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## Obstacles and Solutions of Commercialization of University Research: Case Study of Small Businesses Development Center of University of Tehran

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*With the entrepreneurship mission incorporated into the education and research missions of universities, their role in the economic and social development in societies has increased. Thus, subjects revolving around academic entrepreneurship and knowledge commercialization have drawn the attention of many researchers and politicians in different countries in the world. In Iran, too, the knowledge commercialization phenomenon is in its prime and is in its early stages of taking shape and development. Therefore, this paper aims to identify obstacles and solutions in the commercialization of university research in Iran. The qualitative research method has been used in the form of a case study. The research data collection tools consist of semi-structured interviews. As a compliment of data collection tools, some evidence and documents were also studied. The research statistical population includes all the individuals engaged in knowledge commercialization in the University of Tehran. Twenty six interviews were conducted before data saturation reached. The results of the qualitative research indicate that the*

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*organizational, environmental/institutional and internal university research commercialization impeding factors are critical obstacles in the Small Business Development Center (SBDC) of the University of Tehran and policy makers should devise proper strategies in light of these factors.*

**Keywords:** *Commercialization, Small Business Development Center, Commercialization obstacles*

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## **Introduction**

Given the widespread view that increase in university research boosts society's capacities, one should also note that as long as the outcomes of university research are not transferred to public and private sector companies and implemented by them, it would be practically of no avail to the society. Therefore, the policies governing university researches should focus on rapid transfer of knowledge to the companies in the public and private sectors aided by other organizations to ensure the common good (Zieminski and Warda, 1999).

Commercialization is so important that currently many research and academic institutes have formalized commercializing technologies through offering consulting services and conducting research projects and the number of such consulting services centers is increasing by day in developed countries such that since 1980's until now the number of technology transfer offices in America has increased from 25 to 200 offices (Dilcher, 2002, p.92).

Certainly, one of the reasons that account for the speed of technology development in developed and industrial countries is focus on the commercialization process of the research outcomes in those countries (Tijssen, 2006). In light of the condition of commercialization of university research in the Small Business Development Center of the University of Tehran, from 49 finished projects, all of which were highly potential for commercialization, neither one entered the commercialization process. Therefore, identification of obstacles and challenges in way of commercialization of university research could have a significant and

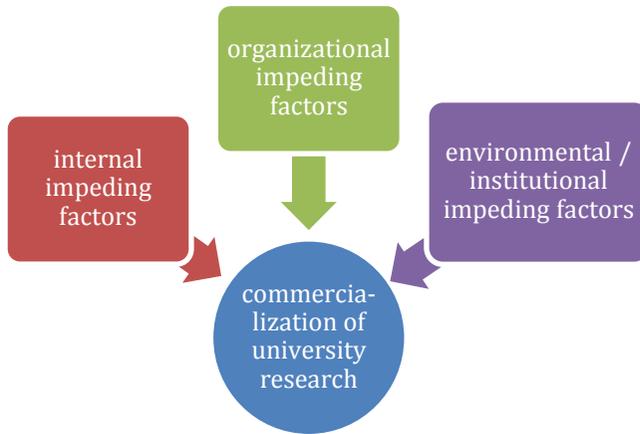
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considerable effect on the development of academic enterprises and the entrepreneurial businesses of university researchers. Recognizing this notion is critical for national officials, R&D managers and technology managers. As a result, the main research question of this paper would be: what are the obstacles and solutions in commercializing university research in the Small Business Development Center of the University of Tehran?

## **Literature Review**

### **Theoretical Framework**

In this section, the theoretical framework of the research is presented to show the relationship between the research components. Given that starting an investigative case study research without having a theoretical framework is futile, in all stages of the research the theoretical framework was employed to enrich the results of the report, organize the interviews, and collect and manage data and not to exercise some kind of research design bias (Eisenhardt, 1989). Therefore, in this paper to avail of a proper theoretical framework, Siegel et al (2003) categorization was used which involve three main subjects of institutional, organizational and internal and it is proved it largely covers the effective factors in this respect. The reason for choosing this framework is its comprehensiveness in employing all the expected variables in previous studies. In fact, it is presumed that all the issues related to the obstacles in way of commercialization of university research could be summarized in these three subjects. The mentioned subjects provided the basis for designing open questions for individuals in this research and collecting the needed data. Although, the framework's components were modified after the interviews, to avoid the risk of describing the phenomenon under study before thoroughly understanding it, we implemented the theoretical framework. The model's indices were examined in figure 1 as the theoretical framework of the present paper.



**Figure 1:** The theoretical framework of the obstacles in the way of commercialization

**Internal impeding factors:** According to the definition, they denote the impeding factors that are recognized as the inputs of the technology transfer process from the university to the industry, examples of which are disclosing inventions, skilled staff employed in the technology transfer offices and imposed legal costs (external) for protecting intellectual properties of the university.

**Environmental/Institutional impeding factors:** Siegel sums up these factors in one topic and argues that they are related to the economic and political conditions of a society and its sub structures and availability of services.

**Organizational impeding factors:** understanding the potential importance of organizational factors could be started with some considerations about activities, motivations and organizational culture that bear the interest of the stakeholders in the technology transfer process from the university to the industry.

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## Research Background

Evidence and examples about the growth of technology based ventures in the valid universities in the world such as Cambridge (Siegel, 1995), Stanford and MIT (Roberts and Malone, 1996) indicate that starting new university ventures and spin-offs and commercializing of university research are easily viable. The only requirement of its success is creating and implementing supportive values and cultures in such risky business ventures. On one hand, many researchers believe that in essence, universities are not entrepreneurial organizations. Perhaps, one reason for it could be the dimensions and largeness of these organizations. Nevertheless, there are many reasons to account for it such as the nature of relationships, the hierarchal structures and organizational levels, intense monitoring of rules and processes, time constraints and the tendency to achieve results quickly, lack of entrepreneurial skills, inappropriate incentive methods and systems, etc. Besides these barriers and constraints, many university professors and staff believe that being an entrepreneur practically prevents them from their main mission as researchers, which is to continue learning and teaching (Zahra and Garvis, 2000).

Various domestic and international researches have been done in the field of identifying barriers of commercializing university research using different methods. For example, stressing the knowledge spill-over theory of entrepreneurship, Acs et al. (2004) investigated the causes of failure among academic entrepreneurs who engaged in commercialization. In 2004, Zhao et al identified the major obstacles of innovation in academic entrepreneurs in the four stages of entrepreneurship (sensing the opportunity, seizing the opportunity, capture the value, reconfiguration). Plewa (2005) used a different approach to identify the barriers of commercializing research which is discovering conflicts of interests between universities and organizations. He was looking to find the answers for two questions which were 1) what interests stimulate universities and organizations to engage in commercialization 2) Do universities and organizations have different interests to stimulate them to enter into the industry-university relationship. In his studies, Kirihata (2007) divided commercialization into three stages of fundamental research, product development, and commercialization and then examined its barriers in each stage. Given the

various international researches in this respect, a summary of the mentioned obstacles are provided in the theoretical background section in table 1.

**Table 1:** A summary of international researches about the obstacles in commercialization of research

Researcher	Barrier
<p>The need for technical supports (Decter et al., 2007, Lockett and Wright, 2005). The inadequate resources allocated to technology transfer in universities (O’Shea et al., 2005). Inefficiency of processes and procedures used (Siegel et al., 2003). Inefficiency of the processes of patent transferring agreements (Debackere and Veugelers , 2005, Decter et al., 2007). The monotonous nature of academic researches (Ndonzuau et al., 2002, O’Shea et al., 2005), Incentive structure (cash and non-cash rewards) including credits to improve employees and the payment and incentive systems of technology transfer offices (Siegel et al., 2003a, Siegel et al., 2003b, Siegel et al., 2003, O’Shea et al., 2005). Different research questions and the current difficulties in the revelation trends of “General knowledge,” unawareness of graduates to the recent industrial advancements (Fontana et al., 2006). The lack of a practical perspective (Kirihata, 2007).</p>	<p><b>Structural</b></p>
<p>The lack of long-term strategies (Elmuti et al., 2005, Chiesa and Piccaluga, 1998, Mahboudi and Ananthan, 2010). Bureaucracy and the inflexibility of administrative systems in universities (Siegel et al., 2003; Sooreh et al., 2011). The inefficient management of intellectual properties (Siegel et al., 2003).</p>	<p><b>Management</b></p>
<p>Clarification and sharing market demands (Kirihata, 2007, Vohora et al., 2004, Rothaermel and Thursby, 2005, Hansen, 2004, Acs et al., 2004). Cooperating with experts outside the organization (e.g. accountants, venture capitalists and lawyers) (Kirihata, 2007), The lack of communication and networks among investors, industry actors and academics (Decter et al., 2007, Abutalib, 2007). Slow speed of knowledge transfer negotiations, detecting and locating the technologies (Decter et al., 2007, O’Shea et al., 2005), Public environment (Chiesa and Piccaluga, 1998; Salamzadeh et al., 2011; Sooreh et al., 2011). Demand conceptualization (Kirihata, 2007). Incapability of products in competition (Abutalib, 2007).</p>	<p><b>Environment al</b></p>

Researcher	Barrier
<p>Not being familiar with companies willing to acquire technology (Decter et al., 2007, O'Shea et al., 2005). Cultural differences of industrial actors and academics (Debackere and Veugelers, 2005, Barnes et al., 2002, Samson and Gurdon, 1993, Siegel et al., 2003a, Siegel et al., 2003b, Siegel et al., 2003, Fontana et al., 2006, Elmuti et al., 2005, Decter et al., 2007).</p>	<p><b>Industrial</b></p>
<p>Contrasting revenues of industrial and academic actors (Samson and Gurdon, 1993, Decter et al., 2007, Plewa, 2005). differing motivations of industrial and academic actors (Decter et al., 2007). the lack of knowledge of industrial actors about technologies produced in universities (Acs et al., 2004). Not trusting the industry regarding the protection of intellectual property right (Siegel et al., 2003, Abutalib, 2007), the contrasting objectives of industrial and academic actors (Debackere and Veugelers, 2005, Fontana et al., 2006, Elmuti et al., 2005). Long academic researches, differing priorities and preferences (Fontana et al., 2006, Barnes et al., 2002, Elmuti et al., 2005).</p>	
<p>Poor regulations regarding the protection of intellectual properties on the national level (Abutalib, 2007). Academic agendas and regulations in all cases and related to commercialization of research (Shane, 2004). regulations and policies applied by governments (Goldfarb and Henrekson, 2003; Salamzadeh et al., 2011; Sooreh et al., 2011).</p>	<p><b>Legal</b></p>
<p>The lack of entrepreneurship spirit in universities (Decter et al., 2007; Salamzadeh, 2011), the lack of participatory culture (Kiriata, 2007). development and improvement of supportive and entrepreneurship culture (O'Shea et al., 2005, Henrekson and Rosenberg, 2001). different value systems (Elmuti et al., 2005, Mahboudi and Ananthan, 2010, Ndonzuau, 2002, Spilling, 2004, O'Shea et al., 2005).</p>	<p><b>Cultural</b></p>

Researcher	Barrier
Inaccessibility to proper human resources (Kiri-hata, 2007, Abutalib, 2007, Lockett and Wright, 2005). Lack of motivation and procedures (Kiri-hata, 2007, Spilling, 2004, Debackere and Veugelers, 2005, Siegel et al., 2003). Not having enough information about personal property rights (Acs et al., 2004). Lack of knowledge and skills in fields of commercial activities and launching businesses (Wright et al., 2007, Lockett and Wright, 2005, Siegel et al., 2003, Decter et al., 2007, Moray and Clarysse, 2005, Acs et al., 2004). The motivation for publishing (Ndonzuau, 2002, Chiesa and Piccaluga, 1998). The ambiguous relationship between researchers and money (Ndonzuau, 2002, Siegel et al., 2003). The characteristics of scientists (O’Shea et al., 2005, Mahboudi and Ananthan, 2010).	<b>Human Resources</b>
Contrasting financial expectations (Decter et al., 2007, Samson and Gurdon, 1993, Wright et al., 2007, Lockett and Wright, 2005, Kiri-hata, 2007, Abutalib, 2007, Moray and Clarysse, 2005, Hansen, 2004, O’Shea et al., 2005).	<b>Financial</b>

## Research Methodology

With respect to the purpose, the present paper falls under the category of applied research. In this paper, the qualitative research method has been used with the aim of investigative research and with the field research strategy of interviewing in person. The in-person interviews involved three groups of individuals bearing interest in commercialization namely, professors experienced in commercialization of university research in the Engineering faculty of the University of Tehran, scholarly professors in university entrepreneurship and commercialization of research, and managers and policy makers in SBDC. The selection criteria were ten years of experience at the minimum for the experienced professors, scientific publications related to commercialization of university research and entrepreneurship for the scholarly professors, and two years of experience at the minimum for the managers and policy makers in SBDC. For sampling purposes, the objective judgments method was used which is considered as one of the non-probability sampling methods. The sampling and interviews

continued until the analysis and investigation process reached theoretical saturation, therefore, 26 semi-structured and open interviews were conducted.

The data collecting method involved examining of the relevant theoretical principles and literature including the pertinent domestic and international scholarly papers, archival data, and interviews with experts. Open ended and semi-structured interviews were conducted according to the guidelines which in fact contained a list of topics, subjects, and areas that needed to be attended to along with other directions for 1) the sequence of topics 2) range and domain of activities 3) nature of visual and audio tools and how to use them. All the interviewees had to answer the same questions such as their definitions of commercialization, barriers and impediments to commercialization and solutions for improving commercialization of research in the SBDC.

Furthermore, based on the research by Eisenhardt et al (1998), three techniques were used for the purpose of increasing the validity and reliability of the qualitative data. First, the answer guessing technique was used to avoid the respondent's (deviation from the topic of discussion) when answering open-ended questions. Afterwards, the interviewees were ensured about their anonymity and confidentiality of the answers so as to increase the accuracy of answers and statements. Finally, each interviewee was informed in advance about the purpose of the research. On the one hand, since the main theme of the case study research involved detailed collection of data from multiple sources, in order to ensure the validity of results and benefit from the advantages of plurality of sources, we did not only suffice to the interviews and investigated the documents and evidence from the SBDC archival data to enhance the results. For the analysis of data, open coding was first used and then the axial coding.

## **Data Analysis (Research Findings)**

For the purpose of analyzing the data, first the responses and opinions of the interviewees were recorded with their permission and provided they did not allow recording, notes were taken during the interviews and they were transcribed later. The main produced data are the result of in-person interviews and which in fact consist of the verbal responses, comments,

ideas, discussions and interactions of the participants. In the next step, the data were categorized and when the area of study was fully determined we decided about the initial interpretation of the results and creating a set of general topics. This set of general topics was later used for categorizing and analyzing the recorded transcripts. The categorization was done according to the topics in the interview guidelines and also the research purposes i.e. the internal and external impeding factors in the SBDC. In the third step, the categorized data were analyzed and this was done in three stages viz. reduction of data (i.e. selecting, simplifying, and transferring raw data to an analyzable format), displaying data and conclusion and testing. The matrix structure of the data and information analysis about barriers of university research commercialization in SBDC which were extracted from the transcripts of the interviews are shown in table 2.

**Table 2:** A summary of international researches about the obstacles in commercialization of research

Subjects	Aspects	Components
Organizational barriers	Inefficiency of university research commercialization structures	Lack of physical substructures in the SBDC
		Lack of technical supports in the SBDC
		Lack of allocated resourced to the SBDC
		Lack of coordination and effective communication between the university structures in the SBDC
	Inefficiency of university research commercialization processes	Lack of transparency of processes in the SBDC
		Incomplete processes in the SBDC
		Inefficiency of the employed procedures and processes

		Inefficiency of patent transferring agreement processes
		Differences in the expected research questions for each party and existing difficulties in the processes of disclosing the required knowledge
		Lack of a thorough research to market cycle
	Lack of proper backgrounds	Lack of entrepreneurship programs
		Lack of knowledge and skill in the area of business activities and launching and
	Management incompetency	Lack of long-term strategies and a practical vision in the SBDC
		Bureaucracy and inflexibility of the university administrative system toward the SBDC
		Ineffective management of intellectual properties in the SBDC
		Lack of support for commercialization from the senior management
	Incompetent expert systems	Low level of education and expertise with evaluators
		Professors' objections to the results from the evaluation of plans
		Incapability of evaluators in most cases
	Lack of an incentive structure	Lack of motivation and inclination
		Lack of incentive structures (cash prizes) such as the promotion of the staff and faculty members

		Lack of incentive structures (non-cash prizes), reward systems and bonuses for the faculty members and the staff
		Have the faculty share the profits
Environmental barriers	Lack of marketing in SBDC	No mass producing products
		Lack of understanding of the needs and priorities of the business sector
		Poor quality of knowledge and technology produced in universities
		Transparency and not sharing of market needs
		Lack of demand conceptualization
		Lack of products' competitiveness
		Lack of market knowledge
		Lack of communication networks with the market
	Environmental barriers	Political constraints and sanctions
		slow speed of negotiations on knowledge transfer
		Identification and location of favorite technologies
		Apolitical planning
		Managerial instability and constant change
	Industry barriers	Failure to identify companies that are willing to acquire technologies
		Different cultures, interests, motivations of industry participants and academics

		<p>Administrative bureaucracy (complexity of the process in the Development Department, slow and bureaucratic process of getting permits, and a lot of meetings and correspondence)</p> <p>Motivation for publishing research</p> <p>Failure of the Industry to ensure full protection of intellectual property rights</p> <p>University project take a long time</p> <p>The public sector's reluctance</p> <p>Different aims and priorities</p> <p>Shared vision of the university and industry</p> <p>Inconsistency between university projects and industry needs</p> <p>Lack of awareness of industry actors of technologies produced in the universities</p>
<p>Internal barriers</p>	<p>Financial barriers</p>	<p>The university's disinclination to provide financial support for researchers and hence to exploit the knowledge generated by them</p> <p>The SBDC's reliance on the government budgets</p> <p>Different financial expectations of the SBDC and the Development Department from the supported projects</p> <p>The government's lack of networking with venture capitalists</p>

		Inadequate budgets allocated for applied research in the university
	Skilled labor barriers	Lack of role models
		Professors' lack of freedom to participate in business activities
		Lack of access to appropriate human resources
		Researchers' lack of awareness of intellectual property rights in universities
		The unrealistic expectations of the universities' administrators and professors about the value of their technology
		Researchers' vague and uncertain relationship with money
		Scientists' characteristics
	Incompetent intellectual property law	Lack of clear intellectual property legislation
	Communications and networks barriers	Failure to cooperate with experts outside the organization (such as accountants, lawyers and venture capitalists)
Lack of communication and networks among investors, industry activists and academics		
Institutional barriers	Legal barriers	Poor intellectual property protection laws at the university and national level
		No implementation or incorrect implementation of the laws

		Poor policies, laws and government policies in all matters related to the commercialization of research
		Rents and relations-oriented in the public sector
	Normative barriers	No motivation or sensing of the need to commercialize knowledge
		Different value systems
		Lack of entrepreneurial spirit in universities
		The general belief about the universities being non-profitable and the need to publish research results instead of preserving them for commercialization
		The unattractive nature of academic research
		Inappropriate attitude toward entrepreneurship in the academic society
		Mental image of the business environment
	Cultural-cognitive barriers	Lack of participatory culture
		Negative attitudes among academics about engaging in business activities
Creating and promoting a supportive and entrepreneurial culture		

## Discussion and Conclusion

In this section, in order to provide a ground for comparison with previous efforts of other researchers mentioned above, it can be argued that in this

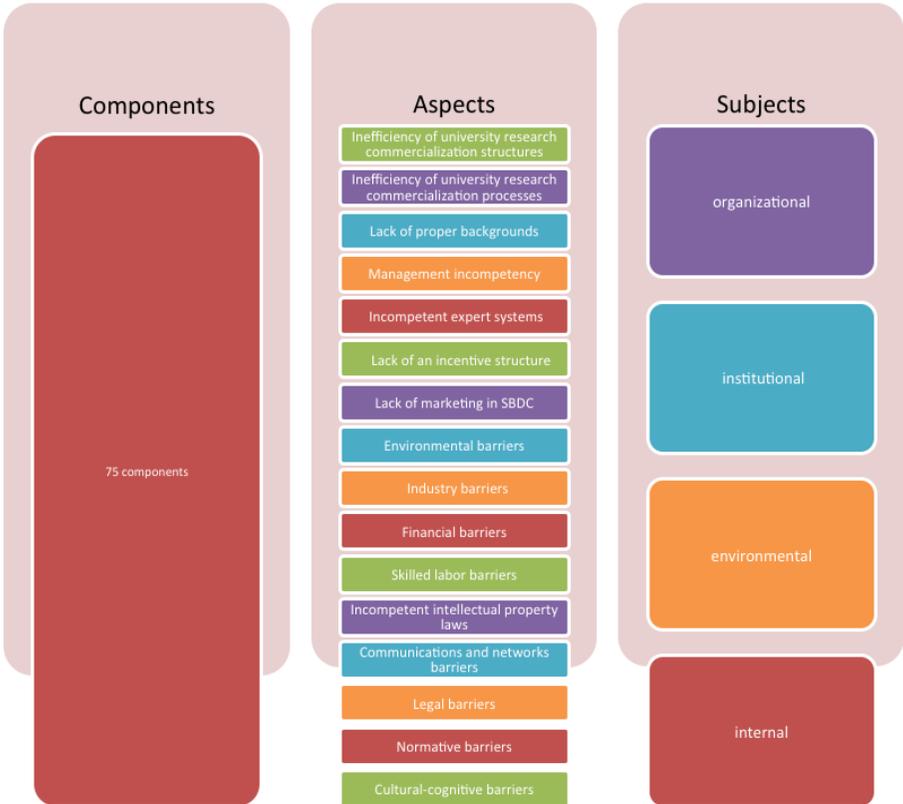
study, by complementing the previous research efforts (Mahbodi and Anatan, 2010; Plewa, 2004) and particularly, the theoretical model of the research (Siegel, 2003), the default theoretical framework of the research was modified after the classification and management of data and ultimately, 3 topics were added to the previous 4 ones. So, the environmental/ institutional barrier – which is generally defined as factors that need to be studied in the environment (Kiriata, 2007; Vohora et al, 2004; Rothaermel and Thursby, 2006; Hansen, 2004; Acs et al, 2004) – are divided into environmental barriers and institutional barriers in this paper. This division and stress on institutional barriers as important barriers are because according to the interviews, institutional barriers such as laws, regulations and legislations are recognized as significant barriers in commercialization in the SBDC and therefore, they should be regarded as a very important dimension. Moreover, cognitive and normative barriers are less investigated in earlier works (Elmuti et al., 2005) whereas they are stressed as one of the dimensions of institutional barriers here in this research. Finally, cultural-cognitive barriers are recognized as institutional barriers. While in earlier works, just cultural barriers were identified as one of the type of barriers and impediments, such that they were viewed in a general manner or from the perspective of cultural differences of the industry and the university (Debackere and Veugelers, 2005; Barnes et al., 2002; Samson and Gurdon, 1993; Fontana et al., 2006; Siegel et al., 2003a; Siegel et al., 2003b; Siegel et al., 2003; Elmuti et al., 2005; Decter et al., 2007) or from the perspective of the cultural differences of the university (O’Shea et al., 2005; Henrekson and Rosenberg, 2001; Mahboudi and Anathan, 2010; Ndonzuau et al., 2002; Spilling, 2004). This is while in the present paper, the cultural barriers are examined from perspective of cultural differences in the industry and the university context and are also recognized as a very important dimension of the university as an institution. On the subject of organizational barriers, the present paper supports the findings from earlier works in the area (Debackere and Veugelers, 2005; Fontana et al., 2006; Siegel et al., 2003a; Siegel et al., 2003b; Siegel et al., 2003; Decter et al., 2007; Ndonzuau et al., 2002; O’Shea et al., 2005). And with regard to the internal barriers, it should be noted that commercialization of university research is only possible when the necessary inputs of this activity exists viz. transparent laws on intellectual properties

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(Abutalib, 2007), sufficient and appropriate financial background (Abutalib, 2007; Moray and Clarysse, 2005; Hansen, 2004; O'Shea et al., 2005; Lockett and Wright, 2005), skilled labor (Lockett and Wright, 2005; Kirihata, 2007; Abutalib, 2007) and finally, the communication networks inside and outside the university (Decter et al., 2007; Abutalib, 2007). Overlooking these aspects have always ensued adverse consequences. In earlier works, researchers have not thoroughly examined all the aspects and they have sufficed to one or some aspects while in this research all the aspects were examined in the context of the SBDC.

Therefore, based on content in the research methodology section and owing to the qualitative research, the research question was appropriately answered. Using interviews and multiple sources, the components of the commercialization of university research barriers in the SBDC were extracted and then illustrated in figure 2 in the form of a three-level pattern with the first level representing the subjects, the second level the dimensions, and the third level the components. It is to be noted that the concepts arising from each of the aspects project in the form of a consistent system in the above-mentioned components. In other words, removing one barrier is not enough for overcoming the all barriers and reducing all the barriers at the same time could become synergically effective. However, due to the constraints in illustrating the 75 components, we sufficed to provide only an outline of them. Solutions for the commercialization of university research in the SBDC were derived from the interviews.

**Figure 2:** Components of university research barriers (subjects, aspects, and components) (researcher made)



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## Recommendations

Based on the results from the present research, some recommendations are offered here for the aim of developing and deepening this area of knowledge commercialization:

- 1) Conducting quantitative studies for ranking the barriers and acquired solutions
- 2) Offering a model for evaluating the barriers of university research commercialization
- 3) Examining the results from the present paper in other commercializing centers and universities and conducting comparative study between them.

In addition to the above-noted recommendations, some practical recommendations are offered below for the managers and policy makers in the field of university research commercialization, as well. A point to note is that the recommendations are given here with an emphasis on the **solutions**.

- 1) Revising the structure and processes associated with commercialization of university research with respect to the internal and external context of the university research commercialization centers.
- 2) Adopting policies and pass laws that support commercialization on the national, regional and local level.
- 3) Determining the research budget and creating a process for the budget to be put to use without any limitations regardless of the type of research.
- 4) Developing a professional proficiency system for evaluating university research projects and appraising the potentiality of these projects for the purpose of commercialization.
- 5) Improving the capacities of the faculty with regard to commercialization and focusing on education and learning.
- 6) Defining common goals for the university and the industry in line with the Development Vision of the country.

- 7) Holding specialized common meetings and sessions between the university and the industry to exchange views and identify common issues
- 8) Defining university projects based on the real needs of the industry.

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