Transfer of Technology from Iranian Universities to Industry: University Perspective

University in regional innovation and social development
University technology transfer

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ABSTRACT

This is a study about transferring technology from Iranian universities to Iranian industry. The relationship between universities and industry is much weaker in Iran than it is in developed countries. Most of the Iranian universities have used the model of western universities, but this model does not seem to be able to solve the problems of Iranian industry. The connection between universities and industry in Iran is, therefore, not strong because industry cannot satisfy all of its needs through collaboration with universities.

The study examines the existing technology transfer process from university to industry, the organizations involved, and the major decisions taken during technology transfer. In addition, the study uncovers the barriers for transferring the technology, examines different ways of establishing contacts, and considers the benefits gained from university-industry collaboration.

To achieve these objectives, we conducted 31 interviews. The interviews revealed that companies were more proactive in establishing contacts with universities; in most situations they initiated contacts with the professors. However, the professor's expertise, reputation, and ability to establish friendly relations with people from industry helped make these contacts successful. Professors measured the success of these transactions by the level of satisfaction the firm expressed with the technology. University liaison officers, most of whom initially had a reactive posture toward

establishing these contacts, measured the success of these transactions by the amount of financial returns for the university. The most important barrier in universities to a successful technology transfer was lack of knowledge about the needs of industry. Within industry, the most important barrier was a poor knowledge about university research capabilities. In the process of the study, we also defined the important benefits gained from transferring knowledge.

Most of the technologies that were transferred from university to industry were based on four processes. The first process is "professor centered" where professors and industry made direct contact with each other. In Iran about 52% of the technology transfers took place by this method. In the second process, which is "university-centered," university liaison offices are responsible for linking university and industry together and helping them understand the potential and needs of the other one. Unfortunately, in Iran the tasks of these offices are not clearly defined and the process of technology transfer is bureaucratic and lengthy. Further, these offices are not active, as is evident from the fact that only 13% of the transfers were made by this method. In addition, these offices weren't successful in solving the problems of intellectual property rights that the professors face.

The third process is transferring projects through intermediary organizations. The intermediary organizations that were considered in this study are: *Saffron* research consortium, science and technology parks, and internship centers. The study showed that about 26% of the transfer projects were conducted by this mode. The fourth process is through the university research center; about 9% of the transfer projects were conducted in this way. In many of the research centers, which are frequently located on university campuses, members of the university and industry work together in researching ideas and developing innovations.

This study is a first attempt to identify the major mechanisms of technology transfer from universities to industry in Iran. Recommendations from this research would be useful for other countries in the same stage of development.

Keywords: University, Industry, Technology Transfer, Intermediary Organization, Iran

1. INTRODUCTION

In this study, technology transfer includes a transmission of knowledge from the source that develops it (university) to the receiver that makes use of it (industry). It is obvious that a university can help industry to fulfill their goals if their policies are oriented in the same direction. The satisfaction of the needs of industry is becoming increasingly dependent on the establishment of colleges and universities. The first college in Iran was established in 1851; it was followed by the establishment of other colleges in big cities, especially during the period of 1870 to 1914 (Gooya, 1994). The motivation for establishing these centers of higher education was to provide for the defense of the country because of military defeats in conflicts with Russia. The *Polytechnic University* was established in 1852 to increase the structural ability and the technology of the official and military organization of country. Later, to have specialists in other areas, government organizations established other universities that are related to different ministries. The first university of Iran, *Tehran University*, was established in 1935 (Gooya, 1994). Although the transfer of knowledge from university to industry can be traced back more than 100 years, these relationships have grown stronger only during the past decades.

The relationship between university and industry in most countries today is the key factor that affects the development of the country in terms of economical, social, cultural, and other aspects. This relationship plays an important role in future economical and social success.

Both firms and universities are under pressure in today's competitive and knowledge-based world. Firms are facing international pressures to innovate and universities are under pressure to look for financial support beyond that provided by the government. These forces provide a strong motivation for wider, more strategic, relations between firms and academia (Doutriaux, 1995). The university-industry relationship will help to enforce and strengthen the system of innovation in the country (Warda, 1996).

The rise of the knowledge economy has underscored the essential role of technological innovation in economical development. Universities and public research institutes, as the major part of the innovation process, have become the center of many theoretical studies. Most of these studies have focused on the different roles of academia and national innovation systems and their relation to industry to complete these roles (Rowen, 2004).

One of the most reputable models that consider the relationships among university, industry, and government is the Triple Helix model. The Triple-Helix Model of university-industry-government interactions was mainly developed by Etzkowitz and Leydesdorff (1997, 1998, 2000).

The Triple Helix model suggests that the university can play an effective role in innovation in knowledge-based societies (Etzkowitz, 2008). Triple Helix not only considers the relationship of university, industry, and government but it also considers the internal transformation within each of these spheres. For example, the university has been transformed from solely a teaching organization to one that focuses on teaching and research at the same time; this kind of transformation is ongoing in many countries (Etzkowitz and Leydesdorff, 2000). In the Triple Helix model, universities play an

innovative role in the country and they are active in the traditional task of teaching as well as in research, entrepreneurial training, and community development. Also in this model industry engages in the transfer of innovation as well as in endogenous innovation. Government in this model must find an appropriate balance between intervention and non-intervention (Dzisah and Etzkowitz, 2008).

In recent years a variety of relations have developed between universities and industries; these vary from graduate scholarships in industry to industrial research chairs and the licensing of university technology to firms (Doutriaux, 1995). The interaction between university and industry is multidimensional, including the exchange of knowledge, expertise, working culture, and money.

This study investigates the process of technology transfer from Iranian universities to industry focusing on the university perspective. For this purpose, it is very important to learn about the steps in the process and identify the important people and organizations that are involved in the process. We also want to discover different ways of establishing links between universities and firms. The study includes an evaluation of technology in terms of its commercial appeal and the readiness of technology for transfer. The study identifies some benefits that may be realized from university-industry links. It also identifies the main inhibitors of technology transfer and the ways to remove them.

It is expected that the results of this study would help bring the two bodies, the Iranian universities and the industry sector, closer together. The investigation has been conducted through interviews with professors, liaison officers, and representatives of intermediary organizations.

This study is organized into five sections. Section 1 introduces the study. Section 2 gives the methodology used in the study. Section 3 provides the results and findings of the study, including the relevant literature on technology transfer from university to industry. This section also gives details on the mechanisms, benefits, barriers, and success criteria of technology transfer. Section 4 provides two cases of intermediary organizations and their role in bringing university and industry together. Finally, section 5 provides a conclusion and the recommendations from this study.

2. METHODOLOGY

This study used interviews to gather data about how technology is transferred from Iranian universities to industry. The following will describe the selection of samples and the data collection process.

2.1 Samples

The samples selected for this study consist of three groups. The first group was 23 professors from different departments in five universities. Seven of them are from the civil engineering group, eight are from mechanical engineering, four are from electrical engineering, and four are from petrochemical engineering. The second group was five people from five liaison offices located in five different universities. The third group that we consider was intermediary organizations: *Pardis Park* in

Tehran and *Saffron Research Consortium* in Mashhad. Two respondents came from *Pardis Park* and one from *Saffron Consortium.* The selection of professors was based on individuals at universities who, through their experience, were aware of the technology transfer process. To locate professors with this experience, we received help from the information center in each university. Since the respondents represent a large percentage of those leading in technology transfer in Iranian universities and other involved organizations, the results of this study can be generalized to apply more broadly in Iran.

2.2 Data collection

In preparation for data gathering we designed questionnaires, identified individuals to be interviewed, and contacted them to arrange an interview. The questions designed for the two groups of professors and liaison officers were divided into two sections: quantitative and qualitative questions. At the beginning of each interview respondents were made aware of the study objectives, the study scope and methodology, and conditions of confidentiality. The average length of each interview was about 1.5 hours. The qualitative and quantitative questions that we asked the professors and liaison officers helped to identify the process of technology transfer in Iran more vividly and also to recognize the people and organizations involved in this process that are the significant players and major decision makers.

3. RESULTS AND FINDINGS

This section describes four items in the technology transfer process: mechanisms, barriers, benefits, and success criteria.

3.1. The Mechanisms of the technology transfer process

The transfer of technology from university to industry can be achieved in many ways. These ways of technology transfer are mainly shaped by different factors, such as the nature and levels of the technology, the national context and country laws, university regulations for technology, university-industry interactions, the type of scientific and technological knowledge, and the availability of venture capital and business angels.

As a result of these factors, different mechanisms exist for the technology transfer process. All forms of technology transfer have become important parts of the whole technology transfer process, industrial growth, and competitiveness. According to Goktepe (2005), all mechanisms should be considered when planning to transfer technology (Goktepe, 2005).

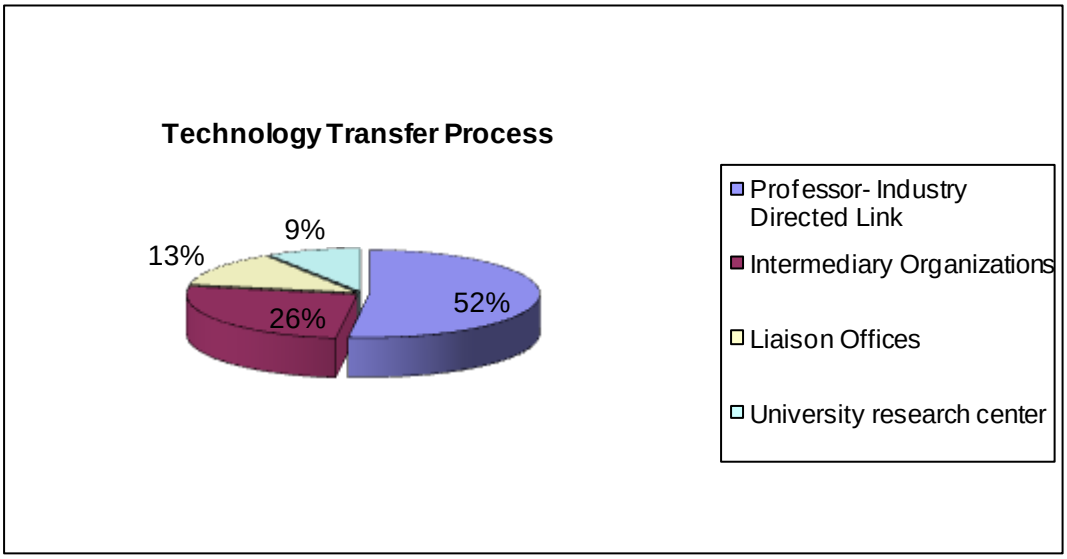
The research that was carried out by Gerwin et al. (1991) shows four interrelated processes for technology transfer: professor-centered, university-centered, intermediary organizations, and spin-offs. In the professor-centered process, normally a company contacts a professor or it may be other

way round. In the university-centered mode, professors take their inventions to the liaison office for help in commercialization. Liaison offices in universities help the industry understand the potential of professors and help the professors' focus on projects that are needed by industry. Intermediary organizations are independent organizations that facilitate the technology transfer from university to industry. In addition to liaison offices, we also found that some research centers located in university campuses were active in transferring technology to industry.

One of the important subjects in the university-centered technology transfer process is the evaluation of the invention's commercial appeal. This evaluation can be risky because there are two potential scenarios. In the first scenario, the commercial potential is overestimated. In this situation, the university or venture capitalists stand to lose massive amounts of the money needed to develop and commercialize the technology. Furthermore, professors may lose a substantial amount of time in an effort that has no probability of leading to academic publications. The second scenario is that the commercial potential is underestimated. In this situation, the cost of losing an opportunity for gaining a competitive advantage can be substantial. Also, in the professor-centered mode of technology transfer, a mutual agreement to develop a technology comes at the beginning of the process. After this agreement the issue of estimating the readiness of the technology for transfer becomes important. If it is defined properly, the probability of facing problems with industry will decrease. If any problems occur during the transfer process – for example, if the development phase takes too long or it is concluded prematurely, the relationship between a professor and a company can be endangered (Gerwin, 1991).

In this study, professors and liaison officers were asked to identify the mechanisms which they have used to transfer technology. Twelve of the professors (52%) chose the professor-centered mode for technology transfer, six (26%) chose intermediary organizations, three (13%) used the university-centered mode to transfer their technology, and two (9%) used the university research center. Figure 1 gives the summary.

Figure 1 – Mechanisms of technology transfer



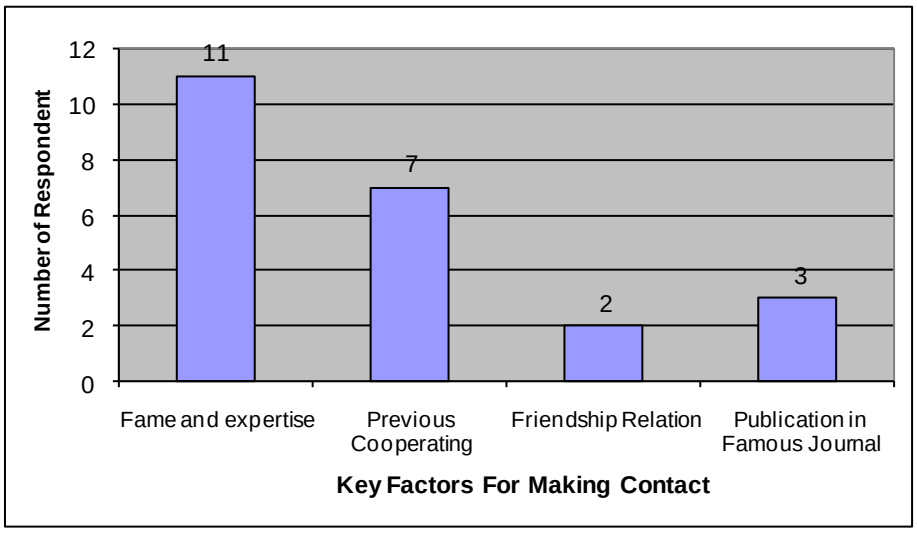
We should note that none of the respondents mentioned the role of spin-off businesses in Iran. This indicates that these kinds of companies are not yet active in Iran.

Professors were asked to explain how they decide when the technology is ready to be transferred. Twelve professors who transfer the technology directly to the firms (using the professor-centered mode) responded that in a meeting with the representatives of industries, the professors explained the project and answered questions about general features of the project. If the results were positive in terms of industry need, they will hold other meetings between professors and industry to reach mutual agreement on various aspects of the project and when the project is ready for industry use. In some cases, professors initially show the advantages and positive features of the projects to industry; in the case of mutual agreement the technology will be ready to transfer.

Eleven professors declared that their fame and expertise were the cause for the contact; some of them had gained fame through the success of previous projects. Seven of the professors said that their previous participation in some projects cooperating with industries had led to new contacts. We must mention that not all of the contacts were directly between professors and industry; in many cases the intermediary organizations and liaison offices were also included. However, we have mentioned the most important factors leading to the contacts. Two of the civil engineering professors said that their friendship with the owners of industries – in these cases a home-building factory and a marine industry – was the main factor in beginning the contact and that helped them to know the needs of these factories and start the process of technology transfer. One of these two also said that his fame and experience had a positive impact on the method of his contact.

Three of the professors said that they had published a special research article in famous scientific journals and this was the main reason for establishing the contact. Details are shown in figure 2.

Figure 2- Key factors for making contacts



Five liaison officers were asked how contact with industry was established. This question was aimed to tell us if the liaison offices were proactive or reactive and also to understand how the contacts between professors and firms were made.

Four of the liaison officers responded that their most frequent contact occurred when an industry with different needs came to them. The liaison office would consider the industry's needs and provide relevant information about the potential capabilities of professors and the current projects that they were working on. Two of the liaison officers during the interview mentioned that they want to improve the process by establishing an information bank containing the potentials of the university; presenting this to different industries would make them eager to establish projects with the university. But this process is not yet developed. One of the liaison offices also responded that a mutual interaction exists between his office and industry. Based on these responses, it seems that only one liaison office was proactive and the other four are reactive in the process of technology transfer.

Liaison officers were also asked their process of evaluating technology in terms of its commercial appeal. Two of the liaison officers declared they almost always go through the following three steps when the professors present their projects to them:

1- They asked the professors about the degree of commercial appeal of the technology, whether they have considered this issue, and the extent to which they have considered it.
2- After considering the responses of the professors, they hold a meeting with the professionals in the liaison offices and use their experience to evaluate the degree of the commercial appeal of the project.
3- Finally, they invite a number of professors and professionals whose major is related to the content of the project to evaluate the commercial appeal.

After these steps, the liaison officer will give a final mark to the project in terms of its commercial appeal and whether in his/her opinion the project is worthy and has the potential for success. Then they will pursue the next steps.

In two of the university offices the process was different. Steps 1 and 2, which are performed by two previous universities, did not exist in these offices and they described their process as follows:

Some of the students who cooperated with professors on the project and one of the representatives from the liaison office will gather together to examine the commercial appeal of the project in different areas. The liaison office will then invite the related professionals and professors to evaluate the commercial potential of the project and report if this is positive or negative. Depending on the evaluation, the process will either stop or continue to the next steps.

In one case, some of the previous processes are not done and only the professionals of industry and university professors come together to evaluate the commercial appeal of the project in order to stop or pursue the project. Their ideas will become the touchstone leading to industry acceptance or rejection of the project.

In three cases, projects were transferred with the help of the university-centered mode, i.e., through liaison offices. In these cases liaison officers facilitated the meetings held between professors and industry.

From the professor's responses, it seemed that most of them were not satisfied with the activities of the liaison office. Professors reported that because there is so much paperwork in these offices the process of technology transfer is too long and time consuming, and not effective. A number of professors said that the liaison offices lack information about the real needs of industry and also do not have information about the capabilities and research of the professors. One professor said that because liaison offices do not have an active role, they cannot easily establish contact with industry.

Some professors mentioned that one major reason for the lack of efficiency in the university-centered mode is because the lack of a strong monitoring system leads most of these offices to become reactive. One professor, who had not been completely successful in technology transfer, complained about the role of liaison officers in the technology transfer process.

From the responses of professors, it is clear that even though intermediary organizations in Iran are young they are relatively successful in the process of technology transfer. Six of the professors whose projects were transferred by intermediary organizations noted that intermediary organizations help to facilitate the meetings between professors and representatives of industry where they discuss the characteristics and technical specifications of the project and come to an arrangement for the transfer of the project.

Finally, in two cases where technology was transferred through university research centers, the representative of industry will usually go to university labs to become familiar with the projects in process. They then consider the quality of the project and, if they come to a mutual agreement with the university, the technology transfer will begin. We should note that although these four modes are interrelated, in this study professors answered in a way that shows four independent processes for deciding when the technology is ready to be transferred.

3.2 Barriers to technology transfer

To be successful, university-industry links must eliminate the traditional barriers that exist between the university culture and the business world. Many impediments exist to effective university technology transfer. These are informational and cultural barriers between universities and firms, and insufficient rewards for faculty involvement in university technology transfer, such as credit toward tenure or promotion (Dooley and Kirk, 2007).

There are some differences in culture that hinder communications between firms and universities: academic people are free to focus on any research topics vs. research led by market demand, free exchange and publications of research results vs. company secrecy, and academics are more attracted to a long-term research orientations vs. short-term problem solving and product development. Moreover, academics tend to focus on basic research vs. applied research (Doutriaux, 1995).

In addition to these issues, a survey of 400 research ventures in the U.S. showed that many firms do not participate in any R&D cooperation with universities because of the problem of intellectual property rights. Industry people also indicate that a geographic limit on knowledge spillover is another important issue that inhibits R&D cooperation with universities. Mansfield and Lee found

that firms prefer to work with local university researchers that are located within 100 miles of the R&D laboratories (Loof, 2004).

A university's own institutional rigidity, fragmented organization, and lack of mutual trust between firms and universities are recognized as other major blockages in university-industry interactions in developing countries such as Tunisia (Bouhamed et al., 2009) and Croatia (Singer and Peterka, 2009).

For this study, we prepared a list of barriers for the professors and liaison officers and asked them to rank these barriers on a scale of 1 to 5, where 1 represents 'not significant' and 5 represents 'extremely significant'. The results are shown in Table 1.

Table 1: Average scores on barriers

WITHIN UNIVERSITY	**Professors (out of 23)**	**Liaison officers (out of 5)**
Lack of knowledge about industry relevant needs	**3.95**	**3.8**
Insufficient experience in commercialization	**3.15**	**4**
Time pressures of industry	**2.97**	**3.2**
Willingness to have basic research	**2.36**	**2.8**
Low capacity to share risk	**1.75**	**2.2**
Few rewards for professors who work with industry	**2.25**	**2**
Professor's delay in delivery	**2.25**	**3**
Concerns about IP rights	**1.92**	**1.8**
More emphasis on theory	**2.75**	**3.2**
Bureaucratic procedures	**3.7**	**3.8**
Poor knowledge about university research capabilities	**4.36**	**2.8**
Decreasing R&D funds within industries	**4.11**	**4.4**
Compressed product development cycle	**3.97**	**4.2**
Poor understanding of the university culture	**3.66**	**3.8**
Lack of technology planning	**2.55**	**2.2**
Emphasis on product development	**2.16**	**2**
Tendency to applied research	**3.37**	**4**
Shortage of educated and skilled people	**3.15**	**3.2**

1= Not significant, 5= extremely significant

According to table 1, from the professor's point of view the main barrier to technology transfer within the university is poor knowledge about industry's needs. Professors also mentioned problems within industry, the most significant of which is lack of information about university research capabilities and potential. Liaison officers mentioned that the most important barrier for university-industry collaboration within the university is insufficient experience in commercialization; within industry the main barrier to technology transfer is the poor investment on R&D.

3.3 Success criteria

In this part of the questionnaire, respondents were asked to tell how they evaluate the level of success and how they know if they were successful in the process of technology transfer. In order to reach our objectives, predetermined choices were designed based on the literature. Respondents were asked to rate them on a scale of 1 to 5 where 1 is 'not important' and 5 is 'extremely important'. Tables 2 and 3 show the average significance of each item from liaison and professor responses.

Table 2: Success criteria- liaison officers

Success criteria	**Average scores on evaluation of success criteria (5 liaison officers)**
An ongoing relationship was developed between professors and a company	**2.8**
Number of students hired by this transfer	**3**
Enhancing the university reputation	**4**
Benefit for Iranian society	**3.8**
Level of financial returns for university	**4.2**

As the results show, from the liaison officer's point of view the level of financial returns is the most important factor for measuring the degree of success.

Table 3: Success criteria - professors

Success criteria	Average scores on evaluation of success criteria (23 professors)
Technical specification were met	**4.19**
The company was satisfied	**4.26**
The company benefited in some way such as impact on profit	**4.22**
Number of students hired by this transfer	**2.9**
The technology worked or was used	**3.9**
Continuation of relationship with industry	**3.74**

From the professor's point of view the company's satisfaction level is the most important factor determining success.

3.4 Benefits gained:

Both universities and industries get benefits from cooperating with each other, especially when the technology is properly transferred between them. Some benefits based on the literature (Gooya, 1994) are as follows:

- Gaining real life practical experience,
- Applying theoretical knowledge,
- Gaining contact with practicing professionals,
- Understanding the culture of industry and decreasing the current gap between the university and industry,
- Gaining access to new research and developing new products,
- Making teaching and research programs more practical,
- Developing mutual trust between the university and industry from successful transfers,
- Learning to understand the work culture of industries by students and professors,
- Increasing access to new ideas and investments, and
- Helping students who are working with professors to gain a balance between theory and practice.

Additionally, a survey of almost 400 research ventures in the U.S showed that access to new research and development of new products are the two most important reasons for industries to cooperate with universities (Loof, 2004).

In this study, respondents were asked to rate their view of the importance of benefits gained as the result of successful technology transfer using a scale of 1 to 5.

Table 4: Average scores on benefits – liaison officers

Benefits	Average scores on benefits (5 liaison officers)
It's good for students and professors to understand the work culture of industries	**2.8**
In successful transfer mutual trust between university and industry will develop	**3.2**
Access to the new ideas, talents, and investments will increase	**4**
It's good for students working with professors to find a balance between theory and practice	**3.8**
Enhancement of university images as a contributor to economy	**3.2**

According to table 4, liaison officers believed that access to new investments, financial issues, and ideas and talents are the most important benefits that are gained from this link between universities and industries.

Table 5: Average scores on benefits - professors

Benefits	Average scores on benefits (23 professors)
Gaining real life practical experience	**3.91**
Application of theoretical knowledge	**2.94**
Contact with practicing professionals	**3.25**
Understanding the culture of industry and decreasing the current gap between industry and the university	**4.21**
Access to new research and development of new products	**2.74**
Teaching and research programs will become more practical	**3.66**
In successful forms of transfer mutual trust between university and industry will develop	**3.15**

Table 5 shows that professors believed that the most important benefit gained from the technology transfer process is understanding the culture of industries.

4. INTERMEDIARY ORGANIZATIONS

Intermediary organizations also sometimes act as broker between university and industry. This section discusses two cases of intermediary organizations, specifically their role in the process of technology transfer. We interviewed the managers of the following two intermediary organizations:

1- Science and Technology Parks - Pardis Technology Park
2- Research Consortia - Saffron Research Consortium

4.1 Pardis Technology Park

Established in 2001, the Pardis Technology Park is located in northeastern Tehran. The mission of this park is to create a proper environment for companies, researchers, and educators in order to increase employment opportunities. Pardis Technology Park is run by a board of directors who are mostly related to Sharif University of Technology. The main objectives of this park are:

1- To help in the development of high tech industries.
2- To promote cooperation between universities and industries.
3- To commercialize innovations and inventions that come from research centers and other researchers.
4- To promote research and development activities in private sectors (Pardis Technology Park, 2005).

For better understanding about the activities of this park an interview was conducted with two managers of the park. They outlined the current structure of the park as including: an incubator center, a multi-tenant building, laboratories, a business center, administration, and a private research and development center. This park is mainly active in the areas of electronics, mechanics and automation, and chemical and biotechnological.

The park provides four functions. First, it serves as an incubator for those who have little experience and need some support. Second, it contains a multi-tenant building with a rental fee for entrepreneurs. Third, the park has independent apartments that may be bought by tenants. Fourth, it assists established companies in buying land and starting their activity by developing their own labs.

In the next series of interviews we asked the extent to which the park was successful in terms of establishing relations between universities and industry. They said that they had experienced some successes. They mentioned that mutual trust has not yet developed between parks and industries, and that industries do not yet have sufficient information about the activities of the park. One respondent believed that if the activities were developed in a proper way and the potential and capabilities were introduced to industry the park could improve their current situation. He also mentioned that recently offices of intellectual property rights were established by the government in the park, and they are facilitating the current procedures that will help professors. Respondents had a

number of suggestions to bring together university and industry, such as training programs and exhibitions in which both industry sectors and universities participate to learn to know the activities and potential of the park. The biggest challenge that the park faces is to get the companies to participate in the park.

4.2 Saffron Research Consortium

Industrial and academic consortia take a number of forms and orientations. They act as a node that facilitates the communication between university researchers and industry.

A research consortium in Iran is considered as an intermediary organization. We arranged an interview with one of the managers of the research consortia. The Saffron Research Consortium is located in Khorasan province, Mashhad. This place was established in 2001 by the board of saffron exports, which includes some saffron producer companies. This center cooperates with university professors in terms of research activities. Currently, the Saffron Research Consortium has 12 members who pay a membership fee to this consortium.

As Khorasan province is the main producer of saffron in Iran, the existence of such a center can help related industry to grow by establishing a relationship between university and scientific centers. In this consortium, the process of making contact with the university is as follows: some members (two or three) who have similar problems gather together and define the project. The Saffron Research Consortium then transfers the problem to professors who have sufficient experience and are professionals in this field. Related industries can become a member of this consortium by paying membership fees. This gives them a link with the most recent research conducted in this center and also with professors to help deal with their problems.

The representative of this center said that the center faces with many problems. The first barrier is that linking with universities is difficult, because the university's processes are so bureaucratic and time consuming. Also, when we asked him to what extent the center was successful in making a link between the university and industry, he mentioned that they were sometimes successful. In Iran research, the consortium is very young, so time is needed to encourage industries to participate in such centers. Currently, the majority of industries in Iran are applying traditional methods to solve their problems. If industries and universities became more familiar with the center's activities and find that it can help solve their problems the center can then reach our goals and change the organization of industries that use traditional methods.

5. CONCLUSIONS AND RECOMMENDATIONS

This study deals with the transfer of technology from university to industry in Iran The perspective taken is that of universities. Respondents came from five universities and two intermediary organizations. Data was collected by interviewing 23 professors, five liaison officers, and three managers of intermediary organizations.

We discovered that the professors and liaison officers were able to get access to new ideas and investments and learn to understand the culture of the industry through the links formed in the process of technology transfer. Most of the professors felt that the apprenticeship programs with the industry made students aware of industrial needs and made them more familiar with the culture of industries. Students can learn to balance theory and practice, although they all felt that specific strategies are required to promote this action.

Iran is a developing country. For technological growth in a developing country like Iran, it is important to have cooperation between university and industry. According to the respondents, the revenue obtained from transferring technology to industry is low and this does not motivate researchers. From the professor's point of view, the main barrier for technology transfer within the university is poor knowledge about industry-relevant needs and no access to sources of information about even the basic needs of industry. Professors also mentioned problems within industry; the most significant of these is lack of information about university research capabilities and potentials.

From the liaison officers' perspective, the most important barrier to university-industry collaboration within the university is insufficient experience in commercialization and within industry is the poor investment in R&D. This is also supported by the literature. A study carried out by Link and Rees (1989), which is about the effects of university-industry collaboration, shows a rate of return on R&D of 34.5 percent for firms that collaborate with universities compared with 13.5 percent for firms without such links (Doutriaux, 1995).

Loof (2004) showed that university-industry partnership has a very strong effect on three measures of innovative activity. At first, if we consider firms in terms of allocating budget for their R&D, we find that the firms that cooperate on innovation with universities spend more money on R&D in comparison with an identical R&D firm which has no collaboration with universities. Second, firms that have collaborating programs with universities also have a greater tendency to apply for patents than other R&D firms. Third, income from new product sales is much greater for firms having joint research projects with universities than firms having no such program.

The criteria to measure the success of technology transfer were different for professors and liaison officers. For professors, the most important criteria used to measure the degree of success is whether the company to which transferring is done is satisfied or not, and for the liaison officers the level of financial return for the university is an important factor for evaluation of success.

It was found that more than half of the projects on technology transfer resulted from direct communication between professors and industry or vice versa. Liaison offices and intermediary organizations were not very active and spin-off businesses did not exist at all. Government support for intermediary organizations and university initiatives to motivate liaison offices to be proactive can improve the linkages and transfer processes to a great extent.

The evaluation of the technology in terms of commercial appeal and readiness of transfer considered in this study shows that most of the liaison offices follow two main protocol for evaluating the commercial potential of technology; each protocol has its own advantages and disadvantages. Also, in the case of professors in terms of readiness of technology for transfer, we found that the majority of the professors mentioned that there are some process-related issues. They mentioned that

in meetings and visits between professors and firms, industries mentioned their technical specifications and professors and the industry representative discussed the general features of the project. If the companies and professors agreed to begin the process and obtained mutual agreement, the technology will be ready to be transferred. Results also show different ways of establishing contacts between professors and industry and between liaison officers and industry. In this regard, we found that liaison offices did not work well with industries and most liaison offices take a reactive posture. Also, we found that more often companies approached the professors to initiate contact and some factors – such as a professor's fame, expertise, and friendly relations with some industrial people and publishing different articles – have an effect in developing relations with companies.

To improve the links between the university and industry, some suggestions included developing plans for coordinated visits, meetings, conferences, joint publications, and exchange of staff (Ghaffari, 2000). This may also include teaching plan development involving the exchange of staff and recent scientific findings; sponsoring research by companies; providing R&D expertise in business development and joint research; coordinating visits; and holding meetings, conferences, seminars, joint publications, etc. that bring these two sectors closer together.

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