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Examining the Development Challenges of Science and Technology Parks in Iran and Providing Strategic solutions

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Examining the Development Challenges of Science and Technology Parks in Iran and Providing Strategic solutions

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Abstract

The fact is, we are living in a world that, due to the pace of technological change, has become much different from the past. The world is changing and the pace of change is increasing day by day. Iran, like all countries of the world, needs to develop technology to achieve progress and comprehensive development. Hence, various mechanisms, including science and technology parks, have been developed to achieve technological goals and sustainable development. The Challenges of the Development of Science and Technology Parks and the Review of Strategic solutions for these Challenges The main objective of this paper is to examine the concepts, processes, and models available and, taking into consideration the effective work that has been done in the world's most prominent parks, to model Applicable to science and technology parks in the world. The research method used is grounded theory. The data gathering method was a deep interview with ten managers, experts from Technology Park and Shezan Accelerated Center. Sampling was done using purposive sampling. The results of the interviews have been analyzed in two phases identifying the challenges of park development and providing strategic solutions. The first phase is to identify the challenges of park development in the form of three main themes, marketing challenges, management and structural challenges, and the challenge of the ecosystem of technology. Finally, the two models are depicted. In the second phase, in order to overcome these challenges, we have proposed strategic solutions that are based on four main themes of management and organizational solutions, the creation of technology ecosystems, marketing strategies and supportive strategies. Two models of Strategic solutions are presented here.

Keywords: Challenges of science and technology parks; grounded theory; science and technology Park

Introduction

In fact, we live in a world which has changed a lot due to the increasing rate of technology revolution. The world is changing and the speed of such change increases day by day. Some new technologies appear and then their use expires so quickly and other technologies are released to the bazaar. On the other hand, the technology always correlates with the advancement and the development of the society and never like today, correlated with the life standard development. Maybe it's the most important reason of quick advancement of our nowadays world. The development as one of the most important goal of the humankind societies, requires some tools like technology to drive to affect their components toward the growth way. The improvement and comfort of the societies, economic boom, industrial development, wealth creation and making the competitive advantage is the result of the utilization of the technology and its advancement (Hajiqolam Saryazdi & Manteqi 2013). Nowadays, the means to achieve the sustainable development is not found in the resources nor in the industrial competences, but in the knowledge and the experience of the human force as the most important fund and the cause to reach the organization goals. Undoubtedly, if an organization can't utilize the useful thinking competence and views of the professional and committed human force efficiently and fails to use such a priceless fund in the economic, social and cultural development, can never achieve the goals of the sustainable development even by possessing the best advance facilities (Zabbah, 2010). In countries where the economic development is considered based on the promotion of innovation and investigation and based on reindustrialization by advance technologies, the construction of the science and technology parks is one of the fundamental solutions. It's about 50 years that this solution was used by developed countries and the positive results attracted the developing countries. Iran like other countries needs to develop the technology to reach the improvement and development in all aspects. In Iran the main axis of the fourth plan of the development, is the awareness and the knowledge and in this plan and in this plan a great deal of attention is paid to science and technology parks. Thereby, various mechanisms like science and technology parks are made to realize the technological goals and sustainable development. (Hajiqolam Saryazdi et al., 2009). Such parks attempt to make basis to reach a level of growth and sustainable development and deepen the knowledge base economy by

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establishing small and medium companies and providing the facilities and supports. In other word, these parks help them to make a link between the universities and the industry by using outstanding forces and entrepreneurs and using the technologic ideas and commercializing them, just by supporting such companies to develop such ideas, and therefore it causes the growth and sustainable development based on competitive advantage in a national, regional or worldwide level.

Scientific parks attempt to reach their goals by making the interaction between the role of science and innovation producers such as companies and profit and non-profit institution, universities, investigators and entrepreneurs. Since often the geographical vicinity is a fundamental solution to exchange the technical science naturally, the science parks attempt to attract and install the knowledge base companies and institutions near each other by providing the infrastructure space and high added value services. The average time to achieve to the goals of parks, in case of success, is estimated to be 10 to 15 years in some studies, while in some studies rate of fails was reported to be high (Zhang An 2005).

But highly found in the subject literature, the presence of a positive capacity in parks is so emphasized for economic development of the host region. In several studies, the necessity of parks attention to regional advantages (host region) was reported. Indeed, the parks success was due to the exact scientific and economic analysis of the region, choosing the relevant model, creating a practical strategy and effective marketing management; in other word, the positive capacity of parks can be realized in case of presence of a suitable market for the parks activities. The appearance of first parks in Iran doesn't belong to long ago and thereby the special case studies in Iran are so rare and majority of the published articles are the review of the subject literature and other countries' experiences (Farjadi & Riyahi, 2007).

In the literature of such park, the aspect of management view is rarely studied. With a management view, challenge analysis is so essential for an increasing success. In case of the lack of study about such challenges, the parks would fail to determine the necessary strategies, orientation and positioning. On the other hand, most parks in the developing countries such as Iran are established by the governmental investment and benefit from governmental supports. According to the high cost that such parks need, lack of attention to the challenges of the park may lead them to some troubles, therefore the case studies about parks in Iran seem to be necessary due to such challenges.

The factors playing an inhibitory role to the growth and success of science and technology parks, are generally divided in to two classes of internal and external factors. The external ones are not dominated by the managers and internal scheduler and the incubator, and generally relate to the major problems of the country and the governments. The internal factors are the ones whose appearance points can be found the parks or the growth factor per se. in addition to these factors, some others can be found that were in the various recent studies in detail. We name some of them such as the regulatory weakness about the Intellectual Property Rights and ignoring this subject, lack of adequate attention to the non-science oriented businesses, presence of some cumbersome official structures, lack of trust for presenting the reports and records to the ideas, lack of adequate experience for Entrepreneurship and the support center management, and disability to provide appropriate consultation services for commercialization due to the lack of experiences (Eslami et al., 2009, Khosravi et al., 2005). Thus in the present study, we would assess the challenges of the science and technology parks and then try to analyze them strategically and at the end, provide the strategic solution of the subject.

A review of the subject literature

Science and technology parks

There is no unique definition for the science and technology parks and it's not surprising because the parks possess various shapes and properties. The lack of a unique definition has led to conceptual problems in the articles (Amirahmadi 1993). The expressions, used to define the parks are more or less similar, namely research parks, science parks, technology parks, innovation center, technopolice, incubators and science city. Among the reasons of the major difference in the park patterns and models and incubators in the world, is the difference in the properties, in other word, it's the vulnerability of the innovation system in the countries, where consequently the parks and the incubators are made to offset such weaknesses based on the facts and the condition of the country, and the more defects are found in the innovation system, the more practical range is needed to be developed for the parks and the more complicated duties are assigned to them. (Soltani et al 2005).

The international association of science parks, defines the science park as this:

" a park is an organization that is managed by professional persons and whose main goal is to increase the society wealth and to promote the innovation culture and make competition among dependent commercial and knowledge base organization. In order to reach this goal, the parks manage the state of science and technology among the universities, research and development centers, companies and markets. The parks facilitate the creation and the growth innovation oriented companies by Incubators and productive processes. Besides, they provide some other added value services such as space and high quality facilities. The expression of "science park" can be replaced with "technology park, technopark and research park"".

The British association of science park, defines the science park as an approach to transfer the technology and commercial support, which is founded to support the newly-created companies with a quick rate of growth, knowledge base and innovative ones. It provides an atmosphere for big and international companies in order that they can have a close interaction with science producer centers to create mutual profits. Official and practical communication with science producer centers like universities, colleges and research organizations can be created. According to this definition park has a knowledge base business necessarily, thus each science park realizing such a definition, can considered as an industrial park. In addition, other problem is the presence of some other expressions like research parks, innovation centers and commercial centers, which sometimes are regarded to be the same. (Sublenz et al 2008).

Since 1980s, several studies were performed about explanation of the differences in the park models in term of practical aspects, the management approach and even the growth mechanism, while we can't reach to a classification accepted to all so far.

Leo (1985) classifies the parks into three kinds namely research, science and technology parks according to the participation of universities in management and the type of research activities. In his opinion, the universities play a key role in the research park management and the main attention belongs to scientific advancements. The main attention of the science park is paid to research and producing the samples and the technology park pay more attention to commercial use of the advance technology; besides the university contribution in the parks are minimized and maybe disappeared.

Also, Grayson (1992) believes that the main activity of parks is to create a crosslink between the universities and the industry in the field of new technology, led by the universities, where scientific and technologic advancement has a great importance. He considers the science park as a place close or inside the university where development researches and producing samples are found, too. He believes that there are usually the high tech commercial universities in the technology parks and the university contribution seem to be minimized (Zhang 2005).

The technology parks are some places for innovation which are managed by experts whose goal is to promote the society wealth and prosperity, introduce the growth of the technology base companies by Incubators and spin-off, and provide other added value services with a high quality physical space and support services. (Anprotec ،2008 ؛ Steiner et al. ،2015). In fact, technology parks or so called "tech parks" are some geographical areas where a set of building hosts the selected entrepreneur companies. These companies are research and science oriented and contributes in scientific subjects. The sources and the provided services in the technology parks include some facilities for technologic license, introduce commercial exhibitions, supplying funds to commercialization, distribution and release the information about the research and development activities of their guests (Löfsten and Lindelöf ،2002؛ Squicciarini ،2009؛ Cumming and Fischer،2012). Therefor they play an important role for investment and regional development (Åstebro و Bazzazian, 2011), especially in the developing economies (Armanios 2012).

Porter (1989) considers the science park as a place close to the university to install knowledge base companies. Contrary to others, he believes that the research parks have less apparent link to the universities and the technology park (technology pole) is a vast space for the science oriented activities which concentrates the most on technology transfer. He considers the crosslink between university and the park as a weak one.

Minshall (1983) hasn't named the research park in his study. He considers the science park as a place to perform research activities, engineering and sampling where no minor production is allowed. In his view, the attention of technology park is paid to develop and improvement of the quality of the products and contains a vast range of

activities such as R&D, minor production in the field of advanced technologies and services. He has named the industrial parks and considers their focus on production and services in classical industries (Zhang 2005).

Loger and Goldstein (1991) have named some official parks and commercial incubator other than science and technology parks, and suggested that their activity is less dependent to research and technology. They consider the most focus of the industrial parks to the production and the official ones to management and sale activities. The commercial Incubators provide some buildings to install newly created and small companies.

The history of science parks and a comparison between the types

The science parks were first established in the USA in the early 1950s. the Stanford science park in California is known to be the first science park. This park was established on 1951 and first, it was named Stanford industrial park, but then due to tendency of attraction and installation of research institutions, it was renamed to research park (Farjadi & Riyahi 2007). The growth of science park was so little until 1970s, somehow there were just 39 science parks, while since 1980s, and it has an increasing rate of growth. By the year 1990, more than 270 and by the tear 2000 more than 900 parks were founded worldwide (Zhang 2005).

Such increasing growth was due to the increase of the importance of knowledge as an important factor of the competitiveness among countries and companies in the late 20th and it caused an increasing attention to support science oriented institution by the developed countries. In the 1970s, some reports was presented about the positive results of the activities of some science parks like Stanford science park, triangular research park and some other industrial ones such as Silicon valley, road 128 and Cambridge park, which made them the patterns to follow. After this, a great deal of planned industrial classes with various name and dimensions were founded in fields of high technology by the complete supports of worldwide governments. For example, technopolices in japan contains several zones and cities and the area of the science cities is like an area of a real city. Minor spaces are usually called research park, science park and technology parks while the incubators have a space about just some buildings. In some cases, all models are considered as science park (Zhang 2005).

In a recent study Loger (2000) added some parks with distribution storages containing big storages with advanced technology and logistics and some green industrial parks linking among installed institutions to minimize the amount of wastes and pollution, to the before-mentioned cases.

According to the mentioned studies, without any special delimitation among the types of parks, the differences of various models of parks are assumed to be in the focus on R&D activities and the area, and merely the category which was refer the most in the articles, is considered. In spite of the ease of understanding the differences between the parks, this definition seems to be useful. The differences are more or less demonstrated in the figure 1.

Fig 1. Types of park models
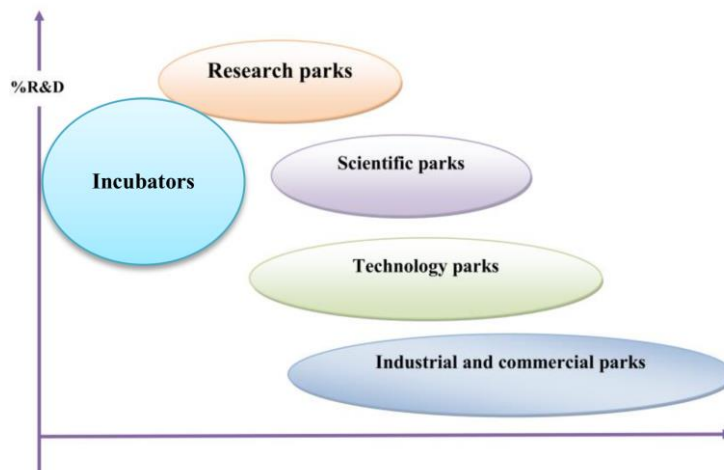
As seen in the figure 1, research parks are mostly the places to support the research and develop the science and technology. The physical presence in such parks doesn't relate to the industry necessarily and mostly such parks are dependent to universities.

Industrial and commercial parks are designed according to industrial and commercial companies. It's so rare that the activities of the participants in park are definitely a scientific or technical R&D and maybe they do these activities as a part of their commercial activity.

Among this, technology parks are placed in the class of commercial and research activities and contains both the organizations which are involved in science or technology R&D ,and the commercial and industrial companies, in other word, the technology parks are created to exploit the opportunities made due to key changes in technology and it's allowed to produce lightly in such parks (Farjadi & Riyahi 2007).

In the science parks, the focus is more on research activities than technology parks and producing the science in the incubators is cheaper than the parks. In fact the parks are the official links of the contribution among universities, research institutions and high tech companies, while the incubators are founded to support the newly created companies and to commercialize them. (Robini 2002) and most of their services has subsides. Anyway, the goal is to increase the society wealth by science oriented activities. Indeed the used strategies by each parks, depends on the park to reach the goal per se (Farjadi & Riyahi 1386).

The importance of science and technology parks
Despite of vast remarkable investments, there is also a question about the efficiency of science and technology parks as a tool to improve the technology and develop the innovation policy. On the other hand, some investigators conclude that science and technology parks have no significant effect on the host company, because they fail to develop the collaboration and increase the added value. (McDonald 1987). Besides, Massey, Quintas and Wield (1992) criticize such parks. Several experimental studies show that no significant differences are found between host companies in science and technology park and other companies which have not attended in term of results and utilizing the researches and innovations (Colombo & Delmastro 2002).

Likewise, other group concludes that the science and technology parks can create a support atmosphere for the science oriented companies by facilitating the technology transfer, attracting the companies and making them grow. Some experimental studies show that having a place in the park is profitable due to several aspects, such as creating a foreign collaboration (which may have a positive influence on the company achievements) and increasing the research performance and supporting while requesting a license(Albahari ،Barge-Gil ،Peres-Cantó ،& Modrego-Rico، 2013). Some researchers have some other explanations: the parks are heterogeneous. Some of them don't work correctly and are just valuable for the host companies, while some others disagree. Albaheri et al (2013) evaluate the heterogeneous influence of parks on the innovative performance of host companies, and suggest a new view in the literature of science and technology parks.

The collaboration improvement between universities and industry is one of the most important strategies of developing countries to promote the innovation and increase the innovative performance. (Gulbas 2011) and such parks are founded by the collaboration of the universities and industry and governments (Yalcintas 2014). According to Storey and Tether (1998), the science and technology parks play some roles such as : encouraging scholars in the local universities to advertise the research ideas, providing a place for actual big companies which are willing to get close to the university, facilitating the research link to persons or sectors in universities, and providing a high quality place for the small businesses which are getting used to utilize and develop high technologies.

The properties of science and technology parks

According to a report of European Commission (2014), among the whole properties of the most science and technology parks, these cases are the most important ones. First, they choose exact policies to get the companies host the parks. Secondly, innovation based companies are prioritized. Thirdly, they take part in transferring the science (mostly by universities and research centers). Fourthly, they attempt to promote the collaboration with other Performers in public and private sector. Fifthly, they manage or control one or more incubators. At last, they design commercial services for innovation which are made to profound the innovations and technology transfer locally or in the park.

Some main dimensions exist in all science parks worldwide. Generally, park is an organization: which create an innovative atmosphere, having essential infrastructures for research field (place, buildings, professional links and support services). The facilitator of the small and big organization growth, provider of various services and aids (like incubators for new companies), involving institutions and other scientific organization in R&D processes, performing and exploiting the innovation from fundamental sciences (Ramezani et al 2013).

In order to evaluate the park performance, the European Commission uses these indicators:

i.   Parks and the area
ii.   The number of hosted companies and their employees. Other useful information about the jobs created due to the park and the professional employees' activities like doctors and engineers.
iii. Number of the companies in the park and number of their employees
iv.   The rent and the services provided by the park, monthly, annually, or totally
v.   Service types and domains provided by the park (Bandwidth, video conferences, meeting room, event management, official supports and etc.). some of these services are free, while some can produce side costs or are comprised in the rent contract.
vi.   The professional service types and ranges, provided (directly) by the parks or companies (for the park purposes) (such as accounting, training, accessing to financial risk, marketing, developing advertisement campaigns and etc.). these services are for the companies may be free or costly.
vii. Funding for the investment and operative purpose
viii. Fundraising for the region by the parks with cooperation of other institutions like research centers

On the other hand, one of the other studies (like Fukugawa 2015) evaluates the influence of science and technology parks on the result of host company innovations. Most of the studies in this field are due to the comparison between the host companies inside and outside the parks and also in response to surveys by the managers of companies and park. The studies focus on the variants like the number of the years the companies are active in the park, the research costs, development and innovation and the number of employees or invention required for the companies and the effects of parks on host companies.

Science and technology park profits

In order to understand how science and technology parks can promote the potential to grow the company, it's necessary to consider the roles constituted of physical vicinity of companies, universities and research centers and also the real park management (Löwegren 2003). While studying such physical vicinity among companies, this subject can mention similar companies until they share a common industry or technology. Marshal (1920) and Croogman (1991) believe in a view of economic and geographic that accessing to a professional job and providers, and easy science transfer and the demand for the services are less (Vedovello 1997). Porter (1998) mentions that these similar companies make a co-op competition in the additional industries; because in some activities they need each other but consequently, they compete in the markets.

Whilst, the companies in these parks also can be of various industries and technologies which provide them other accumulation advantages- Jacobs side effects (Bøllingtoft and Ulhøi 2005). Local links to companies from various industries possessing varied knowledge bases, can provide some opportunities for new composition of science and other resources (Grimaldi and Grandi 2005 Hu 2007).

The science and technology parks can also provide the advantages of vicinity to universities or other educational institutions, such as releasing developed special techniques in universities, solving the special problems experienced by the companies, using the exam services and analysis provided by the universities, employment of staff from university and etc. (Vedovello 1997؛ Bakouros ،Mardas ،Varsakelis 2002؛ Löfsten and Lindelöf 2002). Also, the manager of the parks can do some efforts to initial support structurally such as commercial web, accessing to the funds, regulatory aids and accounting and etc. (Löwegren 2003). The manager can help the companies to make links to other bases and national and foreign institution from non-governmental organization (Grimaldi and Grandi 2005).

While the physical vicinity is essential to understand the advantages of the science and technology parks, develop the organization views, cognitive and social ones (Beshma 2005) and this development may promote the trust links (Schwartz and Hornyn 2008؛ Díz-Vial and Motroe Sanchez 2014). By this view, developing the science and sharing

the resources, is an advantage which just the companies involved in social interactions can utilize, especially when the science is weak (Capello 1999).

The last contributions focus on the properties of each company inside the park (Vásquez-Urriago ‹Barge-Gil ‹and Rico 2016). The inside properties of companies provide their condition to communicate with other bases and institutions, because the companies with better resources, have more access to the links (Phelps, Haylde and Vadova 2012). Besides, the inside properties of companies are limited to the attraction capacity (Cohen and Levinthal 1990) and in a special condition that companies need to realize the information and science values, the attract them and use them for the commercial goals which depend to the base knowledge of this company (Cassiman و Veugelers 2006). Also there are some recent studies considering the importance of this point that parks can improve in which condition (Grimaldi and Grandi 2005 ‹Albahari 2015).

Methodology

This study is a qualitative one and use the data base theory as the research method. The grounded theory method is a qualitative method by which the theory evolutes by a set of data. As this theory determines a process in a broad level and the action and interaction. In this method, one doesn't start the theory from a point and then try to prove this, but the study starts from an investigation period and one has an opportunitty to show what is relevant to that (Bazargan 2008).

According to the subject, the sample of this paper is the experts, managers of the Pardis technology park and accelerator innovation center of Yas & Shezan which are selected by the method of chain reference. The sampling meethod is purposive sampling. The method of data collection is the deep interview. In this study, we interviewd 10 persons, and we observed a repeat in the responses after the fifth interview, but in order to assure, we continued until the 10th one. The interview start by some questions about " the challenges of developing the science and technology parks" (open interview) and the rest questions are designed according to the responses. All the interviews are recorded and studied to assess the key points.

The coding steps in database

1. Open coding
2. Axial coding
3. Selective coding

First step: open coding

The steps of open coding include:

1. Analysis and coding. In this step, the sampling should be done broadly as the researcher can discover the concepts in the open position. In fact, the scholar should pay attention to each interesting event coding. Maybe we can extract a lot of codes from an interview (text) but when they are revised, the final codes are determined.
2. Discovering the classes. In this step, the concepts are classified according to the relation to similar subjects, which is called classification (theming). The titles of the classes are mor summary than the concepts which constitute the whole class. Each classe has a high conceptual power; because they can collect the concepts on their own axis. The selected titles are mostly opted by the scholars and they try to consider the most relation and correlation with the data showing them. Other important origin (titles), is the word or expressions that the participants (interviewees) use in the study and can be practical for the researchers.
3. Describing the classes according to their properties. In order to clarify the classes, in the nest step their properties are explained.
4. Open coding table. Which contains two parts: a table of initial extracted codes from interviews and a table of second extracted codes.

Initial coding: in this step we select some titles for ate ket points then all the titles are collected in a table.

A sample of extracted codes from one of the interviewees, is provided in the following table.

Table 1. Primary coding

1. Initial coding (first interview)
1. Necessity of paying attention to the territory logistics in the ecosystem of the national technology
2. Local prioritization of the innovation
3. The necessity of innovation of the performers of the technology line governments, persons, companies and institutions
4. Presence of a power layer determination in the innovation ecosystem of the parks
5. The role of encouragement of the investability in the innovation ecosystem
6. The necessity to introduce the pole of technology in a university infrastructure
7. The necessity of attention to technology ecosystem
8. The necessity to develop a coherent map of national technology
9. Dividing the duties between the technology parks
10. The necessity of attention to create a start-up ecosystem
11. Synergy in the parks
12. Synergy among the members of the parks
13. Policy challenges and the numerous policy institutions
14. The infrastructures of the technology parks
15. Belonging the parks to the government
16. Interaction with the private sector to develop the parks
17. International communications to develop the parks
18. Necessity to shift the attention from supplying to demands or stimulation of the industry needs to use technology parks
19. Attention to the presence of prosperity facilities and public services for park members
20. Income aspect of the parks
21. The necessity to install the research units and develop some various industries in the park
22. Supplying the appropriate human force by creating a link to university
23. The evaluation of the companies which are park members
24. Necessity of paying attention to the territory logistics in the ecosystem of the national technology
25. Local prioritization of the innovation

The secondary coding and shaping the main themes: in the next step, the initial codes are converted to secondary ones due to their number (initial codes are placed in similar classes). Multiple secondary codes turn into one conceptual code. In these tables, as an example, the open coded results, conceptual ones and the themes are provided.

Table 2. Secondary coding and the formulation of conceptual codes and categories in Identifying challenges

frequency	Secondary codes	Conceptual codes	Main themes
19	attention to increase the park efficientcy installation of R&D units belonging to various industries in the park attention to the companies inside the park shift the attention from supplement to demand or stimulation of industry requirements for using the park technology synergy between the park members privatization of the park attention to the main duties of the park one established organizing of national accelerators more flexibility to develop the parks presence of a responsive system creation a fair and constructive competition between parks continuous study while developing the parks prevention from the domination of the parks clarification of the park structures creating a distinction between universities and parks in regulation parks should play a management role in relation to industry and the companies should communicate with the industry per se responsivity to governmental institution increase the synergy between the park companies creating a link between the companies and other various sectors togather	**Structural modification**	**Management and organizational solution**
6	Park aid to companies and industries to clarify their requirements Regarding the park roles, important to solve the problems Close collaboration of parks with industry and meet their needs Involving the parks into major problems of the country like air pollution and providing a solution Attention to country requirements to attract the companies Attention to prioritized domains in the country to attract the companies	**The university and industry link management**	
3	Presenting an appropriate perspective and the main missions of the organization Long-term perspective in the parks Prediction of technology megatrends in the future	**Strategic view to the future**	
14	The presence of powerful layer determination in innovative ecosystem of the parks Presenting encouragement of investability in innovative ecosystem Creating technology poles in university infrastructure Attention to technology ecosystem Dividing the duties between the parks Attention to create start-up ecosystem Synergy between parks Attention to terittory logistics in technology ecosystem of the country Determination of local priority of innovation Creating the institution for developing the technology Presenting a model by the park in which the companies, accelators, universities and the industries exist Mentorization and ecosystem management of open innovation	**Technology ecosystem**	**Ecosystem creation solution**
6	Attention to presence of the prosperity facilities and public services for park members Creating professional fablab in the parks Creating powerful infrastructure and laboratories	**Supplying the required infrastructure for the park**	

	Presenting prosperity and essential infrastructures in parks Attention to prosperity infrastructures like accomodation and etc. Creating the background for participation of the industry experts and socialists and etc.		
4	Attention to training in the parks Supplement of appropriate human resources by creating links to universities Use expert human force in the park Innovatory of the performers of the technology like innovative governments, persons, companies and institutions	**powerful human forces in the park**	
5	Sales and export the products from parks Income view of parks Attention to marketing and product sale by the park companies Dealing with economical efficiency of parks Attention to the importance of the parks duties in turning the science into wealth	**Economic performances of the park**	**Marketing solution**
4	Introducing the park to society and park branding Introducing the park place to organizations, universities and other persons in the society Targeting the visits of the organizations and various institution from the parks Attention to park banding	**Attention to park branding**	
6	Evaluating the park companies Parks as a medium between problem solver teams Creating a set of technology services for the companies like accounting, law and investment Developing the service companies in the parks like professional market companies, insurance companies and law firms Creating judgement commitees for facilitating the companies in law problems Reducing the risk of member companies of parks	**Providing the services to major companies**	**Support solutions**
3	Presence of governmental support institution for parks Interaction with private sector to develop the parks Creating international communication to develop the parks	**Providing the support elements**	

Table 3. Secondary coding and the formulation of conceptual codes and categories in Identifying challenges

frequency	Secondary codes	Conceptual codes	Main themes
8	Lack of dealing with the economical efficiency of parks Being supplement oriented parks and lack of demands in parks Lack of presenting a marketing model and appropriate sale fot companies Looking for early return businesses by the parks and industries Financial shortage of industries cooperating with the park companies Lack of policy in making the park companies, demand oriented Expectation of high return from start-ups and park companies Sale and export the products from the parks	**Economical challenges**	**Marketing challenges**
10	Low trafficin the parksby scholars and industries Lack of acceptance from foreigners for parks Bringing the call centers to parks instead of R&D experts Too much dependence to statistic and lack of attention the actual returns Lack of prioritization to attract to parks Weak cooperation between university and parks and installed companies	**Weak brand challenges for the universities and industries**	

	Lack of correspondence of the output of universities with the park demands and the demands of installed companied Lack of trust to parks by industry		
13	Lack of flexibility of tax organization dealing with park companies Lack of definite authorities for the parks Lack of familiarity of government and parliament and policy makers with the park Lack of appropriate responsible for parks and knowledge base companies Lack of upstream act about parks and knowledge base companies Weak experiences of some managers in the park Governmental industry of the country Economical problems of the country Management and structural problems Massive advertisements of foreigner products and imported ones Unfair competition in the parks Policy making challenges and multiple policy making institution	**Management and structural challenges**	**Management and structural challenges**
9	Lack of attention to future planning necessary for park growth once the establishment (like predicting the parkings) Lack of long-term views in parks Lack of development model for parks Lack of agreement on a unique strategy Lack of determining the inside and outside duties Doing some duties beyond the parks capacities Dealing with some side subjects (building view and etc.) in the parks Incorrect definition of the park duties (a place to give cash to companies) Lack of prioritization to attract the technologies to parks	**Ambition in unique strategy**	
4	Presence a view of needing a sponsor in parks Lack of appropriate role of banks Limitation of funds Overuse of governmental budget	**Inappropriate support challenges**	**Technology ecosystem challenges**
3	Working insularly of park companies Seperation of parks from innovation ecosystems and start-up ones Lack of a unique technology ecosystem	**The lack of technology system challenges**	
4	Lack of a powerful organization in parks in term of human force Lack of activity and adequate energy in the park companies Lack of appropriate filters to attract the companies Presence an official atmosphere and morality instead of expert ones	**Human resource challenges**	

Shaping the main classes

After determining the subjects, we would follow the step of main class creation which is provided in the following tables.

Table 4: Formation of the main classes of categories (sub-classes) in Identifying challenges

Main classes	Categories (sub-classes)
Economic challenges	Failure to consider economic function Lack of presenting marketing model and appropriate sale Going to quick yield works Financial stresses Lack of policy-making in requiring axis field of companies Sale and exporting products
Weak brand challenges in the Park next to the university and industry	A bit trafficking in parks by industrialisms and university students Lack of supporting foreigners of technology parks Statistical parks and lack of considering to real yield Failing in prioritizing technologies for absorption Weak cooperation of parks and universities Lack of output corresponding of universities with parks` needs Lack of confidence to parks by industry
Managerial and structural challenges	Lack of flexibility of tax organizations The lack of proper custodian structures in parks and knowledge based companies The lack of appropriate upstream documentation in parks and knowledge-based companies Weak experiences of some administrators in parks State-being of the country`s industry Economic problems of the country Structural and managerial problems Outbreak of foreign and imported products Unhealthy competition among the parks Policy Challenges and variety of Policymaking institutions
Ambiguity in single strategy	Lack of good reasons for future resulting park growth Lack of long-term vision in the parks Not having a suitable long-term development model in the parks Lack of some disagreements between park managers on a single strategy The confusion between choosing an Inner Park or outer park mission Doing things beyond the limits and sizes of the park Inappropriate definition of the mission of the parks
Inappropriate supporting challenges	Presence of patronizing attitude towards parks Lack of proper role playing of banks Budget constraints Excessive use of state budget
Lack of the technology system challenges	Isle working of the park companies Separation of Parks from the Ecosystem of Innovation and IP Start The absence of a technology ecosystem
Human resource challenges	Lack of strong headquarters Lack of mobility and energy in companies Absence of suitable filters for attracting companies The existence of a jobholding spirit rather than a bachelor's spirit

Table 5: Formation of the main classes of categories (sub-classes) of strategic solutions

Main classes	Categories (sub-classes)
Performing mechanism for structural reforms	Improvement growth in parks Establishment of research and development units Paying attention to companies inside the park The tendency of attention from the supply side to demand Synergy between park members More agility for the development of parks

Communication management mechanism for industry and university	Park contribution to companies and industries to clarify their needs The role of parks in solving industry problems Parks close cooperation with industry Attention to priority areas of the country in attracting companies
Economic functional mechanism of parks	Sale and exportation of products Incoming approach Considering economic function Taking into account the importance of parks mission in converting knowledge process into wealth
Main infrastructure providing mechanism for parks	Taking into account the existence of welfare possibilities and public services Create specialized Fablabs in the park Creating a platform for the presence of industrialisms, sociologists and ...
Mechanisms for considering park branding	Introducing park to society Introducing park position to organizations, universities and community Targeting visits to different organizations and institutions
Mechanism for presenting services to park companies	Evaluation performing of companies in parks member Park as a mediating tool between problem-solving teams Expansion of servicing companies` development in parks Establishing arbitration committees Reducing the risks of member firms
The mechanism of supporting elements adoption for park development	The existence of supports of state institutions Interacting with private sector Creating international communications
Strategic view towards future	Presenting proper landscape and main mission of an organization Having long-term view Forecasting technology megatrends in future
Strong human resource in park	Considering the education issue in parks Providing proper human invest through the dealing with university Utilizing capable human force in parks Creativity of players in technology period
Solutions for creating technology ecosystem	The existence of a strong coexistence layer in the innovation ecosystem Creating Technology Poles in Academic Infrastructure Comprehensive technology mapping of the country Doing division of labor among the technology parks Pay attention to creating an ecosystem of IP startup Interconnection between parks Attention to land alignment in the country's technology ecosystem Identifying Regional Priorities for Innovation Establishing institutions for technology development Mentoring and Managing Open Innovation Ecosystem

Second step: axial coding

The axial coding is the second step of analysis in the database theory. The purpose of this step is to make a relation between the created classes (in the open coding step). This process is done based on the paradigm model and helps the theorist to do the theorization process easily. The fundament of the relating process in axial coding is based on expansion of one the classes (Danaifar et al 2005).

Third step: theorization step (selective coding)

As said before, the basic theorization purpose is to create a theory, but to describe a phenomenon merely. In order to convert the analyses to a theory, the classes should be correlated to each other regularly.

The selective coding (according to the result of the last two steps) is the main steps of theorization. Somehow the axial class is related regularly to other classes and presents this as a framework and modifies the classes which need to improve. In this step, the scholar provides a framework of paradigm model according to his/her view of the study, or disassembles the paradigm model and shows the final theory, graphically (Danaifar & Azar 2010).

Fig 23. Axis Encoding based on models of (picture of completing model) identifying challenges

Ambiguity in single strategy
- Lack of good reasons for future resulting park growth
- Lack of long-term vision in the parks
- Not having a suitable long-term development model in the parks
- Lack of some disagreements between park managers on a single strategy
- The confusion between choosing an Inner Park or outer park mission
- Doing things beyond the limits and sizes of the park
- Inappropriate definition of the mission of the parks

Economic challenges
- Failure to consider economic function
- Lack of presenting marketing model and appropriate sale
- Going to quick yield works
- Financial stresses
- Lack of policy-making in requiring axis field of companies
- Sale and exporting products

Weak brand challenges in the Park next to the university and industry
- A bit trafficking in parks by industrialisms and university students
- Lack of supporting foreigners of technology parks
- Statistical parks and lack of considering to real yield
- Failing in prioritizing technologies for absorption
- Weak cooperation of parks and universities
- Lack of output corresponding of universities with parks' needs
- Lack of confidence to parks by industry

Managerial and structural challenges
- Lack of flexibility of tax organizations
- The lack of proper custodian structures in parks and knowledge based companies
- The lack of appropriate upstream documentation in parks and knowledge-based companies
- Weak experiences of some administrators in parks
- State-being of the country`s industry
- Economic problems of the country
- Structural and managerial problems
- Outbreak of foreign and imported products
- Unhealthy competition among the parks
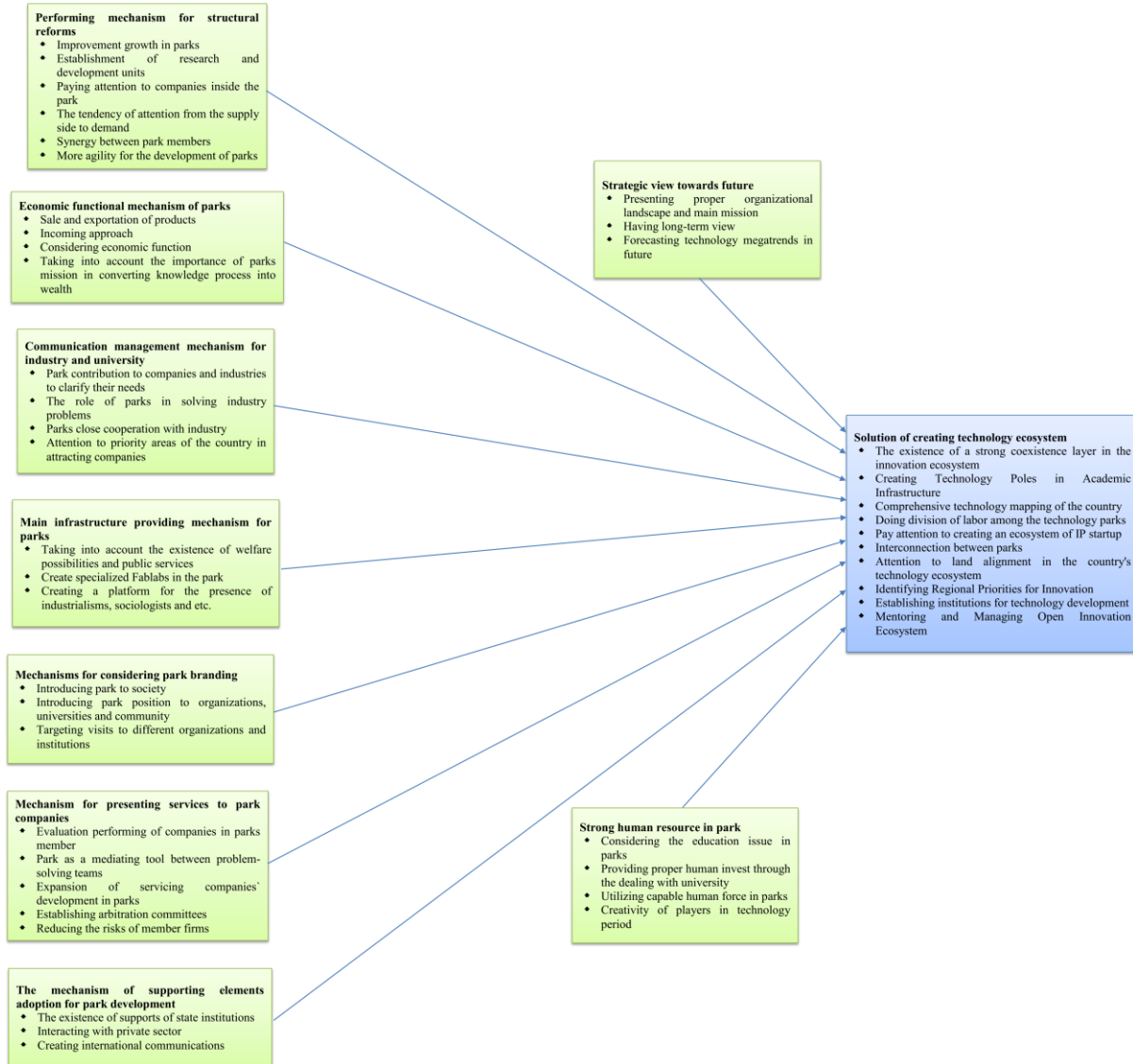- Policy Challenges and variety of Policymaking institutions

Inappropriate supporting challenges
- Presence of patronizing attitude towards parks
- Lack of proper role playing of banks
- Budget constraints
- Excessive use of state budget

Lack of the technology system challenges
- Isle working of the park companies
- Separation of Parks from the Ecosystem of Innovation and IP Start
- The absence of a technology ecosystem

Human resource challenges
- Lack of strong headquarters
- Lack of mobility and energy in companies
- Absence of suitable filters for attracting companies
- The existence of a jobholding spirit rather than a bachelor's spirit

Fig3. Axis Encoding based on models of (picture of completing model) strategic solutions

Performing mechanism for structural reforms
- Improvement growth in parks
- Establishment of research and development units
- Paying attention to companies inside the park
- The tendency of attention from the supply side to demand
- Synergy between park members
- More agility for the development of parks

Economic functional mechanism of parks
- Sale and exportation of products
- Incoming approach
- Considering economic function
- Taking into account the importance of parks mission in converting knowledge process into wealth

Communication management mechanism for industry and university
- Park contribution to companies and industries to clarify their needs
- The role of parks in solving industry problems
- Parks close cooperation with industry
- Attention to priority areas of the country in attracting companies

Main infrastructure providing mechanism for parks
- Taking into account the existence of welfare possibilities and public services
- Create specialized Fablabs in the park
- Creating a platform for the presence of industrialisms, sociologists and etc.

Mechanisms for considering park branding
- Introducing park to society
- Introducing park position to organizations, universities and community
- Targeting visits to different organizations and institutions

Mechanism for presenting services to park companies
- Evaluation performing of companies in parks member
- Park as a mediating tool between problem-solving teams
- Expansion of servicing companies' development in parks
- Establishing arbitration committees
- Reducing the risks of member firms

The mechanism of supporting elements adoption for park development
- The existence of supports of state institutions
- Interacting with private sector
- Creating international communications

Strategic view towards future
- Presenting proper organizational landscape and main mission
- Having long-term view
- Forecasting technology megatrends in future

Strong human resource in park
- Considering the education issue in parks
- Providing proper human invest through the dealing with university
- Utilizing capable human force in parks
- Creativity of players in technology period

Solution of creating technology ecosystem
- The existence of a strong coexistence layer in the innovation ecosystem
- Creating Technology Poles in Academic Infrastructure
- Comprehensive technology mapping of the country
- Doing division of labor among the technology parks
- Pay attention to creating an ecosystem of IP startup
- Interconnection between parks
- Attention to land alignment in the country's technology ecosystem
- Identifying Regional Priorities for Innovation
- Establishing institutions for technology development
- Mentoring and Managing Open Innovation Ecosystem

Research findings

The results of the interviews were categorized into two phases: the phase of identifying the challenges and the phase of providing strategic solutions.

In the phase of identifying challenges, the results of the interviews in the form of three main themes, marketing challenges, management and structural challenges, and the challenges of the ecosystem of technology are as follows:

The marketing challenges are as follows: Economical challenges and Weak brand challenges for the universities and industries. Each of these two sections also includes the following subcategories. Economic challenges include: Lack of dealing with the economical efficiency of parks , Being supplement oriented parks and lack of demands in parks , Lack of presenting a marketing model and appropriate sale fot companies , Looking for early return businesses by the parks and industries , Financial shortage of industries cooperating with the park companies , Lack of policy in making the park companies, demand oriented , Expectation of high return from start-ups and park companies and Sale and export the products from the parks.The Weak brand challenges for the universities and industries are as

follows: Low trafficin the parksby scholars and industries , Lack of acceptance from foreigners for parks , Bringing the call centers to parks instead of R&D experts , Too much dependence to statistic and lack of attention the actual returns , Lack of prioritization to attract to parks , Weak cooperation between university and parks and installed companies , Lack of correspondence of the output of universities with the park demands and the demands of installed companied and Lack of trust to parks by industry

Management and structural challenges are as follows: Management and structural challenges and Ambition in unique strategy. Each of these two sections also includes the following subcategories. Its management and structural challenges include: Lack of flexibility of tax organization dealing with park companies , Lack of definite authorities for the parks , Lack of familiarity of government and parliament and policy makers with the park , Lack of appropriate responsible for parks and knowledge base companies , Lack of upstream act about parks and knowledge base companies , Weak experiences of some managers in the park , Governmental industry of the country , Economical problems of the country , Management and structural problems , Massive advertisements of foreigner products and imported ones , Unfair competition in the park and Policy making challenges and multiple policy making institution . Ambition in unique strategy are as follows: Lack of attention to future planning necessary for park growth once the establishment (like predicting the parkings) , Lack of long-term views in parks , Lack of development model for parks , Lack of agreement on a unique strategy , Lack of determining the inside and outside duties , Doing some duties beyond the parks capacities , Dealing with some side subjects (building view and etc.) in the parks , Incorrect definition of the park duties (a place to give cash to companies) and Lack of prioritization to attract the technologies to parks

Technology ecosystem challenges are as follows: Inappropriate support challenges, The lack of technology system challenges and Human resource challenges. Each of these two sections also includes the following subcategories. As such, the inappropriate support challenges include: Presence a view of needing a sponsor in parks , Lack of appropriate role of banks , Limitation of funds and Overuse of governmental budget. The lack of technology system challenges include: Working insularly of park companies, Seperation of parks from innovation ecosystems and start-up ones , Lack of a unique technology ecosystem. Human resource challenges include: Lack of a powerful organization in parks in term of human force, Lack of activity and adequate energy in the park companies , Lack of appropriate filters to attract the companies and Presence an official atmosphere and morality instead of expert ones

This model describes the mechanisms by which the target community (executive agencies, industries, technology parks, knowledge-based companies, accelerators, etc.) recognizes its needs, and by recognizing itself development challenges will get enough interest of it. To elaborate the main theory of research in the challenges identification phase in the following are presented a general model.

Fig 4. Final research model (identifying challenges)
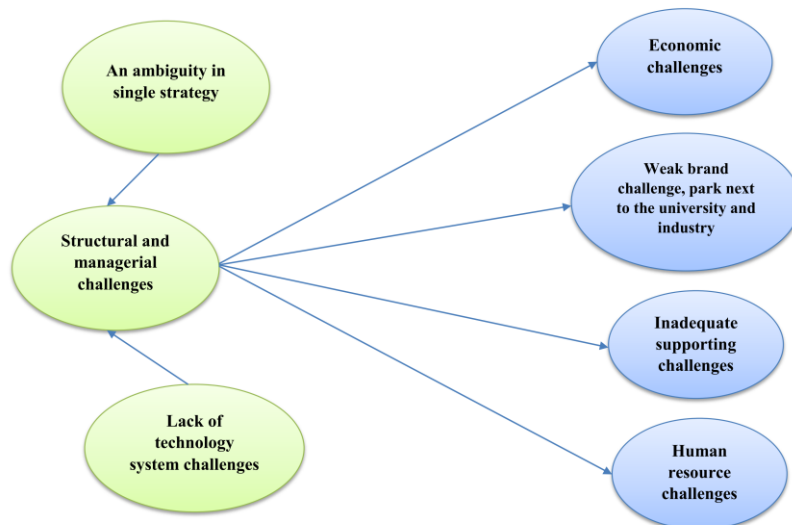
In the phase of providing Strategic solutions, the results of the interviews are divided into four main themes, management and organizational solutions, the establishment of technology ecosystems, marketing strategies and supportive strategies.

The Management and organizational solution are as follows: Structural modification, the university and industry link management and Strategic view to the future. Each of these two sections also includes the following subcategories. Structural modification include: attention to increase the park efficientcy , installation of R&D units belonging to various industries in the park , attention to the companies inside the park , shift the attention from supplement to demand or stimulation of industry requirements for using the park technology , synergy between the park members , privatization of the park , attention to the main duties of the park one established , organizing of national accelerators , more flexibility to develop the parks , presence of a responsive system , creation a fair and constructive competition between parks , continuous study while developing the parks , prevention from the domination of the parks , clarification of the park structures , creating a distinction between universities and parks in regulation , parks should play a management role in relation to industry and the companies should communicate with the industry per se , responsivity to governmental institution , increase the synergy between the park companies and creating a link between the companies and other various sectors together. The Weak brand challenges for the universities and industries include: Park aid to companies and industries to clarify their requirements , Regarding the park roles, important to solve the problems , Close collaboration of parks with industry and meet their needs , Involving the parks into major problems of the country like air pollution and providing a solution , Attention to country requirements to attract the companies and Attention to prioritized domains in the country to attract the companies. Strategic view to the future include: Presenting an appropriate perspective and the main missions of the organization, Long-term perspective in the parks and Prediction of technology megatrends in the future.

The university and industry link management include: Park aid to companies and industries to clarify their requirements, Regarding the park roles, important to solve the problems , Close collaboration of parks with industry and meet their needs , Involving the parks into major problems of the country like air pollution and providing a solution , Attention to country requirements to attract the companies and Attention to prioritized domains in the country to attract the companies. Strategic view to the future include: Presenting an appropriate perspective and the main missions of the organization, Long-term perspective in the parks and Prediction of technology megatrends in the future.

The Ecosystem creation solution are as follows: Technology ecosystem, Supplying the required infrastructure for the park and powerful human forces in the park . Each of these two sections also includes the following subcategories. Technology ecosystem include: The presence of powerful layer determination in innovative ecosystem of the parks , Presenting encouragement of investability in innovative ecosystem , Creating technology poles in university infrastructure , Attention to technology ecosystem , Dividing the duties between the parks , Attention to create start-up ecosystem , Synergy between parks , Attention to terittory logistics in technology ecosystem of the country , Determination of local priority of innovation , Creating the institution for developing the technology , Presenting a model by the park in which the companies, accelators, universities and the industries exist and Mentorization and ecosystem management of open innovation. The Supplying the required infrastructure for the park include: Attention to presence of the prosperity facilities and public services for park members , Creating professional fablab in the parks , Creating powerful infrastructure and laboratories , Presenting prosperity and essential infrastructures in parks , Attention to prosperity infrastructures like accomodation and etc and Creating the background for participation of the industry experts and socialists and etc. powerful human forces in the park include: Attention to training in the parks , Supplement of appropriate human resources by creating links to universities , Use expert human force in the park and Innovatory of the performers of the technology like innovative governments, persons, companies and institutions

The Marketing solution are as follows: Economic performances of the park and Attention to park branding . Each of these two sections also includes the following subcategories. Economic performances of the park include: Sales and export the products from parks , Income view of parks , Attention to marketing and product sale by the park companies , Dealing with economical efficiency of parks and Attention to the importance of the parks duties in turning the science into wealth. Attention to park branding include: Introducing the park to society and park branding , Introducing the park place to organizations, universities and other persons in the society , Targeting the visits of the organizations and various institution from the parks and Attention to park banding.

The Support solutions are as follows: Providing the services to major companies and providing the support elements. Each of these two sections also includes the following subcategories. Providing the services to major companies include: Evaluating the park companies, Parks as a medium between problem solver teams, Creating a set of technology services for the companies like accounting, law and investment, Developing the service companies in the parks like professional market companies, insurance companies and law firms, Creating judgement commitees for facilitating the companies in law problems and Reducing the risk of member companies of parks. Providing the support elements include: Presence of governmental support institution for parks , Interaction with private sector to develop the parks and Creating international communication to develop the parks.

This model describes the mechanisms by which the target community (executive agencies, industries, technology parks, knowledge-based companies, accelerators, etc.) recognizes their place and takes advantage of it. To elaborate the main theory of research in the strategic solutions phase in the following are presented a general model.

Fig 5. Final research model (strategic solutions)
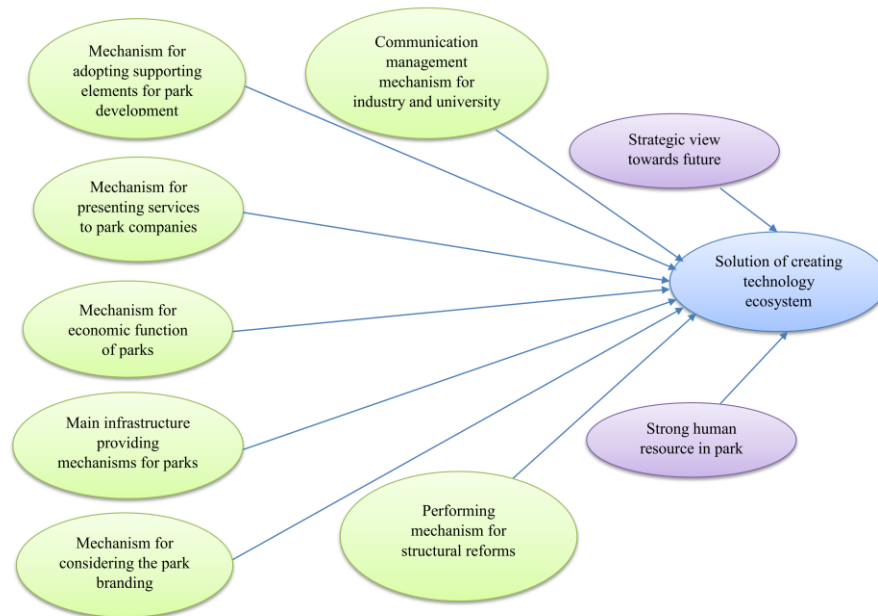
Discussion and conclusion

In this research, we tried first to identify the challenges of the development of science and technology parks and then to provide strategic solutions in this regard. For this purpose, interviews were conducted with the administrators and experts of the Pardis Technology Park and Shezen Accelerated Center, and two general models were presented after analyzing the data.

As shown in the two models above, in the first model, which identifies the challenges of the development of science and technology parks, management and structural challenges are recognized as the main factor. Management and structural challenges also affect two factors: the lack of a system of innovation and ambiguity in the single strategy. It is suggested that, in the upper classes and upstream documents, it is initially proposed to develop an innovation system so that parks can use it well and adapt their structures. It is also suggested at parks level that among park managers, strategically, develop a strategy and all managers agree on a single strategy. These suggestions are seen in the second model, which relates to the provision of strategic solutions; in this model, the technology ecosystem is proposed to be developed strategically with the future with the help of human resources. One of the most important issues affecting the creation of technology ecosystems is structural reform mechanisms. In this regard, it is proposed to adapt the structure of technology parks in order to create a technology ecosystem based on a predetermined target, which is the same as development.

Based on research findings, it has been concluded that four main challenges are caused by the administrative and structural challenges: economic challenges, poor brand challenges facing universities and industry, the challenge of inappropriate support and human resources challenges. Based on the model of providing strategic solutions, it is suggested that managers and decision makers of technology parks in the field of economic challenges and poor brand challenges facing the university and industry using the mechanism of economic functioning and the mechanism of attention of the branding park and the mechanism of industry and university communication management, In the previous section, it came to issues such as proper revenue generation, strong presence in the domestic and international markets, proper identification of the park in the domestic and international arena, and strategies for good cooperation between the university and the industry, and provide the necessary conditions for this. . In the context of the challenges of inadequate support based on the strategic model, it is suggested that park managers and decision makers, using the mechanisms for obtaining support elements for the development of the park, and the mechanism for providing services to the park companies, can well support their subsidiaries. In the context of human resource challenges, based on the strategic delivery model, it is recommended to adopt strong human resource approaches in the park and improve the human resources of parks in order to attract top talent.

Based on the proposed model, the science and technology parks can be developed in the future to develop the best of the parks, which must be made with the help of a strong and strategically powerful human resources ecosystem. In this regard, it is suggested to managers and decision makers of science and technology parks to not forget the necessary infrastructure mechanisms for parks and, with their planning, provided the infrastructure necessary for the better development of the park. Because the provision of infrastructure for parks is one of the most important parts of the ecosystem of technology.

The two models presented in this study can be considered as a roadmap for managers and decision makers of science and technology parks. Because most importantly, administrators and decision makers of science and technology parks should, with the cooperation of all their deputies and managers, expand the culture of development and progress in all their organizational and structural layers, and take all of Park Manpower's capabilities and resources in line with The development and improvement of their parks.

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