KNOWLEDGE CREATION AND ITS TRANSFER: A DIAGNOSIS INTO INDUSTRY-ACADEMIA INTERFACE IN SELECT INDIAN ACADEMIC INSTITUTIONS

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Abstract: *The concept of university-industry collaboration is an important social experiment in the nation's innovation system. This study examines the sustainability of this collaborative experience by focusing on the actual ''give-and-take'' outcomes between academic institutions and industrial firms. This article rests on the idea that knowledge is dispersed among different individuals and entities. For industry to create new knowledge, they need to find ways to combine these dispersed bits of knowledge. Because of the notion that resource constraint and dynamism of market makes industry dependent on external knowledge it is assumed that a portion of knowledge creation and its diffusion takes place in academic networks. Under knowledge and technology transfer, it is broadly understood that any activity targeted at transferring knowledge and technology may help a company or a research institution—depending on the direction of the transfer—to promote its activities. This paper entitled knowledge creation and its transfer seeks to contribute to the growing literature on the knowledge exchange relationships between academia and industry in a comprehensive manner. The study is aimed to support the hypothesis that a considerable amount of researcheres engage in knowledge exchange processes with industry and other acadamic partners. Furthermore in this study the aim is to bring out the differences that can be observed with respect to faculty attitudes towards technology transfer and exchange processes. Integrating data from different academic set ups will be used tro examine the degree of variation that exists in knowledge creation and transfer across these institutions so that various channels of knowledge transfer favoured by different institutions could be evaluated. The data revealed by Ganguli, P., Development of University-Industry Partnerships for the Promotion of Innovation and Transfer of Technology India(1999-02) suggest that one of the key element og knowledge transfer processes is the no. of patent applications filed by various academic institutions and the number varies across various institutions with IIT kharagpur topping the chart by filling 75 patent applications followed by IISC Bangalore and IIT Delhi. So there is a need to evaluate the underlying reasons (funding, institutional set up, infrastructure, human capital, resource profile of departments) for the variations in patent filling by different academic institutions. The study hereby undertaken is aimed to evaluate the transfer agent (characteristics of scientific institutes), transfer forms or media (e.g., informal contacts, personal exchange, research cooperations), transfer motives or objectives (e.g., access to human capital or research results) and transfer obstacles (e.g., firm deficiencies, organizational/institutional obstacles). Their interaction determines whether and to which degree Knowledge transfer takes place and how effective it is with respect to several criteria (e.g., R&D abilities of firms, support of funding agency, skill level). The empirical analysis will be based on a survey of academicians, research assistants, projects fellows from the mentioned universities, which will inquire into the aspects of university– industry relations (UIR) i.e intellectual property, infrastructure build-up, patenting and licensing activities. The survey is also aimed to reveal that the transfer of*

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knowledge from universities to industry is largely dependent on the resource availability and its utilisation, personal and contract-based mechanisms and joint capability development mechanisms. The conclusions thereupon would be summed up to understand managerial and policy implications for capitalizing academic knowledge in Indian academic institutions.

Keywords: Knowledge transfer, Licensing, Commercialisation, U-I partners, Patents, Interface, Research and development.

INTRODUCTION

Knowledge is defined as a justified belief that increases an organisation's capacity for effective action Huber (1991); Nonaka (1994). Knowledge may be viewed from several perspectives (1) a state of mind, (2) an object, (3) a process, (4) a condition of having access to information, or (5) a capability. Knowledge has been described as "a state or fact of knowing" with knowing being a condition of "understanding gained through experience or study'' (Schubert et al. 1998). The perspective on knowledge as a state of mind focuses on enabling individuals to expand their personal knowledge and apply it to the organization's needs. A second view defines knowledge as an object Carlsson et al. (1996). This perspective reflects that knowledge can be viewed as a thing to be stored and manipulated (i.e., an object). Alternatively, knowledge can be viewed as a process of simultaneously knowing and acting Carlsson et al. (1996). The process perspective focuses on the applying of expertise Zack (1998). The fourth view of knowledge is that of a condition of access to information McQueen (1998). According to this view, organizational knowledge must be organized to facilitate access to and retrieval of content. This view may be thought of as an extension of the view of knowledge as an object, with a special emphasis on the accessibility of the knowledge objects. Finally, knowledge can be viewed as a capability with the potential for influencing future action Carlsson (1996). Watson (1999) builds upon the capability view by suggesting that knowledge is not so much a capability for specific action, but the capacity to use information; learning and experience result in an ability to interpret information and to ascertain what information is necessary in decision making.

Knowledge-based theories of the firm advocate that firms are organized to accomplish two distinct goals: the creation of knowledge and the application of knowledge (Demsetz 1991, Spender 1996, Grant 1996). Knowledge is created in two distinct forms: explicit and tacit Nonaka and Takeuchi (1995). Explicit knowledge is easy to communicate and transfer because it can be codified. On the contrary, tacit knowledge is more difficult to transfer and communicate because it is inextricably woven with the experiences and situational contexts within which it was generated. Nonaka and Takeuchi's (1995) theory of organizational knowledge creation revolves around an interaction between two dimensions: conversions from tacit to explicit knowledge and vice versa; and transfers between individual, group, organizational, and interorganizational levels. One of the significant characteristics of the knowledge creation process is that it occurs most efficiently and effectively through specialization and differentiation, i.e., individuals or teams with specific expertise generate

distinct slices of organizational knowledge. Organisationss provide not only forums for the creation of knowledge but also for the integration and application of existing knowledge in ongoing business activities and work processes.

Knowledge has been recognised as one of the most strategically-significant resources for organisations across globe and there is increasing recognition that the competitive advantage of organisations depends on their ability to create, transfer, utilize and protect knowledge. Knowledge is considered as the source of a corporation's competitive advantage and it has a long history in several disciplines. For example, in the discipline of economics, Adam Smith noted that workers learned from experience in *The Wealth of Nations,* and Victorian economist Alfred Marshall later highlighted knowledge as a productive resource. The Nobel Prize winning economist Kenneth Arrow gave this phenomenon further expression in his 1962 article, "Learning by Doing." They argued that if organizations can become better at learning by transferring what workers know, then they can become more efficient. Developing these knowledge transferring strategies became an important theme of knowledge transfer mechanisms. For playing an important role in the economy, it is inevitable that the new knowledge is created at universities, transferred from universities to society, or more precisely to industry. Large differences occur in the way knowledge transfer takes place in different countries and different universities (Polt et al. 2001). Research that enhances insight in the properties and performance of knowledge transfer in different countries, regions, sectors and universities, can help policymakers to optimize their policy regarding knowledge transfer, and by doing this they can enhance economic growth. Knowledge creation and transfer enables organizations to better utilize their current stock of knowledge and position themselves to recognize opportunities to create knowledge faster than their competitors, thus increasing an organization's value and competitive standing. Economic value is increasingly related to an organizations ability to innovate and innovation requires that the organization engage in creating knowledge on a continuous basis. In today's competitive environment organizations need to gauge their potential to create new knowledge by giving careful consideration into their intellectual bandwidth, discuss the key enablers of knowledge creation, and various scenarios and modes that will facilitate proper transfer of knowledge, as these parameters contribute towards sustainable competitive advantage for organisations as well as industries.. For creation and transfer of knowledge across industry, collaboration and innovation are increasingly central to organizational effectiveness. Moreover the most consistent assertions of recent years is the critical role that academic institutes should play in the new era of science and technological development. Robert Reich (1991) in his

provocative analysis of "*The Work of Nations"* observes the symbolic analysts, those workers who excel in terms of higher reasoning and application of analytic abilities will be the most rewarded workers that are researchers and academicians. Nations will need these workers in abundance if they are to compete. But will a nation's academic institutions provide these workers, or will they be developed elsewhere such as through corporate training or overseas study is a matter of concern. Nations also will require the creative conceptual breakthroughs of symbolic analysts. In the past many of these breakthroughs, or at least the most basic components, have come from the laboratories and seminars of universities where a large proportion of the symbolic analysts were employed, and where most of the national funds for basic research tended to be concentrated. A large consensus has emerged in the literature on the positive effect of university-industry ties on organisational problem solving. Organizations creating more cohesive networks on knowledge related dimensions are better able to collectively solve problems, create new knowledge and transfer explicit and tacit knowledge. Cross industry research program promotes knowledge creation and transfer and specifically focuses on characteristics of relationships that are important for knowledge creation in networks: 1) knowing what others know; 2) having access to other people's thinking; 3) having people be willing to actively engage in problem solving; and 4) having a safe relationship to promote learning and creativity. It has been found that start-up organisations that collaborate with universities tend to be more likely to survive (Rothaermel and Thursby, 2005) and enjoy higher rates of patenting and revenue growth (Baum, Calabrese, and Silverman, 2000). On the scientists' side, returns from collaboration are less quantifiable and also more mixed. While some studies tend to be more sceptical about the general academic benefits from collaboration (e.g., Blumenthal et al. 1996), others strongly argue that scientists involved with the industry publish at a higher rate not only before collaboration, but also afterwards, and even more intensely *during* collaboration (Zucker and Darby, 1996; 1997; 1998). In addition, other benefits have been noted, such as scientists' satisfaction from moving an idea on the commercialization path, working on interesting problems, and increasing their research budget (Kenney 1986; Mansfield 1995). The combination of the positive effects led Zucker, Darby and Armstrong (1998) to conclude that "the relationship between academic institutions and organisations appears to be truly symbiotic contributing to the success of both academic and commercial ends". The pioneering work in the field of knowledge creation includes several papers by Zucker, Darby and Armstrong (1998; 2001; 2002) that significantly leads to the conclusion that university-industry knowledge transfer occurs less through spillovers, but through well defined market

exchanges (contracts and ownership ties) between faculty and firms, thus depicting that successful knowledge creation and transfer not only depends upon the two parties that are involved but also on structured formal patterns, that increases the safety and creditworthiness of transfers. In industry university collaborations preferences over potential partners and restrictions in the number of collaborations suggest that in the market for research, agents on each side of the market are in competition for allying with the most "desirable" partner on the other side of the market. While it is typical to view organisations competing in the market for innovation, and scientists competing for funding and academic prestige (Stern; 1995), thus making it important to recognize the presence of competition among organisations for teaming up with the institution. Research on university-industry links has identified supply side (i.e. relating to universities) and demand side (i.e. relating to industry) factors influencing their occurrence. With respect to the supply side, universities have recently been more directly engaged in contributing to economic development; this has been termed the third mission of universities (Etzkowitz and Leydesdorff, 2000). Such mission is related to third stream activities, which are mainly concerned with the generation, use, application and exploitation of knowledge and other university capabilities outside academic environments (Molas-Gallart et al., 2002). Most of the evidence from innovation surveys suggest that organisations draw directly from universities as a source of knowledge (Arundel and Geuna 2004; Cohen et al., 2003; Laursen and Salter, 2004; Hughes et al., 2006). Indeed, firms with different types of R&D activities and different sizes link differently with universities. With respect to the presence of R&D activities, a key contribution from Cohen and Levinthal (1990) argued that firms must perform R&D in order to be able to tap into external knowledge, including that from universities. Historical studies focusing on the late 19th century such as Mowery (2002), Rosenberg (1994) and Reich (1985) showed that when US firms increased their scale, they became able to formalize R&D activities in departments dedicated to R&D. Freeman and Soete (1997) argued that, as German chemical firms increased in scale, this was accompanied by a structuring of internal R&D. In both the US and German cases the formalization and presence of R&D activities was accompanied by stronger links with universities. According to the Global CEO Study 2006, organisations rely on several sources of knowledge in order to develop innovation activity and that university research contributes significantly to industrial innovation. Further the IBM Survey of Chief Executive Officers (IBM Global Business Services 2006) report that around 13% of CEOs from 20 different industries and 11 geographic regions, identified academia as the most significant source of innovative ideas. The success of companies thus depends on their ability

to generate knowledge and transfer the knowledge embodied in organisational routines from one organisation to another in the network they are part of. On these lines, Grant (1996) sees the organisation as an institution for integrating the specialist knowledge resident in individual organisations. The primary task of management is to establish the coordination required for knowledge integration. Knowledge transfer is the essence of the learning-by-interacting logic observable in Japanese buyer-supplier practices (Dyer, 1996; Dyer and Nobeoka; 2000), and in strategic interfaces between partners (Grant and Baden Fuller, 1995). The current research has been proposed in this backdrop with a view to investigate and explore the issues in knowledge creation and its transfer in select Indian Academic Institutions as a result of collaborative interface between the industry and academia.

SCOPE

As stated earlier, the present research seeks to build on the case of select academic institutions in India with special focus on knowledge creation and its transfer through collaborative initiatives between industry and academia. The proposed research case shall include four premier academic institutions in India wherein collaborative research (industry sponsored / industry partners) across various disciplines is carried out. The institutions are as follows:

MDI GURGAON

India ranks sixth in the world in terms of energy demand accounting for 3.5 percent of world's commercial energy demand, with a gross domestic product (GDP) growth of 8 per cent set for the Tenth Five Year Plan. The energy demand is expected to grow at 5.2 percent in future, catering to this uprising demand the Centre for Energy Management set up by the Management Development Institute, Gurgaon in collaboration with other organizations focus primarily on the research collaborations. As part of the activities of the centre, MDI has joined hands with organizations / departments of national and international repute for conducting study, research, consultancy and organizing seminars and conferences in areas of energy and power sector. All activities of the centre will move from formulating local and national level strategies to suggesting global solutions to critical energy and power related issues. The vision of the Centre for Energy Management is to act as a modal centre for documentation and information dissemination activities, research activities in the fields of energy and power. The objectives of the centre would be to promote research which will generate concepts and theory for effective management of energy and power systems and

provide opportunities to managers of energy and power systems for developing managerial skills and techniques, to develop a strategic direction for organizations involved with energy and power, to undertake research, training and organizational work on management of energy and power related issues, to work on organizations and government departments concerned with promotion, development, and distribution of power.

JAWAHAR LAL NEHRU UNIVERSITY

Growth of biotechnology has accelerated particularly during the last decade due to path breaking advancements in biology and new technologies that produce large high quality breakthroughs. Thus biologists need to use almost every new technical development in information technology and computer sciences and intelligent application to solve complex biological problems leading the development of multi-disciplinary area called bioinformatics. The main objectives of research collaborations at JNU are to undertake advanced research in frontier areas of bioinformatics and computational biology, to develop world class human resource in bioinformatics, to establish effective academia-industry interface, to pursue and promote international cooperation with leading institutions, organizations and countries in the world and to create world-class platforms for technology development, transfer and commercialisation.

Serial No.	**Name of the Project**	**Project coordinator**	**Funding Agency**	**Tenure**
1.	Optimization of process parameters for up scaling of tannery effluent treatment by microorganism	Dr. I.S. Thakur	DBT, Govt. of India	April 2004-March 2007
2.	Molecular characterization of pentachlorophenol-degrading bacterial consortium for treatment of chlorinated phenols in industrial effluent	Dr. I.S. Thakur	DBT, Govt. of India	March 2005-Feb. 2008
3.	Molecular characterization of	Dr. I.S. Thakur	CSIR, Govt. of	April 2006-March

	alkalophilic bacterial consortium for degradation of dioxin-like compounds in the environment		India	2009
4.	Optimization of biopulping and biobleaching processes for removal of colour and organic compounds from pulp and paper mill effluent	Dr. I.S. Thakur	University Grant Commission	April 2006-March 2009

Various projects and their funding agencies are:

Source: http://www.jnu.ac.in

IIT DELHI

The Institute is actively involved in collaborative programmes with national and international organizations/universities to remain at the forefront of scientific and technological developments and to share knowledge. A large number of international collaborative research projects are under operation with Institutes/Organizations of Canada, Ethiopia, European Commission, France, Germany, Italy, Japan, Kenya, Mauritius, Poland, Russia and Sri Lanka. Besides, the Institute has been undertaking consultancy assignments with international organizations like Japan Automobile Research Institute, Japan; JGC Corporation, Japan; LG Electronics Inc, Korea; The Mauritius CT Power Ltd., Mauritius; Common Fund for Commodities, Netherlands; INFRAS Switzerland; Thai Acrylic Fibre Company Limited, Thailand; Marvel Chemicals Ltd, UK; PPG Industries Inc., USA; United Technologies Corp./Pratt & Whitney, USA; Solidcore Systems Inc., USA; Gulf Coast Technical Service, USA; Corning Inc., USA; Biomorphic VLSI Inc., USA; Institute for the Future, USA; Yardi Systems, USA and Universities/ Institutions abroad.

FUNDING AGENCIES

Aeronautics Research and Development Board (ARDB)	http://www.drdo.com/boards/ardb
Bhabha Atomic Research Centre (BARC)	http://www.barc.ernet.in
Centre for Development of Advanced Computing (CDAC)	http://www.cdac.in

Centre for Development of Telematics (C- DOT)	http://www.cdot.com
Council of Scientific & Industrial Research (CSIR)	http://www.csir.res.in
Defence Research & Development Organisation (DRDO)	http://www.drdo.nic.in
Department of Biotechnology (DBT)	http://dbtindia.nic.in

Source: http://www.iitd.ac.in

DELHI UNIVERSITY

The University of Delhi is a central university situated in Delhi, India and is funded by Government of India. It was established in 1922. Various research projects and their funding agencies at Delhi University are: chemical designing; funded by UGC, chemical green designing funded by DRDO and genetics funded by UGC. In terms of funding, Department of Science and Technology Purse grant has been sanctioned to the University in 2008-2009 for excellence in science. This is based on the position of the University as No. 1 University in the country in terms of research collaborations during the last ten years. This further has encouraged the sharing of expertise between various faculty members.

JUSTIFICATION

The backdrop in the preceding paragraphs duly supports the argument in favor of undertaking the current research. However, the justification for the proposed research is further presented in the following paragraphs with special focus on the academic institutions constituting the scope of the study. Knowledge is considered to be a key organizational resource in the 21st century and the knowledge management 'movement' has alerted organizations to the fact that they should more strategically exploit their knowledge assets. Organisations are thus lured by the suggestion that they can gain competitive advantage by the more astute management of their knowledge base and in particular, by the creation and transfer of knowledge across individuals, groups and organizational units. With the move of advanced economies from a resource-based to knowledge-based economies, many national governments and organisations have increasingly recognized "knowledge" and "innovation" as significant driving forces of economic growth, social development, and job creation. In this context the promotion of 'knowledge transfer' has increasingly become a subject of public and economic

policy and moreover organisations are keenly interested in researching the various knowledge transfer paradigms, limitations in terms of stickiness, and systems and scenarios that support knowledge transfer. The university knowledge creation environment differs from industrial knowledge creation in many ways, the most important difference is that in the university context, researchers need to publish in scientific journals, while in the industries; they need to improve the profits. Another difference is that most university researchers carry out other activities besides research (in particular, teaching and administration) whereas researchers in industry are involved only in research activities. University and industrial knowledge creation environments are also heterogeneous within themselves that is in terms of structure, interface patterns, and regulatory frameworks. Different types of disciplines require different knowledge creation environments. Thus different disciplines have different cognitive and social styles. This means that the nature of knowledge creation and transfer vary to a substantial degree. This further develops an urgency to diagnose the various environments under which organisational institutional transfers are occurring and identify the dimensions which facilitate knowledge creation and transfer across various sectors. Recent developments in the university-industry relationship suggest that organisations do not passively rely on knowledge spillovers generated through published academic research. Increasingly, organisations search for new scientific knowledge and technological opportunities through direct industry academic interfaces, such as licensing of academic inventions and collaborative research (Cohen, Nelson, and Walsh, 2002; Mowery and Shane, 2002; Thursby, Jensen, and Thursby, 2001). This trend has attracted considerable academic and policy attention. For the management literature, of particular interest is the implications of these relationships for organisational performance. A significant body of evidence shows that organisations establishing direct links with university research increase their innovation performance. Universities have long been involved in knowledge transfer activities. Yet the last 30 years have seen major changes in the governance of university-industry interactions. Knowledge transfer has become a strategic issue: as a source of funding for university research, and a policy tool for economic development, thus mutual dependence between academic institutions and industry is inevitable. Universities vary enormously in the extent to which they promote and succeed in commercializing academic research. The identification of clear cut models of governance for university industry interactions and knowledge transfer processes is not straight forward. Thus there is a need to analyse university knowledge transfer models and access recent developments in the literature on IPR's and research collaborations. In the literature, the sources of value creation in university-industry research

alliances remain largely an under-explored area. Most of the empirical studies of performance have focused on linking an innovation output to a simple cooperation indicator measuring the presence of these relationships. Surprisingly, very few studies go deeper into examining the outcome of collaboration in relation to the characteristics of the partners (e.g. Cockburn and Henderson, 1998; Zucker, Darby and Armstrong 1998, 2001, 2002). The underlying logic is that knowing if, or how many individual characteristics of the partners, structural characteristics and regulatory framework affect the alliance. It is the recognition of these strategic considerations leading to university industry interface formation that motivates this study. The university managements claim to have a strong commitment to the field of knowledge transfer and commercialisation. They portray that there are many (potential) collaborating partners to be found both internally and externally. However, deeper investigation of these potential partners seems to lead to a different conclusion, that perhaps these partnerships are not as solid as claimed. Regardless of what kind of inquiries, dialogues and "evaluations" that are used, the information does not seem to be documented, structured, validated or circulated, to serve as a tool for a university's interaction and selection of strategic stakeholders. As a result, the knowledge about collaboration and who is accountable for what is rather adhoc. There are various institutes, regulatory bodies, policy formulation bodies in India. The Scientific Manpower Committee (1947), Engineering Personnel Committe(1956), AICTE (1958, 1966, 1969, 1971), Thacker Committee (1961), Kothari Education Commission (1966), National Policy on Education (1968), Ministry of Education, Government of India (1978), Draft National Policy on Education (1979), AIEI (1980), Nayudamma Review Committee (1980), Challenge of Education – a policy perspective, Ministry of Education, GOI (1985), IIT Review Report (1986). All these committees have repeatedly advocated and emphasized on the need for strong university industry linkages in India. The institutes in that undergo formal collaboration are:

PATENT APPLICATIONS FILED BY INDIAN TOP 10 PATENTING ACADEMIC INSTITUTIONS (1999-2002):

Name of the institute	**No. of patents**
IIT Kharagpur & Gawahati	75
IISc Bangalore	40
IIT Delhi, Kanpur & Roorkee	31

University of Delhi	29
IIT Mumbai	22
IIT Chennai	14
AIIMS, New Delhi	4
Goa University	4

Source: Ganguli, P., Development of University-Industry Partnerships for the Promotion of Innovation and Transfer of Technology India.

The models of knowledge transfer used in these institutions can provide a basis for others in the sector to draw their policy in this regard accordingly in order to increase industry competitiveness and efficiency as well as overall economic and social development. The present research is hence proposed in this backdrop under the PHD programme, in the faculty of management sciences in the business school, the Jammu University.

HYPOTHESIS

H1: Significant variation exists in knowledge creation and its transfer in institutions under study.

H2: Industry-academia interface is significantly a function of resource availability and its appropriate utilisation.

OBJECTIVES

The research objectives are as follows:

- To identify drivers of knowledge creation and its transfer in collaborative research.
- To examine different categories and forms of existing industry-academia interfaces.
- To draw out a relationship among funding, knowledge creation, and its transfer.
- To study the pattern of research funding for research and development in select academic institutions.
- To examine the resource profile of departments/disciplines hosting industry sponsored research projects (human capital, equipment and infrastructure).

REVIEW OF LITERATURE

The following paragraphs reveal the facts supporting the importance of knowledge transfer across the academia-industry interfaces. Moreover the review provides an insight into the number of companies that have successfully collaborated with academic institutions and have gained in terms of cost efficiency and competitive advantage. The review has provided a basis for understanding the significant role of academia and industry as a resource allocator

and resource facilitator in developing the significant mutual relationship between academia and industry. In the succeeding paragraphs, academia-industry interface has been considered a strategic tool in terms of increasing qualitative research and education with respect to its relevance for society, and on other hand providing breakthroughs for industry in terms of innovation, thus building industrial capabilities and thereby contributing to economic growth.

Knowledge's vital importance to economic growth and to a organisation's competitive ability in an increasingly globalised market has long been recognised Boskin and Lau (1992). In general, organisations acquire new knowledge through two basic options: (1) develop knowledge independently in-house or (2) enter into an interorganisational relationship (IOR). Although in the past firms favoured internal initiatives, increased competition and the need for competitive advantage makes it more and more difficult for organisations to advance knowledge and technologies by relying exclusively on in-house activities Bercovitz and Feldman (2007). Technological development and need for new innovations is becoming increasingly interdependent and complex, requiring organisations to look to other organisations for complementary know-how Hagedoorn (1993), and thus pointing towards interfaces between industry and academia as a key resource. Several innovation studies, including that by Kaufmann and Tödtling (2001), have reported that University-Industry IORs (U-I IORs) offer a potentially powerful alternative to successful IORs for innovation transfer and diffusion between organisations. Therefore, unsurprisingly these partnerships have significantly increased in recent years Plewa and Quester (2006) in several countries including the United States, Japan, Singapore, Hong Kong, European Union Countries and the United Kingdom. The motivations for this increase have been attributed to a combination of pressures on both universities and industry. For industry, pressures have included rapid technological change, shorter product life cycles and intense global competition radically transforming the competitive landscape for most firms .With regard to universities, pressures have included the growth in new knowledge and the challenges of rising costs and funding problems. These have exerted enormous resource pressures on universities motivating them to seek relationships with firms to remain at the leading edge in all subject areas (Hagen, 2002). In addition, universities are under increasing societal pressure to be seen as engines for economic growth and less as fulfilling the broader social remit they have had in the past (see for example, Blumenthal (2003). These pressures on both partners have fed the motivations for increased numbers of, and improved performance of U-I interorganizational relationship.

Knowledge creation: Organizational knowledge creation involves developing new content or replacing existing content within the organization's tacit and explicit knowledge Pentland

(1995). Through social and collaborative processes as well as an individual's cognitive processes (e.g., reflection), knowledge is created, shared, amplified, enlarged, and justified in organizational settings Nonaka (1994). This model views organizational knowledge creation as involving a continual interplay between the tacit and explicit dimensions of knowledge and a growing spiral flow as knowledge moves through individual, group, and organizational levels. Four modes of knowledge creation have been identified: socialization, externalization, internalization, and combination Nonaka (1994). The socialization mode refers to conversion of tacit knowledge to new tacit knowledge through social interactions and shared experience among organizational members (e.g., apprenticeship). The combination mode refers to the creation of new explicit knowledge by merging, categorizing, reclassifying, and synthesizing existing explicit knowledge (e.g., literature survey reports). The other two modes involve interactions and conversion between tacit and explicit knowledge. Externalization refers to converting tacit knowledge to new explicit knowledge (e.g., articulation of best practices or lessons learned). Internalization refers to creation of new tacit knowledge from explicit knowledge (e.g., the learning and understanding that results from reading or discussion).

Ikujiro Nonaka's Dynamic Theory of Organizational Knowledge Creation of organization has long been dominated by a paradigm that conceptualizes the organization as a system that 'processes' information or solves problems. Central to this paradigm is the assumption that a fundamental task for the organization is how efficiently it can deal with information and decisions in an uncertain environment. Any organization that dynamically deals with a changing environment ought not only to process information efficiently but also create information and knowledge. However, it can be argued that the organization's interaction with its environment, together with the means by which it creates and distributes knowledge, are more important when it comes to building an active and dynamic understanding of the organization. For example, innovation, which is a key form of organizational knowledge creation, cannot be explained sufficiently in terms of information processing or problem solving. Innovation can be better understood as a process in which the organization creates and defines problems and then actively develops new knowledge to solve them. Also, innovation produced by one part of the organization in turn creates a stream of related knowledge, which might then trigger changes in the organization's wider knowledge systems. Such a sequence of innovation suggests that the organization should be studied from the viewpoint of how it creates knowledge, rather than with regard to how it processes these entities. The goal of this review is to develop the essential elements of a theory of organizational knowledge creation. In the sections which follow, the basic concepts and

models of the theory of organizational knowledge creation are presented. Based on this foundation, the dynamics of the organizational knowledge creation process are examined and practical models are advanced for managing the process more effectively. Organizational knowledge creation involves developing new content or replacing existing content within the organization's tacit and explicit knowledge Pentland (1995). Through social and collaborative processes as well as an individual's cognitive processes (e.g., reflection), knowledge is created, shared, amplified, enlarged, and justified in organizational settings Nonaka (1994). This model views organizational knowledge creation as involving a continual interplay between the tacit and explicit dimensions of knowledge and a growing spiral flow as knowledge moves through individual, group, and organizational levels. Four modes of knowledge creation have been identified: socialization, externalization, internalization, and combination Nonaka (1994). The socialization mode refers to conversion of tacit knowledge to new tacit knowledge through social interactions and shared experience among organizational members (e.g., apprenticeship). The combination mode refers to the creation of new explicit knowledge by merging, categorizing, reclassifying, and synthesizing existing explicit knowledge (e.g., literature survey reports). The other two modes involve interactions and conversion between tacit and explicit knowledge. Externalization refers to converting tacit knowledge to new explicit knowledge (e.g., articulation of best practices or lessons learned). Internalization refers to creation of new tacit knowledge from explicit knowledge (e.g., the learning and understanding that results from reading or discussion).

Knowledge transfer :Over the last 20 years, the consensus that effective knowledge transfer is necessarily an interactive process has grown Innvaer and Lavis (2002). Unlike earlier understandings of transfer as a unidirectional activity- Jonathan Lomas calls "linkage and exchange of knowledge transfer as a collaboration in which researchers and users together develop knowledge in order to identify, understand, and solve real-world problems. Goering and her colleagues (2003) and Coburn (1998) described examples of formal and informal partnerships used to structure knowledge transfer relationships between academic research units and government agencies charged with making and promulgating policy decisions. Two studies of knowledge transfer efforts by Canadian health research organizations (Canadian Population Health Initiative 2001; Lavis et al. 2003) reported on the use of strategies like outreach, researcher and user capacity-building activities, tailored products and messages, and the engagement of users in the research process. In addition, some research organizations are developing the role of knowledge broker, vesting many of the interactive functions of

communication and collaboration in a defined position (Canadian Health Services Research Foundation 2003).

According to EUROPEAN COMMISSION's Directorate-General for Research, Enterprise and Industry the need for sharing knowledge between research institutions and industry has become increasingly evident in recent years. Historically, research institutions were perceived as a source of new ideas and industry offered a natural route to maximising the use of these ideas. However, the past decade has seen a significant change in the roles of both parties. Many companies are developing open innovation approaches to R&D, combining in-house and external resources, and aiming to maximize economic value from their intellectual property, even when it is not directly linked to their core business. In particular, they have begun to treat public research as a strategic resource. In parallel, it has become clear that academic research institutions need to play a more active role in their relationship with industry in order to maximize the use of the research results. This new role requires an extensive research and understanding to identify and manage knowledge resources with business potential, i.e. how best to take a new idea to market, ensure appropriate resources (funding, support services, etc.) to make it happen, and to obtain adequate buy-in by all stakeholders. It has been recognized that the involvement of business in the governance of academic research institutions can help to orient research and education activities towards the needs of society, bring expertise to support knowledge transfer activities, and signal willingness to introduce innovation-oriented approaches in all activities. European universities and other research institutions are equally realising their changing role in the globalized economy and have undertaken interesting initiatives. In order to remain attractive, they will need to open up to business and international collaboration, which may also help leverage new funds. Sharing knowledge in particular through R&D collaborations with business – while a potential source of income for research institutions – may well give an important boost to both quantity and quality of the research undertaken.Academy industry interface: A research paper titled Collaborative Research in India: "Academic Institution v/s Industry" by Neeraj Parnami, at Indian Institute of Technology Kharagpur, India (2008) suggests that the term 'university-industry interface' is used to depict the all forms of agreement between academic institutions, corporate, universities, and any combination of such two or more parties who share the commitment to reach a common goal by using their resources available. Collaboration in Research and development (R&D) sector has been broadly used phenomenon for many years in India. In the collaborative research, the

significant factors like time & cost being reduced to large extent because of sharing of the resources by the parties. Collaborative research contributes to the technological and economical development of the country. Collaboration avoids duplication in research.

According to WIPO (2007) (World Intellectual Property Organization) universities worldwide play a leading role in advancing the frontiers of knowledge. In recent years, a key concern for policy-makers has been how to ensure that the wealth of knowledge generated within universities can be transferred to industry so that society in general, and local businesses in particular, can benefit from university scientific and technological expertise. The realization that important research results would not reach society as a result of bottlenecks in the commercialization of university research results led to increasing interest in finding the most adequate frameworks to promote university-industry partnerships for the transfer of technology.

"University Strategies for Knowledge Transfer and Commercialisation", an overview based on peer reviews at 24 Swedish universities (2006) puts forth that collaboration is about mutual benefits, where a university contributes to society at large and vice versa, illustrating the idea of a two-way relationship. The university develops relevant research inside the university and effective application of the research takes place outside. There is no doubt that the universities are aiming high; to be "nationally leading and internationally recognised". Collaboration is looked upon as a strategic tool in this context. It is based upon the following assumption: Collaboration can increase the quality of research and education with respect to its relevance for society, which hence contributes to an increased economic growth. This can in turn increase the understanding of the importance of the university's role and as a result attract additional economic resources to the university.

A report by (OECD 1998, 2007) emphasised the role of numerous governments and research agencies in facilitating the interactions between industry and universities with the hope that they can improve productive processes and competitiveness in their national or regional environments. Growth of the knowledge transfer activities have created a demand for suitable information for decision making on several managerial levels. In the public policy sphere a precise diagnosis of university relationships with their socioeconomic settings is needed in addition to useful tools for evaluating the programs aimed at fostering cooperation. On the university side, the professors' Third Mission activities must be identified in order to quantify their weight in comparison with traditional academic teaching and research tasks.

Community Innovation Survey (UK), (2001) concludes that businesses around the world are changing their approach to research and development (R&D). For sound commercial and economic reasons, companies everywhere are cutting back their corporate laboratories and building collaborative research programmes with other partners – most particularly, with universities. At the same time, global competition is having an impact on the way that both business and universities are approaching R&D. Across the country, academic researchers are sharing ideas and best practices with their industrial counterparts. Through their collaborative efforts, they are gaining access to the most advanced equipment as well to financial support from industry.

The most important conclusion here after a close analysis of several studies is that the benefit of knowledge transfer from science is generated mainly on an aggregated level. Knowledge transfer intermediaries have to be funded publicly on a continuing basis. Many of them will not generate profits in the long run and those should be subsidised because society nevertheless benefits from the transfer. Even if they do not run at a loss (as the majority does) they cannot contribute to financing research substantially. This implies that every form of knowledge transfer should be seen as positive. If institutions engage in collaborative research with companies, by transferring the risk of commercialisation as well as the IPRs of what they devise to the company, then this is a contribution to knowledge transfer and should not be hindered. It is not conducive to success if some transfer channels are neglected. As long as there are no sensible conclusions on the relative and absolute importance of different transfer channels, all have to be supported. A high number of patents may lead to litigation against universities. There are further possible negative effects like the delay or even prohibition of publishing results or data. Hall et al. (2001) provide qualitative evidence for the US on intellectual property barriers that inhibit the formation of public-private partnerships. If these and other negative effects are aggravated, policy needs to consider the patent orientation carefully. Regarding the decrease in academic patenting as shown by Schmoch (2007), one needs to find the reasons of this development and analyse, if the lower number of patent applications goes along with a lower level of knowledge transfer overall. A new research approach would be the question of whether patented knowledge makes the transfer by scientist mobility less attractive because the value of the scientist coming to a company is less if his invention is protected and has to be licensed additionally in order to use the scientist's knowledge completely. Finally, the difficult question about the absolute and relative value of knowledge transfer and what academic research can contribute to economic development is far from being solved and remains a significant subject for wider research.

Economic development is about innovation and innovative activity. Typically, studies of the role of universities in systems of innovation tend to focus on metrics that are related to inputs and outputs in the familiar logic of a production function. Inputs such as amounts of research funding, numbers of faculty or scientific personnel, quality of academic programs or resources devoted to knowledge transfer are measurable and collected by government and professional organizations (US National Science Board, 2002; AUTM, 2003). The outputs in this context are the number of patents, the number of licenses to industry, the number of spin-off firms or indicators of employment change or economic growth. These elements form a quantifiable component of university– industry interaction; however there is great variation in commercialization of academic discoveries among universities and the relationship of university inputs to a variety of knowledge transfer output measures is not strictly deterministic and many universities operate below the efficient production frontier Siegel (1999), Thursby and Kemp (2002). This suggests that knowledge transfer involves social convention and legal rights as well as economic interests. While universities have a long recognized role in the system of innovation, this role has changed. The new role of universities as engines of local economic development Feller (1990) or magic beanstalks of invention and research Miner et al., (2001) places new demands on universities and raises question about the role of research universities in advanced economies. Many universities have restructured their research capabilities to be more responsive to local industry—for example, setting up specialized research units, joint cooperative ventures or interdisciplinary projects that are more receptive to industrial needs. These specialized units may focus on revitalizing existing industries. In transferring technology, universities contribute to the stock of technologies that firms may draw on for innovation and economic growth. Some have raised the concern that universities are being asked to deviate from a historically successful role and that increased commercial influences may destroy the norms of open science that have promoted the national interest Nelson (2001). These same concerns may be raised at the regional level. Universities certainly add more to their local economies than the metrics of knowledge transfer capture. There are certainly many different modes of how universities interact with and enrich their local economies than simply counting knowledge transfer indicators. In the wake of the success of Silicon Valley and Route 128, where thriving locally based firms were often linked to the major academic institutions such as Stanford University and the Massachusetts Institute of Technology (MIT), research universities have been increasingly called on to help foster local economic development through technology transfer and the formation of start-up firms based on academic research. Universities are viewed by

many as engines of economic growth and continue to be cited as an important factor in regional technology development and revitalization. However, the process of university-led economic development takes considerable time and patience that is often outside of the immediate demands of the political process. Link (2002) concludes that the development of North Carolina's Research Triangle Park was the result of deliberate public policies that began in the 1920s and took 50 years to realize tangible economic benefit in terms of job growth and enterprise development. Sturgeon (2000) finds similarly that the genesis of Silicon Valley may be traced to the early twentieth century. Universities have demonstrated their adaptability in their response to active knowledge transfer. Certainly, attempts to spin off new companies satisfy an increased expectation that universities need to be engaged in local economic development and to demonstrate relevance. One of the strengths of the American system of higher education has been its diversity and decentralization. We may question if the examples provided by Stanford University and MIT have established a de facto standard against which all research universities are judged and what the long run implications will be. The basic premise of this paper is that the legal, economic, and policy environments that comprise the system of innovation determine the rate and type of university knowledge creation and thereby influence the rate of technological change. Moreover, within a given university, there will be additional internal influences that determine the rates and directions of knowledge transfer from that institution. This paper has the modest aim of identifying these influences and speculating on their effect on knowledge transfer. Certainly this review raises more questions than it answers. But certainly an understanding of the evolution of the role of the university in systems of innovation warrants further attention. If we are going to think creatively about public, government policies towards increasing university knowledge transfer, we need to focus on the larger innovation context.

It is clear from surveying the literature on this topic that much has been learned about the process of knowledge transfer from university to industry. However much work remains. The studies to date on knowledge transfer and knowledge creation have inspired a focus on factors that influence the firm's absorptive capacity. All of the studies have focussed on a single industry, in most cases pharmaceuticals or semiconductors. The field will greatly benefit from future work that explores the degree to which methods for building absorptive capacity differ across industries, and also the ways in which these methods differ. Also while there have been significant efforts to investigate the mechanics of in house R&D , further study is needed to understand the other methods for building connectedness, such as

university links, research consortia, and industrial partnerships. Finally variations in connectedness across different institutional environments remain to be explored. We know very little about the amount and type of knowledge transfer that occurs outside the formal route of knowledge transfer process, but many scholars have suggested that there is a reason to believe this could be quite significant. Finally, given the importance of inventor involvement suggested by several studies, it seems clear that studies to understand better the factors that influence the degree to which professors become involved with the commercialisation of these inventions would make a valuable contribution. The channels of knowledge transfer is an under researched area, basic research into the mechanics and characteristics of other channels, such as faculty consulting and recruiting of graduated students would make a tremendous contribution to this area of inquiry. It is also needed to develop a better understanding via research on the different uses of different channels across institutions, owing to variation in intellectual property rules, university policies, funding scenarios and other factors. To conclude we have learned from the work in this field that there are differences in the degree to which firms are capable of effectively utilising university research to their benefit and that these differences vary systematically with the degree to which firms are connected to the university. The review of literature depicts that we have only begun to investigate the various mechanisms by which firms are connected and the relative benefits associated with each mechanism. However the field has yet to address the many potential university industry interface issues which may be substantially more important from an economic perspective. Overall it is the intention of this research work to illustrate that the economic and social importance coupled with the complex nature of this topic combine to offer a wide range of interesting questions and demand a multiplicity of research methodologies and research insights.

RESEARCH METHODOLOGY

In the context of the above, the research methodology in the present proposed research shall have its basis on both primary and secondary data. The primary data will be collected from respondents to identify the knowledge transfer determinants like, attributes of knowledge encompassing publications, research projects that focus on user needs, novelty of research findings etc. Moreover, financial assets like mode of funding that is private funding, public funding and internal funding as a determinant of knowledge transfer would be taken into consideration. By means of questionnaires the drivers of knowledge transfer like perception of respondents that knowledge is valuable resource, emphasis on getting a return for investment in research, need for protection of trademarks, geographical proximity etc. shall

be identified. Appropriate instruments would be used to examine different categories and forms of industry-university interfaces that include publications, participation in conference professional networks and boards, mobility of people, cooperation in R&D, sharing of facilities and contract research and advertisement, R&D activities and formal consulting work, training and transfer of personnel. Wherever necessary, interviews shall be conducted to supplement the response received through questionnaires. For sample determination, the census will be taken for the research process. The population shall comprise of faculty members, research scholars, research associates and faculty assistants from institutes under study located at Delhi. Due care shall be taken to statistically validate the response / sample selection etc.

CHAPTER SCHEME

The proposed chapter scheme is as follows:

CHAPTER 1	Introduction
CHAPTER 2	Review of Literature
CHAPTER 3	Research Design and Methodology
CHAPTER 4	Knowledge Creation and its Transfer interface in Academic Institutions
CHAPTER 5	Data Analysis, Findings and Interpretation
CHAPTER6	Summary, Conclusions, Suggestions and Recommendations

Bibliography

Appendices

PLAN OF THE PROPOSED WORK

1st year:

Extensive literature survey: A thorough and comprehensive review of literature would be done through various sources like books, reports, academic journals, conference proceedings

and e-journals. Previous research and surveys would be sought for further research references.

Preparation of the questionnaire: The questionnaire would be prepared on the basis of the literature reviewed keeping in mind the scope and relevance of the research topic.

2nd year:

Selection of sample: The census will be taken for the research process. The population shall comprise of faculty members, research scholars, research associates and faculty assistants from institutes under study located at Delhi.

Collection of data, Data interpretation, Analysis & Report writing: Any new research requires original data to be collected because the responses depend on many factors which can be internal or external. Although literature review will give deep insight into the surveys and research done earlier but fresh data will be collected in order to find the relevance in the present scenario. In the 2nd year of the study, the researcher will collect data through questionnaires thus designed and interviews as appropriate and applicable. After data collection, information will be generated by analysis of the raw data; this will be further followed by report writing. The draft will be finalized after incorporating the suggestions of the concerned research supervisor from time to time. Efforts shall be made to submit the final (PhD Thesis) report within the stipulated time prescribed for the purpose in case of a whole time scholar.

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