Identification and Ranking the Potential Fields of Investment in Advanced Technologies in Golestan Province

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Abstract. The current study aims to identify and rank the potential field of investment in the advanced technologies in Golestan Province. This is an applied and developmental research and the method for data gathering is descriptive and survey. The target society (decision-making team) includes all the industry elites of Golestan Province including 'Ministry of Industry, Mine and Trade', 'The Industrial Towns Company', 'Standard Organization', 'Department of Environment', and the deputy governors of Golestan Province. They were 15 people in total. A questionnaire was used to collect the data of the research. In order to analyze the data of descriptive statistics frequency distribution tables, frequency percentage, mean and charts were used. Also, in order to answer the research questions Analytical Hierarchy Process (AHP) and the different types of software like Excel, SPSS, and Expert Choice were used. The findings imply that "Biology-related elements" and "Nano-related industries" stand in the first

and second ranks of investment in advanced technologies of Golestan Province respectively.

1. Introduction

Today, with the rapid changes in technology and trade globalization, manager of economical companies, especially managers of Hi-tech companies face a new challenge. This challenge requires the companies to have a scientific and up-to-date management. This type of management needs to extend in all the part of any organization including strategic management, financial management, human resources management and technology management (Astiri, 2009). The major areas of industry and technology which are referred to as new or advanced industries are found based upon top technologies of production or service providing. Top technologies include information technology, biotechnology, electronics, microelectronics, nanotechnology, aerospace industries, etc. The rate of their growth is increasing in the universal industrial productions. The major similarity between all of these areas, called the new wave of industrial development, is that the role of research and development or human knowledge is very high in the production and service providing (Iranian Trade Promotion Organization , 2016).The unique features of high-tech companies make them quite different from other economical companies. Also, rapid growth of technology and its direction towards top technologies has highlighted the role of high-tech companies. It also has made the domestic companies to join this universal process. Thus we need to study the connections of domestic companies from two different perspectives. Local markets are so limited for the productions of the companies. So, no growth is possible for high-tech companies in local markets. Hence, having access to universal markets is required for the dynamic growth of these companies. Technological growth is so rapid that the domestic companies are unable to meet their technological requirements without interaction with other international companies. Nowadays, one of the strategic actions performed to fulfill the objectives of a company is unity (cooperation) with other companies in the field of technology (Nouri et al., 2014).

2. Literature review

Generally speaking, the major characteristics of top technologies and the industries based upon them include: high influence of technological science, increasing influence in service and industry, increasing influence in everyday life, high rate of innovation, short life cycle, great increased value, and compatibility with the environment. Also, the industrial development strategy of the country is considered. According to the document of future perspective of 2025, Iran will be a developed and industrialized country by the year 2020 (Mohammadi et al, 2014). So, one of the main branches of the country's industrial strategy is based on the new technologies which are regarded as the engine for development. Based on the objectives of the document, rapid and sustainable development of the new technologies like nano-technology, biotechnology, information technology, new materials, etc. are all possible via the following actions: increasing the share of the products that are based on knowledge in the national and international fields, increasing the competitiveness of industrial and mineral products and services, systematic support of the development of advanced technologies at the headquarters level, developmental organizations, manufacturing enterprises and the private sector, supporting the establishment of specialized centers of development and scientific and technological parks, supporting the creation and development of companies based on advanced technologies to expand products and services with an emphasis on the nongovernmental sector (Iran Trade Development Organization, 2016). Also, Singapore and Taiwan are considered as role models, since they are two of the most industrialized countries in the Asia, they have phenomenal economic growth and they have invested on the advance top technologies for a relatively long time. Government of Singapore has played the main role in leading the potential knowledge and technology of the country on the path of development and commercialization in order to attain an economic growth. They have tried to aid commercialization and investment in creative and technological plans by creating organizations, offices and different commercialization centers under the supervision of the Ministries of Education, Commerce, Telecommunications and Information, Defense and Art (Wonglimpiyarat, 2013). Government of Singapore has focused on

research and development and commercialization since the 1980s. They lead the companies towards research and development by means of tax incentives and subsidies. Most of the companies that perform in the area of technology in Singapore are semi-governmental companies. Also, there is a savior state network that identifies and supports innovative plans when they are in their primary steps. Another one of the important plans of Government of Singapore is Growth Financing Scheme. According to this scheme, the companies are provided with facilities as much as one third of their financial requirement (Wong and Sai, 2011). In Taiwan, in order to support commercialization, the Association of Private Investors was established in 1999. It was aimed to organize investments. Risk-taking companies work under the supervision of the Ministry of Economy in this country. Also, state organizations are founded to financially support innovative companies. The most important characteristic of the two countries that makes them appropriate role models for our country is investment in the area of advanced technologies that are initiated and supported by the government (Vinglimpirate, 2013). Gregorio Martín-de Castro, in a study entitled "Knowledge management and innovation in the knowledge-based industrial markets with advanced technology: the role of absorption capacity and the openness of the markets" states that knowledge is like a source and innovation is a dynamic capacity are sources for competitive advantage and survival of knowledge-based companies with advanced technologies. Nikolaos Tzokas et al. (2015) in a paper titled "Absorbent Capacity and Performance: The Role of Customer Relationship and Technology Benefits in Small Business Companies with Advanced Technology" focused on the role of the absorbent capacity of the company and customer communications on the performance of the company. They found out that if absorbent capacity is combined with the new product development program, then they can lead the company to a better situation; as strong communications can attract the customers to the development of the new product. With an emphasis on the interactive nature, the history of absorbent capacity and their connection with the performance of the company, this study this study deals with the understanding of the absorbent capacity as a mechanism to translate the outside knowledge to real benefits for small

companies with high technology. Mu Zhang et al. (2014) in a research entitled "Factors affecting the credit risk of high technology companies" discovered that economical situations have great influence on the company credit risk of high technology companies. They also found out that there is a negative connection between the independent innovation and credit risk of high technology companies. So, financial institutions need to increase their supports for independent and technological innovators. Iranians have always tried to develop the economic development of the country by following the same path of progress. Undoubtedly, in today's world where there are complicated situations, changes are great and the competition is severe, in order to have a sustainable and powerful presence in the economic and social realms, there should be a scientific and strategic viewpoint regarding the subject of technology and technological innovations. Also, all the necessary tools need to be used for the realization of short-term and long-term plans (Hajhoseini and Kohanhoosh nejad, 2012). In the past decade, the importance of technology in the growth and development in the economical, social and competitive realms has been realized and technology has always been in relation with the social development. Never in history, has improvement of life standards been so dependent on the technologies. Also, the role of technology in business has been emphasized (Mentzas, 2012). Technology is the main factor that provides the main path for product diversification, cost cutting, creating new business opportunities, and facilitating and supporting strategic changes in organizations (Floyd, 2000). Innovation is one of the factors of corporate excellence in a competitive environment. Current complex and evolving circumstances, including globalization, reduced product longevity and advanced technical acceleration, require the introduction of a set of theories aimed at understanding innovation (Loviler, 1999). If a country or a society wants to have a highlighted presence in the industrial, economical, and social realms and continue its existence in a higher level of growth, then they need to pay attention to the subject of technology and technological innovations. Also, they need to have a scientific and strategic management system and use this system in realization of short-term and long-term perspectives. Here, identification of high level technologies and potential areas of investment are quite

important. According to this and the document of future perspective of 2025, the current study was prepared in order to identify and rank the potential areas of investment in the advanced technologies of Golestan Province. So, the major questions of the study are presented as follows: What are the potential areas of investment in the advanced technologies in Golestan Province? How is the ranking of the potential areas of investment in Golestan Province? How is the relative importance of investment in the advanced technologies in Golestan Province?

3. Method

This is an applied and developmental research and the method for data gathering is descriptive and survey. The target society (decision-making team) includes all the industry elites of Golestan Province including 'Ministry of Industry, Mine and Trade', 'The Industrial Towns Company', 'Standard Organization', 'Department of Environment', and the deputy governors of Golestan Province. They were 15 people in total. A questionnaire was used to collect the data of the research. The questionnaire includes a pair comparison between 6 main factors (6 questions) and also some tables to compare the indexes of every pair. There are 10 questions for the criteria related to industries, 6 questions about electronics, 10 questions about biotechnology and 6 questions about Nano-technology. The method of scoring every criterion is explained in table 1.

Table1. Rating the criteria

Preferred value	Comparison of I vs. J	Explanation
1	Same importance	I and J have similar importance and none is preferred
3	Relatively more important	I is relatively more important than J
5	more important	I is more important than J
7	Much more important	I is much more important than J
9	Totally important	I is totally more important than J and they cannot be compared
2, 4, 6, 8		These are the in-between values. For example 8 has more importance than 7 and less importance than 9

In order to analyze the data of descriptive statistics frequency distribution tables, frequency percentage, mean and charts were used. Also, in order to answer the research questions Analytical Hierarchy Process (AHP) and the different types of software like Excel, SPSS, and Expert Choice were used. In order to perform the Analytical Hierarchy Process, it is necessary to draw a hierarchal tree with objectives, criteria and Sub-criterion (Momeni, 2012). In the next step, we need to prepare the tables of comparison for couple comparisons of criteria and sub-criteria and give them to the people who take part in the research. In the third step, the filled tables need to be inspected in terms of incompatibility rate. Here, we give back the tables with an incompatibility rate of more than 0.1 so that they reconsider their judgment. Finally, the ideas are combined to create a final ranking of the criteria. In order to rank the criteria and determination of the priority Export Choice 11 Software was used.

4. Findings

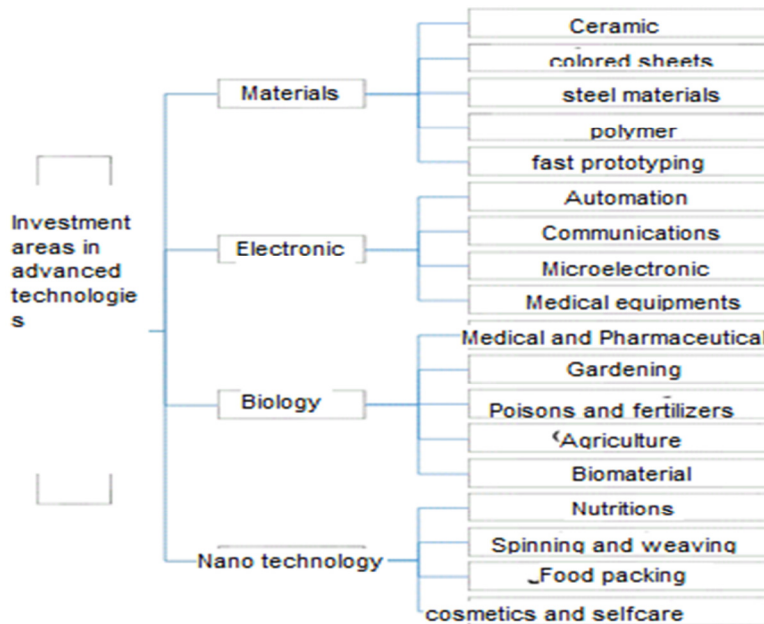As stated before, in the first step decision-making tree is drawn as figure 1.

Figure 1. Analytical hierarchy process

The degree of importance and the influential criteria on the investment in the advanced technologies in Golestan Province were determined using Choice Expert Team software. The weight of the four influential factors on investment is presented in table 2; It shows that Biological and Nano-technology have the highest weight and the factors of material and electronics have the lowest weights.

Table 2. The merged matrix of pair group comparisons

Major factors	Materials	Electronics	Biology	Nano-technology	Level 1 weights	Rank
Materials	1	3.01	0.330	0.493	0.176	**3**
Electronics	0.332	1	0.338	0.249	0.089	**4**
Biology	3.03	2.96	1	2.03	0.441	**1**
Nano-technology	2.03	4.02	0.493	1	0.294	**2**
IR = 0.06 < 0.1						

In Table 3, the weights obtained for the indices are presented based on the response of the experts in subgroups using the pair comparison matrix of subsidiary factors (Materials).

Table 3. The pair comparison matrix of subsidiary factors (Materials)

Materials	M1	M2	M3	M4	M5	Level 1 weights	Rank
M1	1	2.3	2.19	2.24	1.45	0.332	**1**
M2	0.435	1	0.763	1.71	1.81	0.188	**3**
M3	0.457	1.31	1	0.901	2.39	0.201	**2**
M4	0.446	0.585	1.11	1	1.14	0.150	**4**
M5	0.690	0.552	0.418	0.877	1	0.130	**5**
IR = 0.05 < 0.1							

In Table 4, the pair comparison matrix of the subsidiary factors (Electronics) shows the weights obtained for the indices according to the experts' answers in the four subgroups.

Table 4. The pair comparison matrix of the subsidiary factors (Electronics)

Electronics	E1	E2	E3	E4	Level 1 weights	Rank
E1	1	0.575	0.671	1.78	0.216	3
E2	1.74	1	1.81	1.31	0.346	1
E3	1.49	0.552	1	2.01	0.271	2
E4	0.562	0.763	0.498	1	0.166	4
IR = 0.05 < 0.1						

In Table 5, the pair comparison matrix of the subsidiary factors (Biology) shows the weights obtained for the indices according to the experts' answers in the four subgroups.

Table 5. The pair comparison matrix of the subsidiary factors (Biology)

Biology	B1	B2	B3	B4	B5	Level 1 weights	Rank
B1	1	1.69	0.518	1.63	1.58	0.227	2
B2	0.592	1	1.86	0.671	2.21	0.223	3
B3	1.93	0.538	1	1.76	1.79	0.250	1
B4	0.613	1.49	0.568	1	1.82	0.188	4
B5	0.633	0.452	0.559	0.549	1	0.112	5
IR = 0.08 < 0.1							

In Table 6, the pair comparison matrix of the subsidiary factors (Nano-technology) shows the weights obtained for the indices according to the experts' answers in the four subgroups.

Table 6. The pair comparison matrix of the subsidiary factors (Nano-technology)

Nano-technology	N1	N2	N3	N4	Level 1 weights	Rank
N1	1	1.91	145	2.46	367.0	1
N2	0.524	1	3.01	2.93	0.335	2
N3	0.690	0.33	1	2.3	0.190	3
N4	0.407	0.341	0.313	1	0.108	4
IR = 0.08 < 0.1						

In Table 7, the ranking of the potential areas of investment in the advanced technologies based on Analytic Hierarchy Process (AHP) is provided. As the Table 7 shows, Fertilizers and poisons, Food production, and Medical and Pharmaceutical areas are the highest ranked and the Medical equipment, Automation and Fast Prototyping are the lowest ranked areas of the potential areas of investment in the advanced technologies in Golestan province.

Table7. Ranking of the potential areas of investment

The main factors	The weight of main factors	Symbol	Subsidiary factor	The local weight of subsidiary factors	Final weight	Rank
Materials	0.176	M1	Ceramic materials	0.332	0.058	7
		M2	Colored sheets	0.188	0.033	11
		M3	Steel materials	0.201	0.035	10
		M4	Polymers	0.150	0.026	14
		M5	Fast prototyping	0.130	0.023	16
Electronics	0.089	E1	Automation	0.216	0.019	17
		E2	telecommunications	0.346	0.031	13
		E3	Microelectronics	0.271	0.024	15
		E4	Medical equipment	0.166	0.015	18
Biology	0.441	B1	Medical and Pharmaceutical	0.227	0.100	3
		B2	gardening	0.223	0.098	5
		B3	Fertilizers and poisons	0.250	0.110	1
		B4	Agriculture (seeds)	0.188	0.083	6
		B5	biomaterials	0.112	0.049	9
Nano-technology	0.294	N1	Food production	0.367	0.108	2
		N2	Spinning and weaving	0.335	0.099	4
		N3	Food packaging	0.190	0.056	8
		N4	Cosmetics	0.108	0.032	12

5. Discussion and Conclusions

One of the most important tools to attain competitive advantage is using advanced technologies in the contemporary businesses. If used correctly, they can improve business and aid competitive advantage in different aspects. So, using the appropriate technology may lead to valuable results for capital productivity. In the current study AHP method was used to identify and rank the potential investment areas in Golestan Province. This method has been used in the researches of Datta et al. (1992), Weber (1993), O'Brien & Smith (1993), Albayrakoglu (1994), Chan et al. (1999), Dey (2004), Shyjith et al. (2008), Anand & Kodali (2009), Ordoobadi (2012), Farsijani et al. (2014), and Zavadskas et al. (2015). Their results were used to identify the areas of investment. The results of the current paper indicate that the factors related to biology

are in the first rank and the ones related to Nano- are the second in investments in the technologies in the province . Also, according to the finding of the research the 5 subsidiary factors for the main factor of the 'materials' are: 1. Ceramic, 2. Steel sheets, 3. Steel ingots, 4. Polymers, 5. Fast prototypes. The 4 subsidiary factors for the main factor of the 'electronics' are: 1. Automation, 2. Telecommunications, 3. Microelectronics, 4. Medical equipment. The 4 subsidiary factors for the main factor of the 'Nano-technology' are: 1. Food production, 2. Spinning and weaving, 3. Food packaging, 4. Cosmetics. The 5 subsidiary factors for the main factor of the 'biology' are: 1. Medical and pharmaceutical, 2. Gardening, 3. Fertilizers and poisons, 4. Agriculture (seed), 5. Biomaterials. According to the findings of the research each of the subsidiary factors of the 'electronics' includes: 1. Telecommunications, 2. Microelectronics, 3. Automation, 4. Medical equipment . According to the findings of the research each of the subsidiary factors of the 'biology' includes: 1. Fertilizers and poisons, 2. Medical and pharmaceutical, 3. gardening, 4. Agriculture (seeds), 5.Biomaterials. According to the findings of the research each of the subsidiary factors of the nanotechnology includes: 1. Food production, 2. Spinning and weaving, 3. Food packaging, 4. Cosmetics.The findings indicate that biological elements have the highest rank in investment. This is in favor of Yang Yang Deng's findings (2016). These researchers emphasized on investment in the biological industry as well. Though not far ago, there was a huge emphasis on the capital and human resources in economical models, with the overcome of macroeconomics over microeconomics technology started to appear in these models. This went on so much that now technology is at the heart of these economic growth models. Today, the economy of the developed countries is based upon the enterprises with progressed technology; for example, half of the American export is done by companies with less than 20 employees and companies with more than 700 employees only do 7 percent of the American export (Atafar, 2016). This might be the result of the rapid growth of technology in the past decade. Knowledge-based industries like information, hygiene, etc. are focused by global stock markets. The basic factors for the development of these high-tech industries are innovation and technological strength. On the other hand, the factors for the

success of the macro industries are physical capital and saving based on the scale. But this is not a competitive advantage anymore at the moment. Studies on the technological changes in the world indicate that technologically advanced companies have and increasing share of the global economy. One of the important factors of economic growth and competitiveness of the countries is paying attention to innovation, especially advanced technologies in production and commercial enterprises (Farsijani, 2014). Undoubtedly, knowledge and technology are the most important courses of economic development and the progressed and successful countries are the ones that are able to transform scientific and technological innovations into wealth (Orduyady, 2012). The Iranian government has tried so much to facilitate the economic development of the country by producing industrial productions based on science and technology. But Iranian industry is quite weak in this field. One of the factors that affect the growth and development of these companies is investment in technology. But fundraising in the area of advanced technologies requires identification of potential areas of investment and this has is quite important. Findings indicate that biological factors are the first, and nano-based technologies are the second in the field of investment in the advanced technologies of the province. So, it is suggested that the organizations that determine investment in the province cooperate to attract the domestic and foreign investors so that the economy of the province revitalizes and finally the rate of unemployment decreases in the province.

6. Acknowledgment

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