THE ROLE OF UNIVERSITIES ON THE INNOVATION PROCESS OF INDUSTRY AS A KNOWLEDGE SOURCE

I.FIGEN GULENC;OZLEM ARACI

KOCAELI UNIVERSITY / ISTANBUL TECHNICAL UNIVERSITY

Abstract
Increasing possibility of innovation success depends on reducing risk and environmental uncertainties. Firms are forced by competition to benefit from not only internal knowledge sources but also external knowledge sources through the innovation process. This paper examines universities as an external knowledge source. Our aim is to reveal importance level of universities according to innovative and non-innovative firms. The data is gained from Community Innovation Survey (CIS-4), which was based on OECD's Oslo manual. Firstly innovativeness of firms is inquired. Our sample includes both innovative and non-innovative firms. Then firms are asked to indicate importance level of universities for the innovation process. Importance level is scaled as "not used", "low", "medium" and "high". After analysis, this paper draws a conclusion that innovative and non-innovative firms are different based on the importance level of universities as a knowledge source. 73,9% of the non-innovative firms assessed universities in "not used" level. Only 10,3% of innovative firms find universities in the "high" level important category as a knowledge source. Most of the firms evaluate importance level of universities in "low" level category. Firms should evaluate the idea of cooperate with universities. Universities have potential to increase innovative success of firms by providing new instruments, techniques and methods.
Key words: innovation, knowledge source, universities

1.Introduction
Competitive advantage depends on adapting to changing markets and technologies and reflecting these changes to product and production process by innovating successfully.

Innovation is often described in terms of changes in what a firm offers the world (product/service innovation) and the ways it creates and delivers those offerings (process innovation) [1]. Hurley and Hult (1998) define firm innovativeness from a collective perspective, that is, openness to new ideas and adaptation to its environment as an aspect of a firm's culture [2]. Markkula, Lappalailen (2009) emphasize that innovation can be explained through the benefits that can be gained: innovations lead to higher added value, increase productivity and open up new business opportunities, thereby serving entire society [3]. Not all firms adopt or reflect with equal success through the innovation process because success is related with taking up knowledge and applying it effectively.

Knowledge sharing is a key issue in order to enhance the innovation capability of firms. Nevertheless, depending on the innovation capability dimension being considered and the technology intensity of the firm, the type of knowledge sharing which appears to be more fruitful varies [5]. It is obvious that a firm's ability to transform and exploit knowledge may determine its level of organizational innovation, and innovation capability also gives the new product an entrance into marketplaces promoting expansion and competitive advantage [4].

To transform innovation to competitive advantage, openning to cooperation and transferring knowledge from sources should be strategy to differentiate from competitors. Liao, Hu, (2007) indicate the relationship between environmental uncertainty and knowledge transfer is negative, and knowledge transfer and competitive advantage have a positive relationship [6]. Wang et al. (2004) describe that knowledge transfer is the process of a systematically organized exchange of information and skills between entities [7]. Liao, Hu (2007) defines knowledge transfer as the process by which knowledge receivers acquire knowledge from providers so that it could accumulate and renew productive capability. And knowledge transfer can develop core competence, improving organization performance and contributing to the competitive advantage [6].

In the increasingly growing and changing world, economic development occurs knowledge based and this increases importance of knowledge creation capability. Therefore, knowledge sharing and diffusion are both essential in order to create new knowledge and produce innovation [8]. Knowledge creation involves a continuous process through which one overcomes the individual boundaries and constraints imposed by information and past learning by acquiring a new context, a new view of the world, and new knowledge [5].

The university can be expected to remain the core institution of the knowledge sector as long as it retains its original educational mission [9]. Because universities guide new ideas with educated, skilled human resources in addition to knowledge creation capability.

Lester (2005) grouped university contribution into four categories; education and training, adding the stock of codified knowledge, increasing the local capacity for scientific and technologic problem solving, providing space for open ended conversations about independent development pathways and new technological and market opportunities [10]. In the world contribution of universities to industry is being tried to strengthen. If education and research role of universities serves commercial objectives, success of innovation process will provide competitive advantage for firms. In this manner universities will gain financial resource for themselves.

Universities contribute to innovation process in different ways. The most basic way is technology transfer. Agarval, Henderson (2002) surveyed of nearly 70 faculty members in the Massachusetts Institute of Technology (MIT) to explain perception of relative importance of knowledge transfer ways. Faculty consulting, publication, and the recruiting of students are all ranked significantly higher knowledge transfer ways[11]. Lester (2005) indicates based on Local Innovation Systems Project, universities can help to attract new human, knowledge, and financial resources from elsewhere. They can help to adapt knowledge originating elsewhere to local conditions. They can help to integrate previously separate areas of technological activity. They can help to unlock and redirect knowledge that is already present in the region but not being put to productive use. They can shape future directions of market and technology [10]. Other alternative ways of university-industry cooperation except technology transfer; firms may alternatively exploit recent university research results published in the open literature; or they may use university scientists as consultants; or they may collaborate with university scientists and engineers to apply new scientific knowledge developed by researchers at other universities; or they may recruit the students of the leading university researcher in the field [10].

Firms have to get knowledge that necessary for innovation processes. Firms cannot rely on only internal knowledge to make successful innovation. They should communicate with external knowledge sources such as customers, competitors, suppliers, consultants, public research organizations and universities. This paper aims to reveal importance level of universities according to innovative and non-innovative firms. The data is gained from Community Innovation Survey (CIS-4), which was based on OECD's Oslo manual. This survey is carried out with industry firms. Firstly, innovativeness of firms is inquired. Our sample includes both innovative and non-innovative firms. Then firms are asked to indicate importance level of universities for the innovation process. Importance level is scaled as "not used", "low", "medium" and "high". We expect to find that innovative and non-innovative firms are different based on the importance level of universities as a knowledge source. We begin by reviewing background of university- industry cooperation and then recent studies based on the links between university and industry is presented. After that data and empirical findings are outlined in the research methodology part. Finally a brief conclusion is shared.

2.Background of University-Industry Cooperation
Due to the increased international competition and fiscal constraints, universities have been expected to cooperate with research communities and commercial institutions in a more direct way in the past 20 years, they forced leading to more applied research and making the results available for commercial use [12]. Companies also face increased pressure to advance knowledge and create new products and technologies to be successful in today's marketplace [13].

The importance of university-industry collaboration has generally increased in the industrialized world since the late 1970s. Universities throughout the OECD also have been affected by tighter constraints on public funding since 1970. Growth in public funding for higher education has slowed in a number of OECD member states. In the USA and UK governments tend to look on same strategy. They reduced funds of universities [14].

Universities in China have faced similar challenges to find research fund in 1980 and began to seek industrial funding and establish high-tech firms themselves. In 1990, criticisms increased that universities have far from their core mission of generating and disseminating knowledge. Since 1998, research universities have received government funds to improve their research performance [15].

In the early 1980s university- industry linkage in Europe starts to increase with national research programs that are supported by European governments [16]. Bayh Dole Act of 1980 objective is improving university-industry collaboration and technology transfer in the USA national innovation system [14].

Universities have been compelled to find new sources of funding and be more closely to industry. Not only being close to industry but also other forms of R&D partnering have started to applied by universities. They should give importance to cooperate with industry nevertheless education and research must be primary mission. Because universities can contribute to industry so long as they accomplished these missions successfully.

3.Literature Review
There are different aspects and approaches that examine impact of academic research on industry innovation.

Caloghirou et al., (2001) investigate university-industry collaboration in a large set of research joint ventures (RJV) s established in the context of the European Framework Programmes and examine objectives of firms and benefits from cooperating with universities. They indicate that there is a positive relationship between RJV size and university participation. Also in their research, universities are reported to be the most frequent partner. %57 of the respondents ranked cooperation with universities, the second most popular response clients are ranked by %39 of the respondents [16].

Mansfield (1991) estimated that 10% of industrial innovation is based on academic research which lay down 15 years before. But he updated his research (1998) and there was a decrease in the average time lag between academic research results and the first commercial introduction of new products and processes based on these results [17].

It is open that universities have significant impact on industry by contributing to innovation process with different ways. A large number of studies emphasize negative impact of university-industry cooperation as many studies that emphasize positive impact. Caloghirou et al., (2001) signs knowledge base and process development have positive, significant relationship with cooperation with universities. Also there is a strong negative relationship exists between cooperation with universities and improving speed to markets. It means universities are not the best partners for speedy commercialization [16]. Cohen et al. (2002) points out university research results don't play the central role in the new industrial projects with respect to the stimuli originate with customers or from manufacturing operations and university research results have been accepted a modest role in suggesting new projects for the majority of industries [18].

There are numerous difficulties measuring quantitatively the extent to which technology-based firms rely on universities to provide R&D support, or the strength of university-industry technology transfer links [19]. McAdam et al. (2005) show that technology transfer in relation to university innovation centres involves highly complex, recursive and dynamic activity combined with a range of diverse and often conflicting stakeholders [20].

Some studies [17], [21], [18] emphasize the significance of inter industry differences in the relationship between university and industrial innovation. Hong (2008) indicates transferring

knowledge from university to industry subject to geographic constraints and it affects innovation system [12].

Firms cooperate with universities to exploit research synergies leading to cost savings, R&D productivity, keeping up major technological developments and sharing R&D cost [16]. These activities trigger innovation and entrepreneurship. Almeida (2008) emphasizes that universities also forces to stimulate innovation and entrepreneurial activities by different approaches [22]. For example Leydesdorff, Etzkowitz (2001) emphasize triple-helix and explain in terms of arrangements and networks among the university, industry and government institutional spheres provide input and sustainance to science-based innovation processes [23]. Hassink (2001) indicates an integrated approach which includes regional government, partnerships between a broader set of actors—namely regionally and nationally initiated support agencies, large enterprises, small and medium enterprises, universities and public research organizations, will be more realistic innovation [24].

University-industry cooperation approach created a new paradigm. A new paradigm is emerging of the 'entrepreneurial university' which encompasses a more direct involvement in the commercialisation of research activities, and a more proactive approach to regional economic development [19]. The creation of the entrepreneurial university as a response to the increasing importance of knowledge in national and regional innovation systems and the recognition that the university is a cost effective and creative inventor and transfer agent of both knowledge and technology [25]. Entrepreneurial university includes [19];
-Introduction or expansion of university offices involved in licensing and patenting (seeking commercial applications for university research);
-Small business development (providing technical or managerial assistance to entrepreneurs or small businesses);
-Research and technology centres (operating or participating in facilities for the development of new technology);
-Incubators (managing facilities in support of new technology-based businesses);
-Investment/ endowment offices (utilising the university's financial resources for equity in start-up businesses)

4.Research Methodology

Goal of this study is to provide an overview about importance level of universities for the innovation process that is assessed by firms. This study draws information from "Community Innovation Survey" (CIS), which is prepared by Eurostat based on Oslo manual and gives information on the innovativity of different sectors and regions. This survey is implemented to 52 industry firms. Our sample includes both innovative and non-innovative firms. Importance level of university is inquired by the question "How important universities were to your enterprise's innovation activities? Importance level is scaled "not used", "low", "medium" and "high". Firm evaluations lead to our research question whether there is a difference importance level of universities for innovative and non-innovative firms.

Firstly to analyze importance level of universities according to firms, we checked whether distribution is normal or not. Kolmogorov Smirnov normality test is implemented. Formulated hypothesis is;
H_1: Distribution of importance level of universities is normal distribution

Table 1.Kolmogorov Smirnov Test Statistics[a]

		Universities
Most Extreme Differences	Absolute	, 636
	Positive	, 000
	Negative	-, 636
Kolmogorov-Smirnov Z		2,277
Asymp. Sig. (2-tailed)		, 000

a. Grouping Variable: innovativeness

Table 1 shows p-value is ,000. According to 5% significant level, value of Kolmogorov-smirnov Z=2,277. It means that H_1 hypothesis is rejected. When grouping variable is innovativeness, distribution of importance level of universities doesn't suit normal distribution.

Under these conditions instead of t-test, we prefer to imply non-parametric test. Our second hypothesis is;

H_2: There is no difference between innovative and non-innovative firms based on importance level of universities as a knowledge source.

Table 2.Mann-Whitney Test Statistics[a]

	Innovativeness	N	Mean Rank	Sum of Ranks
Universities	Yes	29	34,45	999,00
	No	23	16,48	379,00
	Total	52		

	Universities
Mann-Whitney U	103,000
Wilcoxon W	379,000
Z	-4,543
Asymp. Sig. (2-tailed)	, 000

a. Grouping Variable: innovativeness

According to table 2, result of Mann-Whitney test shows sig=, 000. The H_2 hypothesis must be rejected under the condition of 5% significant level. It shows that innovative and non-innovative firms are different based on the importance level of universities as a knowledge source.

If we look at the survey results table 3 shows all possible importance level percentages of universities. A respectable 38,5% of firms classified universities as "not used" knowledge source. Near to this rate, 40,4% of firms demonstrated universities in "low" importance level. We would like to emphasize especially, only 5,8% of firms find universities in high-level importance as a knowledge source.

Table 3. Importance level of universities

Importance Level	1. UNIVERSITIES		
	Frequency	Percent	Valid percent
Not used	20	38,5	38,5
Low	21	40,4	40,4
Medium	8	15,4	15,4
High	3	5,8	5,8
2. TOTAL	52	100,0	100,0

On the other hand we classified the firms as innovative and non-innovative firm according to their answer. Table 4 indicates that 55,8% of firms are innovative, 44,2% of firms are non-innovative.

Table 4. Frequencies of Innovativeness

Innovativeness	Frequency	Percent	Valid Percent
Yes-innovative	29	55,8	55,8
No-non-innovative	23	44,2	44,2
Total	52	100,0	100,0

According to analyze results, there is difference between innovative and non-innovative firms based on importance level of universities as a knowledge source. Classifying importance level of universities shows that 10,3 % of innovative firms assess universities in the "not used" category. Most of the non-innovative firms (73,9%) don't think to use universities as a knowledge source through the innovation process. While 10,3 % of innovative firms find high-level important, non-innovative firms defend other knowledge sources are more important than universities. 10,3% is not so hig rate for innovative firms. Most of them (55,2%) evaluate universities in the "low" importance level category.

Table 5. Innovativeness & Importance Level Of Universities Crosstabulation

	Universities								Total
	Not used		Low		Medium		High		
Innovativeness	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	
Yes-innovative	3	10,3%	16	55,2%	7	24,1%	3	10,3%	29
No-non innovative	17	73,9%	5	21,7%	1	4,3%	0		23

Figure 1 provides easiness to be aware of different evaluations of firms on importance level of universities.
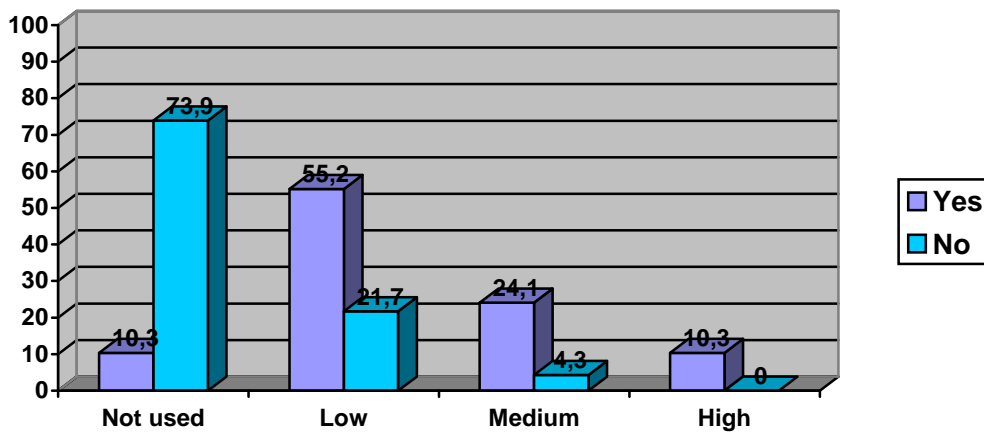
Figure 1. Importance level of universities according to innovative and non-innovative firms

5.Conclusions

The growing importance of knowledge as a source of competitiveness shows firms whose innovation capacity provide to adapt to rapidly changing markets, they will be successfull. Not all firms adapt with equal success, because success is related with taking up knowledge and applying it effectively. Firms don't have all knowledge in their internal sources. They need to take up external knowledge sources to reduce risk and environmental uncertainties.

One of the important knowledge sources is university. Knowledge based growing and changes give additional mission to universities' traditional education and research mission. This mission is transform knowledge to commercial use and cooperating with industry.

This study has attempted to show the difference between innovative and non-innovative firms based on importance level of universities as a knowledge source. After analyzing survey results, most of the firms assess universities in "low" importance level category as a knowledge source. According to 55,2% of innovative firms and 21,7% of non-innovative firms evaluate in low important level. There is no non-innovative firm finds university high importantly and most of them (73,9%) points "not used" category for universities.

Universities have potential to effect innovativeness performance of firms by providing new instruments, techniques and methods. Cooperation with universities increases possibility of

innovation success. Not only firms have advantage from this cooperation, but also universities will gain advantage by interacting with industry.

Limitation of this study is; it is implemented only one area in Turkey. This research can lead to other studies, which include many areas, or it is possible to compare results of different countries also.

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