Challenges in Creation and Management of Knowledge Capital in Technical Educational Institutions

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The global knowledge economy has put the focus on local centres of economic growth and depends on the capacity of institutions and organizations to continually reinvent and reconfigure themselves and their environment. In this context, certain parameters were taken into consideration for a better understanding of how institutions deploy their core resources and competencies towards IP creation and management. This paper examines some of the challenges faced in IP creation for India and suggests approach to effectively manage the knowledge capital. In particular, the objectives of the study are assessment and identification of issues in creation of IP in technical institutions, and finding appropriate measures to address these issues.

Keywords: IP creation, knowledge economy index, knowledge economy, technical educational institutions, patents

India is fast emerging as a knowledge economy. There is a consensus among the leading thinkers that there is vast potential for the country in this field. India’s relatively favourable demographic profile, a large proportion of English-speaking, scientifically trained and talented young population have made India a global innovation hub, from which outsourcing of innovation could be done. The Knowledge Economy Index (KEI) developed by the World Bank – an aggregate index representing overall preparedness of a country or region towards the Knowledge Economy (KE) is constructed as the simple average of four sub-indexes, which represent the four pillars of the knowledge economy, namely, (i) Economic Incentive and Institutional Regime (EIR) – to provide incentives for efficient use of existing and new knowledge and flourishing of entrepreneurship – include variables like tariff & non-tariff barriers, regulatory quality, rule of law; (ii) Education and training – to develop an educated and skilled population to create, share, and use knowledge well – variables used include adult literacy rate, secondary enrollment, tertiary enrollment; (iii) Innovation and technological adoption – an efficient innovation system of firms, research centres, universities, consultants and other organizations to tap into growing stock of global knowledge, assimilate and adapt it to local needs, and create new technology – measured variables are royalty and license fees payments and receipts, patent applications granted by the US Patent and Trademark Office, scientific and technical journal articles; and (iv) Information and Communications Technologies (ICT) Infrastructure – to facilitate effective creation, dissemination, and processing of information – include variables like telephones per 1,000 people, computers per 1,000 people, Internet Users per 10,000 people.

An examination by the KEI (World Bank KAM 2007) indicates that India ranked 101st of 140 countries studied. It lags behind not only the developed countries but also behind the BRIC nations, the fast emerging markets of Brazil, Russia and China and better only than countries of Africa, Pakistan, Nepal and Myanmar. IP creation and knowledge management in technical educational institution is a key component in improving Indian’s ranking in KEI.

IP Creation and Knowledge Management

Van de Ven and Engleman noted four basic issues in studies of knowledge management and innovation. The first is the human issue concerning people’s focus on making organizations more innovative by exploring new knowledge rather than exploiting existing knowledge. The second is the process issue, how to develop a process that manages and implements ideas. The third refers to a structural problem of building an infrastructure across organizational boundaries for absorbing and learning.

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knowledge as well as facilitating, supporting, and promoting innovation activities. The final one addresses the leadership issue concerning creation and management of a context that is appropriate for innovation. In another model\(^1\), the key parameters in knowledge creation for service-oriented organizations included: (1) Human capital—comprising staff structures as well as the staff skills applied to research work. It is captured by indicators, which relate to e.g. ‘staff structure’, i.e. faculty, student and support staff or ‘flexible working arrangements’ as exemplified by freedom to formulate research problems, etc.; (2) Structural capital—encompasses both organizational framework and technical infrastructure. Examples of related indicators are ‘management structure’ and ‘infrastructure’, captured by institutional framework, technical infrastructure and financing; (3) Innovation capital—comprises resources the institutions invest in future-oriented concepts and projects. Some key indicators are ‘staff resources utilized for innovative projects’, research strategies and internal R&D expenditure; and (4) Relational capital—indicators illustrate the importance of national as well as international partners, and of the public. In this context, ‘cooperation and networks’ and communication channels become important. The present study is designed in the light of these frameworks for developing a better understanding of how technical academic institutions deploy their core resources and competencies towards IP creation and management. It examines challenges in IP creation for India and suggests approach to effectively manage the knowledge capital. In particular, the objectives of the study are assessment and identification of issues in creation of IP in technical institutions, and finding appropriate measures to address these issues.

**IP Creation: Indian Perspective**

There is a gradual increase in patenting activity by technical educational institutions, which may reflect a transition currently occurring in academic institutions worldwide. There is an increase in patent filings abroad from countries such as Brazil, India, Israel and South Africa. In India, more patent applications are filed by non-residents in comparison to residents; therefore, it is generally classified as a net user rather than creator of IP. Patent filings in India have been low, but are showing an upward trend. The number of patents granted has increased from a mere 1533 in 1995-96 to more than 7500 in 2006-07. Patent filings by the Indian applicants in every year is growing, though the rate of growth of about 11.6%, is lagging behind foreign applicant filing which is growing at a rate of about 31.7% (Fig.1). Indian educational institutes and universities are one of the major hubs of research in the country. However, the number of patent filings from these institutions is very low. As per the report of the Principal Scientific Advisor of the GOI, the IITs head the list of technical institutions with just 80 patents for the period 1990-2002. The number of patents taken by other institutions like Indian Institute of Science and Jadavpur University is much smaller during the same period. Recently, the study by Gupta\(^4\) shows that the Indian Institutes of Technology, Indian Institute of Science, All India Institute of Medical Sciences, and the University of Delhi are the leading participants from the university sector in obtaining patents worldwide. Dr Reddy’s Research Foundation, Dabur Research Foundation, Vittal Mallya Scientific Research Foundation, Shriram Institute for Industrial Research, Indian Jute Industries Research Association, and Dalmia Center for Biotechnology are the leading non-profit research organizations. In contrast, academic institutes in China, Singapore and South Korea have been more prolific innovators. It implies that the systems and processes required creating IP by the scientific community in academic institutions needs to be improved and managed effectively. An intervention in the procedural
framework related to enhancing the innovation potential and IP creation in technical educational institutions thus becomes significant.

Data and Methodology

In order to determine the processes and practices in place in universities and research institutions, a questionnaire based survey was conducted amongst the students of a prominent technical institution. A sample size of 150 students (with 100 valid entries) covering undergraduate (44.8%), postgraduate students (22.9%) and research scholars (32.3%) was taken. The questionnaire was structured to elicit information on four basic categories of knowledge-based capital, viz. human capital, structural capital, innovation capital and relational capital, which are mainly instrumental in generation of IP.

Findings & Discussion

Human Capital

Presently, the students may easily get an opportunity to work on ongoing projects rather than proposing and getting sponsorships on their own ideas. The students might have an advantage if they would have taken projects by own choice based on the assessment of their innovation potential. An inadequate assessment with respect to IP creation in the initial stages of project planning may turn out to be a disadvantage, as it may not allow fresh innovative ideas of the students to flourish. The study reveals that 91% of the postgraduate students work on ongoing projects while the research scholars and undergraduate students have more freedom in making choice of projects.

Structural Capital

In technical institutions, there is an administrative unit that oversees planning, regulation and coordination of research and consultancy work. This unit also promotes involvement of students at different levels in projects. The involvement of students may come either as a statutory requirement of the courses like undergraduate research projects, assignments of relevant courses, etc. by participating in ongoing projects with faculty members or they may take up projects of their own choice in competition.

With regard to the infrastructural facilities available to students for carrying out research, the survey indicated that the facilities available were not commensurate with the available research capabilities. A continuous source of funding is a key element in promoting the conduct of research or taking activities leading to possible development of IP. The funding of projects in the present technical institutions is still largely sourced from government, with corporate financing accounting for less than 5% of research or consultancy funding. The funding for sponsored research projects ranged from 40% to 55% of the total outlay in the past three years, while the share of consultancy projects has been in the range of 45% to 60%. The status of funding demonstrates the capacity of the institute to undertake basic and applied research as well as to implement the available expertise in solving field problems. It is an encouraging sign for the future potential and development of IP.

Innovation Capital

Innovation capital is one of the most important functional aspects in the creation of intellectual property. Systemic innovation is linked to processes of interactive learning and collective entrepreneurship that take place within local value chains and between local and global value chains. Indeed, what lies at the core of long-term economic growth and development are the evolving and grounded capabilities of public and private agents to learn and expand the knowledge base. This accounts not only for the importance of the science and technology system (universities, research organizations, firms' in-house R&D and so on) but also for a region's organizational, institutional and policy-learning capabilities. The interplay and long-term shared competence-building orientation of all stakeholders throughout the ‘extended’ triple helix (industry-government-university interrelationships) – which explicitly includes financial institutions and society at large – are also key factors. Several parameters were studied to see if an institution or organization was (a) prepared towards IP generation or (b) utilizing IP in developing future innovative potentials.

(a) Preparedness towards IP Generation

In the first case, protection of inventions arising from R&D efforts by patents was significant form of IP. Overall 73% of students polled were aware about IPRs and more specifically about patents. The level of awareness about IPRs is quite low among PG students (41%). The undergraduate students (88%) and research scholars (74%) are better informed.

In order to ensure that any research work may lead to patentable outcomes, it is necessary to carry out a thorough survey of not only the existing literature, but
also of the patent information databases. Such a search would prevent duplication of efforts by research institutions and also lead to breakthroughs in scientific and technical areas which will have the added advantage of being patentable. The study found that just 1% of the researchers undertook a patent database search before defining the research problem. The procedures for patenting in maintaining the Laboratory Record Book establish the authenticity of the research work as well as prevent any fraudulent claims made by other researchers. The survey found that while 42% of the students were maintaining records, nearly 26% of the students had no awareness regarding the need of maintaining records in a suitable format.

Nearly 60% of the students involved in research were aware that there was considerable scope for generating IP which has commercial possibilities. The study found that in only 17% of the cases researchers had made any attempt to protect their invention/innovation through patent or copyright. A majority of the researchers (nearly 84%) never went for IP protection. The main reason is lack of awareness about IPRs and the processes to be followed for the protection of IP. However, a third of the researchers responded by saying that they did not want to take a patent. Further probe into the reasons for not wanting to take a patent revealed that nearly half of them had no knowledge of the commercial possibilities of their invention.

Another important concern is whether research undertaken in institutes finds application in the commercial market. In the institute under study, major research is being reportedly undertaken at a lab scale (74%) and there is considerable scope of up-scaling of the same to field or commercial level for wider applicability.

A systematic process of commercial evaluation of research being carried out in technical institutions by appropriate persons/institutions is lacking and needs to be strengthened. Another reason for not seeking patents is the continued misperception that the process of acquiring it is too cumbersome (Fig. 3).

Relational Capital

Relational capital, as exemplified by cooperation and networking, is emerging as a key link in building an environment conducive to innovation and creation of IP. The orientation of research appears to differ considerably: the probability of developing a new

(b) Utilizing IP in Developing Future Potential

The strategy adopted by researchers in carrying out the research work becomes very important, in the context of utilizing IP generated by them for future commercialization. Students entering the technical institutions are a key factor in innovation. There is a need to harness their new and creative ideas as well as their enthusiasm in research. In order to determine the extent to which a student is involved in defining the research problem (the first step in research), the survey found that less than 38% of the students worked on projects in which they had an active role in defining the research problem while 62% were working on ongoing projects. This is more applicable in the case of PG students where 100% of the students surveyed stated that the research problem was given to them, while there was a greater possibility of undergraduate students and research scholars developing their own research ideas for project work or thesis (Fig. 2).
product or process appears to be much higher if research is done in collaboration with the industry. 45% of students surveyed had undergone internship for an average of 3 months, with various industries. This study shows that the scope of research varies considerably depending on the level of interaction between institution and industry. Modification of existing products is high in both institute and the industry but opportunities for new product development are higher when research is conducted with industrial interaction. However, pure research in terms of advances in the frontiers of knowledge still lies in the main domain of academic technical institutions. Internships not only enhance the employment opportunities by exposing the students to new techniques of production and market awareness, but they also open new avenues of R & D. One of the possible outcomes of such interaction is innovation and development of new products and processes. 26% of students surveyed reports that patents were taken by the industries in the areas in which they had worked during their internship. In nearly one-fourth of the cases, students involved in such innovative research projects were cited as stakeholders in the patents taken.

The major problems for carrying out research emerging from this survey include lack of appropriate facilities (Fig. 4). Institutions carrying out research in isolation tend to get divorced from the requirements of the industry and market and hence cannot develop new technologies or products. Lack of industry-institute interaction has also been identified as one of the major stumbling blocks in creation of IP in the country. This is a problem, not restricted only to small and private technical institutions, but also prevalent in leading institutions of the country.

**Conclusions, Suggestions & Policy Pointers**

The globalizing learning economy has made innovation and competence-building a key part of every nation’s economic growth and future prosperity and highlighted regions as the appropriate ‘strategy sites of intervention’. The study undertaken, throws up some policy indicators, which may be grouped under the following heads:

**Awareness Generation**

There is a need to increase the level of awareness about IPRs amongst students at all levels. Institutions must actively involve students by informing them of the possibilities and the need for IP creation through regular workshops and interactions.

**Infrastructure Upgradation**

One of the major problems in achieving breakthrough results in research has been identified as infra-structural facilities available to researchers. There is a need for upgradation of facilities or increasing the scope of inter-institution/collaborative research facilities. There is a need for tapping alternative sources of funding to unlock the potential of IP generation. Moreover, there is a need to maintain an even balance between research and consultancy, as the latter does lead to the application of research output to field problems and hence enhances the possibility of innovation.

**Procedural Intervention**

The study by Shefalika Ghosh focused on the process of protection and management emphasizes the need to identify strategies for IP creation. It highlights the procedural gaps in the research process itself and lack of synchronization between research outcomes and IP creation.

**Orienting Research to Market Needs**

The filing and obtaining patents should not be regarded as the ultimate goal to be achieved. Getting commercial returns from patents also needs to be brought into the value chain. There is a need to develop a suitable framework for promoting technology transfer and commercialization of innovations and inventions created in institution.

Based on the salient insights obtained from the survey, a conceptual model may be proposed (Fig. 5) to create a cohesive, clearly delineated and vibrant system for creation and commercialization of IP. It includes a representation of the model plus the infrastructure elements that support the model. The
areas of policy and government programme support that comprise the broad environment in which the model will operate have not been delineated here.

At the centre of the model is an interactive platform for promoting interaction among the various stakeholders in IP creation. Currently, inputs of the system (institution) comprise of the students, faculty and sponsoring agencies (mainly government), which undertake research geared mainly towards theoretical advancement in the frontiers of knowledge. Introducing other elements to this interactive system like institute-industry interaction will promote exchange of information on technical, market, management, human resources and other issues leading to innovations and inventions with greater field and market applicability. Development of suitable IP protection and commercialization practices ensures creation and utilization of IP as well as promotes entrepreneurial abilities leading to alternative avenues of revenue generation. Sustainability of the system may be achieved through continuing profitability, global competitiveness and increased participation by concerned individuals. In addition, the framework is intended to be adaptable to changing social, economic and technological circumstances.

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References