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## DETERMINANTS OF ACADEMIC RESEARCH COMMERCIALIZATION IN IRAN GAS INDUSTRY

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**Abstract.** The aim of this research is to identify determinants of academic research commercialization in the Iranian gas industry. For this purpose, we have applied a mixed research methodology. After reviewing the literature we conducted interviews with academics that have experience in the gas industry commercialization in order to develop the research questionnaire. Qualitative data were analyzed by codifying the interviews. To analyze the quantitative results we applied the exploratory and confirmatory factor analysis (EFA, CFA). The results show that there are 6 latent variables and 28 observed variables including the gas industry academic research commercialization requirements and prerequisites in Iran.

**Keywords:** academic research, commercialization, Iran gas industry, EFA, CFA.

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### 1. Introduction

Iran is the second large gas producer in the world and it is predicted that the consumption rate will increase from 2.5 billion CM<sup>1</sup> in 2000 to 5.1 trillion CM in 2030. Regarding environmental issues and reduction of world's oil resources, the consumption share of this fuel is increasing day by day, to the extent that according to the report of World Energy Association natural gas will be the best choice to replace oil by 2020, at least. This issue along with the country's potential in natural gas area confronts us with this question that how we can commercialize the findings of studies in this area in order to benefit from this great source of natural resource using the capability of national experts? And how we can practically convert the gas to a tool for technological entrepreneurship development in the country?

The competency to commercialize the academic research findings could turn a raw materials supplier country to a technology based country. There are various obstacles hindering the development and commercialization of technologies in the gas industry, these obstacles include political, legal, economical, structural, organizational, environ-

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<sup>1</sup> - Cubic meter

mental obstacles, lack of knowledge about the market and sufficient capability of human resources, etc. Complexity and multi-disciplinary nature of technology development, commercialization and lack of documented experience in this field on one hand and faculty promotion rules, that takes a lot of time and energy of them, on the other hand as well as lack of strong relationship between university and industry comprise the major hindrances for achieving this objective. The process of commercialization requires the cooperation and interaction of higher education centers and research organizations affiliated to the government, industrial companies, financial and investment organizations, entrepreneurs and scholars (Popadiuk and Choo 2006).

The subject of technology and commercialization in Iran is a copied and imported topic like most aspects of industrial production, consumption, higher education and even research; they are not formed according to real needs of the community, so finding a clue to solve this complex issue is not an easy task. Solving the problem of how to maintain an effective communication between university and industry and making the training of skilled manpower demand-driven, and also carrying out market-oriented research has produced no effective enforcement mechanism despite many years of addressing the issue.

The gap between academic motivations to achieve competencies and existing interests and incentives for commercialization for realizing what should be sold, is not a gap that can be filled easily. The researchers are content with multiplicity and frequency of studies in order to get promoted without considering satisfaction of clients and market demand. Less research is done with the goal of commercialization and responding to an industrial issue.

In the existing literature there are different definitions for commercialization. Some define it as the process of presenting a new or improved product to the commercial or consumer markets with the goal of commercial success (Lemetyinen 2001). Others consider it changing knowledge to products and services with scientific application and/or valuable use (Metla 2007). In some cases the terms invention, innovation and commercialization are commonly used to refer to the process of developing new technologies and converting them to new products, processes and services. This mix up is much more resulting from the close relationship and subtle differences between the meanings of invention, innovation and commercialization (Degeeter 2004).

Many authors claim that the universities have a new role in commercialization of research findings. As the importance of scientific scholarship in innovation and developments of business is increasing and as a bigger part of the society is getting higher education, the universities can play more important roles in achieving innovation (Rasmussen *et al.* 2006).

The objective of this study is to identify determinants of academic research commercialization in the Iranian gas industry. There are different factors affecting research commercialization. Institutional foundations, inventor, market, technology and property rights are among the main categories that their influence should be investigated. Regarding Iran's context we think that there must be some country specific factors, so we would conduct interviews with the experts of the field. In this article, first Iran Gas

Industry is introduced, then the literature will be studied and the research method will be described. Results are illustrated in the next section and finally based on the results we discuss the effects and implications of the research findings.

## **2. Iran gas industry**

Iran holds the second largest gas reserves in the world with over 27.5 trillion CM of natural gas. Hence, for utilizing this energy carrier, it is essential to have comprehensive and explicit planning knowledge. The study of gas industry development policies is indicative of certain barriers in utilizing prospective opportunities.

Iran is one of the largest gas rich countries in the world that production capacity exceeds domestic consumption and gas injection requirements. Gas can be utilized as feed stock in petrochemical plants and refineries or exported through pipeline or Liquefied natural gas (LNG). Gas consumption in domestic markets and its substitution with oil products, in addition to providing environmental benefits, will also result in optimum consumption of these products and relieving the government from the heavy burden of existing subsidies and heavy expenditures of importing these products into country.

Supplying gas requirements, proper and timely production and operation of joint reservoirs such as the South pars<sup>2</sup> with the intention of supplying gas requirements and providing balance of supply and demand as well as maximum utilization of Iran share in these fields are other development requirements of this significant industry. For Planning and policy making regarding the development of gas industry, it is essential to manage all aspects of gas from exploration and production to consumption, injection and exports and etc. through a sole administrative institution so that prearranged plans could be implemented without becoming subject to such problems as lack of coordination, parallel activities and organizational problems (IEA 2008).

Predictions indicate that natural gas being the favorable fuel of the present century, will enjoy the largest growth among items within the energy basket and during the next twenty years as well, the world's natural gas demand growth will exceed other conventional energy sources . In the future, due to various factors such as accessible vaster sources and reserves, developing technologies which in effect reduce project expenditure and construction periods and consequently improve the economy of developing gas transmission projects as well as global endeavors to curtail emission of greenhouse gases are the major reasons for gas consumption growth.

In conclusion, it could be stated that more than ever before, gas has gained significance and is the leading basis for modern services in energy, and in the long term, is considered a bridge towards a hydrogen resource based economy.

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<sup>2</sup> - The South Pars / North Dome field is a natural gas condensate field located in the Persian Gulf. It is the world's largest gas field, shared between Iran and Qatar.

Gas as a new fuel, provides the modern technology of fuel cell construction for vehicles possible, therefore to portray the enormity of Iran's gas reserves, it is enough to consider that Iran's natural gas reserves alone exceeds the total volume of natural gas reserves in USA, Canada, Europe and the entire Asia Pacific.

### **3. Literature review**

Considering the common view that says increasing academic researches increases the abilities of the society, we should have in mind that as long as the findings of these studies are not implemented by private and public institutions the society will not benefit from these studies. Therefore, the outcome of governing policies of academic studies must be quick transfer of the findings of the studies to the private and public institutions for the interest of the society (Warda, Ziemiński 1999).

The commercialization of the findings is so crucial that now many research and academic institutions using consultancy services and conducting collaborative studies are officially commercializing their technologies, and the number of such consultancy service centers is increasing in industrially advanced countries. In a way that since 1980s so far the numbers of technology transfer offices in the United States has increased from 25 offices to 200 offices (Thursby, Kemp 2002).

Extensive research has been undertaken to identify the success determinants that affect or influence the university technology licensing. Theoretical modeling (Macho-Stadler, Perez-Castrillo, Veugelers 2008; Bercovitz, Feldman, Feller, Burton 2001; Lach, and Schankerman 2003; Banal-Estañol, Macho-Stadler, Pérez-Castrillo 2011), and empirical examinations and studies (Taylor and Silberston 1973; Caves, Crookwell, Killing 1983; Baharat and Tarun 2000; Ziedonis 2003; Shane 2002; Nerkar and Shane 2002; Kim and Vornatas 2004) have been the main themes of research in the area of the university industry technology transfer and licensing.

Literature identified several determinants to be crucial to the successful commercialization of university technologies. These determinants according to Rahal (2005) are classified into the following categories:

- Institutional determinants;
- Inventor related determinants;
- Technology related determinants;
- Market and Commercialization related determinants;
- And intellectual property related determinants.

#### **3.1. Institutional determinants**

The Institutional determinants are classified in three different determinants. The technology transfer office related determinants, and the institutional prestige and licensing policies related determinants.

Using key determinants such as the university research expenditures, faculty quality rating, and resources provided for the technology transfer office, Hauksson (1998) assessed the influence and efficiency of the University Technology Transfer and Licensing Office in the process of commercializing university discoveries, and built regression models to make predictions about the number of licenses, patents, and invention disclosures. The research' results implied that technology transfer help the university accomplish its mission as a purveyor of knowledge, benefit the society by pushing discoveries out of the university laboratories and into the market place, and the results also suggested a strong positive correlation between investment and success in technology transfer.

Hsu and Bernstein (1997) examined the decision policies that dictate the managing of the university licensing process and identified the efforts on the part of the licensee, the value (nature and stage) of the technology, the financial issues, and the university licensing policies such as a university's prompt research publications requirements versus a licensee's preference toward secrecy of invention and publications delays, as the most important determinants contributing to a successful technology transfer and licensing.

### **3.2. Inventor related determinants**

Thursby, J. G. and Thursby, M. C. (2000, 2003) surveyed a sample of the Licensing Executive Society's members, and identified personal contact or involvement (social factor) between university inventors and industry as the most important source of technology transfer and commercialization success, concluding that by "establishing and nurturing such a relationship through some sponsored research, a company may develop an ongoing awareness of university research activity while the research group gains an efficient channel for marketing news results".

Jansen and Dillon (1999) found that relationship with inventors is a critical factor to licensing-in university technology. Their conclusion is in total agreement to a research survey conducted by Thursby, J. G. and Thursby, M. C. (2000) which determined that "industry licensing executives overwhelmingly identified personal contact between their R&D staff and university personnel as the most important source of university technology licensing". In addition, many firms view sponsored research as mechanisms for obtaining access to realistic technology champion's faculty for consulting purposes or graduate students for positions in the firm's R&D labs.

### **3.3. Technology related determinants**

Jensen and Thursby (1998) surveyed 62 universities about invention characteristics, licensing procedures, and licensing objectives in their universities, and found that the vast majority of university inventions licensed are so embryonic or early stage-technologies, and no one knows their commercial potential because they are in such an early stage of development (the survey determined that only 12% of licensed inventions were ready for commercial use, while 75% lacked working prototype). It was also determined that

the continued effort by the inventor is a critical determinant for the further development and for commercial success, and tying the inventor's compensation to the licensee's output, would guarantee his continued involvement.

A survey of 300 licensing executive members by Thursby *et al.* (2000) identified the early stage of the university technology development or its irrelevance to their firm's business objectives as the main factor for not licensing-in university technology due to the nature of university research is despite the fact that 24% stated university patents had been critical for their companies research.

### **3.4. Market related determinants**

A commercially viable technology must demonstrate economic benefit. The greater the benefit, the more desirable and marketable the technology is. On the other hand technology commercialization is a process of acquiring ideas and augmenting them with complementary knowledge, developing and manufacturing saleable goods, and selling the goods in the market (Mitchell and Singh 1996). Successful technology commercialization allows firms to satisfy markets needs by introducing new innovative and quality products in a speedy manner, and at competitive pricing. Meseri and Maital (1996) studied how Israeli universities' project were being evaluated and sought to examine the criteria for choosing technology transfer projects in Israeli universities and whether those criteria were compatible with the industry. It was found that the most important determinants in the project's evaluation were: 1) Market needs and size; 2) the existence of a patent; 3) the success chances in R&D; 4) the level of innovation; and 5) the maturity of the idea.

Kim and Vornatas (2004) in an empirical study of licensing transactions involving United States companies across all sectors during the 1990's, identified the following as the most important determinants of technology licensing: 1) The licensor company's prior licensing experience; 2) The rate of growth of its primary industry; 3) The technological knowledge of the licensor; 4) The strength of the intellectual property protection in that industry; and 5) The nature of the new technology produced by the licensor.

### **3.5. Intellectual property related determinants**

Many companies strive to have a first mover advantage in a specific technological field (where a prior claim to the technology does not exist), to get an early mover advantage in an emerging technology and new markets, and the opportunity to establish an unchallenged and a dominant market share.

A patent will help the competitive advantage of the intellectual property by restricting and excluding unauthorized entities from the protected technology, and help recover returns from the research and development when commercializing a new technology.

Shane (2002) examined the influence of patent effectiveness on the licensing and commercialization using historical data of 1,397 MIT patents between 1980–1996. This

empirical study provided a conceptual framework to explain which university inventions are most likely to be licensed, commercialized, and generates royalties, and who will undertake that commercialization using historical data, a regression model was built to predict licensing rate, licensing termination, commercialization and first sale, effectiveness of the patent, source of funding, and the technology field. This study concluded that university patents are more likely to be licensed when patents are effective, the effectiveness of patents increases royalties earned when inventions licensed to non-inventors, and licensing back to inventors increasing the likelihood of license termination, and reduces the likelihood of invention commercialization. In addition, Shane found that five key determinants played an important role on whether a new invention will be commercialized by a startup: 1) Observability, 2) Tacitness of knowledge in use, 3) The age of the field, 4) Tendency of the market toward segmentation, 5) The effectiveness of the patent.

From the literature review and based on Rahal (2005) framework for commercialization of research we would explore academic research commercialization determinants of Iran gas industry.

#### **4. Research Design**

In terms of purpose, the research falls under the category of applied research and its methodology is a mixed one. In this research, we have used the exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) to answer the research questions. Interviews were used during the qualitative stage of data collection.

The statistical population of the study consists of experts and scholars active in the Iranian gas industry with academic experiences that were selected using purposeful sampling during the qualitative stage. The data began recurring after conducting 9 interviews or in other words reached the saturation point. At this stage, the latent variable i.e. the industry structure was identified which we will discuss more in the results section.

In the quantitative stage, the statistical population involves the senior managers of the gas industry manufacturing firms. Given the 628-firm population, the Cochran's formula was used which produced a resulting statistical sample equaling 122 firms. 150 questionnaires were sent to these people and 107 of them were returned.

To measure the importance of each dimension in the questionnaire, the five-scale Likert index was used. The content validity was applied in the study. To measure the content validity we referred to the opinions of 9 experts in the qualitative stage in which the subjects and dimensions were examined and verified. To assess the reliability of the tools, the Cronbach's Alpha was used according to each category of the model. Table 1 shows the Cronbach's Alpha rates.

**Table 1.** Cronbach’s Alpha

No	Factors	Cronbach’s Alpha
1	Institutional	.807
2	Researcher	.777
3	Technology	.849
4	Market	.773
5	Intellectual property	.879
6	Industry structure	.836

As it is evident on table 1, all factors have the appropriate level of reliability, and we can use the developed questionnaire to gather the data.

## 5. Results

In the qualitative step the data gathered from interviews were analyzed through codification. We studied the Iranian gas industry experts’ statements over and over to identify the main themes. The identified themes were counted and the ones which had more frequency were considered as a new variable. To categorize the new variables we studied the literature and categorized them in a more relevant category. Table 2 shows the themes and new variables.

**Table 2.** Themes and new variables

No	Category	Variable
1	Industry structure	Industry approach
		Demand driven
		Linking chains between industry and university
2	Institutional determinants	University approach

To develop the questionnaire new variables were added to the framework of determinants which were proposed by Rahal (2005). To analyze the data gathered by questionnaire we applied EFA to explore the factors which construct each categories of the proposed framework. In the next step to confirm the framework we examined the remaining factors through CFA. In this research we have examined three criteria: 1 – Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy, 2 – EFA to omit the variables which have not enough correlation with other variables in each category, 3 – structural equation modeling to confirm the framework. Table 3 shows the results of KMO for each category.

**Table 3.** KMO for each category

No	Factors	KMO
1	Institutional	.764
2	Researcher	.781
3	Technology	.847
4	Market	.775
5	Intellectual property	.865
6	Industry structure	.714

As the KMO of each category is more than 0 /7 we can apply EFA. Applying EFA we put away the items which didn't have sufficient loadings. After proposing a model the first question was; is it an appropriate model? To this we used indicators like:  $\chi^2 / df$ , p-value, RMSEA, GFI<sup>3</sup>, CFI<sup>4</sup>, NFI<sup>5</sup>. The goodness of fit criteria of the framework shows that we can rely on framework. Table 4 indicates the goodness of fit criteria which have resulted from CFA.

**Table 4.** Goodness of fit

No	Indicator	Permissive criteria	Value	Result
1	$\chi^2 / df$	$\chi^2 / df < 3$	2.83	Accepted
2	p-value	P < .05	0.000	Accepted
3	RMSEA	RMSEA < .08	0.083	Relatively accepted
4	Goodness of fit index	GFI > 0.9	0.8	Relatively accepted
5	Comparative fit index	CFI > 0.9	0.95	Accepted
6	Normed Fit Index	NFI > 0.9	0.93	Accepted

Except RMSEA and GFI which are close to the Permissive criteria the other criteria's are accepted. We can also consider RMSEA and GFI as relatively accepted.

In the measuring dimension of structural equation modeling to analyze the factor validity and model validity we consider the relation between observed variables and latent variables. To this the researcher must consider the standard coefficient and meaningful level of paths between observed variables and latent variables.

<sup>3</sup> - Goodness of fit index

<sup>4</sup> - Comparative fit index

<sup>5</sup> - Normed Fit Index

After the examining of validity researcher must evaluate the reliability of the variables. We can have the information for the co reliability from Lisrel 8.54 Software, but for calculating the composite reliability (CR) we use the following formula:

$$CR^* = (\sum^* \lambda^*)^2 / [(\sum \lambda)^2 + \sum(\theta^*)],$$

where:

CR\* = composite reliability,

$\lambda^*$  = variable loadings,

$\Theta^*$  = variance error of each variable,

$\Sigma^*$  = sum of all the latent variables.

The values of standard coefficients and meaningful level of each variable and the calculation of co reliability are shown in table 5.

**Table 5.** Standard coefficients, T-statistics, composite reliability

No	LV	CR	OV	Standardized coefficient	T-statistics
1	Institutional	0.845	TTO Effectiveness	0.72*	12.96
2			Licensing policies	0.70	12.52
3			University prestige	0.69	12.45
4			University approach	0.72	13.16
1	Researcher	0.794	Researcher involvement	0.69	12.05
2			Researcher as a leader in research domain	0.70	12.25
3			Researcher credibility	0.63	10.72
4			Researcher realistic expectations	0.62	10.57
1	Technology	0.876	Sophistication of Technology	0.66	11.2
2			Scope of Technology	0.75	13.77
3			Technology uniqueness	0.71	12.71
4			Technology consistency	0.71	12.74
5			Technology comparative advantage	0.66	11.44
6			Feasibility study	0.8	15.1

*Continued Table 5*

No	LV	CR	OV	Standardized coefficient	T-statistics
1	Market	0.764	Market needs	0.68	11.44
2			Potential Market	0.62	10.23
3			Market growth	0.61	9.96
4			Market success	0.52	8.23
5			Investment payback time	0.45	7.08
1	Intellectual property	0.888	Literature search	0.74	13.67
2			Patent search	0.82	16.08
3			Confidentiality of Technology	0.87	17.33
4			No prior claims to technology	0.72	13.15
5			Strength of Intellectual Property	0.66	11.64
6			Exclusivity of Intellectual property	0.65	11.55
1	Industry structure	0.806	Industry approach	0.78	14.06
2			Demand driven industry	0.73	12.97
3			Links between Industry and university	0.86	15.9

\* = underlined variable is the most effective one

Based on table 5, CR of variables is above the acceptance level,  $CR > 0.7$ , so we can conclude that research variables have developed appropriately. T-statistics, also, are confidently significant. Standard coefficients statistics show the effect of each variable. In institutional dimension “TTO Effectiveness” and “university approach” are the most effective variables. “Researcher as a leader in research domain” has the strongest effect at researcher dimension. In technology dimension, also, “feasibility study” has the greatest impact. For the market dimension “market need” is the most effective variable, and in intellectual property dimension “Confidentiality of Technology” has the highest effect. Finally in industry dimension “Links between Industry and university” has the strongest effect on commercialization of academic research.

## 6. Conclusions

To identify a framework for the requirements and prerequisites of academic research commercialization in the Iran gas industry we reviewed literature and based on Rahal (2005) framework, the identified variables proposed to gas industry experts to identify

domestic variables which might have influence on research commercialization of Iran gas industry. Iran gas industry is resource-based along with the present conditions in this country. Since no attention has been paid to the basic and practical knowledge in this industry, more knowledge-based approaches seems to be essential to improve the gas industry in Iran. It has been demonstrated that knowledge creates competitive advantage for the industry and for the whole country; therefore exploitation of natural resource and selling of them is not beneficial in the long term. In addition, the gas industry structure in Iran has been formed based on the supply side and the government is the only controller of all actions. If the government assigns different sections of the industry to the private sector, competition as well as more emphasis on the market demand would be established in the industry. In that case actors would pay more attention to the basic and practical knowledge and they seek to increase technology commercialization to overcome the competitors and to gain competitive advantage. Consequently there is a need to plan some institutions which create a link between universities and the industry. Networks of specialists can also identify the needs of the industry and then meet them through commercialization of the researches.

Universities' licensing strategies, also, are of critical importance in the commercialization of the university research because firms' performance is depended on their type of contract. Assigning the whole project or just a sale percentage or receiving royalty from firms provide the gas companies with different decisions based on their technology and needs. TTOs have also a significant role in the commercialization of university research in the gas industry. TTOs contribute to the commercialization of university research through their specialist human resource, rules and regulations, and communicative networks with political and economic sections. University itself is also a dimension which affects commercialization of research in the gas industry. Firms prefer to establish collaborative relations with more well-known universities. Among the institutional factors, universities approach was the last one identified in our interviews. Since most current universities in Iran just propose theoretical lessons and less effort is made regarding the commercialization of the researches, a change in their approach is needed. Along with this change, university professors' promotion policies should not only be limited to their publication of papers and books.

The present study's findings are along with the previous studies and suggest the participation of the researcher as one of the most important factors in the process of commercialization of the university research. The degree of the researcher's participation is depended on the complexity of the technology. If the technology is too complex, participation of the researcher can solve the problems in the process of product development and provide the investor with more trust to sign a contract to invest in that project. Since the researchers' expertise in the special field of a technology develops new technologies, firms prefer to enter collaborative relations with more professional researchers. In other words firms can have more trust on the probability of the projects' success if they collaborate with those researchers who have a good reputation and credibility on their field. Moreover, firms collaborate with universities in research to gain monopolistic

position according to the market position. Therefore, the reality based expectations of the researchers is significant in the process of commercialization. Researches should have close to real expectations about the type of contract, the amount of collaboration, technology success, and their share and profit at the end of contract.

For the technology factors we can say; the degree of technology complexity affects the process of commercialization in two aspects. If the technology is too complex, on the one hand the actors in the industry may have an improper understanding of the technology and avoid investing on that project. On the other hand by recognizing the opportunities at the right time, some innovative firms in the field of new technologies may facilitate the process of product development and commercialization in order to gain monopolistic position in the market. Another significant point is that technologies which are practical and useful in various fields are more probable to be commercialized. Technologies usually emerge in a special field but with various applications; therefore identifying different applications for a technology is effective in its commercialization. The uniqueness of the technology is also one of the factors which affect the process of the commercialization of the university. A unique technology with clear and explainable application can be developed through defining a special framework for it. Furthermore new technologies should be compatible with the current situation. Doing research on a technology with unavailable complementary products or incompatible with the current processes and functions is a subject to failure. The researchers should be perfectly aware of the partial advantage of a technology in order to define and strategically plan it at the beginning of the project. Technical feasibility study is also one of the important steps in commercialization process. After finishing the primary researches on a project, the overall framework of the project should then be defined in terms of the product characteristics, the production capacity, and the amount of investment. The details in these researches are depended on the request and needs of the employer or investor. Researchers or research institutes usually determine different alternatives and make comparisons among them to decide about processes, sketches, selected places, etc.

In the other hand, investigating unexploited demands of the market is one of the best opportunities for doing research and commercialization. Researches done based on the market demands are more probable to attract investments and to become financially profitable. Therefore potential market is critical for a technology. A research on a technology with no market would be limited to basic knowledge and the probability of commercialization would be failed in the long-term. Doing research on technologies in the early stages of growth is very probable to lead to the commercialization of them and it also improves the life cycle of current technologies. Estimating the probability of technologies' success by researchers can solve many problems in product development and commercialization process. Most activities may go wrong without estimating and measuring the probability of success. Finally since financial problems are the most prominent barriers to the commercialization of researches, estimating rate of return can have a positive influence on the probability of success. Most firms always seek to be

the best in the market or to gain monopolistic position. Therefore intellectual property has a basic role to encourage and to attract investors to collaborate on the university research projects. Reviewing the whole literature of previous researches and careful examination of previous licenses are critical in giving an intellectual property. Institutes responsible for reviewing the literature and previous patents usually do this process carelessly and cause some problems in the later stages on the new product development process. Moreover, researchers usually insist on the confidentiality of their ideas and often are afraid of collaborations with investors. Therefore it is essential to establish an effective system in order to register the innovative ideas and plans. There are also some factors including the uniqueness of technology and a guarantee for implementation of intellectual property which are effective in the process of commercialization and gaining competitive advantage for firms.

## **7. Limitations**

This study faced limitations with respect to availability of experts; it was difficult to find experts on the subject. On the other hand there should be more studies to test the findings of this research in different environments to examine its generalizability.

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