has the fourth priority with the significance value of 0.0689. Thus, creating a supplier management system can be used as a highly advanced database for the registration and maintenance of suppliers' information. Creating a business venture near suppliers or communicating to a large number of suppliers can help knowledge-based, technology-driven businesses to easily access suppliers and meet their needs at a lower cost. Also, facilitating the process of supplying services to these businesses through the elimination of ineffective administrative laws and regulations can be a way to improve this indicator.

In this study, the indicator "Providing government subsidies to the knowledge-based companies with regard to "regional policy" with the significance value of 0.0617 was ranked fifth. The formulation of government policies, including the trade support, the legal system, the tax system and appropriate regulatory policies, can be helpful in developing knowledge-based, technology driven businesses. The creation of guarantee funds for financial support of knowledge-based, technology-driven businesses or the provision of banking facilities to knowledge-based businesses for the purchase and renovation of equipment and research and development activities and the purchase of new machinery on lease and in line with new technologies can be a way to improve this indicator.

It is suggested that the research model should be tested in various samples and industries. The use of qualitative methods such as transversal and qualitative content analysis can be further developed by future researchers in order to extract the drivers for the development of knowledge-based businesses. Further, other methods of multi-criteria decision making, such as network analysis and entropy, are used to prioritize the proposed drivers and its results can be compared with the results of this study. Finally, a research entitled "The pathology of knowledge-based, technology-driven businesses" can also be carried out by researchers to extract the problems of these businesses.

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