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An investigation into factors determining strategic partnership between university and industry

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ABSTRACT

In this era of global economic competition, universities play a dynamic role. Universities are no longer restricted to conventional activities. University needs to interact with industry as it plays an imperative role to foster progress and development of the nation. University-industry partnership (UIP) has become a dominant factor in technology and knowledge transfer through various channels. The aim of present study was to investigate the opinion of university faculty and researchers on partnership between university and industry. This research aimed at finding (i) the need of university-industry partnership (ii) the factors that hinder university-industry partnership, (iii) the roles universities are playing in research partnerships in general, and (iv) the means to increase university-industry partnership. It was hypothesized that academics are directly associated with industries. A questionnaire, consisting of 21 items on 5 point likert scales was developed to determine the opinion of 40 university faculty members and 10 researchers. The findings reveal the distinctive importance of high quality educational programs, industrial practice, research and development, internship and workshops, international attractiveness, flow of knowledge, and entrepreneurial spirit associated with UIP. The study concludes that universities are significantly associated with industries and research and development, publication, licensing and technological advancement paved important stone in UIP.

Introduction

The pace of scientific changes is so fast and unpredictable that a scientist of today will be unable in stating a given course of science for tomorrow. However, no action can take place without a prior thought or knowledge and no knowledge or thought is worth anything without action. Science plays a dynamic contributing role in development and productivity. However, the bond between university and industry is an indispensable factor for the development and progress of a country and to create inventions and innovations for benefit of the humanity.

University is a social capital entity which plays a critical role as producer and promoter of economic development in the society for (Mansfield, 1995; Branscomb et al, 1999; Etzkowitz & Leydesdorff, 2000; Leydesdorff & Meyer, 2003). With technological advancement, transfer of knowledge drastically increases the competition and creates atmosphere conducive to research (M.Ehsam, 2008). However, Leydesdorff & Meyer (2003) explored that in recent time of globalization and technological spillover, apart from teaching and research there is a third important driving factor or stream "University-Industry Partnership" which integrates economic growth and development.

Hunt et al. (2002) define the term Strategic partnership as the "Cooperative labors between two or more firms that combine their assets in an attempt to achieve mutually compatible goals that they could not achieve easily alone". Elmuti et al (2005) characterize the term as an inter-firm cooperative contract intended at attaining the competitive benefits for the partners.

Rossi (2010) coined the term "University-Industry Partnership" (UIP) as an extensive range of interaction or communication at diverse levels and connecting different activities for the exchange of knowledge and technology, between universities and firms. This consists of establishment of start-up firms occupied in the marketable utilization of university inventions and innovation, the presentation of shared research between firms and academic institutions, contract research and academic consulting commissioned by industry, collaboration in graduate education, higher education for enterprise personnel, exchange of researchers between firm and universities.

Although, UIP have long history, yet in late nineteenth century universities were reckoned as valuable sources of technological innovation and invention which drive the economic activity (Bruno & Orsenigo 2003; Mowery et al. 2001; Rosenberg and Nelson 1994). Mowery et al. (2001) stated that the Bayh-Dole basically aims to give universities academic property rights on the results of research funded nationally, and has parked another wave of change in university industry collaboration. However, many previous studies indicate that knowledge transfer usually centers in patenting, licensing, development of the startup companies as the foremost development and growth of universities to technological distribution (D'Este, P. and Patel, P., 2005). Cohen et al (2002) explain that most industries patent and licensing were of lesser significance as a channel for conveying public research compared to publications, conferences, informal interaction and consulting.

Nevertheless, as several scholars have noted, university-industry partnership embraces a much broader spectrum of

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activities than commercialization of intellectual property rights (Agrawal & Henderson, 2002; Mowery & Sampat, 2003; Cohen et al, 2002; Mansfield & Lee, 1996; Schartinger et al, 2001). According to Schiller and Diez (2007), enterprises discover a growing importance of university knowledge because their industrial production is becoming increasingly knowledge-based. Rapid changes in technology and market circumstances are calling for higher innovation rates and shorter lead times for the improvement of products and processes. The university can play an enhanced role in innovation of increasingly knowledge-based societies through forming direct links with industry to maximize capitalization of knowledge and that academia should closely be incorporated with the industrial world.

Uip is a catalyst indicating precise form of relationship between two or more organizations illustrated by the formation of a separate entity having diverse task, policy and strategy. It should be dynamic and responsive to change under different backgrounds, which assure an organization's skill to effectively counter the changing conditions in the long run that highlights the significance of decision-making (Bryson, 2004; Wheelen & Hunger, 2000). Liyanage and Mitcheil (1994) conceptualize that the UIP is an organizational body to strengthen the capability of universities, undertakes high quality and significant research, and enhances the capability of industry to compete internationally. Partnership is generally regarded as a medium for recognition for promoting a higher level of competitiveness. Consequently, Bercovitz and Feldman (2003) envisage that the foremost rationale for focusing on this subject is that we need to develop our understanding about who in academia interacts with industry and why. This is predominantly vital for the design of public policies aimed at facilitating and promoting the university knowledge transfer. However, Landry et al (2006) observe that we would expect that universities who have risen funding for research are more likely to attract the interest of industry. Moreover, the universities play an important role for firms by helping them to realize the full social returns of R&D investments (Martin & Scott, 2000; Siegel & Zervos, 2002).

Sohn and Lee (2011) take into account that the systematic organization of R&D contract agreements is essential in order to increase the efficiency of UIP. The prevalent source of difference between firms and universities is the possession of patents for developed technology. Although, Calvert and Patel (2003) as well as Rothaermel et al. (2007) explain that the industrial partners needed more cooperation with academics. Due to an ever-increased competition, firms are pushed to innovate. In some developing industries (for instance, the biotechnology or the nanotechnology industries), firms simply need universities because of the closeness with the research boundary. There is a need to bridge up gap between academia and industry by building confidence, trust and creditability as both speak of different language.

Moreover, there is a practical indication to imply that the process of partnership between university and industry is an outcome of interaction among various channels encompassing the "traditional" means. Research joint ventures (Hall et al., 2001; Link & Scott, 2005), consultancy projects (Perkmann & Walsh 2008), formal research and development (R&D) projects (Ham & Mowery, 1998; Fontana et al., 2006), informal interactions (Faulkner & Senker, 1994), labour mobility (Zucker et al., 2002a), joint scientific publications (Calvert & Patel, 2003) are various channels for UIP. Some other channels for UIP are (a) patenting (Agrawal & Henderson, 2002; Sapsalis et al., 2006 and Van Looy et al., 2011), (b) licensing (Thursby & Thursby, 2001; Thursby & Kemp, 2002), (c) launching of academic spin-off companies (Shane, 2002; Shane, 2004; Friedman and Silberman, 2003), (d) conferences or other events with firm and university participation, and (e) mobility of researchers between universities and firms (Schartinger et al. 2002).

Research Methodology

Research Questions

This research carried out the following question:

- Why is university-industry partnership needed?
- What are the factors that hindered university-industry partnership?
- What roles do universities play in research partnerships in general?
- How can we increase university-industry partnership?

Sample of the study

The sample consisted of sixty (50 faculty members and 10 researchers) from following public and private universities: NUST (National University of Science and Technology), Quaid-e-Azam University, Comsat University and Fast University. In total, the researchers received 50 valid respondents (40 responses from university faculty members and 10 responses from researchers) out of 60 from universities. The corresponding response rate was 80%. Out of 50 respondents, 40 (80%) were males and 10 (20%) were females. The details of demographic characteristics of respondents are given in Appendix-A. Non-Probability sampling i.e. Purposive and convenient sampling was used for collecting data.

Instrument of the study

The self-developed questionnaire was used to collect data. The questionnaire consisted of 21 items based on five points rating scale (likert Scale) to measure the response. The scale ranged from five (strongly agree) to (strongly disagree).

Data Analysis

Firstly, the Cronbach's alpha was calculated to check the reliability of construct taken into account in research. The results indicated Cronbach's alpha for questionnaire (21 items) is 0.753 (Nunnally 1978, p. 245), suggesting that the items have relatively high internal consistency. The data were analyzed statistically at level 0.05 while applying Chi square.

Findings

1. Table 1 indicates the need of university-industry partnership as perceived by the respondents. It shows that the most significant reason (X^2= 48.00) for UIP is that it assures transfer of knowledge supporting industry and its staff in its competitiveness. UIP is also essential (X^2= 44.40) as it helps to increase international attractiveness of university as well as industry. The other reasons for the need of UIP in order of their significance are; It has positive impact on the supply of attractive, flexible and high quality education programs (X^2=38.00), It will develop continuing education training in cooperation with industry which meets market needs and generating/enhancing innovation culture in the university (X^2=37.40), It helps students to find a placement outside academia (X^2=36.80), It will improve entrepreneurial spirit at university (X^2=35.00), It increases researchers' visibility (X^2=23.00), and It may create opportunities for the flow of Knowledge from industries to universities (X^2=11.12).

2. Table 2 shows the factors that hindered university-industry partnership. It shows that the most important factor (X^2=15.00) is that companies don't cooperate with universities on R &D; they just want their knowledge. One of the factor that hinder (X^2

=26.60) is the cultural differences between academic and commercial researchers.

Table 1: Need of university-industry partnership

Reasons	SD	D	N	A	SA	Mean	X^2
It increases researchers' visibility.	7	4	6	23	10	3.50	23.00
It helps students to find a placement outside academia.	2	4	4	12	18	4.12	36.80
It has positive impact on the supply of attractive, flexible and high quality education programs.	2	1	13	10	24	4.06	38.00
It assures the transfer of knowledge supporting industry and its staff in its competitiveness.	1	3	4	15	27	4.28	48.00
It may create opportunities for the flow of Knowledge from industries to universities	6	8	20	7	9	3.00	11.12
It may increase international attractiveness of university as well as industry.	2	1	5	17	25	4.24	44.40
It will develop continuing education training in cooperation with industry which meets market needs and generating/enhancing innovation culture in the university	2	2	5	20	21	4.12	37.40
It will improve entrepreneurial spirit at university.	1	4	5	18	22	4.12	35.00

df=4

Table Value of $X^2 = 9.488$

Table 2. The factors that hindered university-industry partnership

Statement	SD	D	N	A	SA	Mean	X^2
Some Companies do not want to cooperate on R&D with universities; they just want to absorb our Knowledge.	3	10	10	15	12	3.60	15.00
Cooperation with the industry is hindered by cultural differences between academic and commercial researchers	2	8	9	21	10	3.22	26.60
The Joint R & D is hindered by conflicts between academic researchers who want to publish research and commercial researchers who want to patent research	2	5	17	19	8	3.40	27.60
It is hard to find appropriate industrial partners for joint R & D projects	6	5	14	20	5	3.26	23.00
Conducting contract research only results in more income for research groups	7	1	15	17	10	3.44	16.40
I have lack of incentive to cooperate with the industry since my rewards mostly depend on scientific publications.	2	11	17	10	10	3.30	11.40
Transferring knowledge to the industry is too costly for universities	3	6	13	19	9	3.50	15.60

df=4

Table Value of $X^2 = 9.488$

The other factor that stalled (X^2 =23.00) is that industrial partners are difficult to find for joint R &D projects and transferring knowledge to the industry is too costly for universities (X^2=15.60). The Joint R & D is hindered by conflicts between academic researchers who want to publish research and commercial researchers who want to patent research(X^2=27.60).The other factors that hindered are that contract research only results in more income for research groups(X^2=16.40) and lack of incentive to cooperate(X^2=11.40)

3. Table 3 shows the role played by the universities in research partnerships in general. It shows that the imperative role played is (X^2= 21.80) universities have a will to spend time and money in transferring their knowledge to Industry. Universities offers few courses for university-industry partnership (X^2= 12.00) as universities has not enough funding for Research & Development for creating a strong association with industries (X^2= 16.40).The other role played are contributions of university's incubators to new technology-based firms (X^2= 12.50) and students in the universities are currently less exposed to industrial practice and industry cooperation (X^2= 19.00).

4. Table 4 shows the need to increase UIP. It shows the most significant (X^2=38.00) need for UIP is that university must have and should prove his strong commitment to spend time and money in transferring their knowledge to Industry. The University must have a defined comprehensive policy regarding UIP (X^2=44.00).The other thing needed to increase UIP is that university must offer more courses (X^2=44.40) and provide university enough funding for Research & Development (X^2=20.00). Students in the universities must be exposed to industrial practice and industry cooperation (X^2=19.00).

Statement	SD	D	N	A	SA	Mean	X^2
The Universities have a will to spend time and money in transferring their knowledge to Industry.	7	2	10	22	9	3.48	21.80
The University offers a few courses that may create partnership with industry	1	9	13	15	12	3.56	12.00
The University has not enough funding for Research & Development for creating a strong link with industries	7	1	15	17	10	3.44	16.40
There are some contributions of university's incubators to new technology-based firms.	4	9	13	18	6	3.26	12.60
Students in the universities are currently less exposed to industrial practice and industry cooperation	2	3	15	16	14	3.72	19.00

df=4

Table Value of $X^2 = 9.488$

Table 4: What is needed to increase UIP?

Statement	SD	D	N	A	SA	Mean	X^2
The University must have and should prove his strong commitment to spend time and money in transferring their knowledge to Industry	2	1	13	10	24	4.06	38.00
The University must have a defined comprehensive policy regarding UIP	1	4	19	20	5	3.46	44.00
The University must offer more courses that may create partnership with industry	2	1	5	17	25	4.24	44.40
Provide university enough funding for Research & Development for creating a strong link with industries	3	5	9	21	12	3.68	20.00
Students in the universities must be exposed to industrial practice and industry cooperation.	2	3	15	16	14	3.72	19.00

Discussion

Universities-Industry partnership is regarded as bridging culture on the part of two distinct entities academia and industry

which accelerates economic development in developing countries and strongly focuses on science and technology as 'wealth creators' .At present time the whole scenario of the world is changing rapidly due to innovation in science & technology and enhancing global competitiveness. Three decades ago, UIP was not as important as it is now-a-days.

The statistical analysis has revealed that the current investigation has been very crucial in responding to various significant queries extended from literature and theoretical scaffold of this research that UIP between academics and industrials should satisfy the needs of both .The study revealed that academia are directly incorporated with the industrial world that matches with previous literature of (Fontana et al. ,2006 and Etzkowitz et al. , 2000) referring to the university's ability to network with industry. Education is an indirect benefit to that industry projects that may not lead directly to narrative scientific outputs, but may lead to new research and innovations and learning about new industrial functionalities (Perkmann and Walsh, 2009).

It is important to create an innovative environment for UIP using methods and knowledge in a positive manner and need to incorporate new advances in education and learning for researchers. The hypothesis states that research and development has a positive relationship with university industry partnership which is similar to the result of (Fontana et al., 2006; Laursen and Salter, 2004; Todtling et al., 2009). The result depicts that industry inclination to collaborate with a university for innovation seems to depend positively on the R&D. There is a causal relationship between research and academic output. Some studies indicate that industry involvement is linked to higher academic productivity (like Gulbrandsen and Smeby, 2005).

The studies have emphasized the highly distinctive nature of university industry partnership and considered the specific relationship among various factors of UIP (Bonaccorsi and Piccaluga, 1994; D'Este and Patel, 2007). This study identified that UIP has a direct link with industry to maximize capitalization of knowledge and academia for knowledge builders.

The study depicts that patenting and licensing as measures of industry involvement give evidence of a positive effect on the number of publications (Breschi et al., 2008; Calderini et al.2007; Hicks and Hamilton, 1999; Thursby and Thursby, 2002,; van Looy et al., 2006). Our result is consistent with those of Agrawal and Henderson (2002), who found that patenting did not affect publishing rates of 236 scientists in two MIT departments in a 15-year panel and those of Goldfarb et al. (2009) who report similar results for the effect of licensing on the number of publications for 57 inventors at Stanford University in an 11-year panel.

The study reveals that technological advancement is positively associated to innovation which is similar to the study of (OECD, 2003; Dosi et al., 2006). Innovation in science & technology is increasingly dependent upon the interaction between industry and academia represented by the universities. As our results elaborate , academics seeks mutual engagement with industry favorable to their research and given that industry pays for much of this interaction, it could be implicit that industrial associates also judge it to be practical (Gulbrandsen & Slipersæter, 2007).

The study depicts that the effect of participation in the projects on R&D productivity has positive effect on the university which is similar to the result of (Nishimura & Okamuro, 2009) as it indicates transfers of basic knowledge, accelerates exploitation of new inventions and it link academics to the problems of society. It states that universities portrayed the different factors (economic, structural, organizational, institutional and political) and marked the numerous mechanisms and scales of engagement with industry.

It has been observed that UIP is affected by various factors such as increasing international attractiveness, improving entrepreneurial spirit and innovation culture. Moreover, the educational training, internship, joint research, and educational innovation workshops in collaboration with industry meet the global market needs and engender innovation. In nutshell, UIP is a traffic slot in which knowledge flows from university to industry and vice versa.

Conclusion

Uip is a very powerful vehicle towards the economic growth and development in developed nations but in third world countries like Pakistan, if we are able to conquer the social and economic issues then we will move forward to the bridge of the rapid industrialization and collaborating with higher education institutes. However, government is playing rigid measures for UIP but it ensures that academics are highly efficient, experienced, skillful, proficient and competent enough to take an active contribution in R & D.

This paper aimed to analyze the level of the factors determining the variety of university researchers' interactions with industry. Based on a survey of university researchers and university faculty, it presents some systematic empirical findings that contribute towards establishing some facts on UIP and enlighten empirically grounded hypothetical and policy approaches. In view of the research findings it may be concluded that university is positively linked with industry and that UIP serves as channel for innovation.

It has been observed that respondents agreed that UIP increases researchers' visibility and the university defined comprehensive policy of UIP which will bring industry's perspective and integrative skills to academic. Industry serve as a catalyst for UIP and help to discover new technological challenges, find their solution, assist in the launch of new programs in the academic and add to the knowledge economy, improve their chances in the competition for government research funding and position itself well to work with industry. Thus, the faculty and researchers are going to conduct research and gain experience of production processes in an industrial innovative culture.

It is therefore, evident that university is willing to spend time and money in transferring their knowledge to industry that boosts competitiveness and contributing to the effectiveness of public research. The respondents agreed that university offers such courses that create partnership with industry such as biotechnology, bio-information, nanotechnology, etc.

The respondents' agreed that the contributions of university incubator to new technology-based firms for programs designed to accelerate the successful development and value-added contributions to new research/technology-based had begun. The respondents agreed that cooperation with the industry is hindered by cultural differences between academic and commercial researchers. The respondents agreed that university had enough funding for research & development for creating a strong link with industries.

Universities have a well-developed practice of self-governance and academic freedom for research and development and hold a basis for bringing together university and industry scientists and engineers on a research project of

mutual interest, including joint graduate student advising. However, some companies want to absorb the knowledge do not want to cooperate on R&D with universities and take the researchers for granted using their skills and abilities for innovation but don't pay due rewards for their cooperation in R & D.

Joint R & D is hindered by conflicts between academic researchers who design/publish research and commercial researchers wanting to patent research. The respondent's consent that it is hard to find appropriate industrial partners for joint R & D projects as interdisciplinary university-industry groups are conducting long-term projects and motivated industrial researchers are needed to take an active participation. Contract research only results in more income for research groups as one is doing research with in limited duration with maximum output. University researchers hardly have any incentive to cooperate with the industry since their output depends on scientific publications. The respondents agreed that collaboration with industry helps young researchers to find a placement outside academia as universities are working with confined careers services with companies large and small to encourage placements.

The main function of UIP is transferring knowledge to the industry which is too costly for universities and students in university currently bear the industry practice and industry cooperation. This paper examines the UIP holds positive impact on the supply of attractive, flexible and high quality education programs and undertaking the transfer of knowledge in supporting the industry and its staff in its competitiveness.

The respondents agreed that UIP would improve entrepreneurial spirit at university. Fostering an entrepreneurial mindset as well as the relevant skills among researchers can greatly contribute to the reduction of the cultural divide which exists between research institutions and industry. In order to foster interactions between them, researchers need to be provided with basic knowledge transfer and business skills. Entrepreneurship education should be offered to provide training to manage the intellectual property, interact with industry, start and run a business. However, increase in UIP has brought a creative engine of the knowledge economy rests on research.

UIP will help in increasing international attractiveness of universities and industry. UIP would develop effective cooperation between academia and industry to capitalize on the ever-increasing international demand for products and processes. UIP will develop continuing education training in cooperation with industry that meets market needs and generating/enhancing innovation culture in the university.

It could be concluded that knowledge transfer activities and UIP focus on high level of tangible cooperation between academia and industry. Highly skilled individuals are the backbone of the knowledge economy and education is a key element in efforts to boost economic growth.

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Appendix-A

Gender	Male	40
	Female	10
Marital Status	Single	15
	Married	32
	Divorced	2
	Widow	1
Age	20-30	22
	30-40	20
	40-50	6
	50-60	2
Education	BS honors	4
	Masters	16
	MS	20
	Doctorate	8
	Post Doctorate	2
Sector	Chemical sector	10
	Engineering sector	11
	Banking	5
	Computers	10
	Biological	7
	Telecommunication	8
Function of University	Teaching only	12
	Research only	8
	Teaching and Research only	30