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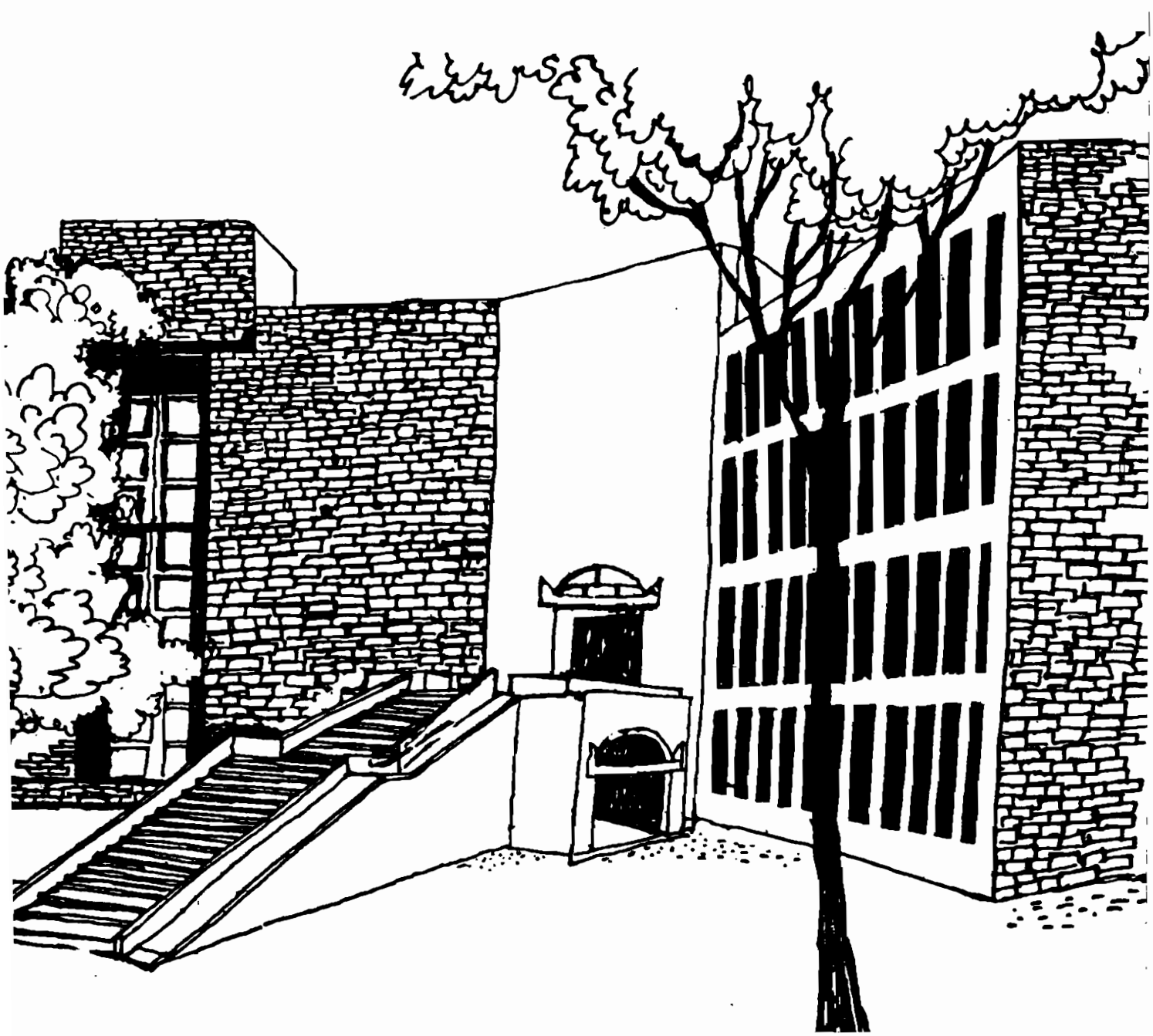

Intellectual Property and Innovation Changing Perspectives in the Indian IT Industry

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Abstract

Indian government has undertaken significant modifications in the IP regime of the country. This will lead to a realignment of business strategies by firms in several sectors. Similarly, with liberalization and globalization, new opportunities for IP creation may emerge for Indian firms. In this context, the paper attempts to document the emerging perspectives vis-à-vis IPRs in the Indian IT industry and explore factors that are driving the change in perspectives.

Large IT firms and firms in high-end niche areas are proactively seeking IP based growth strategies. While they typically seek IP protection in Western nations and not so much in India, this has led them to perceive restrictive IP regimes more positively. IP regimes in the West are more relevant for IP creating Indian IT firms today but this may change in the near future as Indian market expands. Significant IP creation by MNC subsidiaries in India is also contributing to this change in perception. Survey data show that an average IT firm in India also perceives IP protection as an important appropriability mechanism, but access to markets and relevant complementary assets continue to be more important for appropriating profits from their economic activity. A positive view of the restrictive IP regimes also gets reflected in the demands of Indian industry associations for changes in the Indian law. Broadly, these changes in perceptions seem to be linked to the evolving global production networks, changing activity profile of Indian IT firms, emerging business opportunities and changes in the competitive scenario. The understanding of Indian IT firms of the complexities of IP regimes remains rudimentary and they will need significant preparation to deal with these IP related challenges.

Intellectual Property and Innovation: Changing Perspectives in the Indian IT Industry

Rakesh Basant

1. Introduction

The legal framework of Intellectual Property (IP) regimes within a country plays an important role in fostering the direction and the quality of entrepreneurial innovation across all sectors of the economy. The incentives for invention provided by stringent IP regimes are well known. The scope of IP coverage can also have a salient impact on the nature of invention and innovation. For example, an IP law that fosters incremental innovation can allow businesses to benefit by affording protection to incremental improvements on existing intellectual property, that can in turn be used by owners of the IP to move up the technological value chain. In addition, the IPR framework directly affects the ability of entrepreneurs to take advantage of commercial opportunities that require the existence of a suitable IP regime before commercial/ service agreements can be reached with potential clients. In the absence of a suitable IP regime contracting and other transaction costs can be quite high. Such market creating potential of the IPR framework can also impinge on the ability of entrepreneurs to enter into IP intensive activities as subcontractors and licensees.

In recent years, the Indian government has undertaken significant modifications in the IP regime of the country. Some of the key elements of the modified policy having major implications for several sectors in the economy, especially the pharmaceutical, chemical, biotechnology and information technology related sectors. Given the changes in the IP regime, the competitive landscape of many of these sectors in India would see a fundamental change. This will lead to a realignment of business strategies by firms in these sectors in order to adapt to the changing regime, as companies which enjoyed protection under Indian IP laws will have to adapt to India's accession to WTO norms in 2005. Similarly, with liberalization and globalization processes at work, new opportunities for IP creation may emerge for Indian firms.

Given the role of IP regimes for market creation and the emerging economic situation in India and elsewhere, this paper attempts to do the following:

1. Document, albeit briefly, the emerging p7erspectives vis-à-vis IPRs in the Indian IT industry; and
2. Explore factors that may be driving the change in perspectives and may continue to do so.

Accordingly, the following two sections focus on these two dimensions and the final section provides some concluding remarks.

1. Relevance of IPRs: Emerging Perspectives of Indian IT Firms

India today is known worldwide for its Information Technology related capabilities. It is one of the most important outsourcing destinations. Very few Indian firms, however, have been creating IP over the years and IP related issues have not been very important for the Indian IT firms. IP rights facilitate appropriation of rents by the inventors. Larger the share of benefits accruing from an invention the inventor is able to garner, higher is the appropriability of that invention. But IPRs are not the only source of enhancing appropriability. Access to a variety of other resources, including complementary assets (e.g., competitive manufacturing, distribution & marketing, brands and complementary technologies) can play a critical role.[1]

1.1 Effectiveness of Different Appropriability Mechanisms: Insights from a Recent Survey

In a recent survey, about 120 Indian IT firms were interviewed to understand the determinants of alliance formation (Gupta, 2004). As a part of this survey, questions were asked about the efficacy of different appropriability mechanisms to protect and profit from product and process innovations.[2] Tables 1 and 2 summarize the results. The results suggest that better lead times and access to good marketing and distribution

[1] Several studies have highlighted this point. See Teece (1988) for one of the earliest expositions.
[2] The question asked was: "Companies commit time and capital in developing innovations. These innovations can be in products (hardware/software/semiconductors) or tools/techniques/methodologies/

facilities are the most critical for profiting from innovations, both process and product related. Brand building as an appropriability mechanism follows these two strategies in terms of efficacy. Obviously, speed and access to markets is the most important mechanism for Indian IT firms today. Since a large share of revenues come from overseas markets, the importance of such strategies is expected to be high. Interestingly, a significant proportion of firms perceives patent and copyright protection to be important. In fact, such protection on average was considered to be more effective than inimitability due to complexity and secrecy for both product and process innovations. About 17-18 per cent of sample firms perceives patenting and copyright protection to be very effective appropriability mechanisms for protecting profits from product innovations (Table 1). Patenting was considered to be very effective for protecting "process" related innovations by a somewhat smaller proportion of firms in the sample (about 14 per cent, Table 2).

1.2 Intellectual Property Creation and Protection in Indian IT Industry

This does not mean that a large number of IT firms are creating and protecting IP in a big way. But the fact remains that patenting activity in India is on the rise. In 1997, Indian firms and/or individuals filed only 183 patents at the US patent office. In 1999, this number had gone up to 285 and in 2001 the number of applications filed were 883. Apart from pharmaceuticals and chemicals, electricals and electronics were the other sectors where patenting increased substantially. Electricals and electronics include the fast growing software sector (Business Today, 2004). A few small IT firms from India filed as many as 35 patent applications in the US in 2003.[3] Patent applications filed in India also increased rapidly during this period (Business Today, 2004).

While the India IT firms are gearing up to create and protect IP, a large number of MNCs in the IT domain are effectively exploiting the IP creating potential of the Indian skilled workforce. That the potential is very high is evident by the fact that a large share of worldwide IP creation by these MNCs is being created in India. In 2002, Cisco Systems was granted 245 patents, while 120 patent applications were filed by the Indian

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processes. Please rate the effectiveness of the following means in protecting profits from these innovations." Responses were sought separately for "products" and "processes".

[3] These firms were iPolicy & July Systems (7 applications each), HelloSoft (6), Tejas Networks (4), Sasken, vMoksha & Codito Tech (3 each) and VidyaTech & Ribbel (1 each).

entity between January-September, 2002, which comes to almost 50 per cent of the total. Granted, that while 245 is the number of patents granted, while 120 is only the number of applications, it provides a clear indication of the fact that a large part of inventive activity of Cisco systems is being undertaken in India. And Cisco is not an exception. Similar numbers for Analog Devices are 87 and 33 (38 per cent), Texas Instruments 745 and 225 (30 per cent), Adobe Systems 30 and 10 (33 per cent) and so on (Business Today, 2004).[4]

Information compiled in Appendix Table I suggest that not all IP generated by the Indian firms is being protected through various IPRs; a significant share of the IP generates value but firms do not always utilize IP protection tools like copyrights and patents. But one thing is quite clear that a lot of IP related activity is being undertaken in India, both by the Indian firms and the MNC subsidiary.

Another interesting perspective is that the IP regime in the US (or other Western nations) may be more important for the Indian IP creating firms than the regime in India. Most Indian firms that do create IP, either on their own or through alliances with foreign firms tend to protect their IP in the US and other large markets and not necessarily in India. In fact, most of the patent applications referred to in Appendix Table I were filed in the Western nations, especially the US. This is essentially due to two reasons. One, it is essential to protect the invention where the market is and most of the IP in India is being created for the Western markets. Two, some IT related inventions (like algorithms, business methods) are not patentable in India. Thus, the Indian IP regime will become more important as its market expands and as the legal regime gets modified (see discussion below).

Some IT firms indicated that filing of patents is essentially a "signaling" device as they do not expect to make significant financial gains from them.[5] IP is created to demonstrate or signal technology expertise in a particular domain to seek more business in that area from clients. Presumably, IP creation and registration are now partly

[4] Other MNCs creating significant IP in India include Phillips (1203 grants and 102 applications from India), Intel (1126 and 125), Cadence (33 and 44), IBM (3343 and 120), GE (1758 and 95), Oracle (85 and 10), Sun Microsystems (615 and 10) etc. (Business Today, 2004)

[5] I am thankful to Pawan Kumar of vMoksha Technologies for this insight.

performing the role quality certification performed earlier, of differentiating firms with "better outsourcing potential". As more and more firms get quality certification, it is critical for firms to differentiate themselves on other parameters so that they can compete more effectively in the growing outsourcing markets. Such signaling may be particularly relevant for high-end IT activity and for alliances in technology creation.

Interactions with IT professionals suggest that while IP related issues were not as important in the outsourcing activity so far as most Indian firms were involved in low end tasks. Transition to high-end tasks has brought these issues to the fore.[6] As with several other legal issues, some standard remedies for IPR related concerns include indemnification clauses in the contracts, contracting with a US legal entity owned by the Indian firms so that the US laws govern the contract, third country arbitration processes and so on. Obviously, complexity of contingency clauses and the preference for a US entity increase the transaction costs for the contracting parties. Firms also find it difficult to license inventions in the absence of less well-defined (read less stringent) IP rights. It is not surprising, therefore, that the Indian industry is seeking more and more stringent IP regime in India, especially with respect to protection of software related inventions.

1.3 Seeking Changes in Legal Regimes[7]

While the IP regime in India has been made TRIPS compliant, some concerns remain. Recently, the Ministry of Industry, Government of India organized discussions on the new IP regime with several stakeholders including Industry associations to seek inputs on the modifications of the IP regime. Interestingly, in many cases the Industry Associations sought more stringent IP regulation. In this subsection we discuss some of these in the case of IT related IP.

Among others, the exclusions from patentability in the new Indian patent law include:

- a mathematical or business method or a computer program *per se* or algorithms;

[6] This issue is dealt with in some detail later in the paper.

[7] This sub-section is entirely based on the background material circulated by the Ministry of Industry and Commerce, Government of India for the interactive sessions organised by them with various stakeholders regarding the amendments to the Indian Patents Act, 1970.

a mere scheme or rule or method of performing mental act or method of playing game;

a presentation of information; and

topography of integrated circuits.

ince there is a separate *sui generis* protection for integrated circuit design, these xemptions imply that software *per se* is not patentable; although software together ith hardware enabling the machine to function effectively may be protected. The ıdustry Associations have however, argued that there is a need to bring software into the fold of patentability as,

- Copyright was designed to protect, with some exceptions, non-functional matter, whereas software or computer based business models are clearly functional works of technology.
- Copyright does not protect ideas, methodologies, processes, techniques and the like, which are often the most important features of software programs and business models.
- While copyright only exists in the expression of an idea, a patent could be said to grant exclusive rights in the idea itself (provided that such idea can and has been tangibly expressed) thereby precluding others from exploiting a patented invention even if such invention has been developed independently.
- Copyright and patent protections are not mutually exclusive. Patents protect creative functional invention whereas copyright protects creative non-functional authorship.

Clearly, these arguments are significantly influenced by the IP regimes in the West, especially in the US. The recommendation was to revisit the clause that mathematical or business methods or computer programs or algorithms per se are non-patentable subject matter as they may have underlying 'technical' principles and may easily qualify as technology under TRIPs.

The pro-IP stance of industry associations is an interesting development for a country, which was not IP savvy till very recently. In fact the IT industry association, NASSCOM (National Association of Software and Service Companies) has been pro-actively lobbying for more stringent IP laws including those relating to data security, patenting etc. In general, there hardly have been any IP theft cases in overseas outsourcing to India. A few that have been identified have been dealt with quickly.[8] As the IT industry in India evolves further, the strategic role of various types of IP protection would get enhanced and firms in the industry will have to have more systematic look at various options of IP protection. We shall revert to this issue later.

2. The Indian IT Industry and the Emerging IP Requirements

The increasing awareness of IP related issues and the positive outlook towards IPRs is a result of underlying changes in the industry and technology environments. As these changes continue, the role of IP is bound to increase. This section discusses some recent trends that seem to have changed the perception of IPRs among the Indian IT firms.

2.1 Changing Profile of IT Activities in India

The Indian IT industry is undergoing a major change. Despite concerns regarding industry's lock-in into low end tasks, one can see a shift towards more value added services, an emerging specialization in embedded software and even a marginal shift towards products. Table 4 shows that different IT tasks are associated with different levels of complexity, risk, profitability, investment and infrastructure requirements. The importance of IPRs also varies across activities. It has been argued elsewhere that over time Indian firms have moved from less to more complex, risky, investment intensive and profitable IT activities. This transition has largely been facilitated by inter-firm alliances, including those of the outsourcing variety (see Basant, 2004), without which it may not have been possible. Broadly, such alliances and other processes like enhanced competition from low cost producers from within and outside the country, have resulted

in the following types of changes in Indian IT firms:

- Diversification of service offerings and markets;
- Acquisition of knowledge & implementation capabilities in early stages of the product/package life cycle;
- Specialization in service provision through acquisition of domain knowledge and entry into specific verticals like telecom, banking etc; and
- Transition from a low-end "service" firm to a high-end "service or a "product" firm.

The first three processes have been more dominant and within each the complexity of tasks has increased. In fact, the transition to "products" has been among the slowest but in recent times, one observes beginnings of the last process. Intellectual property (IP) related issues were not so important so far because Indian firms were still largely involved in low-end work. However, as Indian IT firms have started to do more complex tasks, IP will become increasingly important. For example, if outsourcing or other inter-firm linkages involve application service provision, sharing of data would be required making IP an important issue. Broadly, IP related issues might be critical for linkages involving complex IT tasks, especially in the early part of the technology and product life cycles. For example, as firms move to software development for databases and other packaged applications, security of data made available for testing would become critical. Similarly, as Indian firms seek high-end BPO opportunities like claims processing, personal data protection for overseas customers would be important.[9] As mentioned, some Indian firms argued that given the legal system in India, most of IP related issues could be sorted out through a proper contract and trust. For MNCs, however, a more stringent IP policy would reduce contracting costs and the cost of legal remedies.

[8] An employee of Geometric Software Solutions Limited (GSSL) was caught selling source code of a 3D CAD package of SolidWorks Plus US company. Indian intelligence agencies laid a trap with the help of FBI.

[9] Some companies tackle such problems by having stringent in-house security procedures like not allowing employees to take home source code to work on it. Some BPO companies do not download data but work only on the client's site.

2.2 Changes in Industrial Structure

The competition in Indian IT industry is on the rise. The competition is not only coming from other low cost locations but also from within the country as well, especially from MNC subsidiaries who have set up shop in the country. It is well known that the growth of the Indian IT industry has largely been fueled by their participation in export markets through outsourcing or other types of inter-firm alliances. A typical trajectory of international inter-firm IT alliances has been that they start with small offshore projects, which subsequently become large and more complex. With time and building of trust, these projects take the shape of dedicated development centers and then of equity JVs. Often, foreign firms prefer ownership transfer. Liberal FDI and M&A policies facilitate these transitions and provide some certainty to foreign firms who have strategically decided to follow this trajectory. As these alliances become more technology intensive, IPR regime may also become important apart from the policy instruments mentioned above. This has started to happen.

There has been another change in the industry structure that may have implications for the IP regime. In the earlier phase of alliances in the IT sector, typically large Tier-1 US firms built linkages with Tier-1 Indian firms. Many of these large Indian firms like Tata Consultancy Services (TCS), Infosys and Wipro have now started to compete with global IT firms like IBM, Electronic Data Systems (EDS) and Computer Sciences Corporation (CSC). In this phase when Indian collaborators of yester years are beginning to compete with the large US multinationals, it is imminent that Tier-1 firms of each country build linkages or acquire Tier-2 in the other nation. Global Tier-1 IT firms would acquire (or ally with) Tier-2 Indian IT services firms to compete with Tier-1 Indian IT services firms. In response, Tier-1 Indian IT service firms would need to acquire (or ally with) Tier-2/3 (typically front-end marketing or consulting) firms in the US or Europe.[10] Such entry into high end and product related activities would further enhance the importance of IPRs for Indian firms.

[10] Pawan Kumar of vMoksha Technologies first pointed out these tendencies to me. Subsequent developments have added empirical support. Wipro has been acquiring a few niche players (like Nervewire) in the system integration and the IT consulting space. Polaris has acquired Orbitech, a product company to offer products in the banking and financial services segment.

The transition from on-shore to the offshore model was not easy but high capabilities and performance of the Indian firms facilitated the same. The offshore model has now become quite stable and the Indian firms have already tapped the "easy" customers in the Western economies. Typically these "easy" customers were large US corporations who were not that concerned about owning equity in the firm to control their alliance with the Indian firms. The Tier-2 IT firms in the US and Europe are now facing competition and in order to be cost competitive, need to build linkages with Indian IT firms. However, they do not feel very comfortable if equity participation and the possibility of acquisition are difficult.[11] Admittedly, more liberal FDI and cross-border M&A policies may facilitate the deepening of the linkages between the Indian and US firms that are based on the offshore model. Moreover, for the Tier-2 US and other foreign firms, a more stringent IP policy and implementation may provide the confidence to develop linkages with Indian firms, especially in the IP intensive segments (see Table 4). These firms may not be as confident of such linkages due to the lack of experience with Indian firms and their relatively small size; Tier-1 US firms have the muscle to arm twist Indian firms in case a problem arises.

2.3 Public and Private Sector Interface

IP related issues might not only be relevant for inter-firm alliances. The R&D partnerships between the private sector firms (often MNCs) and local public sector labs/ educational institutions have been on the rise. The public sector institutions are increasingly becoming IP savvy. For example, Texas Instruments, India has been working very actively with four of the top Indian technical institutions, Indian Institute of Science, Bangalore, Indian Institutes of Technology at Kharagpur & Chennai and Birla Institute of Technology an Science, Pilani (see Reddy 2000 for details). Many of the Indian institutions are seeking joint IP rights. This is happening because they seek to earn revenues from IP created by their faculty. Interestingly, many of these institutions have plans to spin off IP based companies in which faculty will participate. Since educational institutions in India cannot own equity, efforts are on to create structures to facilitate such institutional ownership. Given these plans, the importance of IP issues is bound to increase in the future and one will not be surprised if the Indian educational

[11] I am thankful to Vinod Nair of McKenzie Consulting to point out this trend to me.

institutions ask for an Indian version of the Bayh Dole Act!

Overall, the ability of developing country entities to enter into partnerships with industrial country firms may often be contingent on the nature of the IPR regimes in place in the developing countries. Besides, if such partnerships are to facilitate the maturing of the venture capital related institutions, existence of an IPR regime that provides comfort to investors and inventors seems desirable. All these reasons seem to be changing the perceptions of Indian firms' vis-à-vis IPRs.

2.4 Future Market Growth in Asia

There is a belief that in future, major market growth in IT would take place in Asia, especially in India and China. Consequently, firms will need to create IT products that satisfy the specific needs of these markets. When this trend picks up, the Indian IT firms would find themselves much closer to the market and would be able to respond better to the emerging market needs than firms that are located elsewhere. One of the problems Indian firms have faced vis-à-vis product development has been the "distance from the market". Lack of proximity to the large western markets where the IT products currently sell has put them at a disadvantage. This is also the reason why the IP laws of the nations where the market exists has been more relevant for IP generating Indian firms. Such a disadvantage may get reduced if the local markets pick up and the IP regimes in the emerging markets would become more relevant and important.

2.5 Emerging Technological Opportunities

Technologies underlying the IT industry are changing very rapidly. In many instances, these technological changes bring in possibilities of a change in the global industrial structure. While there are many instances of this type, I will focus on just two to highlight the potential impact on IPR needs of Indian IT firms. The first relates to changes in the semi-conductor industry/embedded software and the other to the interaction of IT with other industrial sectors. New technologies have modified global production networks significantly in the area of semi-conductors in recent years. Similarly, the munificence of IT based technologies across a variety of sectors has

spawned several new technological and economic opportunities. It is argued that changes in these technologies and the associated changes in the industrial structures are likely to throw up new entrepreneurial opportunities for Indian IT firms, which might require a different perspective on IP related issues.

Changes in the Semi-conductor Industry

With the advent of System on Chip (SOC) integration in this industry, the strategic options of firms have changed.[12] As SOCs become larger and more complex, it will become difficult for firms to remain competitive in all the functional design elements that are being integrated into the SOC. An emerging solution for this problem is the fast growing market of design modules (DM) licensed out by small-specialized firms. This change can potentially "disintegrate" the semi-conductor industry providing niche opportunities for small firms. According to Linden and Somaya (2003), this shift can be quite significant:

> "The emerging SOC-based industry structure typifies the historical shifting between integrated and ever more fragmented organizational modes of production in the electronics industry. Just as specialization in components proliferated in the PCB-based electronic systems, the SOC era is showing signs of industry fragmentation driven by specialization in the disembodied semiconductor designs that are being licensed between firms." (Linden and Somaya, 2003: 550)

Recent studies (see for example, Bhuyan 2002) and the information summarized in Appendix Table I show that many Indian firms are already active in this emerging domain and are participating in the emerging networks of SOC creation. India may have missed the IC manufacturing opportunity; it sure can exploit this new opportunity. But this will require sharper focus on IP and a more active participation in standards creation as that will drive the creation of markets in this sector.[13]

Use of IT in other sectors

With technological change several new opportunities for IT firms to work on the boundaries of other sectors like the pharmaceutical, biotechnology and auto are becoming available. For example, the innovation system in the pharmaceutical industry

[12] For detailed discussion of this issue, see Linden and Somaya (2003)

has become very complex. The complexity of R&D, which is essentially science based, has been on the rise due to the emerging synergies in the research streams of conventional chemistry, biotechnology and information technology (IT). It is becoming increasingly important to integrate knowledge at various levels of research in biomedical sciences, pharmaceuticals and IT. Riding on the synergies between different disciplines, the drug discovery and commercialization processes are undergoing significant change. The following developments are particularly important to understand the potential use of IT in drug discovery processes:

- Increasing use of combinatorial chemistry to develop gene libraries that can be hired for IT based screening resulting in significant *reduction in the entry barriers in initial screening business*;
- Use of computer aided development of molecular designs to filter molecules and compounds for testing with wet chemistry. This biotechnology-software interface has meant *higher success rates and speedier selection of compounds*;
- Design of actual drugs with the help of computers. Software are *used to reduce uncertainty in drug development;*
- Use of new IT based technologies in pre-clinical development to reduce the drug development cycle. For example, cassette dosing and simultaneous optimization of toxicity, bioavailability and pharmacokinetics has reduced the time required for clinical trials. *Service firms have emerged to do such trials;*
- Computerized safety and efficacy trials conducted on patients avoid useless regimes to reduce number and size of trials. This saves time and money. These new technologies have also *facilitated the emergence of contract research organization (CROs).*

Like the changes in the semiconductor industry, changes in the drug discovery processes also entail new opportunities for Indian IT firms to enter these domains. All these domains are very IP intensive and would require a more proactive participation of Indian firms in IP protection. This will obviously lead to enhanced participation of these firms in IP generation and creation. There is evidence to show that Indian IT firms are

[13] Linden and Somaya (2003) provide an excellent account of these strategic market creating opportunities.

increasingly exploiting these domains as well.[14] Similar processes are underway in sectors like auto, where use of IT is on the rise creating new market opportunities for Indian firms to make IP based entry or expansion.

3. Some Concluding Observations

All available evidence seems to suggest that Indian entities, both private and public, are gearing up for IP creation and protection. They still have a long way to go but the process seems to have started. Given the experience of other nations, the Indian firms will increasingly have to deal with a variety of strategic issues relating to IPRs. We conclude this paper by a brief discussion of some of these issues.

3.1 Managing IPRs in the Age of Convergence

As it is, IP related issues are relatively new to Indian firms and they are beginning to learn to grapple with them. It is obvious from the discussion above that with the convergence of technologies and developments in legal regimes, sectoral specificity of IP protection is breaking down. For example, IP protection in the IT sector is no more copyright centric. Given the ingress of IT based technologies in pharmaceutical, biotechnology and other sectors, and the emergence various legal forms to protect IT related inventions, IP protection in this sector has to deal with issues relating to patents, copyrights and integrated circuits protection. For example, new inventions in bio-informatics technologies are quite important for the cost of drug discovery. Similarly, the scope of IP protection in the IT sector is no more restricted to copyright and inventions relating to the auto-component sector may come from engineering, software, electronics and other domains. One may therefore need to understand the complex interplay between traditional patenting, software patenting, copyrights and integrated circuit protection. Add to this the complexity relating to database protection, and the IT firms that want to have IP based growth will need to do a lot of learning. Effective participation of Indian firms in the emerging inter-firm networks in different domains may require in the future a more IP savvy mindset.

[14] Strand Genomics, a spin out firm from a well-known institute of science education (Indian Institute of Science, Bangalore) is a prime example of this trend. Other firms active in this domain include Agilent Technologies (Life Sciences and Chemical Analysis), Wipro Health Science, SysArris Software and Kshema Technologies.

3.2 Making Strategic Choices among Various IPRs

Conventionally, copyright protection was the main source of protecting software. Over the years, modes of protection, other than copyright law have emerged to protect intellectual property embodied in computer programmes. Other modes include patenting, integrated circuit protection, trade-dress protection for "look and feel" (screen designs, user interface) of the software etc. Availability of different modes of protection to cover the same (or different aspects of the same) intellectual property raises at least two strategic questions for the inventor:

- Which mode of protection is most appropriate to protect a specific IT related invention say a computer programme?
- Can one improve the appropriability of the intellectual property embodied in a programme by exploiting the overlapping modes of protection?

Indian IT firms will increasingly have to deal with these and related issues. And for that they still have a lot of learning to do.

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Table 1
Relative Effectiveness of Different Appropriability Mechanisms to Protect & Profit from Product Innovations in the Indian IT Industry (Hardware and Software)

Appropriability Mechanism	*Percentage Distribution of Responses (Not effective =1 to Very effective = 5)*					*Average Score*	*Standard Deviation*	*Median Score*
	1	2	3	4	5			
Secrecy	5	19	29	31	15	3.32	1.10	3
Complexity of technology/designs	8	16	25	38	13	3.34	1.13	4
Encryption type copy protection measures	4	13	18	48	17	3.61	1.04	4
Better lead-times than competitors	0	8	13	34	45	4.18	0.93	4
Acquisition of patents	4	13	33	34	17	3.46	1.05	4
Copyright protection	3	10	27	41	18	3.61	1.01	4
Brand building	3	11	21	39	26	3.76	1.04	4
Access to competitive manufacturing	5	18	29	29	19	3.39	1.14	3
Access to good marketing & distribution	3	9	8	32	48	4.13	1.07	4

Source: Computed from Gupta (2004)

Table 2
Relative Effectiveness of Different Appropriability Mechanisms to Protect & Profit from Innovations in Processes, Methodologies, Tools & Techniques in the Indian IT Industry

Appropriability Mechanism	*Frequency Distribution of Responses (Not effective =1 to Very effective = 5)*					*Average Score*	*Standard Deviation*	*Median Score*
	1	2	3	4	5			
Secrecy	10	24	21	30	16	3.17	1.24	3
Complexity of technology/designs	10	23	27	30	11	3.10	1.17	3
Better lead-times than competitors	9	19	38	34	0	3.98	0.94	4
Acquisition of patents	4	18	27	36	14	3.37	1.07	3.5
Copyright protection	4	14	29	35	18	3.47	1.07	4
Brand building	4	10	32	29	25	3.61	1.09	4
Access to competitive manufacturing	2	17	32	31	18	3.47	1.03	3
Access to good marketing & distribution	2	11	14	34	40	3.98	1.07	4

Source: Computed from Gupta (2004).

Table 3: Hierarchy of Software Services and Products							
IT Tasks	**Investment**	**Net Profit**	**Market Valuation**	**Complexity**	**Risk**	**Infrastructure Requirement**	**Potential Importance of IPRs**
Staff Augmentation	Low	Medium	Low	Very Low	Low	Very low	Very low
Remote Maintenance	Medium-	Medium	Low	Medium-	Low+	Medium	Medium
Migration	Medium	Medium	Low	Low	Low+	Medium	Medium
ITES (Call Center)	Medium+	Medium+	Medium-	Low	Low	High	Low
ASP/ITES(BPO)	High	Medium+	Medium	Medium+	High	Very high	Medium
Application development	Medium	Medium	Medium	Meduim+	Medium	Medium	Medium
Package Implementation	Medium	Medium	Medium+	Medium+	Medium	Medium	Medium
Products	High	High	High	High	Very High	High	High

Source: Inputs from Pawan Kumar of vMoksha modified in Basant (2004), Venkataraman et.al (2004).

Appendix Table I: Nature of IP Generation and Protection by Local and Multinational IT Firms in India							
Name of the Company	**Type of firm**	**Nature of Technology**	**Industrial Application**	**No and type of IP**	**Nature of use**	**Market**	**JV/R&D/Tie-ups**
Wipro	Local	SoC and board design, core IP design	Consumer electronics, automobile, communications, defense	5 core-IP*	Sale + licensing	Cisco/Lucent / Japan/ Korea/ Taiwan	Hyundai/TSMC/ARM/Lineo/ST Micro (all for design services)/ASE (test packaging) /Mosis/GE/ Ericsson (buyout of dev. center)/Wind River (Wipro licenses its USB 2.0 software IP)/Analog (alliance)
Sasken	Local	Design and embedded	Communications, test and measurement	39 patents	Licensing	Japan/ Canada	Symbian (development support)/TI (mapped Saken as technology center for development)/Intel (licensing partner)/U.K based Anite (uses licensed IP) /DCM (alliance for development and marketing)
Texas	MNC	Silicon design, embedded software, products	Communications, defense, telecom, networking, DSP (signal processing)	225 patents	Licensing	U.S/Europe	4-offcampus development centers/OMAP tech centers/3rd party developers/Nokia (supplies chips)
Neo Magic (Noida/Kanpur)	MNC	SoC designs and products	Communications, multimedia, entertainment	55 patents		IBM/Dell/HP	Analog/Sony
Mistral	Local	Embedded software, board and chip design	Consumer Electronics, Automotive, Telecommunications, Wireless, Networking, Defense, Aerospace, Office Automation, Semiconductor, Internet Appliances and Industrial Applications	Re-usable components/ IP		Japan (Sony/Sanyo /NEC)	WindRiver(partner)/ Analog/Force/DENON/eTEC(VC)
Cadence (Gurgaon)	MNC	EDA* design tools, design services	Design tools, wireless communications		Sale	IC and systems designers, embedded services	Agilent (test and development)
Cypress	MNC	Chip design, software	Networking, computing, industrial	60 patents compiled			Wipro (jointly developing and designing non silicon design needs)
Analog	MNC	Design and manufacturing of IC, embedded, high-speed semiconductors	Communications, multimedia	Developed 3 DSP products		India/U.S/Europe	IITs/several India companies (for design services)/ Wipro (alliance), Mistral, MIDAS (alliance) IIT-Chennai (worked on WLL technology)

Appendix Table I: Nature of IP Generation and Protection by Local and Multinational IT Firms in India (Continued)							
Name of the Company	**Type of firm**	**Nature of Technology**	**Industrial Application**	**No and type of IP**	**Nature of use**	**Market**	**JV/R&D/Tie-ups**
National Semiconductor	MNC	SoC solution	Computing, wireless, networking, multimedia, communications			Wireless, displays, PCs, networks and a broad range of portable applications	Collaborated with 3 Indian firms for localizing set-top-boxes
Motorola	MNC	Chip design and embedded	Communications, networking, computing, entertainment, automotive, consumer electronics			China/India/ Asia-Pacific/ Europe	Hutch (solution partner)/IISc
Cisco	MNC	Chip design	Networking, Telecom	9 patents filed			Promoting development centers with HCL, Infosys and Wipro (reseller)/ IITs/IISc
Synopsis	MNC	EDA tools, verification, chip design applications, design services	Design tools development			India/U.S/ Europe	IIT-Kharagpur (VLSI lab)/Sasken (sub-contracts)/ TI/ ST /Intel Wipro/DoE ControlNet (clients)/Avanti, Hyderabad (acquisition)
HCL	Local	Core IP design, software	Communications, Industrial	Reusable components			Magma (for design services)/Cisco, GM (clients)/ KLA Tencor, NCR, Convergys, Toshiba, Siemens VDO, NTT Data and Lexis-Nexis/Deutsche Software and GIC (U.S) (JV)
Interra Systems	Local	SoC designs, embedded software	Electronics, video and memory applications	IP blocks/ Design modules		EDA tool designers	Synopsis (licensing)/IKOS/Cypress
Phillips Semiconductor	MNC	SoC, embedded system engineering design, programming and testing	Communications, automobiles				Training IIT-Delhi students
AMD (recent design center2004)	MNC	Chip and system level design	Communications/ networking				
IBM	MNC		Computing, communications, networking	75 patents	Licensing	India/Europe /U.S/Asia Pacific/Japan	Wipro (strategic alliance)/NIIT (training)

Appendix Table I: Nature of IP Generation and Protection by Local and Multinational IT Firms in India (Continued)							
Name of the Company	**Type of firm**	**Nature of Technology**	**Industrial Application**	**No and type of IP**	**Nature of use**	**Market**	**JV/R&D/Tie-ups**
Ittiam (A Texas spin off)	Local	Chip designs and embedded systems	Audio-speech, image-video, wireless and wire line communication	30- IP/2 patents filed	Licensing	US, Europe, Japan, Taiwan and Korea	Silicon Lab (JV)
Control Net (Goa)	U.S start-up	SoC design, IP integration. Embedded software	Networking		IP creation in verification, wireless LAN etc.		
Mind Tree	Local	Designs re-usable building blocks for hi-tech companies, software	Communications			Developed a PDA for a U.S client	Sun (tech partner)/Walden and Capital (VC)/UMC (foundry)/SAS (strategic partner) /Volvo IT (software development)/Cadence (EDA tool partner)/Texas (solutions around TI's silicon)/Xilinx (vendor)
ST Microelectronics (Noida)	MNC	Embedded software, SoC design	Computing,	100 filed and 32 filed (2002)		Europe/US	Wipro licenses its LAN IPs
Ishoni	U.S start-up	Chip design and software for SoC	Broadband (cable/DSL)		Licensing	Europe/US/ India	Phillips Semiconductor (51% stake)/Alcatel (technology support)/Wind River (Ishoni as reseller for a RTOS product)/ Draper Fisher Fund (VC)
Spike	U.S start-up	SoC design	Communications, storage, networking, multimedia, SoC		IP core		TSMC (foundry)
Impulsesoft	Local	IP creation/embedded software	Wireless communications devices/IP is in Bluetooth protocol stacks		IP licensing/ royalties	OEM/silicon vendors	Smart Modular, Matsushita and BenQ/Braodcom/Infeneon/National/TI/ TEN Technology Inc. (licenses its product)/TI,Broadcom,Cirrus Logic, Infineon, Silicon Wave (partners to deliver Bluetooth solutions)
Geometric (Bombay)	Local	IP blocks	Mechanical, manufacturing and industrial		IP licensing/ sale	US/Europe/ Japan	Wipro (provide end-to-end IT solutions)/ Dassault Systems (JV)

Appendix Table I: Nature of IP Generation and Protection by Local and Multinational IT Firms in India (Continued)							
Name of the Company	**Type of firm**	**Nature of Technology**	**Industrial Application**	**No and type of IP**	**Nature of use**	**Market**	**JV/R&D/Tie-ups**
vMoksha	Local		Enterprise solution		One patent filed (authentication protocol)	India/UK/US / Australia/ Singapore/Japan/China	JV with Chinadotcom/ Challenger Systems (San Jose based acquisition)/PeopleSoft(consulting partnership)
Arcus (Dublin based-taken over by Cypress)	Start-up-MNC	Chip design	Networking			Nortel, Lucent, Fujitsu, Siemens, Cisco and Sony	Foundry partners-Goldstar/LG Semicon/UMC
Intel	MNC	Chip design and manufacturer, embedded	Semiconductors, telecom switching, equipment and routers, computing, communications	21 patents filed		India/Asia Pacific/Mobile computing market	Network Solutions, Bangalore acquired /IITs/Thinkit(acquired) /IISc (research)
TCS	Local	Software Development and chip design	Banking/insurance/telecom/manufacturing	35 patents filed		India/Europe /Asia Pacific/U.S/ China	Adobe(resells Adobe products)/EX NGN/Microsoft
GE India	MNC		Controllers, consumer electronics, transport				Wipro (medical systems)
Sun	MNC	App server designed and developed in association with Sun's Bay Area Engineering center etc.	Computing	10 filed			HCL/Wipro (partnership for using Sun systems)

Notes: EDA*= Electronic Design Automation that automates the process of IC and systems designs.
Core IP* design = It is a chip design that can be used as a core in almost all product development.