



Factors affecting technology commercialization in Iranian knowledge based pharmaceutical companies

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ABSTRACT

Background: Looking at the performance of the Iranian knowledge based pharmaceutical companies in recent years shows that, despite extensive capabilities in technological development, many companies involved in technology commercialization have been unsuccessful. Studies show that many components have played role in success or failure of technology commercialization in such companies. This study attempts to identify, and measure the impact of factors affecting technology commercialization in knowledge based pharmaceutical companies, and provides recommendations and considerations for active managers in this field. **Methods:** In this survey, questionnaires were distributed among 10 knowledge based pharmaceutical companies with 19 commercial products. The data were collected, and analyzed to rank the factors based on importance. **Results:** Support of senior management, organizational and operational characteristics, extraction of new product concepts, forming risk-taking team and project management, have the greatest impact on technology commercialization in these companies. **Conclusions:** Based on the study results, adequate attention to these elements by the managers of knowledge based companies can lead to success in technology commercialization actions in knowledge based pharmaceutical companies.

Keywords: Commercialization, Technology commercialization, Knowledge-based Companies.

1. Introduction

Today, the pharmaceutical industry is considered as one of the largest and most important industries in the world. During the last decades, the drug industry has undergone various conditions. However, this industry is now considered as one of the major strategic industries in Iran. Knowledge-based pharmaceutical companies can be defined as companies or private institutions that are formed to promote knowledge-based economy by means of developing invention and innovation and commercializing the results of research and development (R&D). These results include design and production of goods and services in the field of hi-tech pharmaceuticals with great added value. In recent years, we have witnessed a dramatic growth in such companies. Commercialization of research findings in the field of manufacturing and marketing is one of the most complex stages of innovation process. Commercialization of research and knowledge is an inevitable activity in order to offset the cost of R&D in universities and public or private research centers. Commercialization not only provides an opportunity to invest in more advanced technologies for researchers and their institutions, but can also help with the development and competitiveness in this field. Generally, the main challenge of knowledge owners and investors involved in pharmaceutical companies is how to convert their new and produced knowledge into tangible assets. Currently, the major problem is not lack of discovery, but lack of commercialization of discoveries. Commercialization converts knowledge into products and services with practical and valuable applications. It begins when a business is created as a means to use scientific advances and new knowledge, in order to respond to the market needs by designing, developing, manufacturing, and subsequently improving the product. In general, if the research findings are not used and the society does not benefit from their advantages, they cannot be regarded as a source of wealth for the community. Increasing commercialization of R&D results in the field of high-tech pharmaceuticals requires accurate knowledge of the factors affecting it. Familiarity with such factors can help knowledge-based companies with one of their major goals which is expansion of commercialization of R&D results. In this context, this paper seeks to identify key influential components on commercializing technology in knowledge-based pharmaceutical companies.

Theoretical Foundations of the study

Cambridge advance learners dictionary has defined the word "commercialize" as "to organize something to gain profit" and the word "technology" as "study and practical knowledge in the use of scientific discoveries, especially in the field of industry". In this paper, technology commercialization is regarded as a process in which a technology which can be either a product, service, or new process is marketed, and this process includes all activities like generating ideas of prototyping design, testing, production, marketing and selling the final product. Mousai has defined three main approaches concerning technology commercialization in research institutions which depends on the fact that whether we consider technology commercialization only as a phase of technology development/ innovation process or equivalent to technological innovation process:

- *Reactive commercialization approach*
In this approach, after doing a research project, and achieving its results, the commercialization process begins. This method is used mostly for technologies that are obtained as a by-product while carrying out massive research projects.
- *Approach to ensure commercialization (contract or custom research)*
In this approach, before the beginning of the research project, commercialization activities take place, and after ensuring commercialization, the contract is concluded between the trade partners of the project.
- *Simultaneous commercialization approach*
In this approach, commercialization activities begin before the startup of the research project, and continue along with implementation of the project (1).

Generally, the term of commercialization by companies is used in two different conditions:

1. *Commercialization in an emerging company:* In this case, a newly founded company commercializes a new product or service.

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2. *Commercialization as part of the company's activities:* In this case, a company with an established base of customers in a particular market uses commercialization to expand its ongoing business. (2).

According to Markham, a technology is capable of being used in various applications, and provides access to diverse markets, based on dynamic relationships between technology, market and product (3). In today's world, with the extent of globalization, companies have no choice but to develop new products to survive the competition. Perhaps, new product development is one of the main activities of the company, and is considered as one of the most risky decisions in the company which requires a huge amount of time and millions of dollars with a probability to fail than to succeed(4).

New product development process has at least six stages. One of the most well-known new product development processes is the stage - gate process, which is in fact an operational road map to guide new product development projects from idea to market.

According to other researchers, nearly 60% of firms in different industries use the stage-gate process as a guide to their development activities (5). It should be noted that, in marketing text books, commercialization has usually been portrayed as the last part of the product development process, and according to Kotler, the process of commercialization takes place after testing the product market. Market test is done to evaluate the product in real market conditions.

At the beginning of the commercialization process of product, managers must decide about:

1. When, 2. Where, 3. To whom and 4. How they must commercialize the product? (6)

However, considering commercialization as the final stage of the new product development process represents a simplistic view about the issue of commercialization. Such perspective means that we have considered commercialization as the following of the R&D process where it reaches its peak, just before the product enters the market (7).

Technology commercialization in large-scale is a complex process influenced by many factors including, but not limited to, technology, business, social, political, and historical infrastructures. There are a number of factors that can play a role in success or failure of commercialization attempts. The growth and success of technology

commercialization is related to the policy and infrastructure layers. Although these two layers are not the only affecting factors, but their improvement will better the remaining influential elements. Experience has shown that changing science and technology policies in different countries has led to a sudden leap in technology development of those countries. Table 1 shows the classification of success factors of technology commercialization.

Technology commercialization at the level of private knowledge based companies (micro) is a complex process influenced by factors such as top management support, organizational characteristics and operational capabilities, ability to extract new product concepts, forming risk-taking team and project management. Each of these factors can be the driving force of one commercialization effort, and the hindering obstacle of another. These are in fact the determinants of the growth and success of technology commercialization. In other words, according to the literature, these factors, among all, have the greatest impact on the success of technology commercialization. Table 2 shows factors affecting technology commercialization in knowledge based pharmaceutical companies.

2. Methods

This descriptive study was based on a survey through questionnaires distributed among the target population (19 approved projects in 10 knowledge based pharmaceutical companies). In total, 24 questionnaires were distributed, and 17 completed were returned. The reliability of this study is considered as 95%. In other words, we predict the probability of 5% error in the results. The personal characteristics of respondents are shown in Table 3.

3. Findings and discussion

By reviewing the literature, results show that the factors with the greatest impact on technology commercialization, in decreasing order of significance, include support from the senior management, organizational and operational characteristics, extraction of new product concepts, forming risk-taking team and project management. These factors sometimes play a driving force role for commercialization efforts, and at times act as an obstacle to the process in knowledge based pharmaceutical companies. Therefore, a large part of the success factors of technology

Table 1. Classification of success factors of technology commercialization at the macro level

Layer	Time required to change	Agents	Output
Insights	Long-term	Effective elements such as teachers, professors, leaders.	Perspectives, goals, actions and...
Policies	Medium-term and short-term	Different implementation of government	Laws, Regulations, Bylaws
Infrastructures and services	Short-term	Authorities of organizations, institutions, and actors of technology, market and industry	Required Services for Technology Commercialization

Table 2. Factors affecting technology commercialization in knowledge based pharmaceutical companies

Factors	Variables	Theory
Senior management	1. Director's vision, strategy, support, network management. 2. Organizational culture, internal innovation, reward for innovation, Request to evaluate ideas, high motivation	Cooper, 1990 A-- Ferguson, 2008 - Jolly, 1997
Organizational and operational characteristics	3. Combination of functional teams and risk-taking team in organizing new products 4. The task of management and support in organizing new product development 5. Strategy/function guide, support requests, allocating resources according to priorities. 6. The level of public understanding about the new product development process	Roth well and Zegveld, 1985
Extraction of new product concepts	7. The specific experience, skills, understanding motivation	Roth well and Zegveld, 1985
Formation of the risk-taking team	8 - Technology application/market 9. Individual skill level, ability to perform the task, skill and ability levels, the level of understanding of the issues related to new products, the level of the payment of bonus, diversity of group members. 10. Expectations related to the roles	Roth well and Zegveld, 1985
Project management	11. Development of tactics to complete the project objectives. 12. Development of goals, objectives and evaluations 13. Focus on external factors (external support, customers) 14. Foreign technology / market specialists 15. Relationship of management 16. Evaluation activities (Flexibility)	Roth well and Zegveld, 1985

Table 3. Personal characteristics of respondents

	Gender		Age					Education			Job		Experiment		
	M	F	20-30	30-40	40-50	50-60	>60	B A	M A	Ph D	Manager	NA*	1-5	5-10	>10
Frequency	14	3	1	4	8	3	1	2	6	9	13	4	5	9	3
Percent	82	18	6	24	47	18	6	12	35	53	76	24	29	53	18
Perfect		17			17				17					17	
Imperfect		1			1				1					1	

* Non-administrator

Table 4. The effects of factors affecting technology commercialization in the knowledge based pharmaceutical companies.

Main criterion	Sub-criteria	Effects	Mean total effects
Extraction of new product concepts	Specific experience, skill, understanding motivation	6.3211	6.69
	Technology application, market	7.0632	
	Individual skill level, ability to perform the task related to new products	5.3684	
	Skill and ability levels, the level of understanding of the issues related to new products,	6.9947	
Formation of the Risky team	Expectations related to the roles	6.6684	6.08
	The level of bonuses	5.9947	
	Diversity of group members	5.3684	
	Development of tactics to complete the project objectives.	5.0579	
	Development of goals, objectives and evaluations	7.1632	
	Focus on external factors (external support, customers)	6.7895	
	Foreign technology/market specialists	6.1316	
Project Management	Relationship of management	5.0579	6.22
	Evaluation activities (Flexibility)	7.1632	
Organizational and operational characteristics	Combination of Functional teams and risky team in organizing new products	5.1573	6.28
	The task of management and support in organizing new product development	7.1742	
	Strategy/function guide, support requests, allocating resources according to priorities	6.6875	
Senior Management	The level of public understanding about the new product development process	6.1115	6.76
	Director's vision, strategy, support, network management	6.2452	
	Organizational culture, internal innovation, reward for innovation, Request to evaluate ideas, high motivation	7.1421	
		6.8895	

commercialization are affected by these factors. Furthermore, in this study, the impact of these factors on technology commercialization in knowledge based pharmaceutical companies have been measured and ranked. The research findings are shown in Table 4.

As reflected in Table 4, senior management support with an average effect of 6.76 has shown the highest impact and forming risk-taking teams with an average impact of 6.08 has shown the lowest impact on the success of technology commercialization in knowledge based pharmaceutical companies. The findings emphasize the role of the senior management in the following areas: considering organizational perspective and strategy, support for the commercialization activities, forming a network management system for technology commercialization chain, support for the desired organizational culture for innovation and commercialization, focusing on domestic innovation, creating reward systems for innovation and creating a system to evaluate ideas related to business development.

Product definition: A certain product in different areas of science and engineering has various definitions. For example, the definition of a product in a biology, chemistry, materials or metallurgical engineering business is different.

Product Development: includes the tasks of marketing the product, product design and product development process based on a road map.

Characteristics of a successful product development: Includes product quality, product cost, development time, development costs and development capabilities.

Product development challenges: These challenges include inaccurate estimation of the target market, inaccurate forecast of market demand,

wrong understanding of customer needs and demands, and complex and turbulent competition in domestic markets, the complex and turbulent competition in global markets, shortening product life cycles, technical risk in projects of product development, commercial risk in product development projects and marketing research. Thus, as research has shown, knowledge of new product concepts in technology commercialization in knowledge based pharmaceutical companies play an important role in technology commercialization. Organizational and operational characteristics are shown as important factors in technology commercialization. If knowledge based companies are weak in areas such as forming task teams and risky teams in developing new products, allocating resource-based priorities and managing public perception associated with new product development process, there is no doubt that the technology commercialization will not be successful. Because of the costs, complexities and risks of technology commercialization projects, the need for establishing a strong administrative team is emphasized as a crucial factor in the success of technology commercialization projects in knowledge based companies. In the poll that was conducted, 56.16% of respondents considered poor management and not forming a risk-taking team as a reason for the failure of commercialization. Forming a risk-taking team means a team with the features such as: high level of personal skills, the ability to perform the duties, high skill and ability as individuals and group members, appropriate knowledge level in areas related to new products and appropriate levels of bonuses.

In the present research, the existence of a variety of team members is known as the last important factor in the success of technology commercialization.

4. Conclusion

Recent research suggest that the process of technology commercialization

in Iranian knowledge based companies is faced with major problems and constraints. The most common problems include: exclusive focus on pure research, the limited use of research results, poor strategies for insight and policies, inadequate technology infrastructures, a poor focus by management on key components affecting the development of technology commercialization. The results indicate that, the factors; support of senior management, organizational and operational characteristics, extraction of new product concepts, forming risk-taking team and project management have greatest impact on technology commercialization in these companies. Therefore, adequate attention to these elements by the management of companies, and active policy makers in the pharmaceutical field, can lead to increased success in technology commercialization.

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