



Study on changing trend of technology transfer in pharmaceutical biotechnology in Iran in order to identify the model

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ARTICLE INFO

Article history:

Received: 10 October 2012;

Received in revised form:

15 February 2013;

Accepted: 23 February 2013;

Keywords

Technology transfer,
Pharmaceutical biotechnology,
Dematel.

ABSTRACT

Biotechnology is one of the new and strategic technologies which have been regarded as a suitable and powerful tool for access to sustainable development. For this reason, some countries have made long-term investments and planning for utilization of its potential. In Iran, many efforts have been made to progress biotechnology and pharmaceutical biotechnological projects have been transferred to the country. But requirement of a suitable technology transfer to the country is transfer of this technology based on a compiled and conscious plan. In this article, three objectives have been considered: The first objective is views of the experts about essential questions including barriers to technology transfer in pharmaceutical biotechnology, methods of technology transfer and the used models for transfer. The second objective is study of technology transfer process in projects transferred to the country. In this regard, different phases of technology transfer were specified and the specialists were asked to answer this question to specify weak and strong points in technology transfer. The third objective is study of factors effective on technology transfer in pharmaceutical biotechnology. In this regard, important elements in technology transfer process which can cause to progress this industry in the country were specified by coordination with specialists and experts and such indices were studied with use of *DEMATEL* technique to specify what elements are effective on technology transfer process and which elements are affected in technology transfer process which can play important role in decision of the authorities.

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Introduction

Technology is one of the main factors of economic development of each country. Today, selection of suitable technology for economic development, fulfilling essential needs of the country and planning in order to be applicable are very important. Seven new knowledge-based technologies include new material, biotechnology, nanotechnology; telecommunication, information technology; robots and aviation have been considered by the development planners as strategic sciences of the century. In two recent decades, biotechnology has been considerably progressed and now is regarded as one of the important and effective sciences and techniques for improving development indices. With regard to low share of the country out of global export and necessity for increase of the country's share out of the world industrial products, an industry is needed, which fill this technologic and income can gap with the developed countries. With advance of societies and increase of population in the world, there is need for progress of sciences and technology in these countries. In most biotechnological articles, it is mentioned that biotechnology is a new emerging field which has not been developed long before. One can observe through study on biotechnological status that biotechnology dates back 1750 BC and even before that. Modern biotechnology started in early 70s in 20th century. In early 80s, its first scientific application was concluded by confirming clinical use of human new-compound insulin. In 80s, multilateral new biotechnological development was done in

different fields. In 2000, human genome plan was specified and century 21 was regarded as century of biotechnology development. Advance of biotechnology has been rapid in some recent decades.

Research problem

With regard to the performed studies and discussion with some biotechnology experts who have long experience of activity in the field of biotechnology, it was concluded that it is necessary to study biotechnology changes trend in Iran for improving condition of this industry and to identify the available problems and provide solutions for removing the problems with regard to views of the experts in industry. For example, one of the problems has been biotechnology transfer technology process without formulated and predetermined plan. Most managers and experts employed in this section have taken action regarding selection and acquisition of technology at times they have found need for technology transfer in their sections with regard to their technical and managerial records. It is evident that there will be more error in transfer of the technologies which have no formulated and specified plans.

Research methodology

Goals of execution of this research are to explain and describe condition of pharmaceutical biotechnology in the country recognize strong and weak points of this industry (especially technology transfer) in the country during the years of this industry and also to gather views of experts and researchers in this field for presentation of the model which can

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help the specialists at time of technology transfer. In this research, documents available in the libraries were studied in order to study the researches done on the research subject and publications such as biotechnology bulletin which is published by Presidency Technology Institution are studied and their useful materials regarding research subject are classified and applied in the research.

For preparation of the questionnaire, effort has been made to gather the related information from respondent group by raising some questions. The questionnaire used in this article is a named questionnaire with regard to busy respondents, short time of response to the questions, time limitation in performance of research and rapid analysis of responses. In order to determine accuracy of the questionnaire, limited number of questionnaire was copied and given to the experts and defective questions, ambiguous questions in original copy of the questionnaire which should be given to the main group were corrected. In this research, the respondents were interviewed. In order to deal with space of interview and freedom of action in asking questions, free interview was used so that one can obtain answer of the questions in the best way.

- In order to determine authenticity and increase trust in the given answers, the respondents were interviewed. 10 questionnaires were considered for interview randomly among the gathered questionnaires.
- With regard to the subject referred in the previous discussion, interview was used for gathering information for two other reasons. The first reason was about the experts and authorities who didn't answer the questionnaires for some reasons of which the most important ones were lack of time and lack of motivation for answering the questions. With regard to the need for views of these experts, these experts were interviewed. The second reason why the interview was used in this research was that it was hard to gather information in this research and the published information was mostly old and dispersed and necessary information was not available on most occasions.

In this section, technology transfer was considered as a concept. This concept is dependent variable of the model and dimensions of this concept include selection and acquisition, conformity, application, development and promulgation. For each one of the following dimensions, its suitable subcomponents have been gathered. These cases are presented in table 1.

Dematel Technique

This technique was created in late 1971 in order to study very complex problems. Strategic and objective goals and of the global issues were considered in order to have access to suitable solutions and the experts of scientific, political, economic and social fields and leaders were used. In order to have access to judgment of the experts, the interview and questionnaire were frequently used. DEMATEL technique is applied in order to structure a sequence of the assumed information so that it studied intensity of the communication as ranking method. It studied feedbacks combined with their homogeneity and accepts non-transferable relations, though experimental information showed that (judgment of experts about direct communication of elements with each other) it allows transferability more or less.

Case study

Here, information has been analyzed with regard to the information obtained from questionnaires and interviews with experts. It is worth noting that three questionnaires have been used in order to gather views of the experts during term of research. The first and second questioners have been used for

organizational study of biotechnology companies and specifying different stages of technology transfer. The third questionnaire has been designed on the basis of DEMATEL technique in which the studied indices have been extracted with regard to articles and books about biotechnology and in consideration of views of the experts of biotechnology.

First questionnaire

In this questionnaire, it has been tried to extract general information about the studied companies. In this questionnaire, two series of open and closed questions have been used so that one can study views of the respondents properly. Information available in this questionnaire contains field of activities of the companies, combination of manpower, and technology transfer method (for answering the second question), barriers of technology transfer (for answering the first question). The technology transfer models are used (for answering the third question). With regard to type of the questions raised in this questionnaire, managing directors completed the questionnaire. Through the negotiations with different companies, seven companies and organizations active in biotechnology announced their agreement with research. These seven companies have been classified in the following table and their field of activity has been specified.

Methods used for technology transfer

The second question for specifying technology transfer method in companies active in pharmaceutical biotechnology has been designed. Answers given to this question are given in summary in table 3.

With regard to study of table 4, it is found that technical training of the staff in developed countries industries with 40% has the most application in technology transfer in pharmaceutical biotechnology among the methods used in different companies. It seems that this method is suitably efficient in pharmaceutical biotechnology transfer in comparison to other methods. After this method, methods of establishing research centers in the technology origin country, technology transfer through contracts and technology transfer through reverse engineering are included in the next ranks.

In response to the second question of research "what are methods of technology transfer in pharmaceutical biotechnology field?" Answer of this question is given in table 4. With regard to the presented material, one can conclude that technical training of the staff in developed countries is one of the methods used in pharmaceutical companies in the country.

Technology transfer model

The third question in the first questionnaire has been considered for gathering technology transfer models in different companies, but one company have not used technology transfer models. This question was ambiguous for most managers active in biotechnology and they didn't know if they can follow a single model or some models for technology transfer.

We can answer the third research question "what model has been important for biotechnology transfer in pharmaceutical biotechnology field and what model is suitable in Iran?" "That a special model has not been used for technology transfer in biotechnology field and there is need for presentation of a model in this field. A conceptual model has been presented for continuing this research.

- barriers to technology transfer in pharmaceutical biotechnology

This question was raised by aiming at barriers to technology transfer in biotechnology field which is the first research question. In order to gather information and conclude about barriers to technology transfer, the open question was raised

because the number of experts who can answer the questions properly was low. The results obtained from this question are given in table 5. With regard to the given answers, one can conclude that sanctions with frequency of 25% have priority.

In order to be informed of technology transfer in biotechnology field in the country, this questionnaire was prepared to specify how technology transfer is in each one of the fields. In this questionnaire, indices with views of professors and experts of this field were considered in order to test each one of the phases of technology transfer. information presented in this questionnaire will be answer to the fifth question.

Selection and acquisition of technology

In order to specify status of this phase, 12 indices were used. These indices and percentage of their completion in pharmaceutical biotechnology field are drawn in Figure 2. As shown in the diagram, the maximum effort is made to deal with three indices of training the experts receiving technology, execution of contract and foresight and prediction of technology. These indices are distant from maximum rate and more efforts have been made to promote these indices. The minimum actions in this phase are focused on three indices of communication with technology holder, encouraging them to cooperate and receive suggestion, presence of suitable infrastructures and assessment and determination of technologies required by the country/agency. Double effort should be made to promote percentage of these indices so that one can increase percentage of selection and acquisition phase considerably.

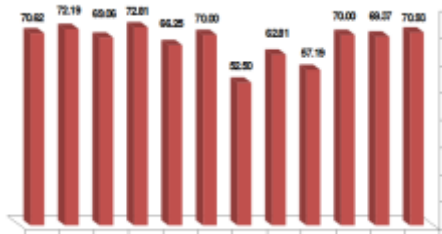


Figure 2: percentage of selection and acquisition phase Technology conformity

In order to specify status of this phase, 13 indices have been used. These indices and percentage of their completion are drawn in Figure 3. As shown in the diagram, the maximum effort is made to deal with three indices of equipping laboratories on the basis of import technology, gathering and compiling standards and conformity of substructures with import technology. The minimum actions in this phase are focused on indices of revision in design of the product and making necessary changes, corrections and changes of methods in production and construction technique and study of organization and management and reorganization.

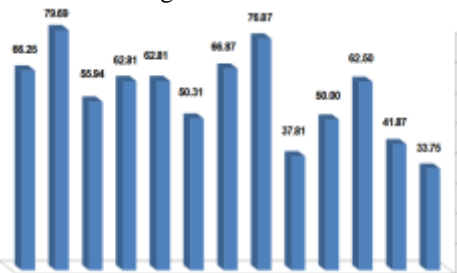


Figure 3: percentage of conformity phase performance Technology absorption

In order to specify status of this phase, 13 indices have been used. These indices and percentage of their completion are drawn in Figure 4. As shown in the diagram, the maximum effort is made to deal with indices such as careful study of the

received documents and use of cooperation of the experts during conformity of the acquired technology and employment of the specialized forces. There are also indices of study of similar technologies and visiting the plants out of the country and establishing relationship and effective use of research and university centers.

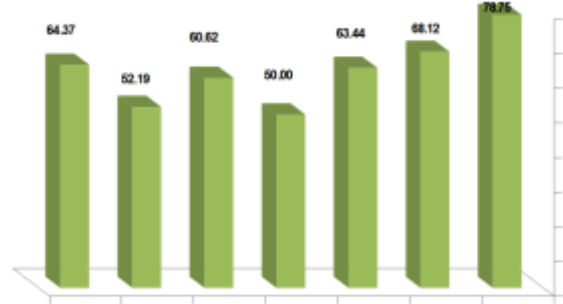


Figure 4: percentage of absorption phase performance Technology application

In order to specify status of this phase, 10 indices have been used. These indices and percentage of their completion are drawn in Figure 5. As shown in the diagram, the maximum effort is made to deal with three indices of identification of market in access and sale of the product, supervision on execution of construction, installation and commissioning of machinery and equipment and documentation. The minimum activities are bidding construction of the building, installations and accessory equipment and conclusion of contract with contractors, use of management systems and structures such as planning, production control, organization of manpower and necessary designs on the basis of the conformed technologies.

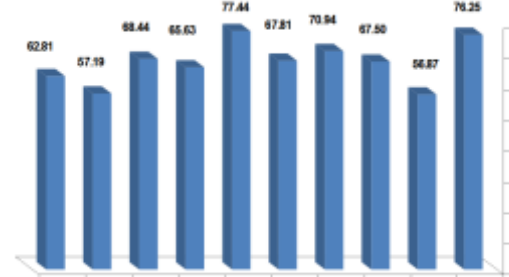


Figure 5: percentage of application phase performance Technology development and improvement

In order to specify status of this phase, 16 indices have been used. These indices and percentage of their completion are drawn in Figure 6. As shown in the diagram, the maximum effort is made to deal with three indices of continual study of the available standards, gathering books and possible information in the field of experimental production and technology and removing its defects. The minimum activities are post education courses with help of universities and higher education centers, doing common research with help of companies, research and university centers and study of demands, views and tastes of the potential customers.

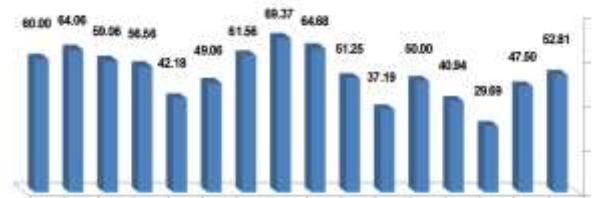


Figure 6: percentage of development phase performance

Publication

In order to specify status of this phase, 14 indices have been used. These indices and percentage of their completion are drawn in Figure 7. As shown in the diagram, the maximum effort is made to deal with three indices of publication through seminars and specialized conferences, publication of technology information and publication through mass media. The minimum activities are transfer of technology to other countries, publication through formal and informal trainings and presentation of finding resulting from transfer of technology to research and engineering centers.

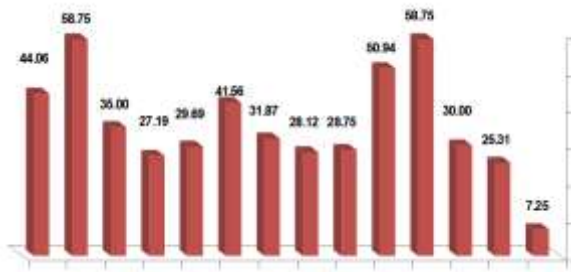


Figure 7: percentage of publication phase performance
Results about phases of technology transfer

In order to execute a process of technology transfer process, it is necessary that the authorities do their best to improve status of technology transfer phases and control status of biotechnology in the country by following and surveying this information regularly. Progressing six phases of technology transfer in order to make technology endogenous.

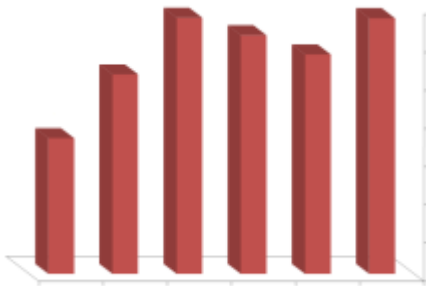


Figure 8: percentage of technology transfer process

Conclusion of the second questionnaire specifies status of technology transfer in the field of pharmaceutical biotechnology in Iran. As shown in Figure 8, application phase with 67.08 has the highest rank. High rank of this phase is due to suitable market for products of pharmaceutical biotechnology and the activities performed in this phase should be done by the companies and they independent perform these activities. After it, phases of acquisition, absorption, conformity, development and publication are prioritized. Percentage of performance of technology transfer process specifies that status of technology transfer in the field of pharmaceutical biotechnology in Iran is not so satisfactory. This subject is worsened in publication phase which can create problem in Iran in the future because technology development in an economic agency level and even in a section level will not be possible without expanding it in structure of sciences and technology of society. Distance of 65% between this phase and final value shows that there is need for more activity and effort in order to make biotechnology endogenous in the country.

The information gathered in this section is an answer to the fifth question of the research on status of technology transfer process in pharmaceutical biotechnology. All phases of technology transfer process were studied. The information given in this section proves authenticity of the first hypothesis 'phases

of development and promulgation have not grown properly in technology transfer phases. In this section, method of calculation in DEMATEL technique is summarized. Constituent elements of this matrix have been specified through NGT method and on the basis of view and interview with five experts of pharmaceutical biotechnology industry. List of these factors is given in table 6.

Ranking method

In this stage, the extracted elements in the previous stage are written in a matrix of 39*39 and experts were asked to rank relationships between elements by distributing the above matrix. In this ranking method, zero number was used for the least effect and 10 were used for the maximum effect. It is necessary to note that the expert is asked about the intensity of direct relationships between elements (generally DEMATEL method) and he is asked to make comment about it. In order to ensure authenticity of numbers and increase accuracy of the calculation in DEMATEL method, each company was given two matrices to be completed by experts and specialists of the companies and their views were averaged.

The obtained matrix was named M^{\wedge} indicating intensity of influence of the available elements from that row on element available in that column (Asghar Pour, 2003).

- Total intensity of an element (across longitudinal axis) in terms of dispatching and receiving

In this section, total intensity of dispatching and receiving elements is given. Actual place of each element in final hierarchy is specified by column(R-J) and (R+J) so that (R-J) shows position of an element (across traverse axis) and this position will be dispatcher in case of being positive (R-J) and it will be receiver in case of being negative. (R+J) shows total intensity of an element (across longitudinal axis) in terms of dispatching and receiving.

Explanation of conceptual model

The presented model has been designed on this basis that most of the companies which are active in biotechnology field are part of small or medium companies. Therefore, these companies don't have enough capital to have ready access to required financial sources in order to compensate for the performed investment and get necessary profit and spend this profit in performing research, innovation and development of new products.

In suggested model, two overlapping circles have been used for technology transfer. In external circle, the companies can take action regarding getting the related technology (technology transfer). This circle includes phases of technology prediction, technology assessment, methods of technology transfer and six phases of technology transfer which will result in commercialization and customer. In order to do successful commercialization, phases of development and publication should be considered in technology transfer process. In this model, it is suggested to perform activities of selection and acquisition, absorption and conformity and application sequentially. At the same time, specified activities should be performed in the company for development and publication of technology. As mentioned before, these two processes had lower percentage of execution than other processes had and it is necessary to adopt some formulated plans for improving them to do effective commercialization process. In external circle, the product is commercialized and is given to the customer and we will have accumulation of technology in company and society because, the information obtained during technology transfer process will be transferred to research and development unit and published in society.

In the next phase, present and future needs and demands of the customers will be dealt with and this information causes to create 4 new ideas in the company. The company will study if one can create these ideas with regard to accumulation of the created technology in research and development unit inside the company. In case that the answer is yes, these ideas are sent to research and development unit for performing and competing phases to be converted to the product which fulfills need of the customer after passing phases mentioned in the model. This product development process can cause to create competitive advantage. In this phase, ideas are turned into a product and science to wealth conversion trend will be performed. In this model, it is not necessary for the companies to perform all phases of converting idea to the product by themselves but they can benefit from scientific and university centers in the country and companies will try to deal with innovation process. In this model, research and development and innovation will be critical for prevention from premature death of the biotechnology companies.

Innovation model has been considered on the basis of market elasticity or demand elasticity. In this model, innovations are results of demand and need of markets and market demand creates new need of technology development in the companies. In this model, most innovations result from work of the units which communicate with customer directly because these units know need of the customer and recognize place of investments. In this model, market determines what projects of research and development should be invested and emphasis is on market and customer's need.

At the end of this phase, there are product marketing and technology marketing in which the experts investigate status of the product in market and if they face an improper market, they will notify the research units and a feedback will be created in the company. Some factors out of the control of the company will be effective on technology transfer process, which are classified into cultural, economic, political, legal and technological factors like other technology transfer models. With regard to the results obtained from analysis of the gathered information in DEMATEL method, one can specify the elements which are effective on these factors and finally on technology transfer process. Regarding political factors, the most important factor is economic sanctions in Iran which has effect on the entire process of technology transfer. There are more cases about legal factors which include role of supervisory bodies, intellectual property rights, role of technology transfer centers and specialized biotechnology courts. The most important cultural factors are management stability and transfer of biotechnological finding to scientific and university centers. Important parameters in economic factors are trend of research, budget, and loan and grant supports. Important technological parameters are technology assessment, adjustment of technology with conditions of the country and training of technology to the receiving country. In the relates model, it is suggested to perform all phases of technology transfer under supervision of person (group) as senior authority of technology so that this person (group) takes action regarding determination of suitable indices for each phase of technology transfer and measures completeness of each phase and remove defects and problems of transfer.

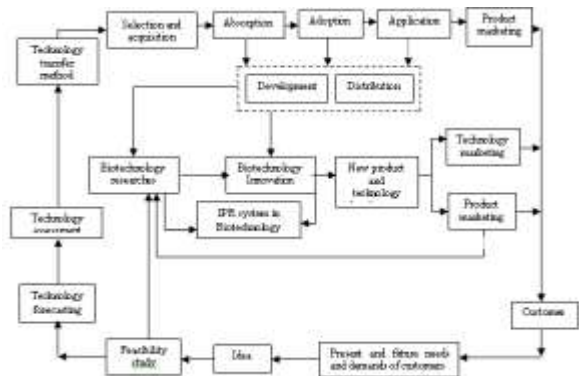


Figure 9: Suggested conceptual Technology transfer model Conclusion

On the basis of table 4, it is clear that the most frequent method of technology transfer used in biotechnology in Iran is technical training of staff in the developed countries. This subject is an answer to the second question of the research. This method of technology transfer is one of the modern methods of technology transfer. With regard to the information gathered from the distributed questionnaires, it was specified that most of companies active in pharmaceutical biotechnology have not used a clear model for technology transfer. Only 14.2% of the companies (one company out of 7 studied companies) have used the model for technology transfer. With regard to the information gathered from the distributed questionnaires, it was clear that one can cluster major barriers of technology transfer in this field in accordance with table 5. Major barriers are economic sanctions of Iran and management instability in major level. With regard to information analysis in DEMATEL method, these two factors are of the factors effective on technology transfer process. Policy makers in pharmaceutical biotechnology field should find suitable strategies in order to control such problems. With regard to the information obtained from distribution of the second questionnaire, one can conclude that process of technology transfer in Iran has not been performed completely. This case can prevent from expansion of this industry in the country. By studying different phases of technology transfer in the country, one can specify some of the barriers to technology transfer in the country. Generally, we conclude through study of technology transfer process that we have more problems in phases of development and publication in comparison to other phases and this indicates that it is necessary to follow this subject seriously in major biotechnology policy making. In order to perform technology transfer, other conditions in a country should be considered in addition to issues mentioned in the previous sections such as six-phase process of technology transfer. It is necessary for a factor to be receiver or dispatcher in correct decision making and authorities should try to improve status of the dispatcher elements. In order to improve status of technology transfer in pharmaceutical biotechnology field, it is necessary to invest on some elements such as role of supervisory and decision making bodies, presence of sanctions, intellectual property rights system, management stability, and cultural factors than other elements under suitable conditions. The elements which are subject to other elements are obtaining local and foreign standards, Commercializing medicines and produced vaccines, Use of specialists of other countries or Iranian researchers residing in other countries and even use of local resources are subject to other elements in pharmaceutical biotechnology.

Table 1: relation of concept, component dimension

Concept	Dimension	Component
Technology transfer	Selection and acquisition	Assessment and determination of required technologies of country/agency
		Study and selection of suitable technologies for transfer
		Study and recognition of technology authorities and recognition of technology transfer methods
		Prioritizing possible methods of technology transfer
		Communication with technology owners , encouraging them to cooperate and receive suggestion
		Negotiation for attaining the best situation
		Preparing draft and concluding contract
		Enforcement of contract
		termination and documentation
		Revision in product design and making necessary changes
	Conformity	Correction and changes of the methods I production and construction techniques
		Adjusting building and installations with production methods and volumes
		Study of the organization and required management and reorganization
		Correction and change of product sample
	Absorption	Planning for absorption of technology, study of documents and training inside and outside the country
		Employment of specialized manpower
		Establishment of research unit (study of technology from conclusion of the contract t exploitation of technology)
		Study of similar technologies and visiting plants out of the country
	Application	Necessary designs on the basis of conformed technologies
		Use of managerial systems such as planning , production control , manpower organization
		Preparing organizational chart
		Execution of machinery construction , transportation and installations and commissioning operations
		Exploitation of the performed actions
		Product marketing and sale
	Development	Design and production of new products
		Making educational sample
		Experimental production and removing defects
		Mass production
	Promulgation	Publication of technology achievements in industry and university level
		Teaching knowledge in technical and vocational institutes
Publication of technology information in publications		
Encouraging researcher in the industry		

Table 2: list of the companies studied in this research and type of the manufactured products

Row	Name of company	Field of activity
1	Sina Gene	Production of interferon and single lineage antibodies
2	Pars Rose	Production of herbal medicines in biotechnology method
3	Pastor Institute	Production of different types of vaccine
4	University of Tehran	GCSF, Alpha interferon EPO
5	Behshid Zist Fanavar	Gasilase , production of asiagenase enzyme and penicillin
6	Aria Tina Gene	Anti cancer and cardiovascular new compound medicines
7	New compound products	Production of interferon

Table 3: access of the companies to the related technologies

Row	Name of company	Access to the technology
1	Sina Gene	Establishment of research centers in the technology origin country, Joint venture, technical training of the staff in the developed countries, employment of the foreign labor, technology transfer through contracts, technology transfer through reverse engineering
2	Pars Rose	Establishment of research centers in the technology origin country, technical training of the staff in the developed countries ,
3	Pastor Institute	technical training of the staff in the developed countries industries, technology transfer through contracts
4	University of Tehran	technical training of the staff in the developed countries industries
5	Behshid Zist Fanavar	Primary research order to a foreign company(2 cases)
6	Aria Tina Gene	training the staff in the developed countries industries and technology transfer through reverse engineering
7	New compound products	technical training of the staff in the developed countries industries

Table 4: frequency and frequency percentage of technology transfer methods

Row	technology transfer method	Frequency	Frequency percentage
1	Joint venture	1	6.66
2	Establishment of research centers in the technology origin country	2	13.33
3	employment of the foreign labor	1	6.66
4	technology transfer through contracts ,	2	13.33
5	technology transfer through reverse engineering	2	13.33
6	technical training of the staff in the developed countries	6	40
7	Primary research order to a foreign company(2 cases)	1	6.66
Total		15	100

Table 5: barriers to technology transfer in pharmaceutical biotechnology

Row	barriers to technology transfer	Frequency	Frequency percentage
1	Sanctions and lack of access to the suitable equipment	18	25
2	Lack of suitable planning	15	20.83
3	instability of the management in major level	15	20.83
4	Need for more manpower	9	12.5
5	failure to pay loan and financial supports	9	12.5
6	Lack of risk capital	6	8.34
Total		72	100

References:

- [1] Abedi, Z. 1997. study of technological studies of the country, deputy of economic affairs of Ministry of Finance and Economic Affairs, Tehran, first edition, P68.
- [2] Ahrens. J. 1999. Governance and the implementation of technology policy in less developed countries. Maastricht.
- [3] Ahmadi. A. 2000. overall attitude to technology transfer, Tadbir periodical, No. 109.
- [4] Arasti, M. presentation of model for selection of suitable method of technology transfer.
- [5] Asghar Pour, M. 2003. group decision making and theory of games with attitude to operational research, University of Tehran, first edition, P92.
- [6] Asia and Pacific Center for Transfer of Technology (APCTT), 1986. Technology Policy formulation and planning: A reference manual, Bangalore, India.
- [7] Bakaei, M. summer 1998. Technology development model: a suggestion for Islamic Republic of Iran, Pajoohesh Yar, No. 2, P27.
- a. BIO, Biotechnology Industry Organization; "What is biotechnology?" www.bio.org/aboutbio/guide2000/whatis.html
- [8] Biotechnology Bulletin, 1996. Biotechnology Research Center, Scientific Studies and Research Office, first year, No. 1, Nov.
- [9] Biotechnology Bulletin. 1996. Biotechnology Research Center, Scientific Studies and Research Office, first year, No. 12, Dec.
- [10] Biotechnology Bulletin. 1997. Biotechnology Research Center, Scientific Studies and Research Office, first year, No. 3, Jan.
- [11] Biotechnology Bulletin. March 1997. Biotechnology Research Center, Scientific Studies and Research Office, first year, No. 5.
- [12] Biotechnology Bulletin. 1997. Biotechnology Research Center, Scientific Studies and Research Office, second year, No. 6, Apr.
- [13] Biotechnology national committee holding by law. 2001. Ministry of Sciences, Research and Technology.
- [14] Borg .W and Meredith .D," Educational Research: An introduction 5th edition), London, Longman.
- [15] Brawn, E. 2003. technology assessment and prediction, translated by Aghil Maleki Far, Karaneh Elm Publication Cultural Institute, Tehran, first edition, P4.
- [16] Defensive Industries Training and Research Institute research office. Year 1994. General technologies for promotion of all industrial sections for years 1990-2005, P 73-81.
- [17] Draft national document, interests, goals, policies and strategies of biotechnology in Islamic Republic of Iran, Biotechnology National Strategic Planning Group, 2002.
- [18] Erabi, S. methods of technology transfer methods, Tadbir periodical, No. 179.
- [19] Esfahani, S. 2002. knowledge of Iran in international level., Iran Studies and Scientific Documents Center, Ministry of Sciences, Research and Technology.
- [20] Eslami, R. factors of success in technology transfer and industrial development of developing countries, industry and development, third year, No. 17.
- [21] Falah, A. 1999. fundamentals of technology and technology transfer from the policy making point of view for technology development, aerial consulting engineers, P53.
- [22] Farazmand, A. 1992. Biotechnology, Allameh Tabatabaei University.
- [23] Hossein Zadeh. 2000. Technology transfer methods, the first conference on challenges of technology transfer in oil industry and executive strategies.
- [24] Industrial policy office. 2006. Technology policy and market encouragement, industrial policy office of technology research center of Sharif University of Technology, P67-69.
- [25] Jacobs .D. 1998. Innovation policy within the framework of internationalization. Research Policy, p718, 719.
- [26] Kefayati .E. 2003. Status of research and biotechnology in Japan, biotechnology group of Iran technology analyst's network.
- [27] Khaki, G. 1999. research methodology with approach to thesis writing, Baztab, Tehran, fourth edition.
- [28] Khalil Pour .B. 2003. pharmaceutical biotechnology, Technology Analysts Network.
- [29] Kheirandish et al. 2001. Final report of study on biotechnology in different countries in the world, biotechnology commission of state council of scientific researches.
- [30] King F.D; Medical Chemistry. 2002. Principles and Practice. Second Edition; The Loyal Society of Chemistry, London, p183.
- [31] Kish, L, 1967. Survey Sampling. New York, John Wiley, p 519.
- [32] Kondo, M, 2001. Networking for Technology Acquisition and Transfer", forum on management of technology, Vienna, Austria.
- [33] Lee K. C. Lim, 2001. Technology regimes, catching up and leapfrogging: finding from the Korean industries", Research Policy, p 210-212, 1998, "Market – Stimulating Technology Policy.
- [34] Mahnak K. 1992. entering technical knowledge for self sufficiency: to native technology, translated by Abdolhossein Azarang, Negah No, No. 11, P135.
- [35] Manteghi .M. 2006. Facing challenges of technology management in automotive industry, Abaron, first edition, Tehran, P42.
- [36] Ming X.w, Xing .z, 1995, "A new strategy of technology transfer", management, Vol 19, p 527-530.
- [37] Ministry of Islamic Guidance, future technology and technology future, Department General of Publication and Advertisement, first edition, Tehran, March 1987, P 24 and 25.
- [38] Mir Darikvand, M. review on status of biotechnology in the world, biotechnology group of technology analyst's network, 2003.
- [39] Mohammad Khan. 1994. process of technology transfer in Iran light industries section, Ministry of Finance and Economic Affairs.
- [40] Moosavi, A. study of foreign investment in Iran, Tadbir Periodical, No. 173, 2006.
- [41] Nurmemmedov, E. 2004. Bio entrepreneurial partnership: A tool for biotechnology transfer .MA, Lund Sweden, p 12-13.
- [42] Plan and budget organization. 1990. Technology atlas, general framework of planning based on technology first edition, Tehran, P 19 and 20.
- [43] Sarkisian, A. 2005. 2003. Science and technology policy, principles and concepts, modern industries center.
- [44] Sharif N. Tehran 1987. Technology transfer, management and development, translated by Rashid Aslani, Ministry of Plan and Budget. Economic and Social Documents Center, first edition, P 20 and 73.
- [45] State council of scientific researches .1995. Technology and Environment of Malaysia 1990. development of industrial technology development in Malaysia, a national action plan .Ministry of Sciences, P 20.

- [46] Tabaeian .K. 1998. Trend of science and technology policy of six countries, training and research institute of Ministry of Defense, P5.
- [47] Tabatabaeian, H. 2005. Assessment of technological abilities in agency level.
- [48] Taregh, K. 2004. technology management , secrete of success in competition and creation of wealth , translated by M. Erabi , Cultural Researches Office , first edition , Tehran ,.
- [49] Tavakol , M. 1992.technology transfer and its social aspects , Sharif Magazine , No. 3, Dec.
- [50] The Council for Science and Technology (Japan). 1998. Comprehensive and Basic Policy for Upgrading and Strengthening of infrastructure to Support Science and Technology.
- [51] Walker W.E. 2001.Adaptive Policies, policy analysis and policy making. European Journal of operation Research, p 286.
- [52] Zargham, N. 1998.status quo of biotechnology in Islamic Republic of Iran, biotechnology commission of state council of scientific researches.