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Indian Patenting Activity in International and Domestic Patent System: Contemporary Scenario

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Indian Patenting Activity in International and Domestic Patent System: Contemporary Scenario

NISTADS
National Institute of Science, Technology
and Development Studies

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Sujit Bhattacharya
Principal Investigator

Dated: December, 2005

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Executive Summary

Introduction

The study investigated the patenting activity in India based on Indian patents granted in US and India for the period 1990-2002. Main focus of the study was on patenting by Indian organisations. Patents were analysed for the period 1990-2002. Current patenting trends (2003-04) by Indian organisations in US were investigated. Indian patenting activity in US for the period (1998-2002) was compared with patenting activity of US, Japan, South Korea, Brazil, and China. Strategic options for patent commercialization were examined based on case study of CSIR.

The main observations, analytical interpretations and conclusions that have emerged from this study are highlighted in the sections below.

Indian Patenting Activity in US

There were 1051 patents by India in USPTO during the period covered by this study (1990-2002). This included patenting under all the three different categories: India Owned (patents assigned to Indian organisations), Foreign Owned (invented in India and assigned to foreign organisations), and "Unassigned" (mainly owned by Indian individuals). Of the 1051 patents invented in India, 669 were India Owned Patents, 273 were Foreign Owned Patents and rest 109 belonged to the "Unassigned" category.

India Owned Patents (IOP)

The maximum growth in patenting activity was observed in the current period (1999-2002) and accounted for 74% of the total patents (1990-2002). 332 patents (approximately 50%) of the IOP patents granted in U.S. had 'country of priority application' in US. This is an encouraging trend as it shows that Indian organisations are gaining confidence in their invention and are hoping to get technological advantage by first filing in US.

Majority of IOP patents were utility patents (provides protection to useful process, machine, article of manufacture or composition of matter). There were a few design patents (protecting ornamental appearance of a useful product). None of the design patents were granted in the current period. India was among a few countries in USPTO having plant patents (provides protection to plant varieties).

Process patents were the dominant patenting category. However, post-WTO onwards (i.e. from 1995) there was a positive trend towards product patent particularly in 'Pharmaceuticals', 'Agro-chemicals', and 'Food'. These areas are to be under product patents in IPO from 2005 onwards. This provides a positive indication of Indian firm's preparedness in the new scenario (post WTO period).

There were 92 organisations involved in patenting activity. Pharmaceutical firms were prominently involved in patenting activity. There was only one firm from computer industry. Patenting in embedded software, software's involved in communication (signal processing, etc), and in computer hardware (VLSI, digital decoders, etc) are allowed by USPTO. The lack of patenting in US in the above technological domain plausibly

indicates limited innovation/invention activity in this area by Indian computer firms.

Patenting activity across organisations exhibited a skewed pattern. Only 8 organisations had more then 10 patents and accounted for 519 patents (80% of total patents). CSIR was the leading organisation accounting for 378 (57%) of the IOP. Joint patents were a few in numbers. Only 7 Indian universities were involved in patenting activity during the entire period i.e. 1990-2002.

Patents were classified under 9 Sectors (Chemicals, Pharmaceuticals, Machinery, Electrical equipments, Transport, Electronics, Instruments, Miscellaneous, and Biotechnology) and further in 43 sub-sectors. India Owned Patents addressed all the 9 technology sectors. However, out of the 43 technology sub-sectors, patenting activity was observed in 26 sub-sectors. 'Pharmaceutical' and 'Chemicals' were major areas of India's patenting activity. There was not much patenting activity in the sectors 'Electronics', and 'Electrical equipments'. *There were 53 patents in Biotechnology, majority of them in the current period (46 patents).* This indicates that innovation activity is taking place in this high technology science based area, which is mainly dominated by advanced technology leaders.

39% of patents attracted citations. A few patents were highly cited plausibly indicating that they are important in defining the state of art in the said technological domain. Self-citations i.e. patents citing their own patents were also substantial. Some of the IOP attracted citations from journals plausibly indicating their scientific significance.

Foreign Owned Patents (FOP)

96 foreign organisations were involved in patenting activity. Majority of them were industrial firms. Most of these patents were assigned to

institutions from USA (68%) followed by Germany (16%). The foreign organisations prominently involved were: Texas Instruments (40 patents), Hoechst Aktiengesellschaft (30 patents), GEC (26 patents), and IBM (17 patents).

Product patents constituted the dominant category of patents (77% of the total FOP patents). The majority of patenting activity was in 'Office machinery and computers', and 'Pharmaceuticals'. The areas that attracted maximum attention under 'Office machinery and computers' were 'Electrical digital data processing', 'Pulse technique', and 'Recognition devices'. Pharmaceuticals' (27%), 'Chemicals' (14%), and 'Electronics' (11%) were the other sectors of prominent activity.

Unassigned Patents

Similar to IOP, 'Pharmaceuticals' and 'Chemicals' were the major areas of patenting activity. Substantial activity was also observed in 'Machinery', 'Instruments', 'Transport', and 'Food & beverages' sector.

Comparative Trends

IOP and FOP exhibited increasing trend in their patenting activity. Unassigned category exhibited random activity. Utility patents were the dominant type of patents in all three categories. FOP did not have any plant patents. In IOP, process patents were the major category of patenting whereas product patents formed the dominant area of patenting in foreign owned patents. IOP mainly addressed 'Pharmaceutical', and 'Chemical' sectors whereas FOP was mainly in 'Office machinery and computers', and 'Pharmaceuticals.

Indian Patenting Activity in IPO

There were 22,695 patents accepted by IPO during 1990-2002. Foreign organisations dominated the patenting activity with approximately 71% share of accepted patents.

India Owned Patents

Like USPTO, only a few organizations accounted for majority of patents. The top 20 entities had approx. 60% share of patents with CSIR being the most prolific with 34% share of patents. 21 universities were involved in patenting activity accounting for 171 patents. Universities acquired around 54% patents during the Current period indicating an increasing awareness in universities towards patenting activity.

Only two sub-sectors 'Tobacco products', and 'Publishing & printing' exhibited no patenting activity. Like USPTO, 'Pharmaceutical' and 'Chemical' sectors were the major areas of patenting activity. High degree of activity was also observed in sub-sectors 'Food & beverages', 'Basic metals', 'Non-metallic mineral products', and 'Fabricated metal products'.

Foreign Organisations Patenting in India

Patenting activity by foreigners (majority of these patents were from foreign institutions) exhibited decline in the post-WTO period. In real terms this was not the case as foreigners had taken two other routes for filing patents in India (i) through PCT, and (ii) 'Mailbox' provision allowed in IPO. These patents were not accounted in the period of study i.e. 1990-2002.

Organisations from USA and Germany accounted for maximum share of overall patenting by foreigners, 38%, and 14% respectively. Unlike Indian patenting activity in IPO, foreigners exhibited substantial patenting activity in 'Instruments', 'Electrical equipments', and 'Electronics' sectors.

Patenting by Individuals

Machinery was the most important sector of activity of individuals in IPO. Significant patenting activity was also observed in the areas 'Fabricated metal products', and 'Rubber & plastic' products'.

Overall Activity of IOP

There are 5517 patents granted to Indian institutions in US and Indian patent system in the period 1990-2002. The current period (1999-2002) exhibited maximum patenting activity. Majority of patenting activity was in IPO (4848 patents). Patenting activity was skewed in both the systems. However, a much larger number of organisations were involved in IPO.

21 universities were involved in patenting activity in IPO whereas only 7 universities were granted patents in USPTO. CSIR was the most prolific patenting institution in both the systems. Patents with multiple assignees (jointly owned) were a few in both the systems. 'Chemical' and 'Pharmaceutical' were the major sectors of patenting activity.

Patenting Activity of Indian Institutions in US (2003-04)

Substantial patenting activity by Indian organisations was observed in 2003-2004. There were 467 patents during this period in comparison to only 669 patents in the entire period (1990-2002). 95 organisations were granted patents during this two-year period. This included 63 organizations that were granted patents for the first time. University were involved in a much larger number (11 universities were granted patents). CSIR with 272 patents was again the most prolific institution. Pharmaceuticals' and 'Chemicals' were again the major areas of patenting activity. 'Biotechnology', 'Food &

beverages' and 'Office machinery & computers' exhibited considerable activity.

Patents Granted to Indian Institutions in European Patent System

Majority of granted EPO patents from India had country of priority as India. This is very important in the context of this study. It points out that reliable estimation of Indian patenting activity in international and domestic patent system can be achieved by covering patents granted in IPO and USPTO.

Indian Patenting Through PCT (Patent Cooperation Treaty)

Accession to PCT in 1998 had opened another route for Indian organisations/individuals for filing patents in different countries. Organisations that exhibited prolific patenting activity in USPTO were again the major players in filing patents through PCT. Indian organisations particularly CSIR was observed to be vigorously using this route for patent filing.

International Comparison

Overall Indian patenting activity ranked between 21-25 in USPTO over the different periods. USA ranked first followed by Japan, Germany, Taiwan,

etc. Unlike other countries were majority of patents were utility patent, patenting in China was mainly in design patents.

Patents from USA, Japan, Germany addressed all the sectors/sub-sectors. Patents from India and Brazil were concentrated in a few sectors/sub-sectors. Indian patenting activity in biotechnology was comparable to that of Korea.

Around 10,000 plant patents have been granted by USPTO till date. Majority of them have been granted to USA. Japan had a few plant patents whereas countries like Korea, China, and Brazil had none. India was one of the few countries having plant patents. All the 13 plant patents from India were granted to CSIR.

Strategic Options for Commercialisation of Patents in India

Examination of strategy undertaken by CSIR for IPR brings out the importance of having an Intellectual Property Management Policy (IP policy). The articulation of IP policy by CSIR in 1996 and actions undertaken to implement this policy was instrumental in creating an innovation climate within the organsiation. It helped CSIR to achieve the objective of increasing patenting activity, creating patent portfolio's, provide proper management of IPR and facilitate the process of appropriation.

Main Implications of the Study

Changes in the Indian Patent Act allowing product patents in 'Pharmaceutical' sector will have substantial impact on Indian Pharmaceutical Industry as drugs that fall under patent protection post 1995 will have to be withdrawn. The study has revealed that patenting in pharmaceuticals is a prominent feature of Indian patenting activity. Indian

firms/research organisations have also been granted product patents in pharmaceuticals in US (as product patents in pharmaceuticals are allowed in US). This is a positive indication of India's preparedness in the new patent governed pharmaceutical industry. However, this activity has to involve more organisations i.e. firms, research organisations, and universities.

A few research organizations and firms played a major role in patenting activity. Except for CSIR, limited patenting activity was observed from other scientific agencies. Scientific agencies such as ICAR, ICMR have now articulated intellectual property management policy. This should help in IPR creation, management and appropriation in these agencies.

CSIR is among a few organisations having plant patents in their patenting portfolio. Multiple protections of their utility patents through design or plant patents (wherever applicable) will make CSIR's patent difficult to infringe. CSIR has undertaken strategic initiatives in this direction.

Only a few patents were the outcome of joint cooperation. A number of programs have been initiated by scientific agencies especially CSIR, DST, DBT involving joint technology development through participation of research laboratories, universities and firms. This should lead to proprietary knowledge creation and subsequent patenting.

Indian universities are beginning to participate in patenting activity, at least in the IPO. However, their activity is limited in the USPTO. For participation of more universities in IPR activity, necessary incentives, infrastructure and other resources are required to be created. University Grant Commission has created an intellectual property management document that among other issues related to IPR has provided guidelines for establishing National IPR Facilitation Centre. This centre would be expected

to create awareness, facilitate and promote filing of patents and management of IPRs from the university system in the country. This initiative is a step in the right direction.

Foreign R&D institutions in India are patenting in advanced/emerging technological areas such as 'Computers' and 'Communications'. Indian firms in these areas exhibited insignificant patenting activity in spite of the presence of large number of firms in this domain.

Some Indian owned patents were cited by other patents and in journals. These cited patents broadly indicate that they are getting noticed and have technological significance (cited by patents) or scientific significance (cited by journals).

Some organizations like CSIR, Ranbaxy, Dr Reddy's laboratory are building up portfolio's (number of related patents addressing an application area). This is important in the context of appropriation from patenting activity.

CSIR's IPR Policy has provided strategy and implementation plan to achieve the objective of increasing patenting activity, creating patent portfolio's, provide proper management of IPR and facilitate the process of appropriation.

Substantial increase in patenting activity Post 2002 (2003-04) in USPTO was observed. Indian organisations are also using PCT route for filing international applications. Substantial increase in patents granted to Indian institutions in EPO was also observed. Overall significant increase in the number of new organisations involved in patenting activity post 2002 signifies increasing awareness and thrust of Indian organisations in patenting activity.

Recommendations

Recommendation 1

Patent data (of applications filed and granted) in Indian Patent Office by resident and non-resident inventors should be made available by the patent office. Online access with various search features should be incorporated in this database. This data needs to be updated regularly. This will help in providing correct assessment of Indian patenting activity. Further it can be used by patent examiners, applicants, researchers etc in examining the different aspects of patent document as per their requirement.

Recommendation 2

Patent office and other agencies that are involved in creating patent awareness should highlight the various types and scope of patenting that are available in different countries for proprietary protections. In the context of patenting in US, apart from utility patents, patenting is possible in design (protecting ornamental features), and plant patents (protecting plant varieties). Software-related inventions (and mathematical algorithms in general) are patentable in US.

Recommendation 3

Importance of protecting the inventive activity is to be addressed at the research level in universities itself. NAAC should take patenting activity in universities as one of the criterion in ranking universities/departments.

Recommendation 4

Special incentives should be given for research groups that have a well-defined research focus leading to innovation activity. They should be stakeholders in any appropriation that results from innovation activity.

Recommendation 5

Foreign owned patents (patents invented in India but assigned to foreign institutions, mainly MNCs) have demonstrated substantial activity in 'computer & communications', and 'electronics'. Lack of Indian patenting activity in these areas should be addressed.

Recommendation 6

Drafting a patent specification, negotiating with the patent examiners (especially when a patent is filed in a foreign patent system), following the different procedures of the patent office requires experience and skill. This type of facility within institutions like universities, SME's etc is to be created.

The above constraint needs to be addressed urgently by establishing specialized set-ups, providing special incentives within scientific agencies, universities, etc. Agencies like TIFAC, NRDC are required to play a more proactive role to support these institutions as well as SME's in patenting activity. CSIR's experience in this area should also be extended especially to major scientific agencies. The above initiatives should help in increasing patenting activity across institutions.

Recommendation 7

There were only a few patents as a result of joint collaboration between different organizations. Major scientific agencies CSIR, DST, DBT, etc have initiated a number of network programs for joint technology development involving research laboratories, universities and industries. These programs are steps in the right direction. Other institutions should replicate these types of efforts.

Recommendation 8

Awareness should be created in organisations that exhibit substantial patenting activity to direct their R&D and innovation efforts in specific applications / target areas and protecting them appropriately through patents. A number of related patents covering a specific technology (patent portfolio) are able to give monopoly to an organisation resulting in plausible appropriation.

Recommendation 9

Organisations should evolve their own IPR policy. This policy should be able to guide an organisation in IPR creation, management and deriving economic benefits and other returns. Policy should be designed keeping in view the mandate and mission of the organisation. CSIR's IP policy, strategy and implementation plan can provide necessary directions particularly to other scientific agencies.

Recommendation 10

Amendment in the patent act has extended the scope of patenting. Firms, research organisations, universities have to invest more in R&D and protect their innovations through patents in the new emerging scenario. Patenting through PCT has shown substantial increase in recent years. Thus future study is required to investigate the post 2002 scenario in details.

Recommendation 11

Investigation is required to probe the factors that have helped firms to undertake patenting, constraints faced by them and related issues. Detailed analysis is also required to uncover the reasons of lack or low levels of patenting activity in some major institutions.

Abbreviations

CSIR	Council of Scientific & Industrial Research
DOE	Department of Electronics
EPO	European Patent Office
FOP	Foreign Owned Patents
HS	Harmonized Commodity Description and Coding System
ICAR	Indian Council of Agricultural Research
IPMD	Intellectual Property Management Division
IIT	Indian Institute of Technology
IOP	India Owned Patents
IPC	International Patent Classification
IPO	Indian Patent Office
IPR	Intellectual Property Rights
MNC	Multi-National Corporation
NAAC	National Assessment and Accreditation Council (an autonomous body under University Grant Commission)
NRDC	National Research Development Corporation
PCT	Patent Cooperation Treaty
PSU	Public Sector Undertaking
SME	Small Manufacturing Enterprises
TIFAC	Technology Information, Forecasting And Assessment Council
TRIPS	Trade Related Intellectual Property Rights
USPTO	United States Patent and Trademark Office
WTO	World Trade Organisation

1 Introduction

1.1 Preamble

Indian patent activity has shown remarkable growth in the last few years particularly in filing patents as well as patents being granted under the U.S patent system. This growth has been observed in different technological areas/sectors. Public funded research organizations as well as private enterprises have both contributed to this growth. Some major drug companies and research organisations like CSIR are playing a key role in this process. However, only a few organisations are contributing to this growth. There is not much patenting activity by universities. Linkages across R&D institutions and between R&D institutions and industry contribute only a small fraction in this patenting activity. Cases have shown that important patents can be derived from our traditional knowledge in medicine, agriculture and remains to be exploited.

Examination of Indian patenting activity is thus required to properly estimate the overall activity as well as reveal its different facets. Patenting trend over a long period of time, patenting by different agencies, sectors and sub-sectors of patenting activity are some of the important aspects that are required to be explored in details. It is important to distinguish the characteristics of Indian patenting in the international and the domestic patent system. The examination would show the firms/research institutions patenting in both the system, continuity in addressing technology sectors/application areas, application areas that are mainly addressed by Indian organisations, etc.

To what extent India's patenting activity has created impact within the technological community remains to be explored. Economic appropriation through patenting activity i.e. to what extent Indian patents have been commercialised has only attracted limited attention. The present study attempts to address some of the above issues and thus contribute towards better understanding of Indian patenting activity. In examining the trend over a period of time, the study takes into account the important changes that have taken place and have direct bearing on the patenting activity.

1.2 Objectives

To bring out the various aspects of Indian patenting activity, the study had the following objectives:

1. A detailed analysis of India's patenting activity during the period 1990 to 2002.

This analysis helped in the identification of agencies involved, areas/sub-areas of patenting activity, linkages, etc. This covered Indian patents granted in US; and patents accepted by Indian Patent Office.

2. Identification of major distinctions and similarities of India's patenting activity in US and Indian patent system.

This examination revealed the strengths and weaknesses of India's activity in each of the above two patent systems as well as provided a broad overall picture of India's patenting activity.

3. Examination of the impact of Indian patents based on citations given by other patents and scientific articles.

This part was restricted to Indian patents in US.

4. Comparison of India's current patenting trend (1998-2002) with patenting activity of some other countries.

5. Strategic options for commercialisation of patents in India.

Initiatives undertaken by CSIR in this context were examined.

6. Implications of India's patenting activity in the new WTO scenario.

Based on the detailed examination and analysis, the study has given recommendations towards strengthening the patenting activity in the country.

1.3 Chapter Outline

The study is being presented in six chapters. Chapter 2 details the patenting activity by institutions (Indian and foreign) and individuals in US. Comparison among the above three categories are also presented. Patenting activity of Indian institutions, foreigners, and Indian individuals in IPO are covered in Chapter 3.

Overall patenting activity by Indian institutions and patenting activity post 2002 is presented in Chapter 4. Further, the results of comparison of Indian activity in USPTO with five other countries (US, Japan, South Korea, China, Brazil) are covered in this chapter. Chapter 5 looks at strategic options for commercialisation of patents and takes CSIR as a case study for this examination. Chapter 6 summarises the main findings of the study. Main implications and recommendations of this study are also presented in this chapter. Salient features of patenting in US, Indian Patent Act 1970 and various amendments that govern the patenting activity in IPO are given in the annexure I-V.

3 Patenting Activity In The Indian Patent System

3.1 Introduction

Patenting activity in the domestic patent system based on patents accepted by Indian Patent office (IPO) was examined for the period 1990-2002. Patenting activity of domestic organisations, foreigners and Indian individuals was covered for this purpose. The main focus was on patenting activity of domestic organisations termed as Indian Owned Patents (IOP) in this study. IOP included all organisations that had an Indian address (IOP mainly comprised of Indian entities. However, foreign MNCs who had assigned their patents to Indian subsidiary were also included in IOP). Patents by foreigners were mainly comprised of foreign organisations (there were a few foreign individuals). The analysis of patents by foreigners and Indian individuals was undertaken to assess the overall activity in the IPO.

The patenting activity was examined for the period 1990-2002 as well as in the three sub-periods: 1990-94 (pre-WTO), 1995-98 (post-WTO), and the current period (1999-2002).Patenting in the IPO is mainly governed by the Indian Patent Act 1970. This act has been modified by subsequent amendments to harmonize patent laws with patenting provisions in major patent systems. Amendments were also necessitated to comply with the WTO-TRIPS patent provisions. Salient aspects of the Indian Patent Act 1970, major changes due to amendments and other important aspects that govern patenting in IPO are covered in annexure V.

Unlike United States, design patents and plant patents are not granted in India. However, India has taken necessary steps to meet the requirements of TRIPS. Designs are subject matter of registration in India. The Indian Design ACT 2000 has introduced number of provisions to ensure effective protection to registered design. Design protection uses two specific terms as used for grant of patent, novelty and prior art but its content do not match with that of the patent.

Protection of Plant Varieties and Farmer's Right Act 2001 (PPVER 2001) has introduced provisions for the protection of new plant varieties, legislative features to protect farmer's rights, etc. In the US, the patenting of plant varieties is particularly important because, with appropriate claims in the patent, the holder of the patented

variety can prevent others from using it for breeding purpose. Patents are the strongest form of intellectual property protection in the sense that they normally allow the right holder to exert the greatest control over the use of the patented material by limiting the rights of the farmers to sell, or reuse seeds they have grown, or other breeders to use the seed (or patented intermediate technologies). India has in principal met the obligations of TRIPS and has enacted a novel system that provides flexibility to farmers and researchers.

Present study has not covered the plant protection and design registration in India as this is beyond the scope of the defined study.

3.2 Data and Methodology

Patent information from the Indian Patent Office is published weekly in the Gazette of India, Part III, Section 2. The gazette publishes particulars of the provisional specifications such as the inventors, assignees, date of application, number of application, and title of the patent application. Similarly, details of the complete specifications after 18 months from the priority date, and specifications open for opposition after prosecution by the Patent Office, include the name of the applicant, inventors, date of filing, title, application number, main claim and main drawing and the abstract of the invention and international patent classification.

Other relevant information in the gazette include, patents under opposition, decisions by the patent office on opposition matters, amendments to specifications, patents sealed, renewals fees paid, cessation of patents, restoration proceedings, registration of licenses, assignments, working of patented inventions, registration of designs, and relevant details of the PCT applications that enter the national phase in India.

The data on patent sealed/granted is not available in a machine-readable form that can be accessed and necessary processing/analysis can be further undertaken. The analysis of sealed data would thus require creating database from the gazettes by scanning 48 gazettes each year. However, the bibliographic data on patent for opposition is available from different sources in machine-readable form. The patents that are in opposition are those patents that are accepted by the IPO and can be sealed if no opposition is received from the public within four months. Interaction with patent office revealed that there were very a few patents for which opposition was

received. In majority of the cases, patents that were in opposition (in some cases with suitable modifications) were finally granted. Thus for the present study it was decided to use the opposition data available in machine-readable form after necessary validation.

The opposition data is available from two sources in CD-ROM format; for the period 1990-2000 (June) from NISCAIR and for the period 1995-2002 from TIFAC. In-house databases were created after extraction of data from these two databases. Validation of this data was done with the help of online database INPADOC and from the published data in gazette of India. Data was organised in terms of calendar year to have uniformity with Indian patent data in US (IPO reports patent data in terms of financial year. Patent statistics in different countries are always in terms of calendar year).

Patents were classified on the basis of type of organisations owning the patents similar to that undertaken for Indian patents in USPTO (*refer Chapter 2 methodology section for details of classification undertaken*). Patents were also identified under 9 main and 43 sub-sectors (*refer Chapter 2 methodology section for details of the technology classification scheme).* The elaborate classification scheme helped to uncover patents in different industrial sectors/sub-sectors.

3.3 Results

3.3.1 Overview

Figure 25 illustrates the distribution of patents in IPO in the three categories: Patenting by Indian organisations (IOP), Foreigners, and Indian individuals.

Figure 25: Distribution of Patents in IPO (1990-2002)

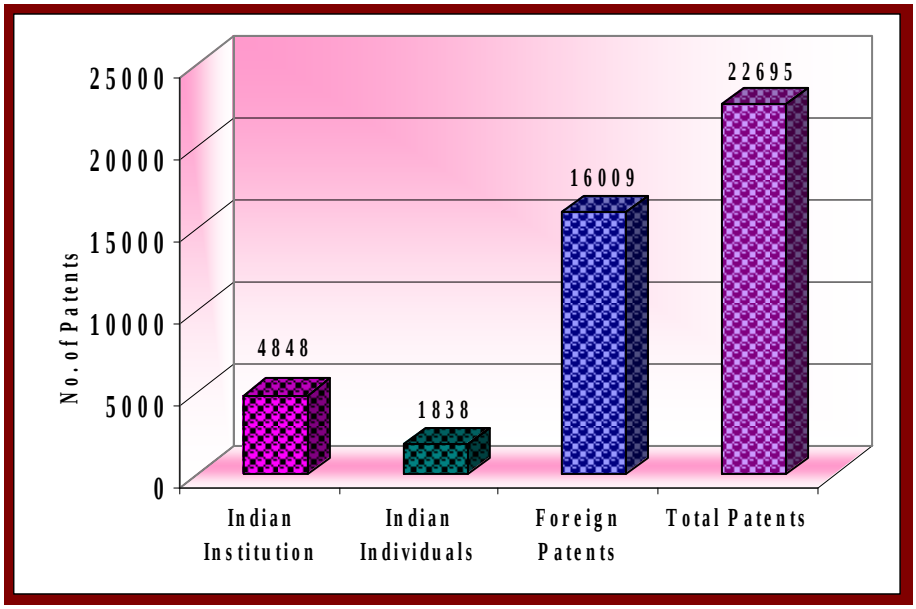
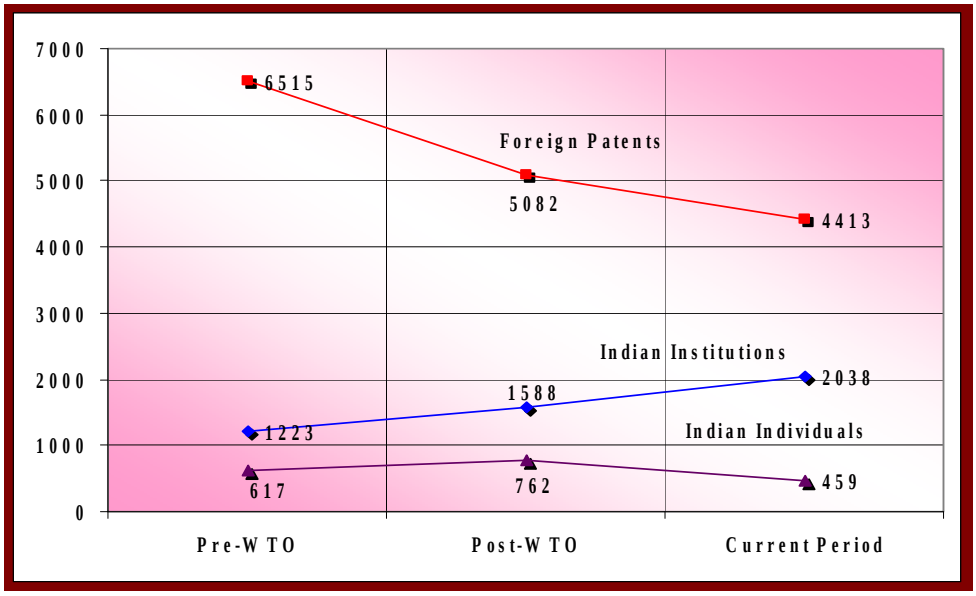


Figure 26, exhibits the patenting activity in the three designated sub-periods; 1990-94 (pre-WTO), 1995-1998 (post-WTO), and 1999-2002 (current period). Patenting by Indian institutions in IPO exhibited slight increase over the three designated periods of activity. Even though foreigners accounted for the maximum number of patents in the IPO, they exhibited decline in their number over the periods. *Infect due to different reason as explained in the box 2 below, the patenting activity by foreigners was not reflected in this period. In real terms there was no decline as Box 2 clarifies.* For Indian individuals patenting in IPO, it was observed that the post-WTO period (1995-98) exhibited highest activity. Decline was observed in the current period

Figure 26: Patenting Activity in the Pre/Post WTO and the Current Period: Indian Organisations, Foreigners and Indian Individuals



Box 2

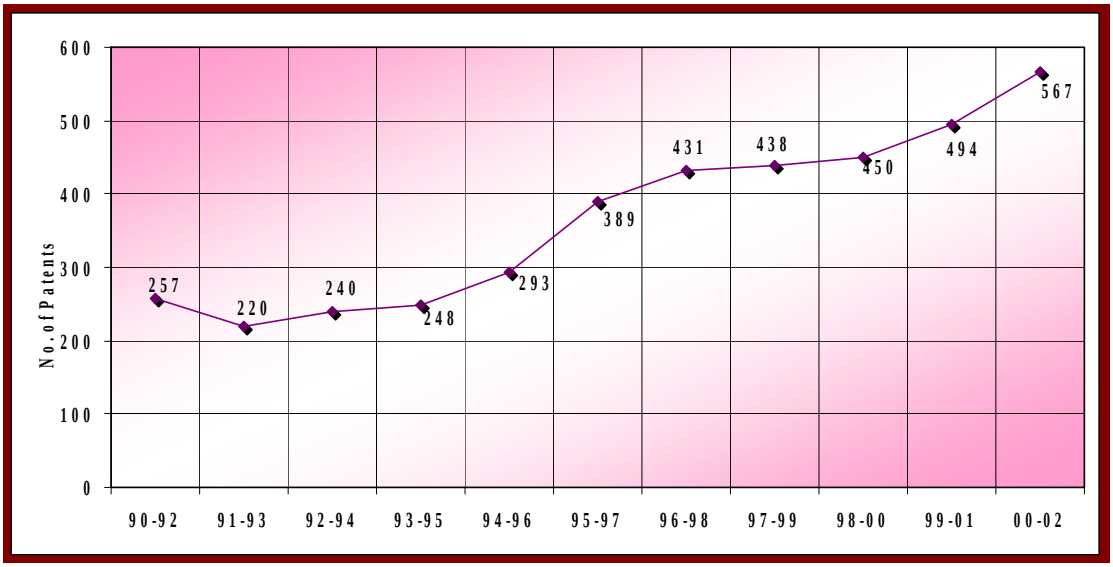
Decline as exhibited in foreign patents in the IPO does not reflect the real position. Apart from the traditional direct filing, foreigners were filing patents in India during the period covered by this study through two other routes: PCT (Patent Cooperation Treaty), and 'Mailbox' provisions. PCT patents that indicate India as country for protection enter the national phase (i.e. IPO) through this mode. Patent entering the national phase takes a minimum of 18 months from the date of filing of the PCT patent. India became member of PCT in 1998, and thus only from 2000 onwards PCT patents are entering national phase. In general it has been observed that it takes 4-5 years for the patents to be examined and come into opposition. Thus it is unlikely that these patents would be covered in the period of this study. At present it is estimated that 40,000 patents have entered the national phase through PCT.

Patents covering product patents in food, drugs, and agro-chemicals have been filed from 1995 through 'Mailbox' provision. Patents in these three sectors where not allowed as per Indian patent act 1970. However as per TRIPS agreement (India joined WIPO in 1995 and thus it had to comply with the TRIPS agreement) it was mandatory for India to make alternative arrangements for allowing product patents to be filed in these three sectors from 1995 onwards till product patents can be filed directly. However, TRIPS allows these patents to be opened for examination after the product patents are allowed in these sectors. Thus these patents were kept separately (designated as 'mailbox') and only now after the necessary amendments have been made in the Patent Act, these patents are opened for examination. 12,000 applications have already been filed in 'mailbox', majority of the filing are from foreign institutions. Thus these substantial numbers of patents will also not be accounted for during the period covered by this study.

3.3.2 Patenting Activity by Indian Organisations in IPO

A total number of 4848 patents that belonged to Indian institutions were analysed in the IPO for the period 1990-2002. Figure 27 exhibits the patenting activity during this period. A three-year moving average was taken to remove random fluctuations. The rising trend is clearly visible. Patenting activity in the three periods, pre/post WTO and current period were 1223, 1558, and 2038 patents respectively. The major transition was in the post-WTO period, an increase of around 30% from the pre-WTO period. There was an increase of approx. 28% in the current period from the post-WTO period

Figure 27: Patenting Activity by Indian Organisations: 1990-2002



Similar to India's activity in USPTO, patenting activity in IPO was highly skewed i.e., a few organizations accounted for majority of patents. However, there was considerable increase in the number of organisation involved in patenting activity as well as in prolific organisations i.e. those having substantial patenting activity.

749 domestic organizations were granted patents during the entire period: 1990-2002. There were 265, 340, and 388 organisations involved in patenting activity in the three periods, 1990-94, 1995-98, and 1999-2002 respectively. Patenting activity was much skewed as 411 institutes had only 1 patent, 126 institutes had 2 patents and 167 institutes had more than 3 patents during the entire period. Only 45 organisations had more then 3 patents in the entire period.

There was significant difference in the number of different organization types involved in patenting activity. Industrial firms were predominant with 667 firms being

granted patents during this period. Patenting activity in other organisation types comprised of: 37 research institutes, 21 universities, 20 special institutes, and 3 belonging to non-scientific entities (other ministries/departments). Unlike in USPTO, considerable number of universities, and special institutes were involved in patenting activity in IPO.

The number of patents from each organisational type provided an interesting profile. Thirty-seven research organisations had 1886 patents whereas 667 industrial firms had 2673 patents. Thus there were on average 51 patents per research organisation compared to 4 patents per firm. The 21 universities contributed to 171 patents, and on the other hand 20 special institutes accounted for 115 patents. The three organisations classified under other ministries/departments accounted for only 4 patents. Table 55 exhibits the details of the patenting activity by different types of institutions.

Table 55: Number of Patents Granted to different Types of Organisations: Overall and in Sub-periods

Period	Industry	Research	University	Special Institute	Other Ministries/ Departments
1990-1994	790	369	26	38	-
1995-1998	882	591	58	59	1
1999-2002	1001	926	87	22	3
Total (1990-2002)	2673 (55.14%)	1886 (38.9%)	171 (3.42%)	119 (2.37%)	4 (0.08%)

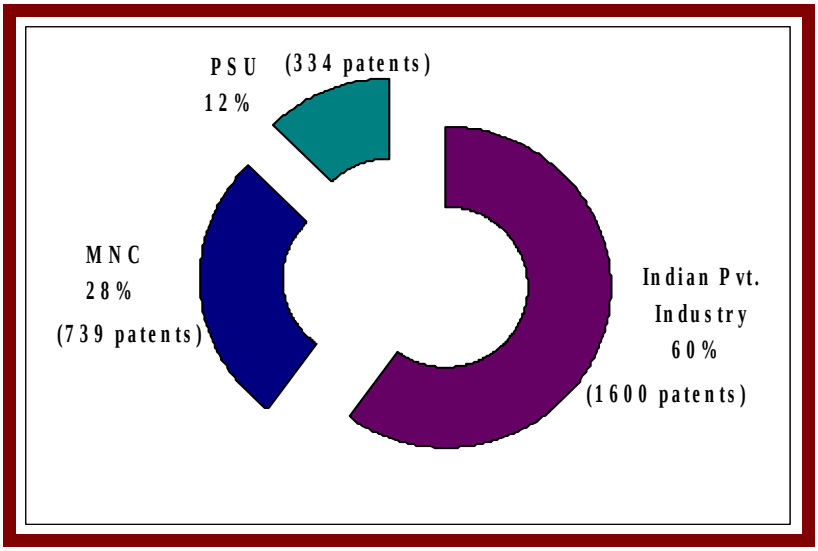
From the above table, the increase in patenting activity in each of the later periods is clearly visible in three main assignee types i.e. industrial firms, research institutions, and university. Only in special institutions some randomness can be observed.

Patenting was dominated by industry with around 55% of patents arising from this sector. Research institutes contributed to a share of around 40% of patents. Unlike USPTO, universities also exhibited some activity in IPO with 171 patents (3% of total) domestic patents granted to 21 universities all over the country. IIT (Indian Institute of Technology) had the maximum

number of patents among the academic institutions (80 patents) followed by Sree Chitra Tirunal Institute of Medical Sciences with 41 patents.

Among the industrial sector, Indian private industry had the major share accounting for 1600 patents, approx 60% of total patents granted to industries. PSU and MNC's accounted for 739, and 334 patents respectively. The share within the industry is highlighted in Figure 28.

Figure 28: Share of Patents within Industry



In the Indian private industry, Hindustan Lever Limited (565 patents), Hoechst India Ltd (48 patents), Ranbaxy Laboratories (36 patents), J. B. Chemicals & Pharmaceuticals Ltd. (31 patents) and Lupin Laboratories Ltd. (28 patents) were the most active organisations. *These firms have been classified as prolific institutions and have been separately analysed in the study*. These five prolific firms accounted for 708 patents i.e. 44% of the total patents granted to industry.

Among the PSU, Indian Oil Corporation Limited (IOCL) accounted for 40 patents (this firm is classified under prolific institution and its patent profile is analysed in details). The other PSU's that exhibited substantial activity were Bharat Heavy Electricals Limited (BHEL) and National Research & Development Corporation (NRDC) with 41 patents each and Steel Authority of India Ltd (SAIL) and Indian Petrochemical Corporation Ltd (IPCL) with 38 and 37 patents respectively.

CSIR dominated the patenting activity among the research institutes CSIR had share of 88% of the total patents granted to research institutes. In fact CSIR was the most prolific organisation in the IPO accounting for 34% of the total patents (1660

patents). Apart from CSIR, ISRO (30 patents), and BARC (20 patents) were only the other two research organisations that had substantial activity. None of the other research organisations had more then 10 patents. Overall scientific agencies had better representation in IPO then observed in USPTO. Table 56 illustrates patenting activity by scientific agencies.

Table 56: Patenting Activity of Scientific Agencies

Scientific Agency	No. of Institutes	No of patents
Indian Council for Agriculture Research (ICAR)	84	14
Defence research & Development Organisation (DRDO)	53	51
Council for Scientific & Industrial Research (CSIR)	38	1660
Indian Council for Medical Research (ICMR)	27	6
Department of Science & Technology (DST)	17	32
Department of Atomic Energy (DAE)	14	9
Department of Electronics (DOE)	14	4
Department of Space (DOS)	8	34
Department of Biotechnology (DBT)	3	7

The lack of patenting activity in scientific agencies (i.e. research institute under them) can be clearly observed from Table 56. It can be seen that ICAR with 84 research institutes accounted for only 14 patents. ICAR had no patents in USPTO. Some other major scientific agencies like DAE, and DOE exhibited patenting activity in IPO (*these agencies had no patents in US*). As per IPO provisions, invention relating to atomic energy are not patentable. This may have restricted patenting of innovations in some scientific agencies, DAE in particular. It is likely that patents by DST and DBT have originated from research organisations that are affiliated to them.

Only 3 organisations from the Non-scientific Departments/Ministries were involved in patenting activity. These were Ministry of Information Technology (2 patents), Ministry of Health & Family Welfare (1 patent), and Ministry of Mines (1 patent).

a) Patenting Activity of Prolific Organisations

20 organisations were observed to have major activity in IPO accounting for 60% share (2914 patents) of the total IOP patents. They were designated as prolific patenting organisation for this study. CSIR was the most important patenting organization with a major share of around 34% (1660 patents). The other nineteen organizations accounted for approx. 26% share (1254 patents) of total IOP patents. Among these 20 entities, 2 MNC subsidiaries were Hindustan Lever Ltd., (565 patents), and Hoechst India Ltd.(48 patents) occupied 2nd and 5th positions (IIT had no granted patent in USPTO for the period 1990-2002). IIT occupied 3rd position in IPO with 80 patents. It should be noted that the patents from the six IIT's are aggregated together. This has been done to have uniform basis of comparison with other entities like CSIR, DRDO which have number of laboratories/units. These entities i.e. CSIR, DRDO report their aggregate patents and thus separately analysing patents of each IIT was not undertaken. The other organizations exhibiting substantial activity were: DRDO (51), IOCL (43), BHEL (41), NRDC (41), Sree Chitra Tirunal Institute of Medical Sciences (41), SAIL (38), IPCL (37), Dr. Reddy's Laboratories (36) and Ranbaxy Labs Ltd. (36).

Table 57 highlights the patenting activity of the prolific organisations in the three sub-periods: 1990-94 (pre-WTO), 1995-98 (post-WTO), and 1999-2002 (current period).

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Table 57: Patent Activity of Prolific Organisations (1990-2002)

Organization/ Industry	No. of Patents (90- 94)	No. of Patents (95- 98)	No. of Patents (99- 02)	Total Patents (1990- 2002) (% Share)*
Council of Scientific & Industrial Research (CSIR)	314	532	814	1660 (34%)
Hindustan Lever Limited (HLL)	192	184	189	565 (12%)
Indian Institute of Technology (IIT)	14	26	40	80 (2%)
Defence Research & Development Organization (DRDO)	6	14	31	51 (1%)
Hoechst India Ltd	41	7	-	48 (1%)
Indian Oil Corporation Limited (IOCL)	13	7	23	43 (0.9%)
Bharat Heavy Electricals Limited (BHEL)	10	17	14	41(0.9%)
National Research Development Corporation (NRDC)	9	13	19	41 (0.9%)
Sree Chitra Tirunal Institute For Medical Sciences & Technology	4	21	16	41 (0.9%)
Steel Authority of India Ltd (SAIL)	7	21	10	38 (0.8%)
Indian Petrochemicals Corporation Limited (IPCL)	6	14	17	37 (0.8%)
Dr. Reddy's Research Foundation	-	7	29	36 (0.7%)
Ranbaxy Laboratories Limited	6	7	23	36 (0.7%)
Project & Development (India) Ltd.	19	11	1	31 (0.6%)
J. B. Chemicals & Pharmaceuticals Ltd.	-	25	6	31(0.6%)
Indian Jute Industry Research Association (IJIRA)	6	22	2	30 (0.6%)
Indian Space Research Organization (ISRO)	17	10	3	30 (0.6%)
National Council for Cement & Building Material (NCCBM)	19	10	1	30 (0.6%)
Lupin Laboratories Ltd.	1	10	19	30(0.6%)
South India Textile Research Association (SITRA)	8	13	1	22 (0.4%)

** % share in the total published Indian owned patents of IPO (90-2002)*

Majority of the organisations exhibited high degree of activity in the current period (1999-2002). Only Hoechst India Ltd, Project & Development (India) Ltd, ISRO and NCCBM exhibited decreasing trend. Some organisations like IOCL, SAIL exhibited random activity. HLL had almost similar levels of activity in all three designated periods.

b) Collaborative Activity

Collaboration activity was again less and mirrored the activity in USPTO. A total number of 35 joint patents (out of 4848 IOP patents) were observed among the Indian institutions in IPO. Table 58 details the collaboration activity in IPO.

Table 58: Collaborative Patents of Indian Organisations (1990-2002)

Organizations (No. of patents)	Collaborating with (No. of Collaborative Patents)
CSIR (1660)	Nicholas Piramal India Ltd (2)
	Keshava Deva Malaviya Institute of Petroleum Exploration (2)
	Department of Biotechnology (DBT) (1)
	Indian Oil Corporation Ltd (IOCL) (1) **
	Novo Nordisk A/S (1)
	Department of Science & Technology (DST) (1)**
	Department of Electronics (DOE) (1) **
Indian Institute of Technology (80)	Metallurgical & Engineering Consultants (India) Ltd (4)**
	Madras Refineries Ltd (1)
	Department of Science & Technology (DST) (1)
Indian Oil Corporation Ltd. (43)	Engineers India Ltd (1)
South India Textile Research Association (22)	Milltex Engineers (P) Ltd (1)**
Agharkar Research Institute (9)	Eco Solar Systems India Pvt Ltd (2)
	Central Bee Research And Training Institute (1)
National Institute of Immunology (6)	Central Sericulture Research and Training Institute (2)
National Research Development Corporation (41)	Kusum Dhatu Pvt Ltd (1)
Vittal Mallya Scientific Research Foundation (19)	Rennaissance Herbs; Inc (1)**
Indian Institute of Science (19)	Vittal Mallya Scientific Research Foundation (1)**

Organizations (No. of patents)	Collaborating with (No. of Collaborative Patents)
Sir Padampat Research Centre (11)	JK Synthetics Ltd (1)**
Otto India Private Ltd (9)	Still Carl Gmbh Co KG (1)*
Oil & natural Gas commission (8)	Institute of Drilling Technology (1) **
Dalmia Institute of Scientific and Industrial Research (6)	Orissa Cement Ltd (1) **
Engineers India Ltd (3)	Gujarat Narmada Valley Fertilizers Co Ltd (1)
Alpha Research Laboratories (Pvt) Ltd (2)	Kaemia Industries Limited (1)
Regional Engineering College (1)	Individual (1)
Desai Brithers Ltd (1)	Chotabhai Jethabhai Patel, Tobacco Products (1)
Institut Armand-Frappier (1)	Punjab Agro Industries Corporation Ltd (1)
Dalmia Indistries Ltd (1)	Dalmia Centre for Biotechnology (1)

** collaborations during the pre-WTO period (1990-94)*
*** collaborations during the post-WTO period (1995-98)*

Table 58 points out that most of the linkages were in the current period (1999-2002). Some linkages are shown involving research institution and firms, and between university and industrial firms. These types of linkages are important particularly in science-based innovations i.e. in biotechnology, nanotechnology, etc.

c) Sector Activity

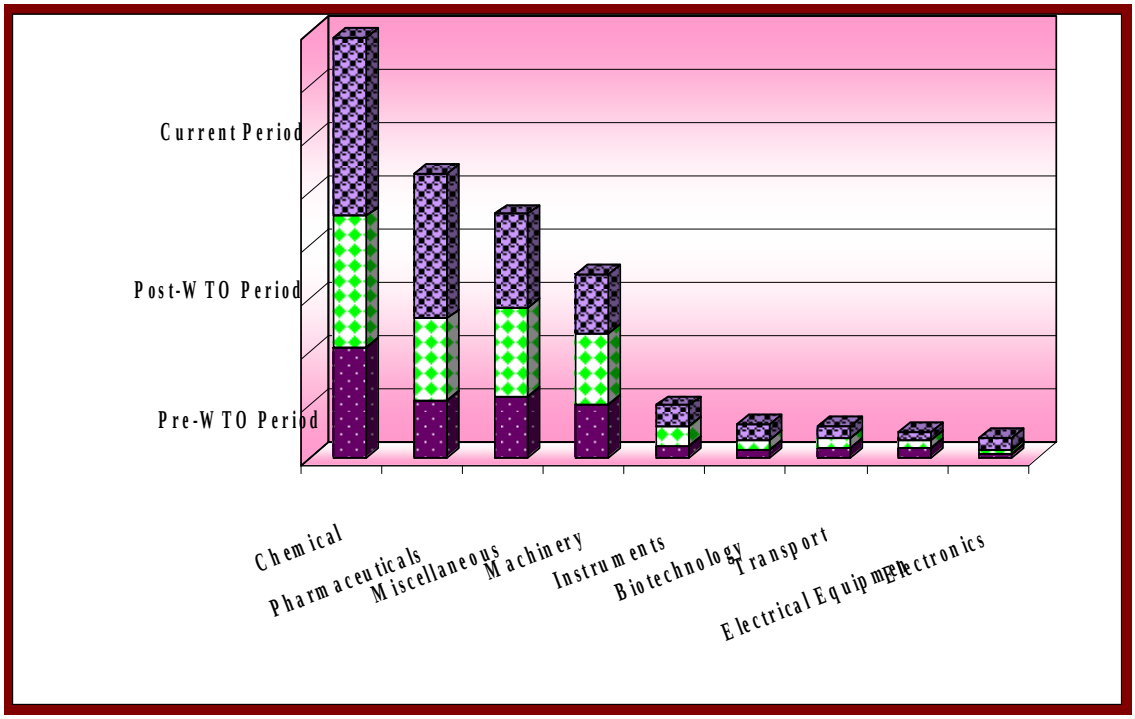
Similar to USPTO, Indian institutions had addressed all the 9 technology sectors. 'Pharmaceuticals' and 'Chemicals' were again the major sectors of activity and accounted for around 55% share of total patents. However, unlike USPTO, patenting activity in sectors 'Machinery', and 'Instruments' were also substantial. Table 59 and Figure 29 highlight the overall patenting activity of Indian Institutions in major sectors as well as during the three sub-periods: Pre/ post WTO and current period.

Table 59: Activity of Indian Organisations in Major Sectors: Overall and in Sub-periods

Sectors	No. of Patents (90-94)	No. of Patents (95-98)	No. of Patents (99-02)	Total Patents (1990-2002) (% of total)
Chemical	419	492	668	1579 (33%)
Pharmaceuticals	221	305	547	1073 (22%)

Miscellaneous	234	333	352	919 (19%)
Machinery	201	267	223	691 (14%)
Instruments	48	71	81	200 (4%)
Biotechnology	32	38	60	130 (3%)
Transport	38	41	43	122 (2%)
Electrical Equipment	39	30	30	99 (2%)
Electronics	15	17	42	74 (2%)

Figure 29: Activity of Indian Organisations in Major Sectors in the Pre/Post-WTO and Current period



The activity of different sectors in the three designated periods underscores many important points. 'Electrical equipment' was the only sector that exhibited declining trend. 'Biotechnology' exhibited steady increase in patenting activity. Unlike USPTO, some degree of activity was observed in the 'Transport' sector (*this area accounted for only four patents in USPTO*).

d) Sub-sector Activity

Out of 43 technology sub-sectors, patenting activity was observed in 41 sub-sectors. Only in two sub-sectors 'Tobacco products' and 'Publishing and printing',

there was no patenting activity. Thus patenting activity was widespread i.e. across different sub-sectors unlike USPTO were only 26 sub-sectors were addressed. Majority of the sub-sectors addressed more than 10 patents in the entire period.

Within 'Chemical' sector, 'Basic chemical' was the major sub-sector contributing to 70% of activity. 'Special purpose machinery' showed dominance under 'Machinery' sector. Within the Transport sector, 'Motor vehicles' attracted the maximum patenting i.e. 88 patents. Similar to USPTO, high performing sub-sectors within 'Miscellaneous' were 'Food & beverages' (203 patents), 'Basic metals' (185 patents), 'Non-metallic mineral products' (161 patents) and 'Fabricated metals products' (119 patents). Only some sub-sectors had insignificant activity. Table 60 highlights the sub-sectors with low patenting activity.

Table 60: Sub-sectors of Lower Activity

Sub-Sectors	No. of Patents (90-94)	No. of Patents (95-98)	No. of Patents (99-02)	Total Patents (90-02)
Lighting equipment	4	3	1	8
Watches, clocks	-	4	2	6
Man-made fibres	3	-	1	4
Wood products	-	3	1	4
Paint. Varnishes	1	1	1	3
Weapons and ammunition	-	-	3	3
Leather articles	-	2	1	3
Wearing apparel	-	1	-	1
Tobacco products	-	-	-	-
TOTAL	8	14	10	32

The major technological domain of patents in IPO was more varied than that of USPTO. The technological domains addressed by patents in 'Pharmaceuticals', 'Basic chemicals', and in 'Pesticides and agrochemicals' were similar to that in USPTO.

Apart from above, there were distinct technological domains addressed by different sub-sectors. Table 61 illustrates the details.

Table 61: Major Technological Domains of Patents in IPO

Sector / Sub-sectors	Technological domain (Patents)
Pharmaceuticals	Medicinal preparations (717),Heterocyclic compounds (305), Micro-organisms, compositions thereof (36), Fermentation or enzyme-using processes to synthesise a desired chemical compound (29)
Chemicals / Basic Chemicals	Acrylic or carboxylic compounds (402),Chemical or physical processes, (120),Non-metallic elements (87),Macromolecular compounds (57)
Chemicals / Soaps, detergents, toilet preparations	Detergent compositions, soap or soap-making (207)
Chemicals / Other Chemicals	Lubricating compositions (18)
Chemicals / Pesticides, Agrochemical products	Biocides (139)
Misc./ Non-metallic mineral products	Lime; magnesia; slag; cements; compositions thereof, treatment of natural stone (123)
Misc / Food, Beverages	Foods, foodstuffs, or non-alcoholic beverages, their preparation or treatment (96)
Misc/ Basic metals	Treatment of alloys (39) Production or refining of metals, pre-treatment of raw materials (26)
Misc / Rubber And Plastic Products	Containers for storage or transport of articles or materials, thereof; packaging elements (27)
Machinery/Special purpose machinery	Machines, apparatus or devices for, or methods of, packaging articles or materials (36) Spinning or twisting, natural or artificial threads or fibres (19)
Machinery/ Non-Specific Purpose Machinery	Separation by physical or chemical processes (57)
Machinery / Domestic appliances	Kitchen equipment; coffee mills; spice mills; apparatus For making beverages (43)

e) Sector Activity of Prolific Organisations

Activity in the various sectors/sub-sectors of the 20 prolific institutes identified earlier (refer table 57) was examined in details. Table 62 exhibits the activity in various sectors by these prolific institutions. Unlike USPTO, considerable distinctions were visible in the technological profile (at the sector level). It is thus possible to group a set of prolific organizations with a particular sector (s) focus.

CSIR, HLL, IOCL and Project & Development (India) Ltd. had major share of patents in Chemicals. Additionally CSIR and HLL had substantial activity in 'Pharmaceuticals'. Ranbaxy, Dr Reddy's Research Foundation, and J.B. Chemicals &

Pharmaceuticals Ltd had their major patent focus in 'Pharmaceuticals'. BHEL, IJIRA, NCCBM and SITRA had their major patenting activity in the 'Machinery' sector. CSIR and HLL also exhibited some degree of activity in this sector. Except for CSIR, patenting activity by other prolific institutions in the Electrical sector was insignificant.

SAIL and 'Sree Chitra Tirunal Institute of Medical Science & Technology' had their major patenting activity in the 'Instrumentation' sector. CSIR also exhibited some degree of activity in this sector. Patenting activity in the 'Transport' sector was hardly addressed by prolific institutions. Similar to the 'Electrical' sector, only CSIR exhibited some degree of activity in the 'Electronic' sector. CSIR, HLL, IIT, DRDO, SAIL, ISRO, and NCCBM had substantial share of patenting activity in the 'Miscellaneous' sector (the activity within the 'Miscellaneous' sector of these institutions are elaborated in the next section).

Table 62: Sector Activity of Prolific Institutes

Institution	Sectors							
	Chemical	Pharmaceuticals	Machinery	Electrical	Instruments	Transport	Electronics	Miscell
Council of Scientific & Industrial Research	662	406	137	24	56	8	24	304
Hindustan Lever Ltd	271	159	37	-	4	2	-	88
Indian Institute of Technology	11	8	14	2	9	4	4	22
Defence Research & Development Corporation	15	9	4	1	4	1	1	16
Hoechst India Ltd.	1	47	-	-	-	-	-	-
Indian Oil Corporation Limited	33	-	1	2	-	1	1	4
Bharat Heavy Electrical Limited	2	-	23	1	3	-	-	12
National Research Development Corporation	8	7	9	1	4	1	-	9
Sree Chitra Institute of Medical Science & Technology	13	12	1	-	15	-	-	-
Steel authority of India Ltd.	2	-	8	-	14	-	1	22
Indian Petrochemical Limited	29	3	5	-	-	-	-	-
Ranbaxy Laboratories Ltd.	5	31	-	-	-	-	-	-
Dr Reddy's Research Foundation	4	31	-	-	-	1	-	-
J. B. Chemicals & Pharmaceuticals Ltd.	3	28	-	-	-	-	-	-
P & D (India) Ltd.	22	1	7	-	-	-	-	1
Indian Jute Industry Research Association	4	1	17	3	-	-	-	5

Institution	Sectors							
	Chemical	Pharmaceuticals	Machinery	Electrical	Instruments	Transport	Electronics	Miscell
Indian Space Research Organization	3	-	5	1	5	1	2	13
National Council for Cement & Building Material	2	-	15	-	-	2	-	10
Lupin Laboratories Ltd.	4	24	-	-	-	-	-	-
South India Textile Research Association	-	-	18	-	2	-	-	1

CSIR had addressed a total of 38 technological sectors during the entire period of study. There was not much change in the number of sub-sectors addressed in each sub-period. The highest activity was in 'Basic chemicals' accounting for 34% patents of CSIR granted patents. Apart from 'Basic chemical', 'Other chemicals' (63 patents) and 'Pesticides, agro-chemical products' (35 patents) also exhibited substantial activity under Chemical sector. Basic metals (115 patents), Non-metallic mineral products (73 patents), Food & beverages (34 patents), Fabricated metal products (32 patents) accounted for the major share of activity within the Miscellaneous sector. Two sub-sectors that exhibited considerable activity within Machinery sector were 'Special purpose machinery', and 'Non-specific purpose machinery'.

CSIR patenting activity was mainly concentrated in 'Basic chemical' and sector 'Pharmaceuticals' and accounted for 34% and 24% respectively of their total patents. In the 'Miscellaneous' sector, maximum activity was in sub-sector 'Non-metallic mineral products' (4.5%) and 'Basic metals' (7%). Maximum activity was exhibited in the post-WTO period.

In HLL, maximum activity was in the sector 'Pharmaceuticals' (28%) and sub-sectors 'Soap, detergent and toilet preparations' (34%), 'Food & beverages' and 'Basic chemical' also have substantial activity with 11% and 9% share of their overall patents respectively. Table 63 illustrates the technological profile of prolific organisations.

Table 63: Major Technological Domains of Patents of Prolific Organisations

Organization	Major Technological Sectors (No. of patents)	Relative Specialisation	Major Technological Domains	Major Application Areas
CSIR	Basic Chemical (563)	1.53	Catalysts	Silicon; Compounds (22) Compounds comprising of aromatic ring (18)
	Pharmaceuticals (406)	1.13	Medicinal preparations of organic ingredients (109)	Heterocyclic compounds (29) Enzymes, e.g. ligases ; proenzymes; compositions thereof (20)
	Misc / Food, Beverages (34)	0.09	Foods or foodstuffs; their preparation or treatment (14)	–
	Misc / Non-metallic mineral products (73)	0.20	Shaped ceramic products characterised by their composition (26)	–
	Misc / Pesticides, agro-chemical products (35)	0.09	Biocides, pest repellants or attractants, or plant growth regulators containing plant material (10)	–
	Misc / Fabricated metal products (32)	0.87	Electroplating; baths thereof (11)	–
Dr. Reddy's	Pharmaceuticals (31)	3.90	Heterocyclic compounds (13)	–
Ranbaxy	Pharmaceuticals (31)	3.90	Medicinal preparations of organic ingredients (17)	–
HLL	Pharmaceuticals (159)	1.05	Cosmetics or similar toilet preparations (131)	–

Organization	Major Technological Sectors (No. of patents)	Relative Specialisation	Major Technological Domains	Major Application Areas
	Basic Chemical (54)	0.43	Silicon; compounds thereof (10)	–
	Misc / Food, Beverages (61)	0.49	Food products	Frozen sweets, e.g. ice confectionery, ice-cream; mixtures thereof (15) Tea; Tea substitutes; preparations thereof (14)
	Chemicals / Soaps, detergents, toilet preparations (194)	1.55	Other compounding ingredients of detergent compositions (67)	Detergent compositions based essentially on surface-active compounds; (63) Compositions of detergents based essentially on soap (26)
	Special purpose machinery (28)	0.24	Packaging of materials presenting special problems (12)	–
IOCL	Chemicals / Other Chemicals (15)	1.57	Lubricating compositions characterised by the base-material being a mineral or fatty oil (5)	–
SAIL	Misc / Non-metallic mineral products (10)	1.19	Shaped ceramic products characterised by their composition (8)	–
Sree Chitra Tirunal Medical Institute	Medical Equipment (15)	1.65	Suction or pumping devices for medical purposes (5)	–

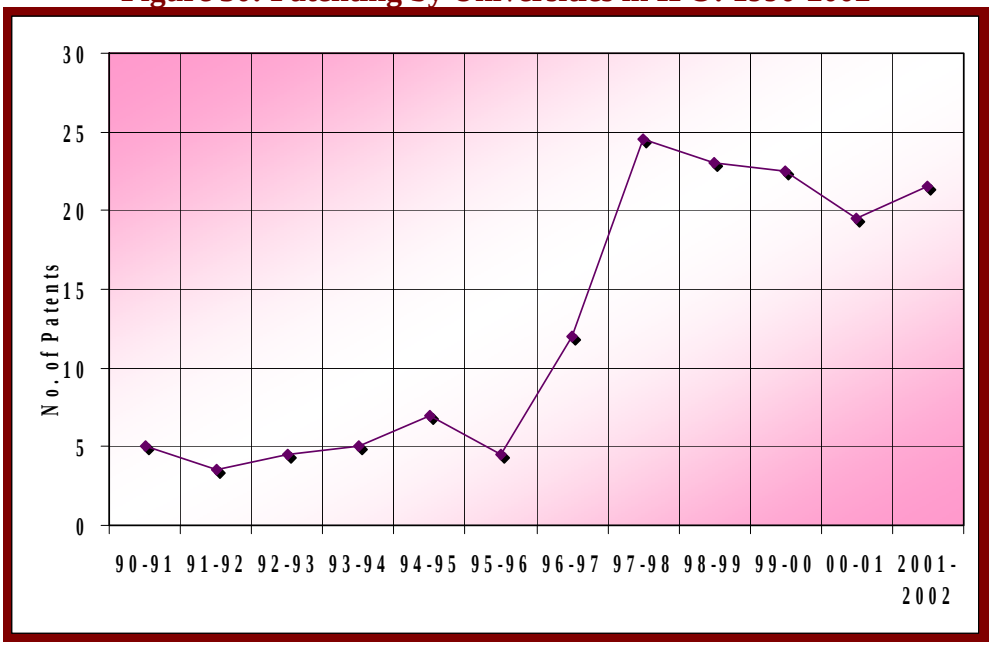
3.3.3 Patenting by Indian Universities in IPO (1990-2002)

a) Overview

Unlike USPTO, Indian universities exhibited some degree of activity in IPO during the period 1990-2002. Patenting by university is important as it demonstrates research/innovation activity at the university level. Many of the emerging new technologies are science based. Innovations in areas like biotechnology, nanotechnology have developed due to close interaction between university and industry. Thus it is important to uncover to what extent innovations are taking place in Indian universities. Patenting activity is an important indication of innovation activity and thus patenting activity by India universities are being discussed in more details.

171 patents (approx. 3% of total domestic patents) were granted to 21 universities in IPO. In USPTO, patenting activity by university was insignificant. Six universities accounted for 8 patents in USPTO. Universities exhibited an increasing trend over the years in IPO. Substantial increase in patenting activity was observed in the current period as 52% of university patents were granted during this period. The relative increase in patenting activity during the current period from earlier two periods, pre-WTO and post-WTO was 69% and 34% respectively. Figures 30 show the patenting activity by universities in the entire period. A two-year moving average was taken to overcome random fluctuations.

Figure 30: Patenting by Universities in IPO: 1990-2002



Inspite of taking a two-year moving average, the fluctuations are apparent. This exhibits that in some years more patents were granted and vice-versa. In the three sub-periods there were 26 patents (1990-94), 58 patents (1995-98), and 97 patents (1999-2002) respectively. Thus there was steady increase in activity over the years.

A total number of 21 universities acquired patents during the period. The number of distinct universities involved in patenting showed substantial increase in each of the sub-periods. 3 universities were involved in patenting activity in 1990-94 whereas 8 and 21 universities were involved in the later two periods (1995-98, 1999-2002)

Table 64 exhibits the universities involved in patenting activity in the entire period.

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Table 64: Universities Patenting in IPO (1990-2002)

University Name	No. of patents
Indian Institute of Technology (IITs)	**80**
Sree Chitra Tirunal Institute for Medical Sciences & Technology	**41**
Indian Institute of Science	**19**
Jadavpur University	5
Osmania University	4
Forest Research Institute	3
Bharati Vidyapeeth	2
Bhavnagar University	2
Hyderabad (Sind) National Col-Legiate Board	2
Kurukshetra University	2
University of Bombay	2
All India Institute of Medical Sciences	2
Ajit Nivas Arts College	1
Assam Agricultural University	1
Assam Engineering College	1
Birla Institute of Technology	1
Pune University	1
Punjab University	1
Regional Engineering College	1
Sri Venkateswara University	1
University of Delhi	1

Table 64 underscores the fact that only a few universities accounted for majority of patents in IPO. This again is similar to the overall Indian patenting activity i.e. concentration of majority of patents in a few institutions. However, it is interesting to note that IITs accounted for the maximum number of patents in IPO. IITs had no granted patents in USPTO. IITs accounted for 2.0% of total domestic patents and around 47% of patents by universities. 'Sree Chitra Institute of Medical

Sciences' follows IIT with around 24% of patents granted to universities. Table 65 illustrates the details of the patenting activity by the prominent patenting universities

Table 65: Patent Activity of Prolific Universities (1990-2002)

Universities	No. of Patents (90- 94)	No. of Patents (95- 98)	No. of Patents (99- 02)	Total Patents (1990- 2002) (% Share)*
Indian Institute of Technology	14	26	40	80 (1.20%)
Sree Chitra Institute for Medical Sciences & Technology	4	21	16	41 (0.6%)
Indian Institute of Science	8	6	5	19 (0.30%)
Jadavpur University	-	1	4	5 (0.07%)
Osmania University	-	1	3	4 (0.06%)

***** % share in the total domestic patents in IPO (90-2002)

Table 65 points out that except for IISc, substantial increase in patenting activity had taken place over the three time period.

b) Collaborative Patents of Universities

Collaborative patents by universities in IPO were a few in number (7 patents) and accounted for only 4% of the total patents. 3 of these collaborative patents were during the Post-WTO period and 4 during the Current period.

Table 66: Collaborative Patents of Universities

Organization	No. of patents (Collaborations)	No. of collaborations	Collaboration with
Indian Institute of Technology	80 (5)	4	Metallurgical & Engineering Consultants (India) Ltd.
		1	Department of Science & Technology
		1	Madras Refineries Ltd.
Indian Institute of Science	19 (1)	1	Vittal Mallya Scientific Research Foundation
Regional Engineering College	1 (1)	1	Individual

*** Three collaborative patents during Post-WTO Period & four during Current Period*

University-industry interaction is very important. The joint patent is a good reflection of this activity. Thus some interactions exhibited by Indian universities with firms is a good beginning.

c) Patenting by Universities in Major Sectors

Universities had shown high degree of patenting in sectors such as miscellaneous (high activity/performing subsectors within this were Basic metals, Fabricated metal products, Food beverages and Non-metallic mineral products) Pharmaceuticals, Chemicals and Machinery. The major sector Instruments also had a significant number of patents.

Figure 31: Patenting by Universities in Major Sectors (1990-2002)

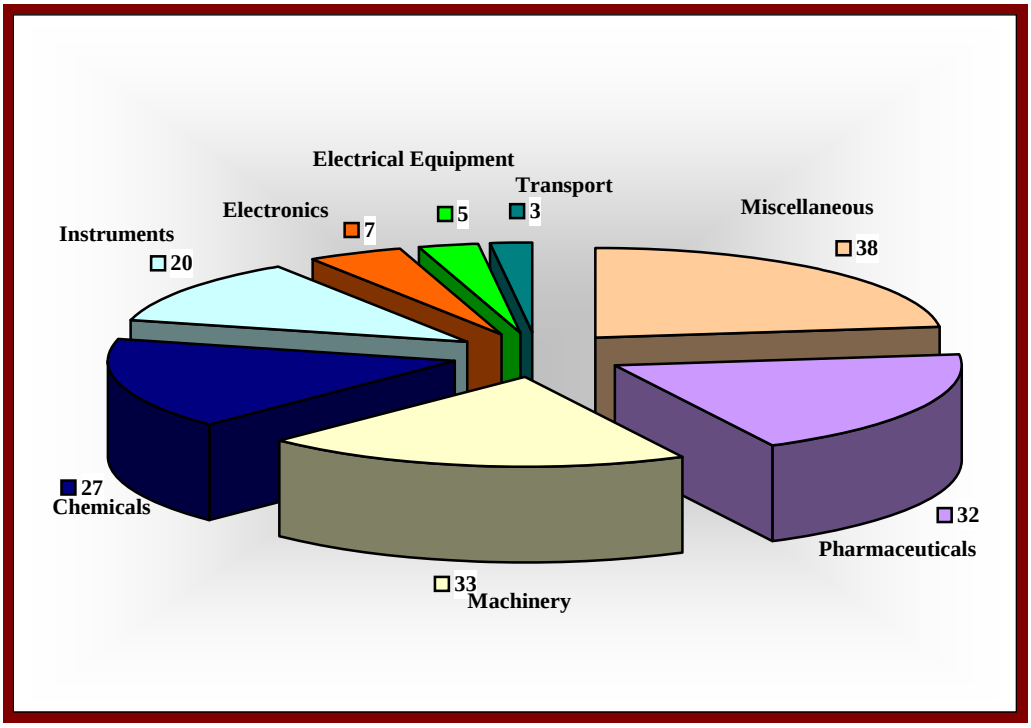


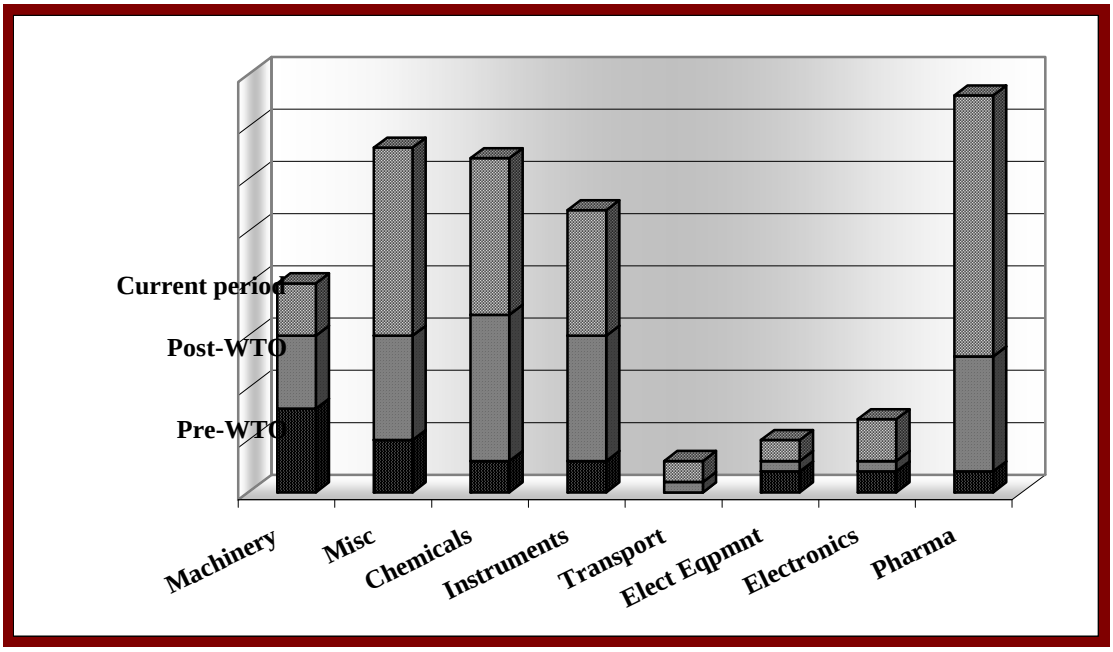
Table 67: Patents in Major Sectors during the Three Periods of Activity

Designated period / Sector	Pre-WTO (1990-94)	Post-WTO (1995-98)	Current (1999-02)
Pharmaceuticals	2	11	25
Miscellaneous	5	10	18
Chemicals	3	14	15
Instruments	3	12	12

Designated period / Sector	Pre-WTO (1990-94)	Post-WTO (1995-98)	Current (1999-02)
Machinery	8	7	5
Electronics	2	1	4
Electrical Equipment	2	1	2
Transport	0	1	2

Most of the sectors such as Pharmaceutical, Miscellaneous, Chemical and Instruments had demonstrated higher activity during the current period. Machinery was the only sector that had considerable activity during the pre-WTO period.

Figure 32: Patents in Major Sectors during the Three Sub-Periods of Activity



Within the 'Miscellaneous sector', the high performing subsectors were 'Basic metals', 'Fabricated metal products', 'Food, beverages & non-metallic mineral products'. Among other higher activity subsectors, 'Basic chemicals' had prominent activity. The activity in subsectors like 'Machine-tools', 'Medical equipment', 'Non-specific purpose machinery' and 'Special purpose machinery' also cannot be overlooked.

Table 68: Sub-sectors of Higher Activity

Sub-sectors	No. of patents (90-94)	No. of patents (95-98)	No. of patents (99-02)	Total Patents (1990-2002)
Basic chemicals	3	12	13	28
Medical equipment	3	9	7	19
Basic metals	1	5	1	7
Fabricated metal products	-	1	6	7
Machine tools	3	2	1	6
Special purpose machinery	2	2	2	6
Food, beverages	1	-	5	6
Non-specific purpose machinery	2	2	1	5
Non-metallic mineral products	2	1	2	5
Measuring instruments	-	2	3	5
Electronic components	1	-	3	4

d) Sector Activity of Prolific Institutes

The IITs had shown maximum patenting in the Miscellaneous sector especially in areas such as Basic metals and Fabricated metal products. The Machinery sector also exhibited significant activity followed by activity in Chemicals, Instruments, and Pharmaceuticals sector. *IITs was the only university that exhibited patenting activity in all sectors*. Sree Chitra Tirunal Institute on the other hand exhibited the maximum number of patents in the instruments sector. Some degree of activity was also observed in chemicals and pharmaceuticals sectors. *Majority of the patents of this university were obtained during the later two periods*. IISc had most of its patents in Chemicals. All 4 patents of Osmania university were granted in Pharmaceuticals.

3.3.4 Activity of Foreign Patents in IPO

a) Overview

Patenting by foreigners in IPO constituted 71% of the total patents (16009 patents) in the period 1990-2002. The patenting activity exhibited decline in the post-WTO period. A total of 17,833 PCT applications (as per 2002-2003 Annual Report of the Indian patent office) have entered national phase i.e. in the Indian patent office, from 1998 onwards and are being examined (*entering the national phase implies these patents have been filed through the PCT route and have designated India as one of the country in which the protection for the said patent has been sought*). Mailbox provision has resulted till date approx. 12,000 applications.

Patents can get advantage of the PCT first filing/priority date of 18 months before it is examined in the national patent offices of the designated country. An additional twelve months can be obtained if the applicant asks for international preliminary examination of the filed patent. Thus there would be many more patents that would enter the national phase. Thus only an extensive detailed analysis of the PCT patent applications filed in India, under examination and finally being sealed is required to obtain a complete view of the foreign patent activity in IPO. Till 2002 these patents were in examination stage and thus did not affect the result of this study (in this study patents that have been accepted by the Indian Patent Office were only taken into account).

The other option of filing product patents in Food, Agrochemicals, and Pharmaceuticals were provided from 1995 in IPO. But these patents would be examined only after the product patent is allowed in the IPO. This provision was created as per TRIPS requirement as India did not allow product patents in the above areas. In real terms there has been no decline as illustrated by Box 2, Overview Section of this chapter. However, as explained in Box 2 these patents would enter the examination process at a later stage and thus is not reflected in the present analysis. Figure 33 exhibits the patents filed by foreigners that were examined and sealed during the period of this study (however, there were a few patents that were in opposition). Three-year moving average was taken to take care of the random fluctuations.

Figure 33: Foreigners Patenting in IPO 1990-2002

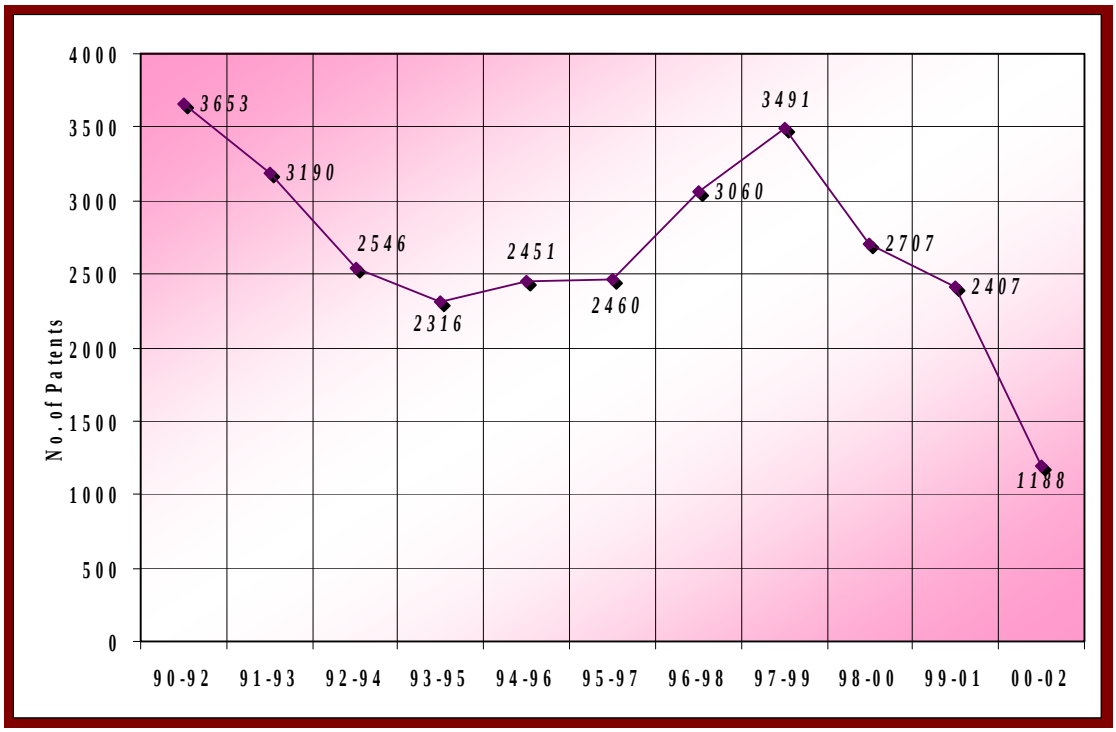


Table 69 exhibits patenting activity by foreigners in the three defined periods. The relative decline in the later period indicates that foreigners were entering IPO through other routes (PCT, 'Mailbox' provisions).

Table 69: Patenting by Foreigners in the Three Designated Sub-periods

Period	No. of patents
Pre-WTO Period (1990-94)	6515
Post-WTO Period (1995-98)	5082
Current Period (1999-02)	4413

b) Patenting by Different Types of Entities

Institutional patenting was the dominant category of patenting. There were 1524 institutional patents, constituting 95% of the total patents by foreigners in IPO. Only 755 patents were by individuals, less then 5% of the total patents in IPO. Within institutional patenting, industrial firms were the major contributor to the patenting activity, accounting for 65% of the total patents (14708 patents). Table 70 exhibits patents granted to different entities in the overall period as well as in the sub-periods.

Table 70: Year wise Trends in Patenting by Different Types of Foreign Organisitions

Year	Research	Industry	University	Individuals	OMD
1990-1994	264	**5883**	38	330	-
1995-1998	111	**4712**	21	250	-
1999-2002	94	**4112**	28	175	-
(Total) 1990-2002	469	**14708**	87	755	3

c) Prolific Foreign Organisations Patenting in IPO

The prominent foreign organisations that were granted patents in IPO were Hoechst Aktiengesellschaft and Proctor and Gamble, each being granted 276 patents. Other prolific foreign institutions were Siemens Aktiengesellschaft (237 patents), Maschinenfabrik Rieter AG (216 patents) and E.I.DU PONT de Nemours and company (215 patents). Organisations that exhibited major activity are shown in Table 71.

Table 71: Patenting by Prolific Foreign Organisations

Organizations / Institutes	No. of patents (90-94)	No. of patents (95-98)	No. of patents (99-02)	No of patents (1990-2002) (% of total foreign patents)
Hoechst Aktiengesellschaft	119	113	44	276 (1.7%)
Procter & Gamble Company	25	81	170	276 (1.7%)
Siemens Aktiengesellschaft	70	81	86	237 (1.5%)
E. I. Du Pont De Nemours and Company	99	73	43	215 (1.3%)
Maschinenfabrik Rieter AG	60	85	42	187 (1.2%)
Lubrizol Corporation	77	70	19	166 (1.0%)
Societe Des Produits Nestle SA	35	37	69	141 (0.9%)
Shell International Research Maatschappij BV	74	33	17	124 (0.8%)
General Electric Company	24	37	60	121 (0.8%)
Colgate Palmolive Company	66	27	18	111 (0.7%)
Institut Francais Du Petrole	50	26	23	99 (0.6%)

Organizations / Institutes	No. of patents (90-94)	No. of patents (95-98)	No. of patents (99-02)	No of patents (1990-2002) (% of total foreign patents)
Westinghouse Electric Corporation	82	14	-	96 (0.6%)
International Business Machines Corporation	4	67	20	91 (0.6%)
UOP INC	39	31	17	87 (0.5%)
Imperial Chemical Industries PLC	35	23	26	84 (0.5%)
Daewoo Electronics Co Ltd	-	2	80	82 (0.5%)
Minnesota Mining & Manufacturing Company	49	32	-	81 (0.5%)
Motorola INC	10	37	29	76 (0.5%)
Samsung Electron Devices Co Ltd	19	67	-	75 (0.5%)

d) Prominent Patenting Activity of Major Countries

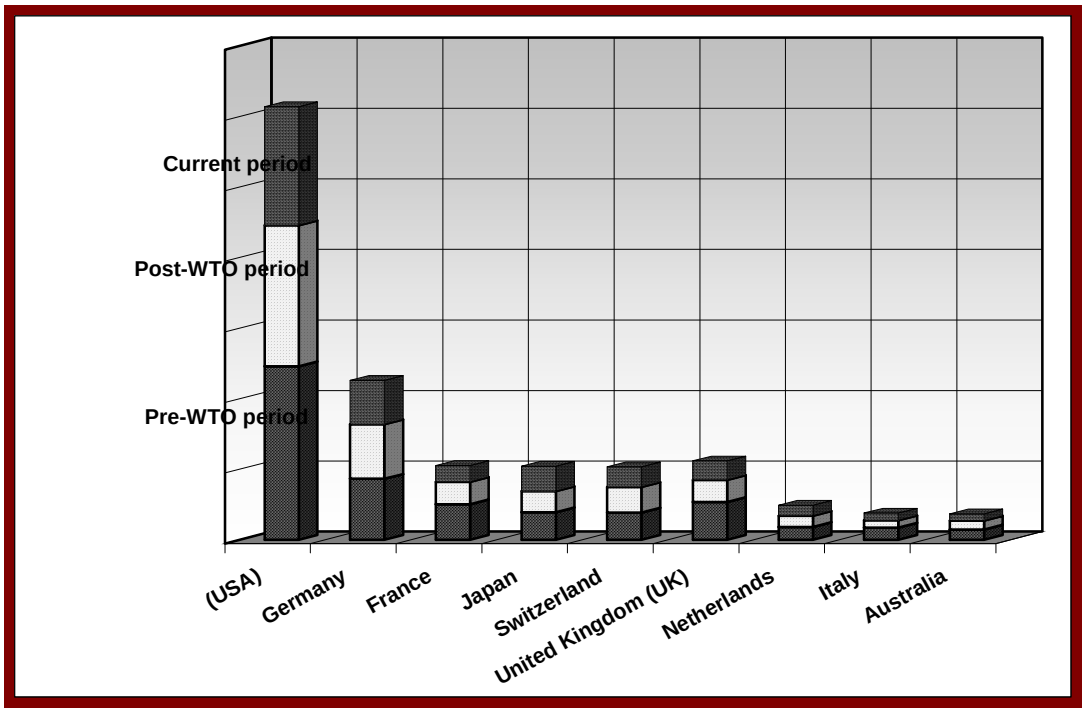
USA was the prominent country accounting for 38% of patents in IPO followed by Germany with around 14% patents. Foreign filing was also prominent from France, Japan and Switzerland each contributing approximately 7% of the total patents. The above five countries had a share of 72% of the total patents by foreigners in the entire period.

Table 72 illustrates the activity of foreign filing by countries prominent in IPO during the three designated periods of activity. It is worth noticing that except for Japan, all other countries exhibited a decrease in patenting activity over the periods. Only Japan shows an increase during the current period from the post-WTO period. (Although highlighted by Box 2 that in real sense there might be increase in activity as patents are being filed by countries through two additional routes, PCT and mailbox provision). It can be probably concluded that these countries are using different routes to enter the IPO.

Table 72: Prominent Patenting Activity of Major Countries during the Three Designated Periods

Country	No. of patents (1990-1994)	No. of patents (1995-1998)	No. of patents (1999-2002)	Total patents 1990-2002 (% share)
USA	2464	1995	1682	6141 (38%)
Germany	867	774	621	2262 (14%)
France	507	318	232	1057 (7%)
Japan	394	300	351	1045 (7%)
Switzerland	386	366	285	1037 (6%)
United Kingdom (UK)	536	315	270	947 (6%)
Netherlands	185	158	151	494 (3%)
Italy	174	107	100	381 (2%)
Australia	148	127	96	371 (2%)

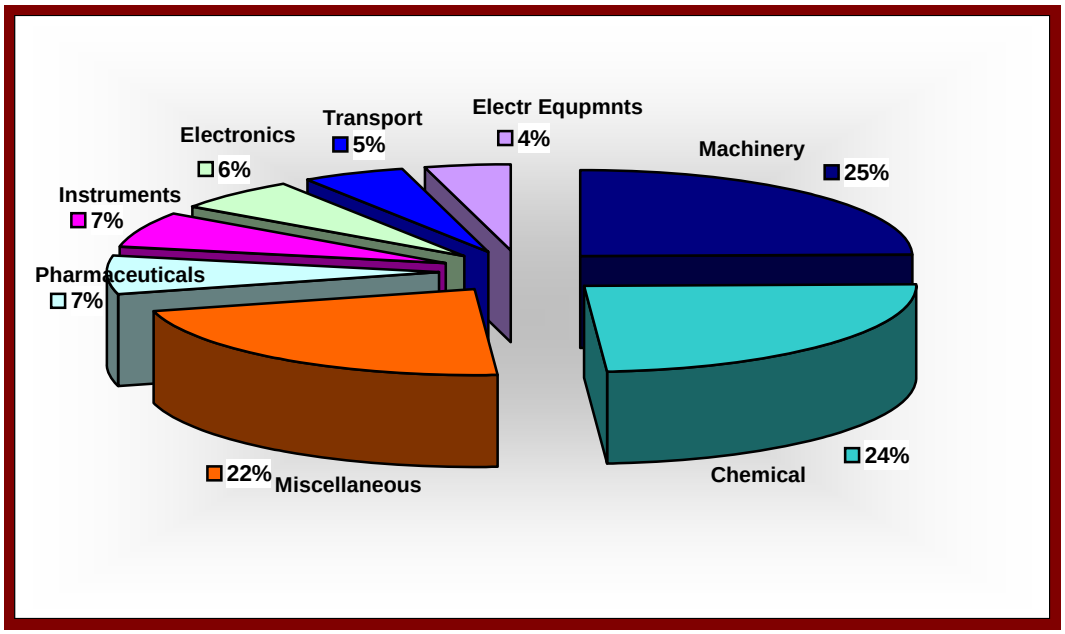
Figure 34: Patenting Activity of Major Countries in Pre/post WTO and the Current Period



e) Sector Activity

Machinery and Chemical were the dominant sectors accounting for 25% and 24% of patents respectively. High performing subsectors were 'Rubber and plastic products', 'Basic metals', 'Non-metallic mineral products' and 'Office machinery and Computers'. All these sub-sectors were under 'Miscellaneous' sector. The activity under major sectors are shown in Figure 35.

Figure 35: Patenting Activity in Major Sectors (1990-2002)



The focus of patents by foreigners was different then that of domestic institutions patenting in IPO. Majority of patenting by domestic institutions were in Chemicals (33% of the total patents), and Pharmaceuticals (2% of the total patents). Table 73 further highlights the patenting activity in the three sub-periods.

Table 73: Patenting Activity in Different Sectors in the Three Sub-Periods

SECTORS	1990-94	1995-98	1999-02	Total Patents 1990-2002 (% share)
Machinery	1630	1282	1005	3917 (24%)
Chemical	1588	1178	1025	3791 (24%)
Miscellaneous	1489	1048	934	3471 (22%)
Pharmaceuticals	397	314	413	1124 (7%)
Instruments	411	343	296	1050 (7%)
Electronics	299	345	296	940 (6%)

SECTORS	1990-94	1995-98	1999-02	Total Patents 1990-2002 (% share)
Transport	375	236	194	805 (5%)
Electrical Equipments	289	221	148	658 (4%)
Biotechnology	54	37	37	128 (1%)
Total	6533	5004	4348	15885

The relative decline in activity in all the sub-sectors in the later period may not reflect the true picture as intensive patent filing would have taken place in some sectors. They would be reflected in the foreign patents entering the IPO through the other two routes (PCT filing, and 'Mailbox' provisions).

f) Sub-sector Activity

All the 43 sub-sectors were addressed by foreign patents. Except for two subsectors, 'Paints & varnishes' (6 patents) and 'Watches & clocks' (7 patents) all the other subsectors had more than 15 patents in the entire period. Unlike Indian patenting activity in IPO, 'Instrument', 'Electrical equipment' and 'Electronic' sectors exhibited substantial patenting activity. The sub-sectors that exhibited maximum activity are shown in Table 74.

Table 74: Higher Activity Sub-Sectors of Foreign Patents

Sub-Sectors	90-94	95-98	99-02	Total
Basic chemical	1267	966	834	3067
Special purpose machinery	697	596	386	1679
Non-specific purpose machinery	400	269	221	890
Rubber & plastic products	294	219	174	687
Energy machinery	306	196	127	629
Basic metals	301	185	132	618
Medical equipment	178	194	191	563
Motor vehicles	226	143	127	496
Non-metallic mineral products	269	95	112	476
Signal Transmission, Telecommunications	132	119	188	439
Office machinery and computers	155	128	123	406

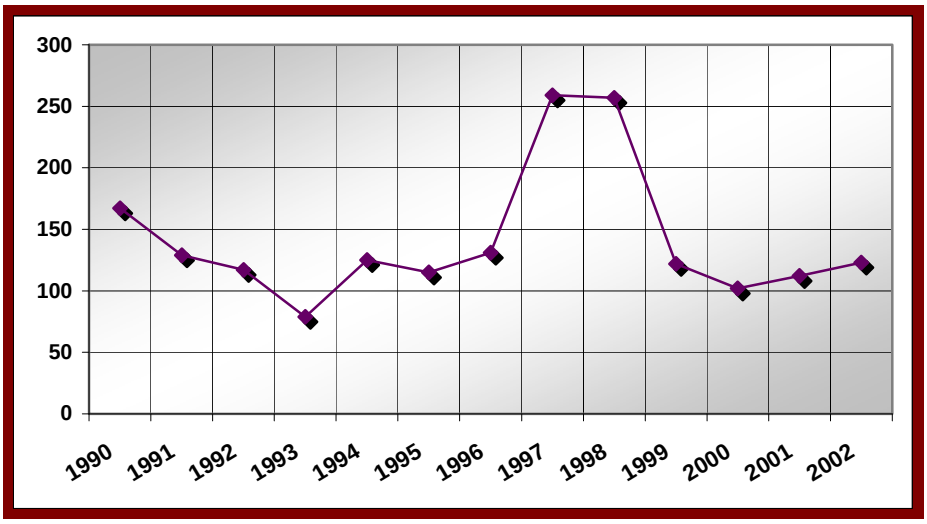
Sub-Sectors	90-94	95-98	99-02	Total
Fabricated metal products	150	130	100	380
Electric distribution, control, wire, cable	159	121	68	348
Other chemicals	174	123	51	348
Food, beverages	109	92	141	342
Electronic components	130	133	59	322
Domestic appliances	58	89	171	318
Machine-tools	125	103	82	310
Other transport equipment	149	93	67	309

3.3.5 Patenting by Indian Individuals in IPO (1990-2002)

a) Overview

Considerable number of patents was granted to Indian individuals in IPO. Individuals accounted for around 1838 (8%) of total patents in IPO. But the patenting activity of individuals exhibited random activity. The lowest activity was in the year 1993 while the years 1997 and 1998 saw the highest activity.

Figure 36: Year-wise Trends in Patenting Activity by Indian Individuals

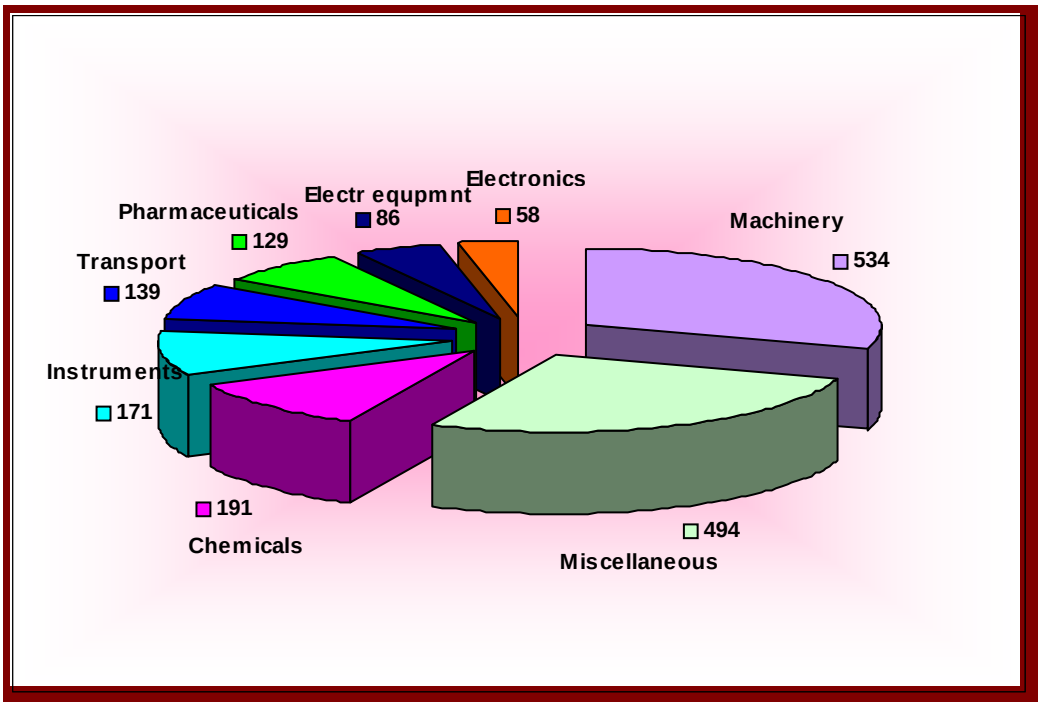


The post-WTO period exhibited the highest patenting activity (762 patents) by individuals followed by pre-WTO period (617 patents). This was unlike patenting by domestic institutions were maximum activity was observed in the Current period (1999-2002). Individuals exhibited the lowest activity in the Current period (459 patents). The reason for this decline is not clear.

b) Patenting by Individuals in Major Sectors

Machinery was the major sector exhibiting the highest activity (~29%) among individuals. This was similar to the patenting activity by foreigners. Miscellaneous sector counted for 27% of patents. Chemicals and Instruments were the other prolific sectors of activity with 10% and 9% patents of total patents granted to individuals.

Figure 37: Patenting by Individuals in Major Sectors (1990-2002)

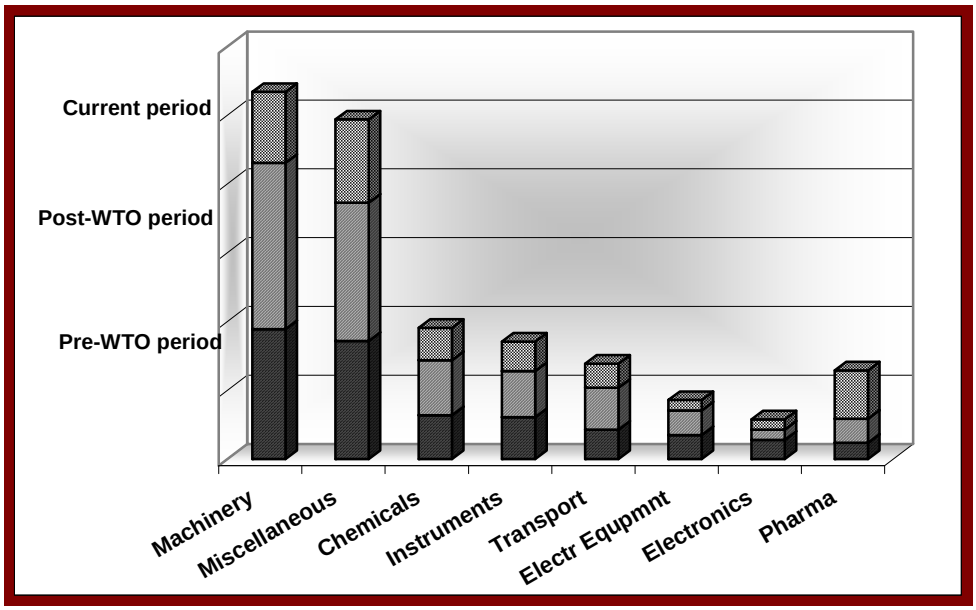


Low patenting in some sectors/sub-sectors probably points out the pre-requisite of institutional set-ups.

Table 75: Patents in Major Sectors during the Three Sub-periods of Activity

Major Sector	Pre-WTO (1990-94)	Post-WTO (1995-98)	Current (1999-02)
Machinery	189	242	103
Miscellaneous	172	201	121
Chemicals	64	80	47
Instruments	61	67	43
Transport	43	61	35
Electrical Equipment	35	36	15
Electronics	28	15	15
Pharmaceuticals	24	35	70
Biotechnology	1	5	4

Figure 38: Patents in Major Sectors during the Three Sub-periods of Activity



There were some sub-sectors that had substantial activity within each major sector. Table 76 highlights the sub-sectors of high patenting activity.

Table 76: Sub-sectors of Higher Activity in Three Designated Sub-Periods

Sector/Sub-sector	No. of patents (90-94)	No. of patents (95-98)	No. of patents (99-02)	Total Patents (1990-2002)
Machinery / Special purpose machinery	51	61	33	145
Machinery / Energy machinery	48	55	18	121
Machinery / Non-specific purpose machinery	34	49	28	111
Machinery / Domestic appliances	27	44	11	82
Machinery / Agricultural and forestry machinery	12	20	6	38
Machinery / Machine-tools	17	13	7	37
Chemical / Basic chemical	52	53	32	137
Chemical / Pesticides, Agro-chemical Products	7	20	9	36
Instruments / Medical equipment	27	43	25	95
Instruments / Measuring instruments	23	20	14	57
Miscellaneous / Fabricated metal products	49	40	22	111
Miscellaneous / Rubber & plastic products	33	34	16	83
Miscellaneous / Furniture, consumer goods	30	18	19	67
Miscellaneous / Food, Beverages	8	42	14	64
Miscellaneous / Non-metallic mineral products	16	30	15	61
Miscellaneous / Basic metals	20	11	14	45
Miscellaneous / Office machinery and computers	6	9	6	21

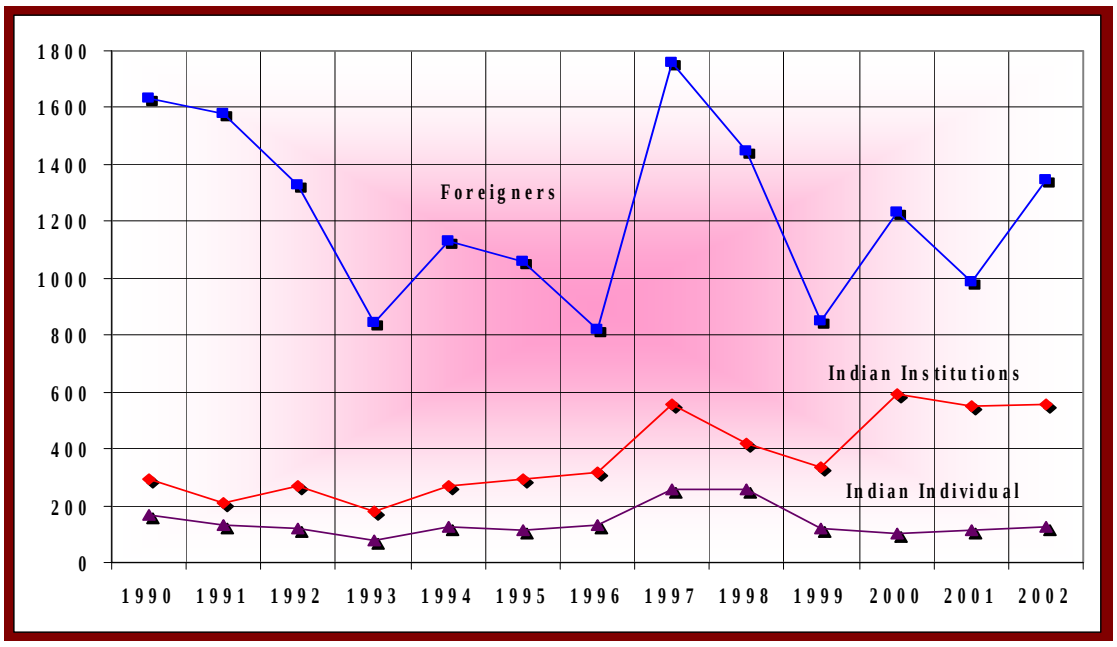
3.3.6 Comparative Activity of Indian Institutions, Foreigners and Indian Individuals Patenting in IPO

a) Overview

Patenting in IPO comprised of patents by Indian institutions, Foreigners and Indian individuals. Unlike USPTO, in IPO the maximum number of patents were granted to Foreigners, followed by Indian institutions and lastly Indian Individuals. Foreigners included both foreign institutions and foreign individuals patenting in IPO. While foreigners had a share of 71% (16009 patents) of total patents in IPO, Indian institutions had a share of 21% and patents by Indian individuals constituted 8% of total patents.

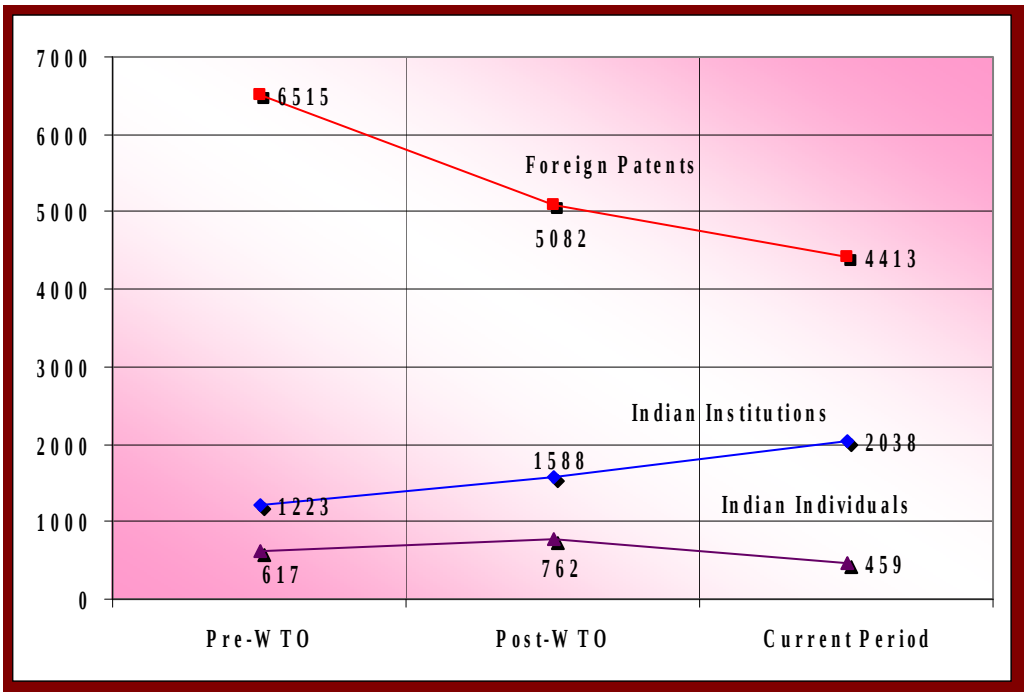
The year 1997 saw the maximum number of patents being granted to foreigners and Indian individuals while for Indian institutions maximum number of patents were granted in the year 2000. Figure 39 demonstrates that in the later periods Indian activity shows increase. Patenting by Foreigners in IPO showed a random decline. The probable reason as highlighted earlier is due to foreigners filing applications through the PCT route and 'Mailbox' provision.

Figure 39: Year wise Patenting Activity of Indian Institutions, Foreigners and Indian Individuals in IPO (1990-2002)



Foreigners followed by Indian institutions and Indian individuals respectively had show maximum activity. Foreigners exhibited maximum activity in pre-WTO period while Indian institutions exhibited maximum activity in the Current period. There was not much change in the patent activity of Indian individuals in pre-WTO and post-WTO period. Some decline was observed in the Current period. However, the Foreign institutions are using PCT and 'Mailbox' provisions to patent in India. As explained earlier (refer Box 2 in this chapter) the patents coming from these routes would take some time to enter the examination process. Thus in the current period there was an apparent decline in foreign patents.

Figure 40: Patenting by all Three Categories of Patents in Three Designated Periods



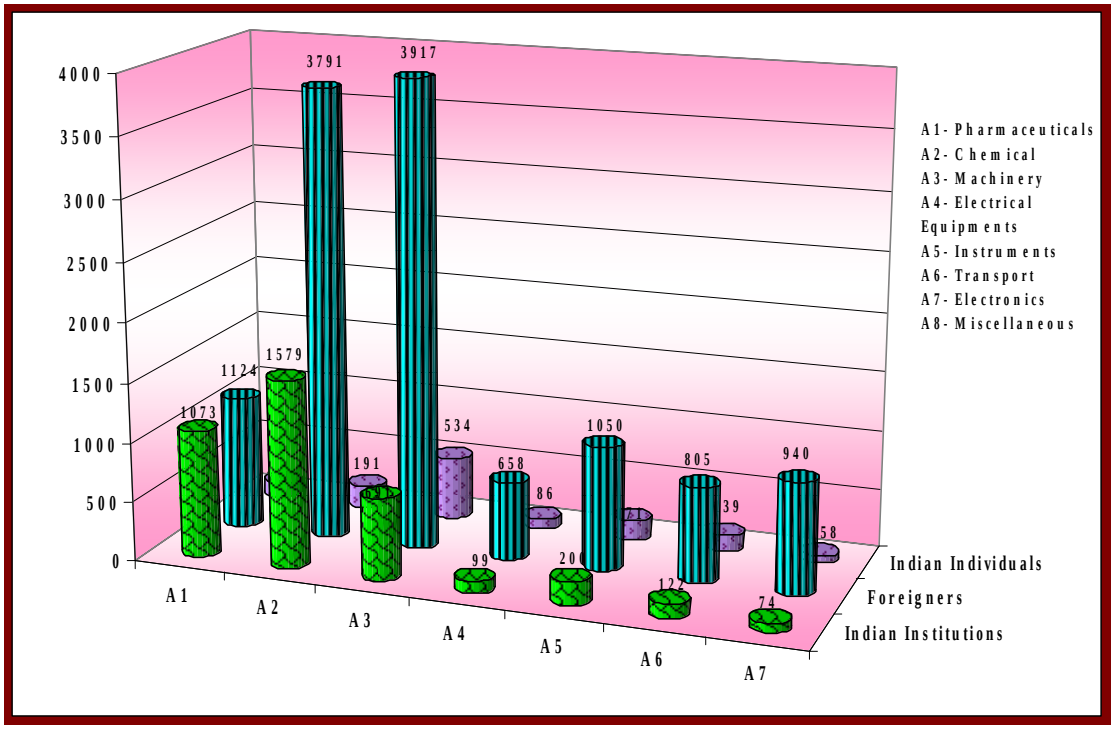
b) Sector Activity

Table 77 and Figure 41 exhibits activity of Indian institutions, Foreigners, and Indian individuals in various sectors.

Table 77: Major Sector-wise Patent Activity Among all Three Categories of Indian patents in IPO (1990-2002)

Major Sectors	Indian Institutions	Foreigners	Indian Individuals
Pharmaceuticals	1073	1124	129
Chemical	1579	3791	191
Miscellaneous	919	3471	494
Machinery	691	3917	534
Instruments	200	1050	171
Electronics	74	940	58
Transport	122	805	139
Electrical Equipment	99	658	86
Biotechnology	130	128	10

Figure 41: Sector Activity by the Three Categories of Patents in the Three Defined Sub-periods



Indian individuals had higher activity in Miscellaneous, Machinery, Instruments and Transport sector. Indian institutions showed highest activity in Chemical and Pharmaceutical sectors whereas foreigners exhibited higher activity in

Electronics. Table 78 exhibits in details the activity of Indian institutions, foreigners, and Indian individuals in the three designated periods.

Table 78: Major Sector-wise Patent Activity in the Three Designated Sub-periods

Sector	Indian Institutions			Foreigners			Indian Individuals		
	90-94	95-98	99-02	90-94	95-98	99-02	90-94	95-98	99-02
Chemical	419	492	668	1588	1178	1025	64	80	47
Pharmaceuticals	221	305	547	397	314	413	24	35	70
Machinery	201	267	223	1630	1282	1005	189	242	103
Electrical Equipment	39	30	30	289	221	148	35	36	15
Instruments	48	71	81	411	343	296	61	67	63
Transport	38	41	43	375	236	194	43	61	35
Electronics	15	17	42	299	345	296	28	15	15
Miscellaneous	234	333	352	1489	1048	934	172	201	121
Biotechnology	32	38	60	54	37	37	1	5	4
TOTAL	1247	1594	2046	6533	5004	4348	617	742	473

3 Patenting Activity In The Indian Patent System

3.1 Introduction

Patenting activity in the domestic patent system based on patents accepted by Indian Patent office (IPO) was examined for the period 1990-2002. Patenting activity of domestic organisations, foreigners and Indian individuals was covered for this purpose. The main focus was on patenting activity of domestic organisations termed as Indian Owned Patents (IOP) in this study. IOP included all organisations that had an Indian address (IOP mainly comprised of Indian entities. However, foreign MNCs who had assigned their patents to Indian subsidiary were also included in IOP). Patents by foreigners were mainly comprised of foreign organisations (there were a few foreign individuals). The analysis of patents by foreigners and Indian individuals was undertaken to assess the overall activity in the IPO.

The patenting activity was examined for the period 1990-2002 as well as in the three sub-periods: 1990-94 (pre-WTO), 1995-98 (post-WTO), and the current period (1999-2002).Patenting in the IPO is mainly governed by the Indian Patent Act 1970. This act has been modified by subsequent amendments to harmonize patent laws with patenting provisions in major patent systems. Amendments were also necessitated to comply with the WTO-TRIPS patent provisions. Salient aspects of the Indian Patent Act 1970, major changes due to amendments and other important aspects that govern patenting in IPO are covered in annexure V.

Unlike United States, design patents and plant patents are not granted in India. However, India has taken necessary steps to meet the requirements of TRIPS. Designs are subject matter of registration in India. The Indian Design ACT 2000 has introduced number of provisions to ensure effective protection to registered design. Design protection uses two specific terms as used for grant of patent, novelty and prior art but its content do not match with that of the patent.

Protection of Plant Varieties and Farmer's Right Act 2001 (PPVER 2001) has introduced provisions for the protection of new plant varieties, legislative features to protect farmer's rights, etc. In the US, the patenting of plant varieties is particularly important because, with appropriate claims in the patent, the holder of the patented

variety can prevent others from using it for breeding purpose. Patents are the strongest form of intellectual property protection in the sense that they normally allow the right holder to exert the greatest control over the use of the patented material by limiting the rights of the farmers to sell, or reuse seeds they have grown, or other breeders to use the seed (or patented intermediate technologies). India has in principal met the obligations of TRIPS and has enacted a novel system that provides flexibility to farmers and researchers.

Present study has not covered the plant protection and design registration in India as this is beyond the scope of the defined study.

3.2 Data and Methodology

Patent information from the Indian Patent Office is published weekly in the Gazette of India, Part III, Section 2. The gazette publishes particulars of the provisional specifications such as the inventors, assignees, date of application, number of application, and title of the patent application. Similarly, details of the complete specifications after 18 months from the priority date, and specifications open for opposition after prosecution by the Patent Office, include the name of the applicant, inventors, date of filing, title, application number, main claim and main drawing and the abstract of the invention and international patent classification.

Other relevant information in the gazette include, patents under opposition, decisions by the patent office on opposition matters, amendments to specifications, patents sealed, renewals fees paid, cessation of patents, restoration proceedings, registration of licenses, assignments, working of patented inventions, registration of designs, and relevant details of the PCT applications that enter the national phase in India.

The data on patent sealed/granted is not available in a machine-readable form that can be accessed and necessary processing/analysis can be further undertaken. The analysis of sealed data would thus require creating database from the gazettes by scanning 48 gazettes each year. However, the bibliographic data on patent for opposition is available from different sources in machine-readable form. The patents that are in opposition are those patents that are accepted by the IPO and can be sealed if no opposition is received from the public within four months. Interaction with patent office revealed that there were very a few patents for which opposition was

received. In majority of the cases, patents that were in opposition (in some cases with suitable modifications) were finally granted. Thus for the present study it was decided to use the opposition data available in machine-readable form after necessary validation.

The opposition data is available from two sources in CD-ROM format; for the period 1990-2000 (June) from NISCAIR and for the period 1995-2002 from TIFAC. In-house databases were created after extraction of data from these two databases. Validation of this data was done with the help of online database INPADOC and from the published data in gazette of India. Data was organised in terms of calendar year to have uniformity with Indian patent data in US (IPO reports patent data in terms of financial year. Patent statistics in different countries are always in terms of calendar year).

Patents were classified on the basis of type of organisations owning the patents similar to that undertaken for Indian patents in USPTO (*refer Chapter 2 methodology section for details of classification undertaken*). Patents were also identified under 9 main and 43 sub-sectors (*refer Chapter 2 methodology section for details of the technology classification scheme).* The elaborate classification scheme helped to uncover patents in different industrial sectors/sub-sectors.

3.3 Results

3.3.1 Overview

Figure 25 illustrates the distribution of patents in IPO in the three categories: Patenting by Indian organisations (IOP), Foreigners, and Indian individuals.

Figure 25: Distribution of Patents in IPO (1990-2002)

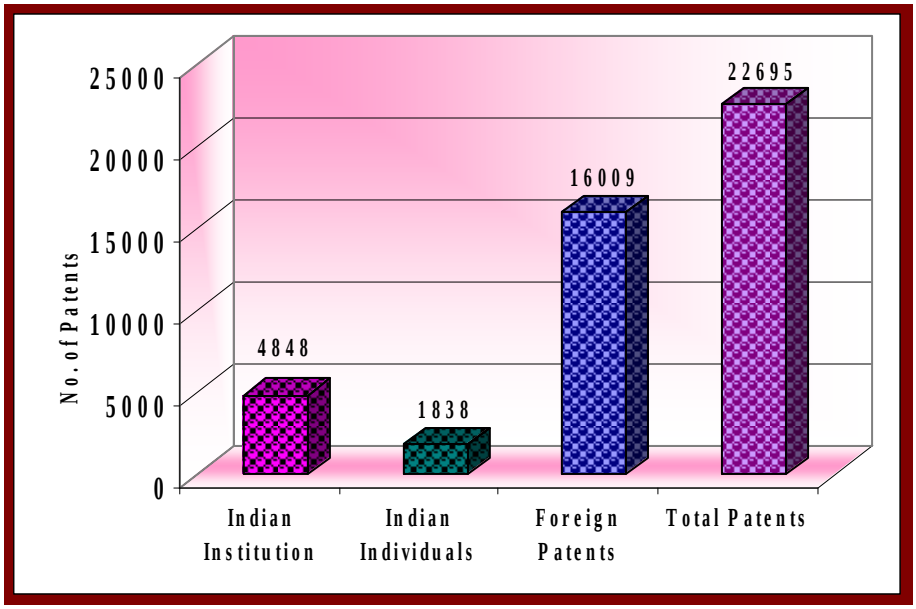
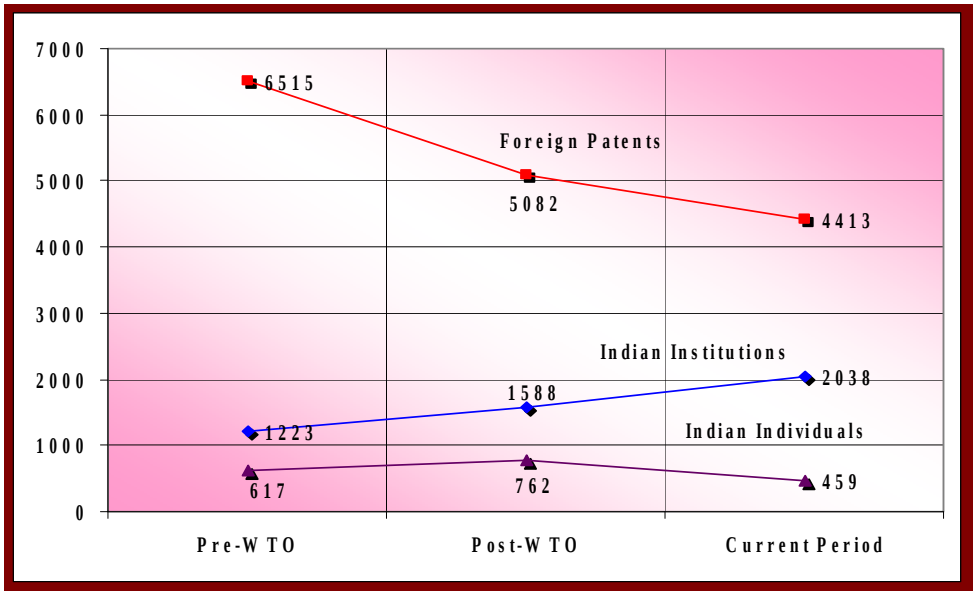


Figure 26, exhibits the patenting activity in the three designated sub-periods; 1990-94 (pre-WTO), 1995-1998 (post-WTO), and 1999-2002 (current period). Patenting by Indian institutions in IPO exhibited slight increase over the three designated periods of activity. Even though foreigners accounted for the maximum number of patents in the IPO, they exhibited decline in their number over the periods. *Infect due to different reason as explained in the box 2 below, the patenting activity by foreigners was not reflected in this period. In real terms there was no decline as Box 2 clarifies.* For Indian individuals patenting in IPO, it was observed that the post-WTO period (1995-98) exhibited highest activity. Decline was observed in the current period

Figure 26: Patenting Activity in the Pre/Post WTO and the Current Period: Indian Organisations, Foreigners and Indian Individuals



Box 2

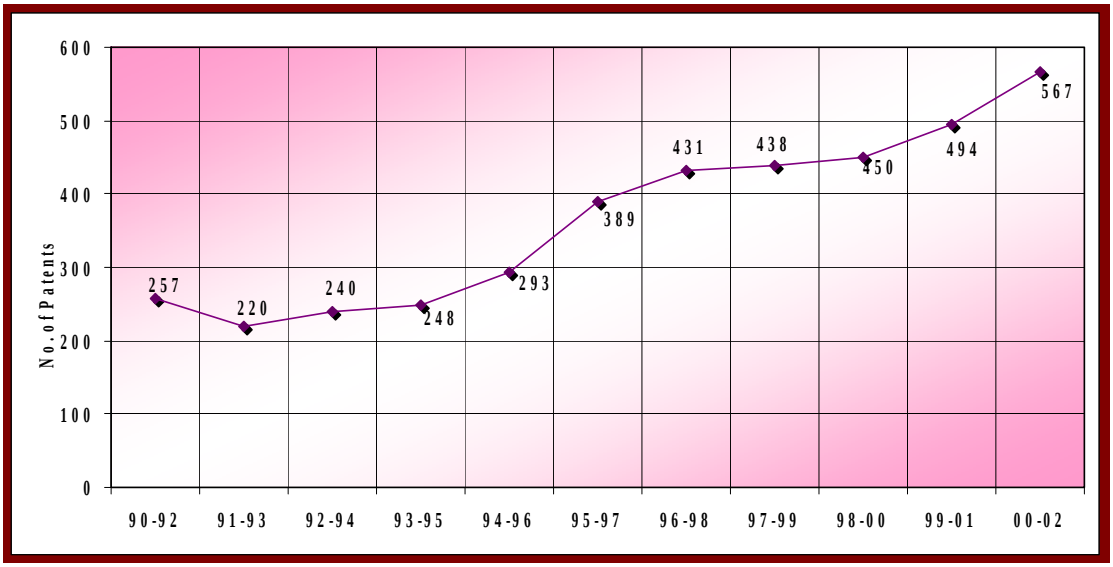
Decline as exhibited in foreign patents in the IPO does not reflect the real position. Apart from the traditional direct filing, foreigners were filing patents in India during the period covered by this study through two other routes: PCT (Patent Cooperation Treaty), and 'Mailbox' provisions. PCT patents that indicate India as country for protection enter the national phase (i.e. IPO) through this mode. Patent entering the national phase takes a minimum of 18 months from the date of filing of the PCT patent. India became member of PCT in 1998, and thus only from 2000 onwards PCT patents are entering national phase. In general it has been observed that it takes 4-5 years for the patents to be examined and come into opposition. Thus it is unlikely that these patents would be covered in the period of this study. At present it is estimated that 40,000 patents have entered the national phase through PCT.

Patents covering product patents in food, drugs, and agro-chemicals have been filed from 1995 through 'Mailbox' provision. Patents in these three sectors where not allowed as per Indian patent act 1970. However as per TRIPS agreement (India joined WIPO in 1995 and thus it had to comply with the TRIPS agreement) it was mandatory for India to make alternative arrangements for allowing product patents to be filed in these three sectors from 1995 onwards till product patents can be filed directly. However, TRIPS allows these patents to be opened for examination after the product patents are allowed in these sectors. Thus these patents were kept separately (designated as 'mailbox') and only now after the necessary amendments have been made in the Patent Act, these patents are opened for examination. 12,000 applications have already been filed in 'mailbox', majority of the filing are from foreign institutions. Thus these substantial numbers of patents will also not be accounted for during the period covered by this study.

3.3.2 Patenting Activity by Indian Organisations in IPO

A total number of 4848 patents that belonged to Indian institutions were analysed in the IPO for the period 1990-2002. Figure 27 exhibits the patenting activity during this period. A three-year moving average was taken to remove random fluctuations. The rising trend is clearly visible. Patenting activity in the three periods, pre/post WTO and current period were 1223, 1558, and 2038 patents respectively. The major transition was in the post-WTO period, an increase of around 30% from the pre-WTO period. There was an increase of approx. 28% in the current period from the post-WTO period

Figure 27: Patenting Activity by Indian Organisations: 1990-2002



Similar to India's activity in USPTO, patenting activity in IPO was highly skewed i.e., a few organizations accounted for majority of patents. However, there was considerable increase in the number of organisation involved in patenting activity as well as in prolific organisations i.e. those having substantial patenting activity.

749 domestic organizations were granted patents during the entire period: 1990-2002. There were 265, 340, and 388 organisations involved in patenting activity in the three periods, 1990-94, 1995-98, and 1999-2002 respectively. Patenting activity was much skewed as 411 institutes had only 1 patent, 126 institutes had 2 patents and 167 institutes had more than 3 patents during the entire period. Only 45 organisations had more then 3 patents in the entire period.

There was significant difference in the number of different organization types involved in patenting activity. Industrial firms were predominant with 667 firms being

granted patents during this period. Patenting activity in other organisation types comprised of: 37 research institutes, 21 universities, 20 special institutes, and 3 belonging to non-scientific entities (other ministries/departments). Unlike in USPTO, considerable number of universities, and special institutes were involved in patenting activity in IPO.

The number of patents from each organisational type provided an interesting profile. Thirty-seven research organisations had 1886 patents whereas 667 industrial firms had 2673 patents. Thus there were on average 51 patents per research organisation compared to 4 patents per firm. The 21 universities contributed to 171 patents, and on the other hand 20 special institutes accounted for 115 patents. The three organisations classified under other ministries/departments accounted for only 4 patents. Table 55 exhibits the details of the patenting activity by different types of institutions.

Table 55: Number of Patents Granted to different Types of Organisations: Overall and in Sub-periods

Period	Industry	Research	University	Special Institute	Other Ministries/ Departments
1990-1994	790	369	26	38	-
1995-1998	882	591	58	59	1
1999-2002	1001	926	87	22	3
Total (1990-2002)	2673 (55.14%)	1886 (38.9%)	171 (3.42%)	119 (2.37%)	4 (0.08%)

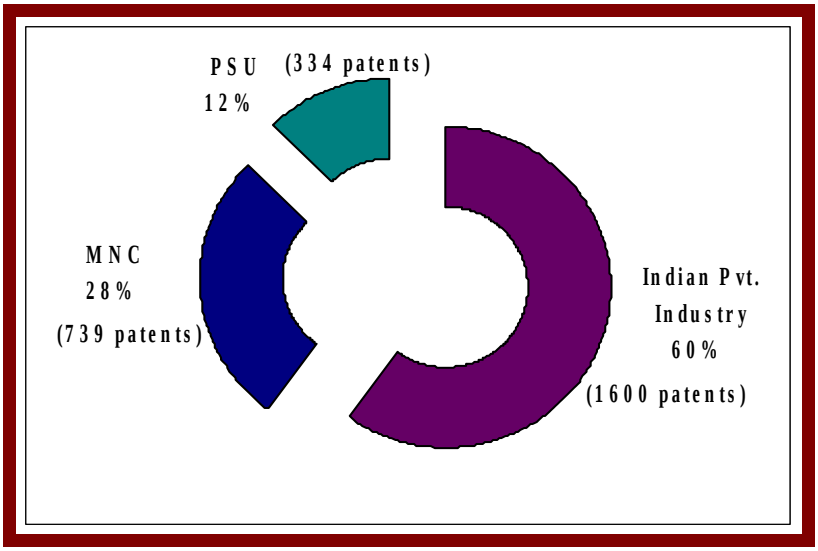
From the above table, the increase in patenting activity in each of the later periods is clearly visible in three main assignee types i.e. industrial firms, research institutions, and university. Only in special institutions some randomness can be observed.

Patenting was dominated by industry with around 55% of patents arising from this sector. Research institutes contributed to a share of around 40% of patents. Unlike USPTO, universities also exhibited some activity in IPO with 171 patents (3% of total) domestic patents granted to 21 universities all over the country. IIT (Indian Institute of Technology) had the maximum

number of patents among the academic institutions (80 patents) followed by Sree Chitra Tirunal Institute of Medical Sciences with 41 patents.

Among the industrial sector, Indian private industry had the major share accounting for 1600 patents, approx 60% of total patents granted to industries. PSU and MNC's accounted for 739, and 334 patents respectively. The share within the industry is highlighted in Figure 28.

Figure 28: Share of Patents within Industry



In the Indian private industry, Hindustan Lever Limited (565 patents), Hoechst India Ltd (48 patents), Ranbaxy Laboratories (36 patents), J. B. Chemicals & Pharmaceuticals Ltd. (31 patents) and Lupin Laboratories Ltd. (28 patents) were the most active organisations. *These firms have been classified as prolific institutions and have been separately analysed in the study*. These five prolific firms accounted for 708 patents i.e. 44% of the total patents granted to industry.

Among the PSU, Indian Oil Corporation Limited (IOCL) accounted for 40 patents (this firm is classified under prolific institution and its patent profile is analysed in details). The other PSU's that exhibited substantial activity were Bharat Heavy Electricals Limited (BHEL) and National Research & Development Corporation (NRDC) with 41 patents each and Steel Authority of India Ltd (SAIL) and Indian Petrochemical Corporation Ltd (IPCL) with 38 and 37 patents respectively.

CSIR dominated the patenting activity among the research institutes CSIR had share of 88% of the total patents granted to research institutes. In fact CSIR was the most prolific organisation in the IPO accounting for 34% of the total patents (1660

patents). Apart from CSIR, ISRO (30 patents), and BARC (20 patents) were only the other two research organisations that had substantial activity. None of the other research organisations had more then 10 patents. Overall scientific agencies had better representation in IPO then observed in USPTO. Table 56 illustrates patenting activity by scientific agencies.

Table 56: Patenting Activity of Scientific Agencies

Scientific Agency	No. of Institutes	No of patents
Indian Council for Agriculture Research (ICAR)	84	14
Defence research & Development Organisation (DRDO)	53	51
Council for Scientific & Industrial Research (CSIR)	38	1660
Indian Council for Medical Research (ICMR)	27	6
Department of Science & Technology (DST)	17	32
Department of Atomic Energy (DAE)	14	9
Department of Electronics (DOE)	14	4
Department of Space (DOS)	8	34
Department of Biotechnology (DBT)	3	7

The lack of patenting activity in scientific agencies (i.e. research institute under them) can be clearly observed from Table 56. It can be seen that ICAR with 84 research institutes accounted for only 14 patents. ICAR had no patents in USPTO. Some other major scientific agencies like DAE, and DOE exhibited patenting activity in IPO (*these agencies had no patents in US*). As per IPO provisions, invention relating to atomic energy are not patentable. This may have restricted patenting of innovations in some scientific agencies, DAE in particular. It is likely that patents by DST and DBT have originated from research organisations that are affiliated to them.

Only 3 organisations from the Non-scientific Departments/Ministries were involved in patenting activity. These were Ministry of Information Technology (2 patents), Ministry of Health & Family Welfare (1 patent), and Ministry of Mines (1 patent).

a) Patenting Activity of Prolific Organisations

20 organisations were observed to have major activity in IPO accounting for 60% share (2914 patents) of the total IOP patents. They were designated as prolific patenting organisation for this study. CSIR was the most important patenting organization with a major share of around 34% (1660 patents). The other nineteen organizations accounted for approx. 26% share (1254 patents) of total IOP patents. Among these 20 entities, 2 MNC subsidiaries were Hindustan Lever Ltd., (565 patents), and Hoechst India Ltd.(48 patents) occupied 2nd and 5th positions (IIT had no granted patent in USPTO for the period 1990-2002). IIT occupied 3rd position in IPO with 80 patents. It should be noted that the patents from the six IIT's are aggregated together. This has been done to have uniform basis of comparison with other entities like CSIR, DRDO which have number of laboratories/units. These entities i.e. CSIR, DRDO report their aggregate patents and thus separately analysing patents of each IIT was not undertaken. The other organizations exhibiting substantial activity were: DRDO (51), IOCL (43), BHEL (41), NRDC (41), Sree Chitra Tirunal Institute of Medical Sciences (41), SAIL (38), IPCL (37), Dr. Reddy's Laboratories (36) and Ranbaxy Labs Ltd. (36).

Table 57 highlights the patenting activity of the prolific organisations in the three sub-periods: 1990-94 (pre-WTO), 1995-98 (post-WTO), and 1999-2002 (current period).

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Table 57: Patent Activity of Prolific Organisations (1990-2002)

Organization/ Industry	No. of Patents (90- 94)	No. of Patents (95- 98)	No. of Patents (99- 02)	Total Patents (1990- 2002) (% Share)*
Council of Scientific & Industrial Research (CSIR)	314	532	814	1660 (34%)
Hindustan Lever Limited (HLL)	192	184	189	565 (12%)
Indian Institute of Technology (IIT)	14	26	40	80 (2%)
Defence Research & Development Organization (DRDO)	6	14	31	51 (1%)
Hoechst India Ltd	41	7	-	48 (1%)
Indian Oil Corporation Limited (IOCL)	13	7	23	43 (0.9%)
Bharat Heavy Electricals Limited (BHEL)	10	17	14	41(0.9%)
National Research Development Corporation (NRDC)	9	13	19	41 (0.9%)
Sree Chitra Tirunal Institute For Medical Sciences & Technology	4	21	16	41 (0.9%)
Steel Authority of India Ltd (SAIL)	7	21	10	38 (0.8%)
Indian Petrochemicals Corporation Limited (IPCL)	6	14	17	37 (0.8%)
Dr. Reddy's Research Foundation	-	7	29	36 (0.7%)
Ranbaxy Laboratories Limited	6	7	23	36 (0.7%)
Project & Development (India) Ltd.	19	11	1	31 (0.6%)
J. B. Chemicals & Pharmaceuticals Ltd.	-	25	6	31(0.6%)
Indian Jute Industry Research Association (IJIRA)	6	22	2	30 (0.6%)
Indian Space Research Organization (ISRO)	17	10	3	30 (0.6%)
National Council for Cement & Building Material (NCCBM)	19	10	1	30 (0.6%)
Lupin Laboratories Ltd.	1	10	19	30(0.6%)
South India Textile Research Association (SITRA)	8	13	1	22 (0.4%)

** % share in the total published Indian owned patents of IPO (90-2002)*

Majority of the organisations exhibited high degree of activity in the current period (1999-2002). Only Hoechst India Ltd, Project & Development (India) Ltd, ISRO and NCCBM exhibited decreasing trend. Some organisations like IOCL, SAIL exhibited random activity. HLL had almost similar levels of activity in all three designated periods.

b) Collaborative Activity

Collaboration activity was again less and mirrored the activity in USPTO. A total number of 35 joint patents (out of 4848 IOP patents) were observed among the Indian institutions in IPO. Table 58 details the collaboration activity in IPO.

Table 58: Collaborative Patents of Indian Organisations (1990-2002)

Organizations (No. of patents)	Collaborating with (No. of Collaborative Patents)
CSIR (1660)	Nicholas Piramal India Ltd (2)
	Keshava Deva Malaviya Institute of Petroleum Exploration (2)
	Department of Biotechnology (DBT) (1)
	Indian Oil Corporation Ltd (IOCL) (1) **
	Novo Nordisk A/S (1)
	Department of Science & Technology (DST) (1)**
	Department of Electronics (DOE) (1) **
Indian Institute of Technology (80)	Metallurgical & Engineering Consultants (India) Ltd (4)**
	Madras Refineries Ltd (1)
	Department of Science & Technology (DST) (1)
Indian Oil Corporation Ltd. (43)	Engineers India Ltd (1)
South India Textile Research Association (22)	Milltex Engineers (P) Ltd (1)**
Agharkar Research Institute (9)	Eco Solar Systems India Pvt Ltd (2)
	Central Bee Research And Training Institute (1)
National Institute of Immunology (6)	Central Sericulture Research and Training Institute (2)
National Research Development Corporation (41)	Kusum Dhatu Pvt Ltd (1)
Vittal Mallya Scientific Research Foundation (19)	Rennaissance Herbs; Inc (1)**
Indian Institute of Science (19)	Vittal Mallya Scientific Research Foundation (1)**

Organizations (No. of patents)	Collaborating with (No. of Collaborative Patents)
Sir Padampat Research Centre (11)	JK Synthetics Ltd (1)**
Otto India Private Ltd (9)	Still Carl Gmbh Co KG (1)*
Oil & natural Gas commission (8)	Institute of Drilling Technology (1) **
Dalmia Institute of Scientific and Industrial Research (6)	Orissa Cement Ltd (1) **
Engineers India Ltd (3)	Gujarat Narmada Valley Fertilizers Co Ltd (1)
Alpha Research Laboratories (Pvt) Ltd (2)	Kaemia Industries Limited (1)
Regional Engineering College (1)	Individual (1)
Desai Brithers Ltd (1)	Chotabhai Jethabhai Patel, Tobacco Products (1)
Institut Armand-Frappier (1)	Punjab Agro Industries Corporation Ltd (1)
Dalmia Indistries Ltd (1)	Dalmia Centre for Biotechnology (1)

** collaborations during the pre-WTO period (1990-94)*
*** collaborations during the post-WTO period (1995-98)*

Table 58 points out that most of the linkages were in the current period (1999-2002). Some linkages are shown involving research institution and firms, and between university and industrial firms. These types of linkages are important particularly in science-based innovations i.e. in biotechnology, nanotechnology, etc.

c) Sector Activity

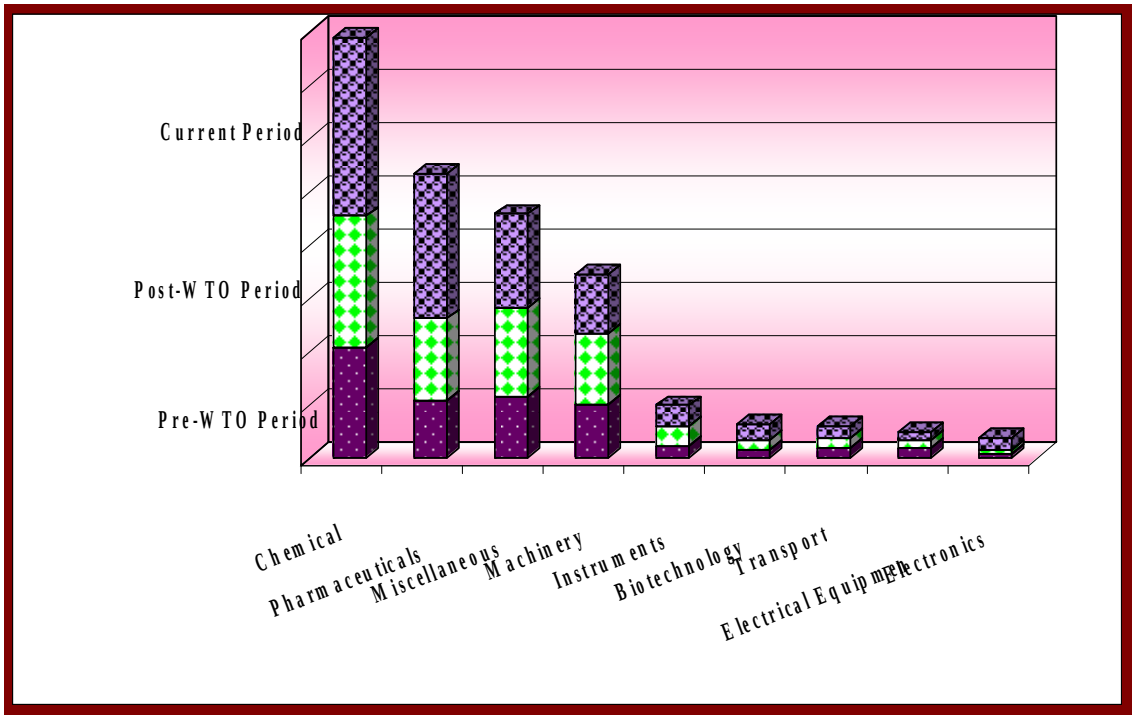
Similar to USPTO, Indian institutions had addressed all the 9 technology sectors. 'Pharmaceuticals' and 'Chemicals' were again the major sectors of activity and accounted for around 55% share of total patents. However, unlike USPTO, patenting activity in sectors 'Machinery', and 'Instruments' were also substantial. Table 59 and Figure 29 highlight the overall patenting activity of Indian Institutions in major sectors as well as during the three sub-periods: Pre/ post WTO and current period.

Table 59: Activity of Indian Organisations in Major Sectors: Overall and in Sub-periods

Sectors	No. of Patents (90-94)	No. of Patents (95-98)	No. of Patents (99-02)	Total Patents (1990-2002) (% of total)
Chemical	419	492	668	1579 (33%)
Pharmaceuticals	221	305	547	1073 (22%)

Miscellaneous	234	333	352	919 (19%)
Machinery	201	267	223	691 (14%)
Instruments	48	71	81	200 (4%)
Biotechnology	32	38	60	130 (3%)
Transport	38	41	43	122 (2%)
Electrical Equipment	39	30	30	99 (2%)
Electronics	15	17	42	74 (2%)

Figure 29: Activity of Indian Organisations in Major Sectors in the Pre/Post-WTO and Current period



The activity of different sectors in the three designated periods underscores many important points. 'Electrical equipment' was the only sector that exhibited declining trend. 'Biotechnology' exhibited steady increase in patenting activity. Unlike USPTO, some degree of activity was observed in the 'Transport' sector (*this area accounted for only four patents in USPTO*).

d) Sub-sector Activity

Out of 43 technology sub-sectors, patenting activity was observed in 41 sub-sectors. Only in two sub-sectors 'Tobacco products' and 'Publishing and printing',

there was no patenting activity. Thus patenting activity was widespread i.e. across different sub-sectors unlike USPTO were only 26 sub-sectors were addressed. Majority of the sub-sectors addressed more than 10 patents in the entire period.

Within 'Chemical' sector, 'Basic chemical' was the major sub-sector contributing to 70% of activity. 'Special purpose machinery' showed dominance under 'Machinery' sector. Within the Transport sector, 'Motor vehicles' attracted the maximum patenting i.e. 88 patents. Similar to USPTO, high performing sub-sectors within 'Miscellaneous' were 'Food & beverages' (203 patents), 'Basic metals' (185 patents), 'Non-metallic mineral products' (161 patents) and 'Fabricated metals products' (119 patents). Only some sub-sectors had insignificant activity. Table 60 highlights the sub-sectors with low patenting activity.

Table 60: Sub-sectors of Lower Activity

Sub-Sectors	No. of Patents (90-94)	No. of Patents (95-98)	No. of Patents (99-02)	Total Patents (90-02)
Lighting equipment	4	3	1	8
Watches, clocks	-	4	2	6
Man-made fibres	3	-	1	4
Wood products	-	3	1	4
Paint. Varnishes	1	1	1	3
Weapons and ammunition	-	-	3	3
Leather articles	-	2	1	3
Wearing apparel	-	1	-	1
Tobacco products	-	-	-	-
TOTAL	8	14	10	32

The major technological domain of patents in IPO was more varied than that of USPTO. The technological domains addressed by patents in 'Pharmaceuticals', 'Basic chemicals', and in 'Pesticides and agrochemicals' were similar to that in USPTO.

Apart from above, there were distinct technological domains addressed by different sub-sectors. Table 61 illustrates the details.

Table 61: Major Technological Domains of Patents in IPO

Sector / Sub-sectors	Technological domain (Patents)
Pharmaceuticals	Medicinal preparations (717),Heterocyclic compounds (305), Micro-organisms, compositions thereof (36), Fermentation or enzyme-using processes to synthesise a desired chemical compound (29)
Chemicals / Basic Chemicals	Acrylic or carboxylic compounds (402),Chemical or physical processes, (120),Non-metallic elements (87),Macromolecular compounds (57)
Chemicals / Soaps, detergents, toilet preparations	Detergent compositions, soap or soap-making (207)
Chemicals / Other Chemicals	Lubricating compositions (18)
Chemicals / Pesticides, Agrochemical products	Biocides (139)
Misc./ Non-metallic mineral products	Lime; magnesia; slag; cements; compositions thereof, treatment of natural stone (123)
Misc / Food, Beverages	Foods, foodstuffs, or non-alcoholic beverages, their preparation or treatment (96)
Misc/ Basic metals	Treatment of alloys (39) Production or refining of metals, pre-treatment of raw materials (26)
Misc / Rubber And Plastic Products	Containers for storage or transport of articles or materials, thereof; packaging elements (27)
Machinery/Special purpose machinery	Machines, apparatus or devices for, or methods of, packaging articles or materials (36) Spinning or twisting, natural or artificial threads or fibres (19)
Machinery/ Non-Specific Purpose Machinery	Separation by physical or chemical processes (57)
Machinery / Domestic appliances	Kitchen equipment; coffee mills; spice mills; apparatus For making beverages (43)

e) Sector Activity of Prolific Organisations

Activity in the various sectors/sub-sectors of the 20 prolific institutes identified earlier (refer table 57) was examined in details. Table 62 exhibits the activity in various sectors by these prolific institutions. Unlike USPTO, considerable distinctions were visible in the technological profile (at the sector level). It is thus possible to group a set of prolific organizations with a particular sector (s) focus.

CSIR, HLL, IOCL and Project & Development (India) Ltd. had major share of patents in Chemicals. Additionally CSIR and HLL had substantial activity in 'Pharmaceuticals'. Ranbaxy, Dr Reddy's Research Foundation, and J.B. Chemicals &

Pharmaceuticals Ltd had their major patent focus in 'Pharmaceuticals'. BHEL, IJIRA, NCCBM and SITRA had their major patenting activity in the 'Machinery' sector. CSIR and HLL also exhibited some degree of activity in this sector. Except for CSIR, patenting activity by other prolific institutions in the Electrical sector was insignificant.

SAIL and 'Sree Chitra Tirunal Institute of Medical Science & Technology' had their major patenting activity in the 'Instrumentation' sector. CSIR also exhibited some degree of activity in this sector. Patenting activity in the 'Transport' sector was hardly addressed by prolific institutions. Similar to the 'Electrical' sector, only CSIR exhibited some degree of activity in the 'Electronic' sector. CSIR, HLL, IIT, DRDO, SAIL, ISRO, and NCCBM had substantial share of patenting activity in the 'Miscellaneous' sector (the activity within the 'Miscellaneous' sector of these institutions are elaborated in the next section).

Table 62: Sector Activity of Prolific Institutes

Institution	Sectors							
	Chemical	Pharmaceuticals	Machinery	Electrical	Instruments	Transport	Electronics	Miscell
Council of Scientific & Industrial Research	662	406	137	24	56	8	24	304
Hindustan Lever Ltd	271	159	37	-	4	2	-	88
Indian Institute of Technology	11	8	14	2	9	4	4	22
Defence Research & Development Corporation	15	9	4	1	4	1	1	16
Hoechst India Ltd.	1	47	-	-	-	-	-	-
Indian Oil Corporation Limited	33	-	1	2	-	1	1	4
Bharat Heavy Electrical Limited	2	-	23	1	3	-	-	12
National Research Development Corporation	8	7	9	1	4	1	-	9
Sree Chitra Institute of Medical Science & Technology	13	12	1	-	15	-	-	-
Steel authority of India Ltd.	2	-	8	-	14	-	1	22
Indian Petrochemical Limited	29	3	5	-	-	-	-	-
Ranbaxy Laboratories Ltd.	5	31	-	-	-	-	-	-
Dr Reddy's Research Foundation	4	31	-	-	-	1	-	-
J. B. Chemicals & Pharmaceuticals Ltd.	3	28	-	-	-	-	-	-
P & D (India) Ltd.	22	1	7	-	-	-	-	1
Indian Jute Industry Research Association	4	1	17	3	-	-	-	5

Institution	Sectors							
	Chemical	Pharmaceuticals	Machinery	Electrical	Instruments	Transport	Electronics	Miscell
Indian Space Research Organization	3	-	5	1	5	1	2	13
National Council for Cement & Building Material	2	-	15	-	-	2	-	10
Lupin Laboratories Ltd.	4	24	-	-	-	-	-	-
South India Textile Research Association	-	-	18	-	2	-	-	1

CSIR had addressed a total of 38 technological sectors during the entire period of study. There was not much change in the number of sub-sectors addressed in each sub-period. The highest activity was in 'Basic chemicals' accounting for 34% patents of CSIR granted patents. Apart from 'Basic chemical', 'Other chemicals' (63 patents) and 'Pesticides, agro-chemical products' (35 patents) also exhibited substantial activity under Chemical sector. Basic metals (115 patents), Non-metallic mineral products (73 patents), Food & beverages (34 patents), Fabricated metal products (32 patents) accounted for the major share of activity within the Miscellaneous sector. Two sub-sectors that exhibited considerable activity within Machinery sector were 'Special purpose machinery', and 'Non-specific purpose machinery'.

CSIR patenting activity was mainly concentrated in 'Basic chemical' and sector 'Pharmaceuticals' and accounted for 34% and 24% respectively of their total patents. In the 'Miscellaneous' sector, maximum activity was in sub-sector 'Non-metallic mineral products' (4.5%) and 'Basic metals' (7%). Maximum activity was exhibited in the post-WTO period.

In HLL, maximum activity was in the sector 'Pharmaceuticals' (28%) and sub-sectors 'Soap, detergent and toilet preparations' (34%), 'Food & beverages' and 'Basic chemical' also have substantial activity with 11% and 9% share of their overall patents respectively. Table 63 illustrates the technological profile of prolific organisations.

Table 63: Major Technological Domains of Patents of Prolific Organisations

Organization	Major Technological Sectors (No. of patents)	Relative Specialisation	Major Technological Domains	Major Application Areas
CSIR	Basic Chemical (563)	1.53	Catalysts	Silicon; Compounds (22) Compounds comprising of aromatic ring (18)
	Pharmaceuticals (406)	1.13	Medicinal preparations of organic ingredients (109)	Heterocyclic compounds (29) Enzymes, e.g. ligases ; proenzymes; compositions thereof (20)
	Misc / Food, Beverages (34)	0.09	Foods or foodstuffs; their preparation or treatment (14)	–
	Misc / Non-metallic mineral products (73)	0.20	Shaped ceramic products characterised by their composition (26)	–
	Misc / Pesticides, agro-chemical products (35)	0.09	Biocides, pest repellants or attractants, or plant growth regulators containing plant material (10)	–
	Misc / Fabricated metal products (32)	0.87	Electroplating; baths thereof (11)	–
Dr. Reddy's	Pharmaceuticals (31)	3.90	Heterocyclic compounds (13)	–
Ranbaxy	Pharmaceuticals (31)	3.90	Medicinal preparations of organic ingredients (17)	–
HLL	Pharmaceuticals (159)	1.05	Cosmetics or similar toilet preparations (131)	–

Organization	Major Technological Sectors (No. of patents)	Relative Specialisation	Major Technological Domains	Major Application Areas
	Basic Chemical (54)	0.43	Silicon; compounds thereof (10)	–
	Misc / Food, Beverages (61)	0.49	Food products	Frozen sweets, e.g. ice confectionery, ice-cream; mixtures thereof (15) Tea; Tea substitutes; preparations thereof (14)
	Chemicals / Soaps, detergents, toilet preparations (194)	1.55	Other compounding ingredients of detergent compositions (67)	Detergent compositions based essentially on surface-active compounds; (63) Compositions of detergents based essentially on soap (26)
	Special purpose machinery (28)	0.24	Packaging of materials presenting special problems (12)	–
IOCL	Chemicals / Other Chemicals (15)	1.57	Lubricating compositions characterised by the base-material being a mineral or fatty oil (5)	–
SAIL	Misc / Non-metallic mineral products (10)	1.19	Shaped ceramic products characterised by their composition (8)	–
Sree Chitra Tirunal Medical Institute	Medical Equipment (15)	1.65	Suction or pumping devices for medical purposes (5)	–

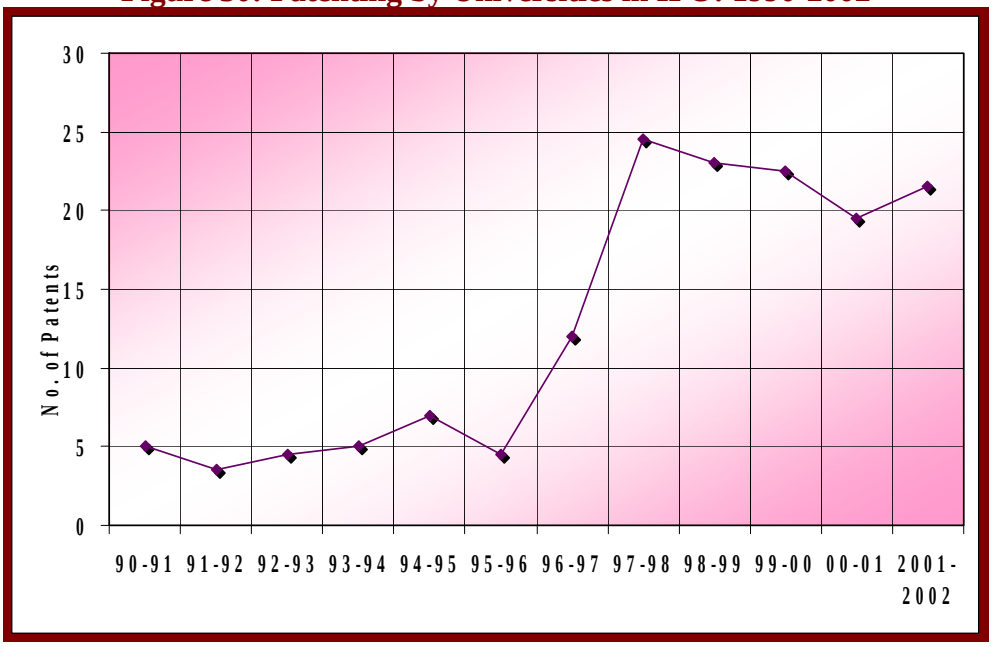
3.3.3 Patenting by Indian Universities in IPO (1990-2002)

a) Overview

Unlike USPTO, Indian universities exhibited some degree of activity in IPO during the period 1990-2002. Patenting by university is important as it demonstrates research/innovation activity at the university level. Many of the emerging new technologies are science based. Innovations in areas like biotechnology, nanotechnology have developed due to close interaction between university and industry. Thus it is important to uncover to what extent innovations are taking place in Indian universities. Patenting activity is an important indication of innovation activity and thus patenting activity by India universities are being discussed in more details.

171 patents (approx. 3% of total domestic patents) were granted to 21 universities in IPO. In USPTO, patenting activity by university was insignificant. Six universities accounted for 8 patents in USPTO. Universities exhibited an increasing trend over the years in IPO. Substantial increase in patenting activity was observed in the current period as 52% of university patents were granted during this period. The relative increase in patenting activity during the current period from earlier two periods, pre-WTO and post-WTO was 69% and 34% respectively. Figures 30 show the patenting activity by universities in the entire period. A two-year moving average was taken to overcome random fluctuations.

Figure 30: Patenting by Universities in IPO: 1990-2002



Inspite of taking a two-year moving average, the fluctuations are apparent. This exhibits that in some years more patents were granted and vice-versa. In the three sub-periods there were 26 patents (1990-94), 58 patents (1995-98), and 97 patents (1999-2002) respectively. Thus there was steady increase in activity over the years.

A total number of 21 universities acquired patents during the period. The number of distinct universities involved in patenting showed substantial increase in each of the sub-periods. 3 universities were involved in patenting activity in 1990-94 whereas 8 and 21 universities were involved in the later two periods (1995-98, 1999-2002)

Table 64 exhibits the universities involved in patenting activity in the entire period.

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Table 64: Universities Patenting in IPO (1990-2002)

University Name	No. of patents
Indian Institute of Technology (IITs)	**80**
Sree Chitra Tirunal Institute for Medical Sciences & Technology	**41**
Indian Institute of Science	**19**
Jadavpur University	5
Osmania University	4
Forest Research Institute	3
Bharati Vidyapeeth	2
Bhavnagar University	2
Hyderabad (Sind) National Col-Legiate Board	2
Kurukshetra University	2
University of Bombay	2
All India Institute of Medical Sciences	2
Ajit Nivas Arts College	1
Assam Agricultural University	1
Assam Engineering College	1
Birla Institute of Technology	1
Pune University	1
Punjab University	1
Regional Engineering College	1
Sri Venkateswara University	1
University of Delhi	1

Table 64 underscores the fact that only a few universities accounted for majority of patents in IPO. This again is similar to the overall Indian patenting activity i.e. concentration of majority of patents in a few institutions. However, it is interesting to note that IITs accounted for the maximum number of patents in IPO. IITs had no granted patents in USPTO. IITs accounted for 2.0% of total domestic patents and around 47% of patents by universities. 'Sree Chitra Institute of Medical

Sciences' follows IIT with around 24% of patents granted to universities. Table 65 illustrates the details of the patenting activity by the prominent patenting universities

Table 65: Patent Activity of Prolific Universities (1990-2002)

Universities	No. of Patents (90- 94)	No. of Patents (95- 98)	No. of Patents (99- 02)	Total Patents (1990- 2002) (% Share)*
Indian Institute of Technology	14	26	40	80 (1.20%)
Sree Chitra Institute for Medical Sciences & Technology	4	21	16	41 (0.6%)
Indian Institute of Science	8	6	5	19 (0.30%)
Jadavpur University	-	1	4	5 (0.07%)
Osmania University	-	1	3	4 (0.06%)

***** % share in the total domestic patents in IPO (90-2002)

Table 65 points out that except for IISc, substantial increase in patenting activity had taken place over the three time period.

b) Collaborative Patents of Universities

Collaborative patents by universities in IPO were a few in number (7 patents) and accounted for only 4% of the total patents. 3 of these collaborative patents were during the Post-WTO period and 4 during the Current period.

Table 66: Collaborative Patents of Universities

Organization	No. of patents (Collaborations)	No. of collaborations	Collaboration with
Indian Institute of Technology	80 (5)	4	Metallurgical & Engineering Consultants (India) Ltd.
		1	Department of Science & Technology
		1	Madras Refineries Ltd.
Indian Institute of Science	19 (1)	1	Vittal Mallya Scientific Research Foundation
Regional Engineering College	1 (1)	1	Individual

*** Three collaborative patents during Post-WTO Period & four during Current Period*

University-industry interaction is very important. The joint patent is a good reflection of this activity. Thus some interactions exhibited by Indian universities with firms is a good beginning.

c) Patenting by Universities in Major Sectors

Universities had shown high degree of patenting in sectors such as miscellaneous (high activity/performing subsectors within this were Basic metals, Fabricated metal products, Food beverages and Non-metallic mineral products) Pharmaceuticals, Chemicals and Machinery. The major sector Instruments also had a significant number of patents.

Figure 31: Patenting by Universities in Major Sectors (1990-2002)

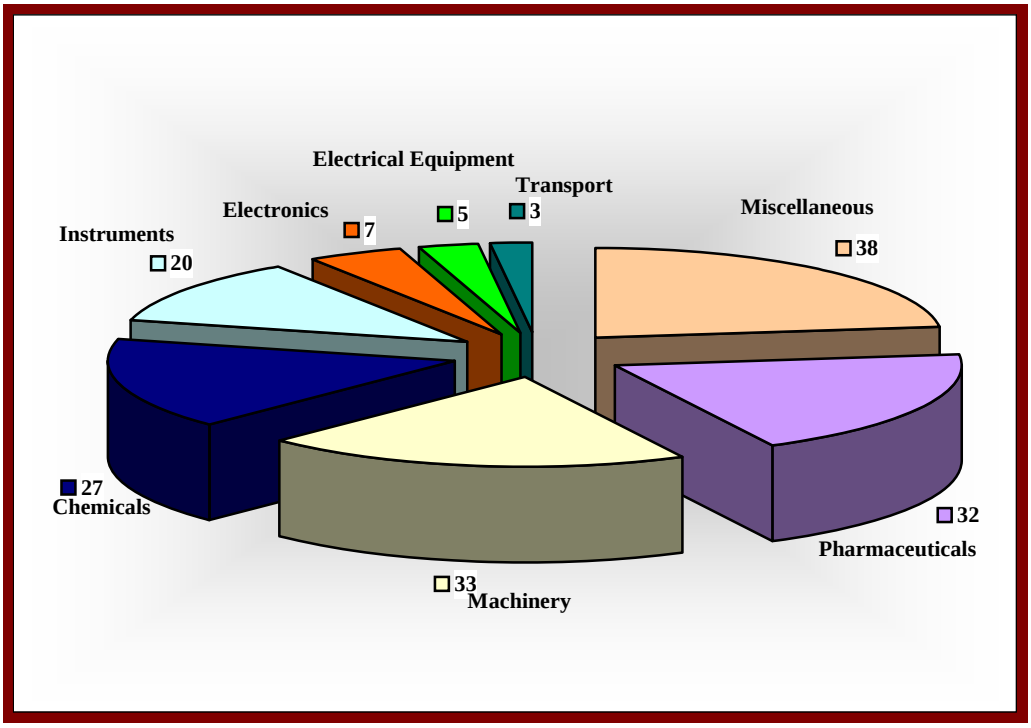


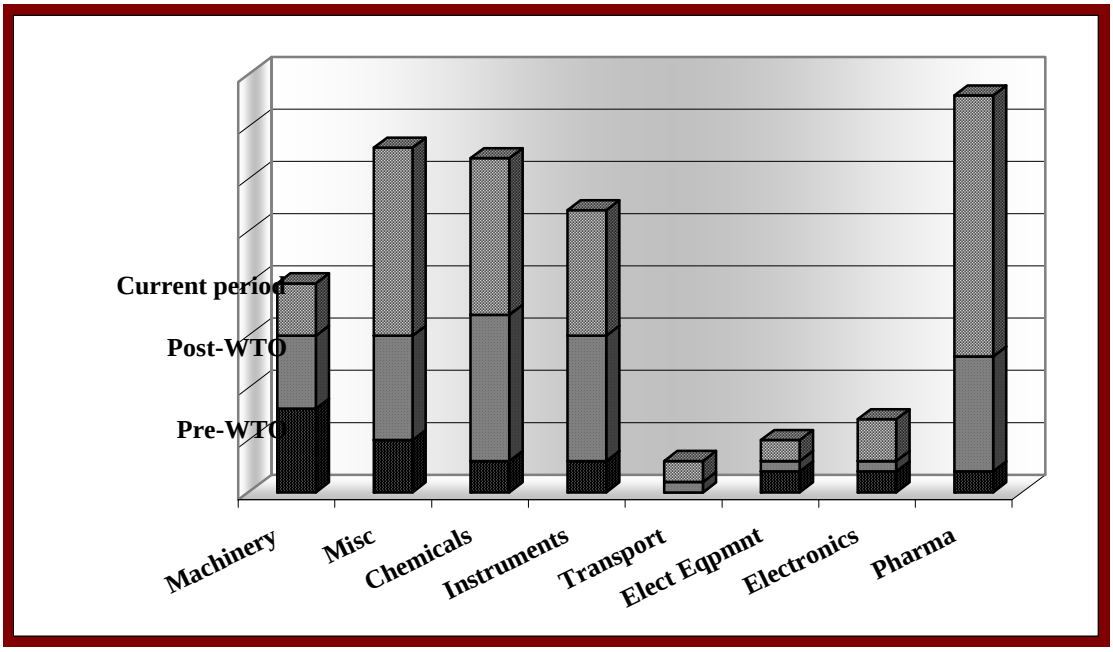
Table 67: Patents in Major Sectors during the Three Periods of Activity

Designated period / Sector	Pre-WTO (1990-94)	Post-WTO (1995-98)	Current (1999-02)
Pharmaceuticals	2	11	25
Miscellaneous	5	10	18
Chemicals	3	14	15
Instruments	3	12	12

Designated period / Sector	Pre-WTO (1990-94)	Post-WTO (1995-98)	Current (1999-02)
Machinery	8	7	5
Electronics	2	1	4
Electrical Equipment	2	1	2
Transport	0	1	2

Most of the sectors such as Pharmaceutical, Miscellaneous, Chemical and Instruments had demonstrated higher activity during the current period. Machinery was the only sector that had considerable activity during the pre-WTO period.

Figure 32: Patents in Major Sectors during the Three Sub-Periods of Activity



Within the 'Miscellaneous sector', the high performing subsectors were 'Basic metals', 'Fabricated metal products', 'Food, beverages & non-metallic mineral products'. Among other higher activity subsectors, 'Basic chemicals' had prominent activity. The activity in subsectors like 'Machine-tools', 'Medical equipment', 'Non-specific purpose machinery' and 'Special purpose machinery' also cannot be overlooked.

Table 68: Sub-sectors of Higher Activity

Sub-sectors	No. of patents (90-94)	No. of patents (95-98)	No. of patents (99-02)	Total Patents (1990-2002)
Basic chemicals	3	12	13	28
Medical equipment	3	9	7	19
Basic metals	1	5	1	7
Fabricated metal products	-	1	6	7
Machine tools	3	2	1	6
Special purpose machinery	2	2	2	6
Food, beverages	1	-	5	6
Non-specific purpose machinery	2	2	1	5
Non-metallic mineral products	2	1	2	5
Measuring instruments	-	2	3	5
Electronic components	1	-	3	4

d) Sector Activity of Prolific Institutes

The IITs had shown maximum patenting in the Miscellaneous sector especially in areas such as Basic metals and Fabricated metal products. The Machinery sector also exhibited significant activity followed by activity in Chemicals, Instruments, and Pharmaceuticals sector. *IITs was the only university that exhibited patenting activity in all sectors*. Sree Chitra Tirunal Institute on the other hand exhibited the maximum number of patents in the instruments sector. Some degree of activity was also observed in chemicals and pharmaceuticals sectors. *Majority of the patents of this university were obtained during the later two periods*. IISc had most of its patents in Chemicals. All 4 patents of Osmania university were granted in Pharmaceuticals.

3.3.4 Activity of Foreign Patents in IPO

a) Overview

Patenting by foreigners in IPO constituted 71% of the total patents (16009 patents) in the period 1990-2002. The patenting activity exhibited decline in the post-WTO period. A total of 17,833 PCT applications (as per 2002-2003 Annual Report of the Indian patent office) have entered national phase i.e. in the Indian patent office, from 1998 onwards and are being examined (*entering the national phase implies these patents have been filed through the PCT route and have designated India as one of the country in which the protection for the said patent has been sought*). Mailbox provision has resulted till date approx. 12,000 applications.

Patents can get advantage of the PCT first filing/priority date of 18 months before it is examined in the national patent offices of the designated country. An additional twelve months can be obtained if the applicant asks for international preliminary examination of the filed patent. Thus there would be many more patents that would enter the national phase. Thus only an extensive detailed analysis of the PCT patent applications filed in India, under examination and finally being sealed is required to obtain a complete view of the foreign patent activity in IPO. Till 2002 these patents were in examination stage and thus did not affect the result of this study (in this study patents that have been accepted by the Indian Patent Office were only taken into account).

The other option of filing product patents in Food, Agrochemicals, and Pharmaceuticals were provided from 1995 in IPO. But these patents would be examined only after the product patent is allowed in the IPO. This provision was created as per TRIPS requirement as India did not allow product patents in the above areas. In real terms there has been no decline as illustrated by Box 2, Overview Section of this chapter. However, as explained in Box 2 these patents would enter the examination process at a later stage and thus is not reflected in the present analysis. Figure 33 exhibits the patents filed by foreigners that were examined and sealed during the period of this study (however, there were a few patents that were in opposition). Three-year moving average was taken to take care of the random fluctuations.

Figure 33: Foreigners Patenting in IPO 1990-2002

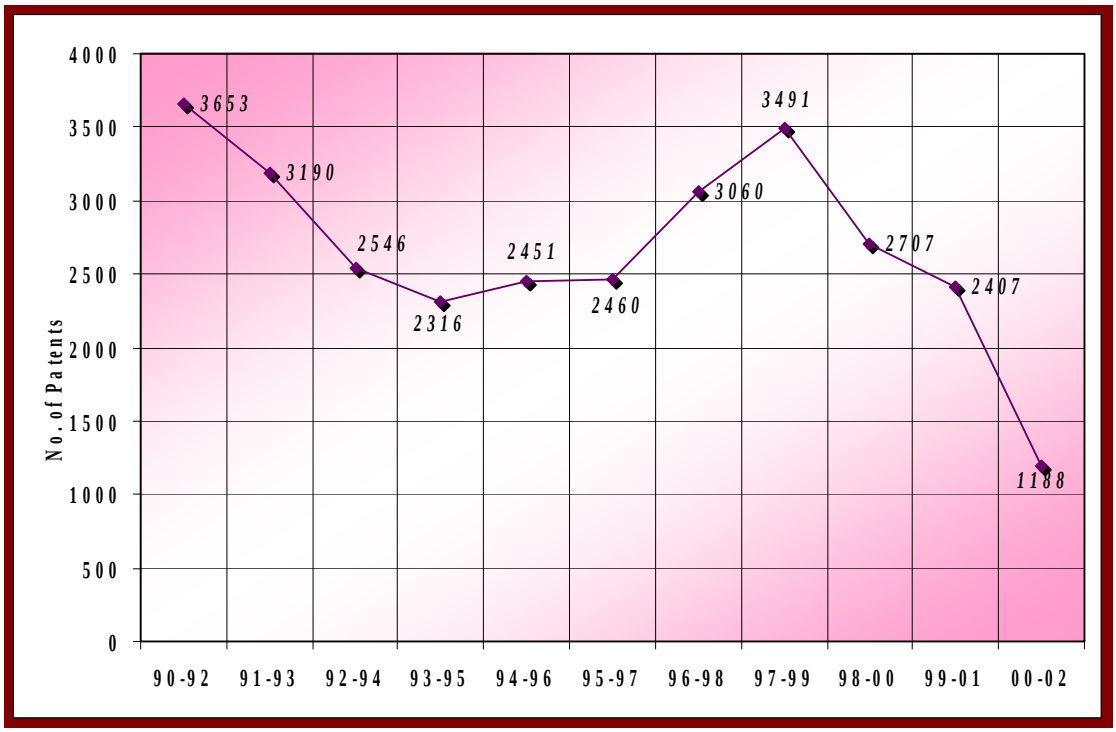


Table 69 exhibits patenting activity by foreigners in the three defined periods. The relative decline in the later period indicates that foreigners were entering IPO through other routes (PCT, 'Mailbox' provisions).

Table 69: Patenting by Foreigners in the Three Designated Sub-periods

Period	No. of patents
Pre-WTO Period (1990-94)	6515
Post-WTO Period (1995-98)	5082
Current Period (1999-02)	4413

b) Patenting by Different Types of Entities

Institutional patenting was the dominant category of patenting. There were 1524 institutional patents, constituting 95% of the total patents by foreigners in IPO. Only 755 patents were by individuals, less then 5% of the total patents in IPO. Within institutional patenting, industrial firms were the major contributor to the patenting activity, accounting for 65% of the total patents (14708 patents). Table 70 exhibits patents granted to different entities in the overall period as well as in the sub-periods.

Table 70: Year wise Trends in Patenting by Different Types of Foreign Organisitions

Year	Research	Industry	University	Individuals	OMD
1990-1994	264	**5883**	38	330	-
1995-1998	111	**4712**	21	250	-
1999-2002	94	**4112**	28	175	-
(Total) 1990-2002	469	**14708**	87	755	3

c) Prolific Foreign Organisations Patenting in IPO

The prominent foreign organisations that were granted patents in IPO were Hoechst Aktiengesellschaft and Proctor and Gamble, each being granted 276 patents. Other prolific foreign institutions were Siemens Aktiengesellschaft (237 patents), Maschinenfabrik Rieter AG (216 patents) and E.I.DU PONT de Nemours and company (215 patents). Organisations that exhibited major activity are shown in Table 71.

Table 71: Patenting by Prolific Foreign Organisations

Organizations / Institutes	No. of patents (90-94)	No. of patents (95-98)	No. of patents (99-02)	No of patents (1990-2002) (% of total foreign patents)
Hoechst Aktiengesellschaft	119	113	44	276 (1.7%)
Procter & Gamble Company	25	81	170	276 (1.7%)
Siemens Aktiengesellschaft	70	81	86	237 (1.5%)
E. I. Du Pont De Nemours and Company	99	73	43	215 (1.3%)
Maschinenfabrik Rieter AG	60	85	42	187 (1.2%)
Lubrizol Corporation	77	70	19	166 (1.0%)
Societe Des Produits Nestle SA	35	37	69	141 (0.9%)
Shell International Research Maatschappij BV	74	33	17	124 (0.8%)
General Electric Company	24	37	60	121 (0.8%)
Colgate Palmolive Company	66	27	18	111 (0.7%)
Institut Francais Du Petrole	50	26	23	99 (0.6%)

Organizations / Institutes	No. of patents (90-94)	No. of patents (95-98)	No. of patents (99-02)	No of patents (1990-2002) (% of total foreign patents)
Westinghouse Electric Corporation	82	14	-	96 (0.6%)
International Business Machines Corporation	4	67	20	91 (0.6%)
UOP INC	39	31	17	87 (0.5%)
Imperial Chemical Industries PLC	35	23	26	84 (0.5%)
Daewoo Electronics Co Ltd	-	2	80	82 (0.5%)
Minnesota Mining & Manufacturing Company	49	32	-	81 (0.5%)
Motorola INC	10	37	29	76 (0.5%)
Samsung Electron Devices Co Ltd	19	67	-	75 (0.5%)

d) Prominent Patenting Activity of Major Countries

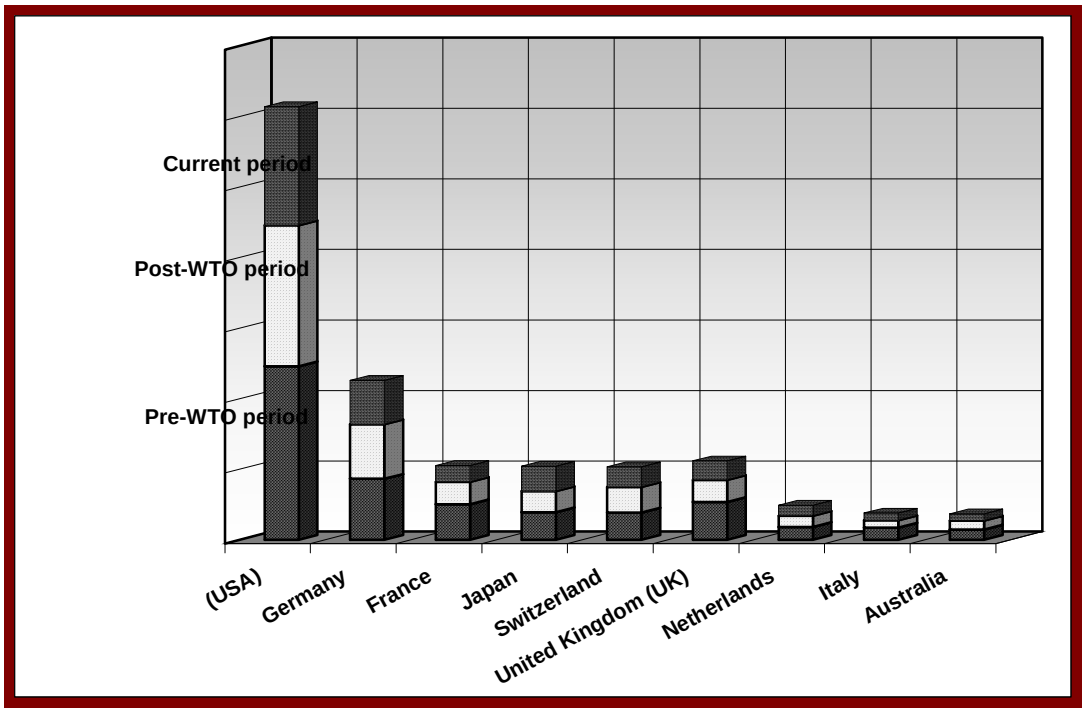
USA was the prominent country accounting for 38% of patents in IPO followed by Germany with around 14% patents. Foreign filing was also prominent from France, Japan and Switzerland each contributing approximately 7% of the total patents. The above five countries had a share of 72% of the total patents by foreigners in the entire period.

Table 72 illustrates the activity of foreign filing by countries prominent in IPO during the three designated periods of activity. It is worth noticing that except for Japan, all other countries exhibited a decrease in patenting activity over the periods. Only Japan shows an increase during the current period from the post-WTO period. (Although highlighted by Box 2 that in real sense there might be increase in activity as patents are being filed by countries through two additional routes, PCT and mailbox provision). It can be probably concluded that these countries are using different routes to enter the IPO.

Table 72: Prominent Patenting Activity of Major Countries during the Three Designated Periods

Country	No. of patents (1990-1994)	No. of patents (1995-1998)	No. of patents (1999-2002)	Total patents 1990-2002 (% share)
USA	2464	1995	1682	6141 (38%)
Germany	867	774	621	2262 (14%)
France	507	318	232	1057 (7%)
Japan	394	300	351	1045 (7%)
Switzerland	386	366	285	1037 (6%)
United Kingdom (UK)	536	315	270	947 (6%)
Netherlands	185	158	151	494 (3%)
Italy	174	107	100	381 (2%)
Australia	148	127	96	371 (2%)

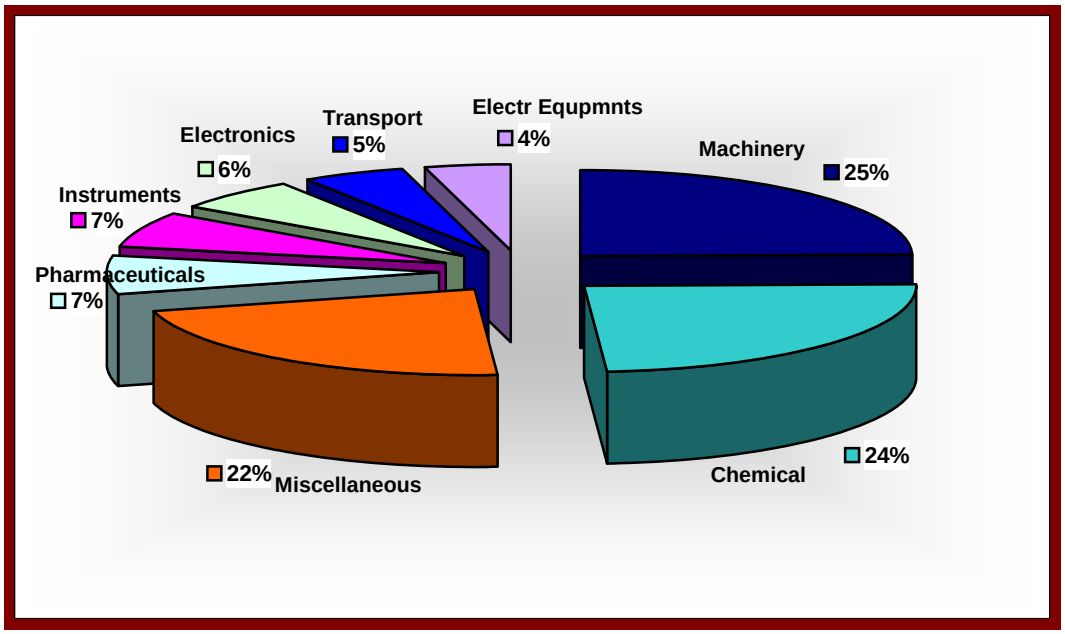
Figure 34: Patenting Activity of Major Countries in Pre/post WTO and the Current Period



e) Sector Activity

Machinery and Chemical were the dominant sectors accounting for 25% and 24% of patents respectively. High performing subsectors were 'Rubber and plastic products', 'Basic metals', 'Non-metallic mineral products' and 'Office machinery and Computers'. All these sub-sectors were under 'Miscellaneous' sector. The activity under major sectors are shown in Figure 35.

Figure 35: Patenting Activity in Major Sectors (1990-2002)



The focus of patents by foreigners was different then that of domestic institutions patenting in IPO. Majority of patenting by domestic institutions were in Chemicals (33% of the total patents), and Pharmaceuticals (2% of the total patents). Table 73 further highlights the patenting activity in the three sub-periods.

Table 73: Patenting Activity in Different Sectors in the Three Sub-Periods

SECTORS	1990-94	1995-98	1999-02	Total Patents 1990-2002 (% share)
Machinery	1630	1282	1005	3917 (24%)
Chemical	1588	1178	1025	3791 (24%)
Miscellaneous	1489	1048	934	3471 (22%)
Pharmaceuticals	397	314	413	1124 (7%)
Instruments	411	343	296	1050 (7%)
Electronics	299	345	296	940 (6%)

SECTORS	1990-94	1995-98	1999-02	Total Patents 1990-2002 (% share)
Transport	375	236	194	805 (5%)
Electrical Equipments	289	221	148	658 (4%)
Biotechnology	54	37	37	128 (1%)
Total	6533	5004	4348	15885

The relative decline in activity in all the sub-sectors in the later period may not reflect the true picture as intensive patent filing would have taken place in some sectors. They would be reflected in the foreign patents entering the IPO through the other two routes (PCT filing, and 'Mailbox' provisions).

f) Sub-sector Activity

All the 43 sub-sectors were addressed by foreign patents. Except for two subsectors, 'Paints & varnishes' (6 patents) and 'Watches & clocks' (7 patents) all the other subsectors had more than 15 patents in the entire period. Unlike Indian patenting activity in IPO, 'Instrument', 'Electrical equipment' and 'Electronic' sectors exhibited substantial patenting activity. The sub-sectors that exhibited maximum activity are shown in Table 74.

Table 74: Higher Activity Sub-Sectors of Foreign Patents

Sub-Sectors	90-94	95-98	99-02	Total
Basic chemical	1267	966	834	3067
Special purpose machinery	697	596	386	1679
Non-specific purpose machinery	400	269	221	890
Rubber & plastic products	294	219	174	687
Energy machinery	306	196	127	629
Basic metals	301	185	132	618
Medical equipment	178	194	191	563
Motor vehicles	226	143	127	496
Non-metallic mineral products	269	95	112	476
Signal Transmission, Telecommunications	132	119	188	439
Office machinery and computers	155	128	123	406

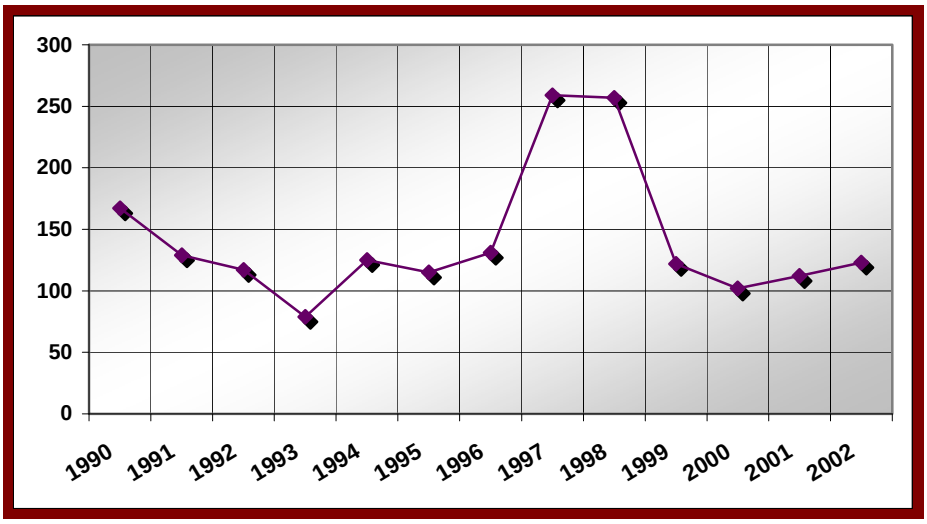
Sub-Sectors	90-94	95-98	99-02	Total
Fabricated metal products	150	130	100	380
Electric distribution, control, wire, cable	159	121	68	348
Other chemicals	174	123	51	348
Food, beverages	109	92	141	342
Electronic components	130	133	59	322
Domestic appliances	58	89	171	318
Machine-tools	125	103	82	310
Other transport equipment	149	93	67	309

3.3.5 Patenting by Indian Individuals in IPO (1990-2002)

a) Overview

Considerable number of patents was granted to Indian individuals in IPO. Individuals accounted for around 1838 (8%) of total patents in IPO. But the patenting activity of individuals exhibited random activity. The lowest activity was in the year 1993 while the years 1997 and 1998 saw the highest activity.

Figure 36: Year-wise Trends in Patenting Activity by Indian Individuals

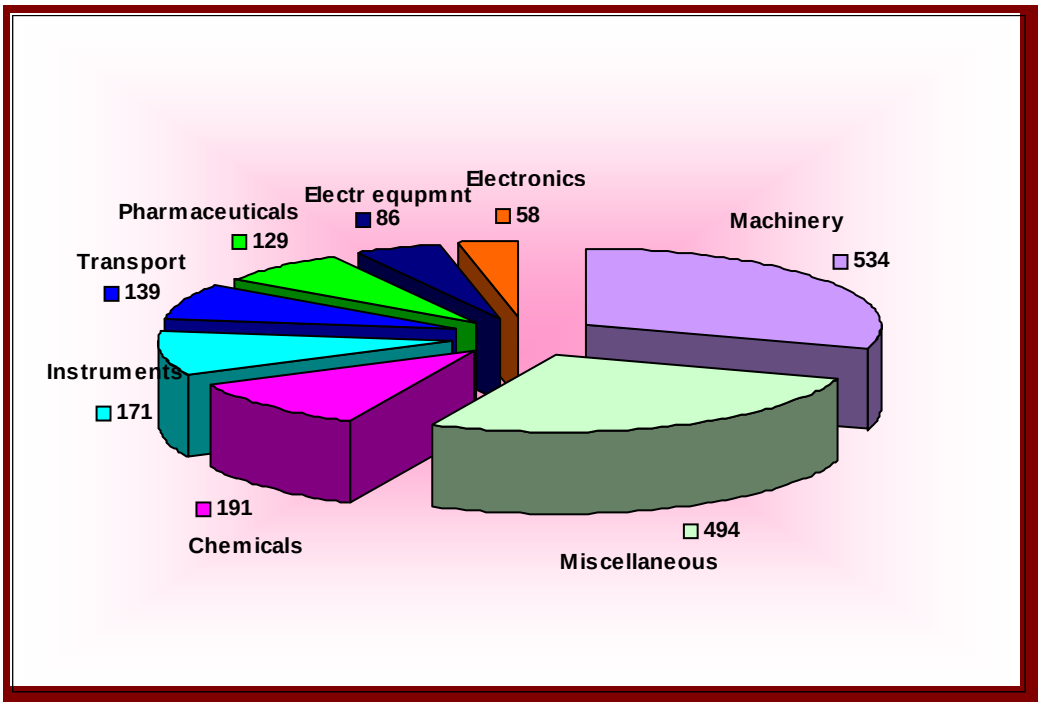


The post-WTO period exhibited the highest patenting activity (762 patents) by individuals followed by pre-WTO period (617 patents). This was unlike patenting by domestic institutions were maximum activity was observed in the Current period (1999-2002). Individuals exhibited the lowest activity in the Current period (459 patents). The reason for this decline is not clear.

b) Patenting by Individuals in Major Sectors

Machinery was the major sector exhibiting the highest activity (~29%) among individuals. This was similar to the patenting activity by foreigners. Miscellaneous sector counted for 27% of patents. Chemicals and Instruments were the other prolific sectors of activity with 10% and 9% patents of total patents granted to individuals.

Figure 37: Patenting by Individuals in Major Sectors (1990-2002)

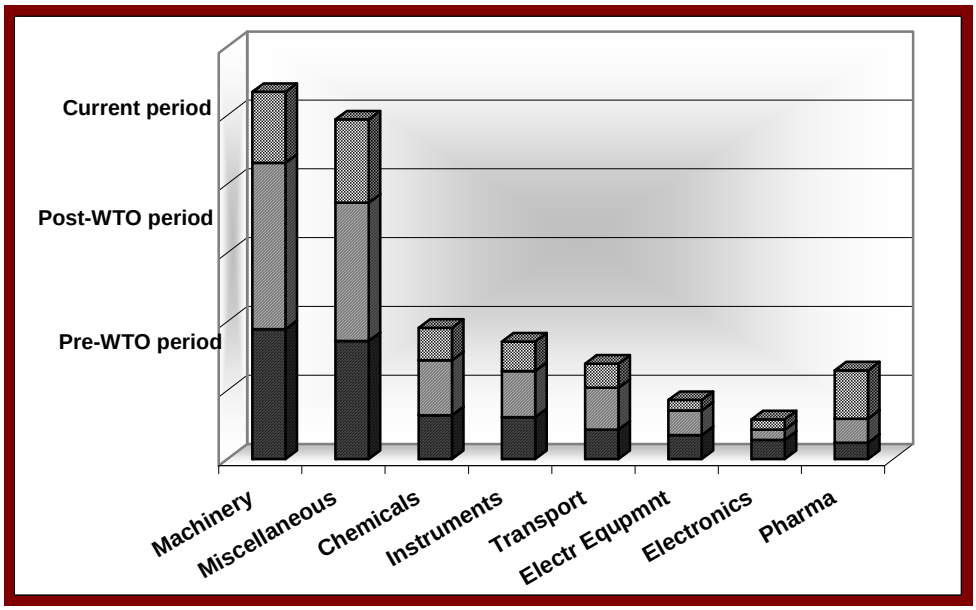


Low patenting in some sectors/sub-sectors probably points out the pre-requisite of institutional set-ups.

Table 75: Patents in Major Sectors during the Three Sub-periods of Activity

Major Sector	Pre-WTO (1990-94)	Post-WTO (1995-98)	Current (1999-02)
Machinery	189	242	103
Miscellaneous	172	201	121
Chemicals	64	80	47
Instruments	61	67	43
Transport	43	61	35
Electrical Equipment	35	36	15
Electronics	28	15	15
Pharmaceuticals	24	35	70
Biotechnology	1	5	4

Figure 38: Patents in Major Sectors during the Three Sub-periods of Activity



There were some sub-sectors that had substantial activity within each major sector. Table 76 highlights the sub-sectors of high patenting activity.

Table 76: Sub-sectors of Higher Activity in Three Designated Sub-Periods

Sector/Sub-sector	No. of patents (90-94)	No. of patents (95-98)	No. of patents (99-02)	Total Patents (1990-2002)
Machinery / Special purpose machinery	51	61	33	145
Machinery / Energy machinery	48	55	18	121
Machinery / Non-specific purpose machinery	34	49	28	111
Machinery / Domestic appliances	27	44	11	82
Machinery / Agricultural and forestry machinery	12	20	6	38
Machinery / Machine-tools	17	13	7	37
Chemical / Basic chemical	52	53	32	137
Chemical / Pesticides, Agro-chemical Products	7	20	9	36
Instruments / Medical equipment	27	43	25	95
Instruments / Measuring instruments	23	20	14	57
Miscellaneous / Fabricated metal products	49	40	22	111
Miscellaneous / Rubber & plastic products	33	34	16	83
Miscellaneous / Furniture, consumer goods	30	18	19	67
Miscellaneous / Food, Beverages	8	42	14	64
Miscellaneous / Non-metallic mineral products	16	30	15	61
Miscellaneous / Basic metals	20	11	14	45
Miscellaneous / Office machinery and computers	6	9	6	21

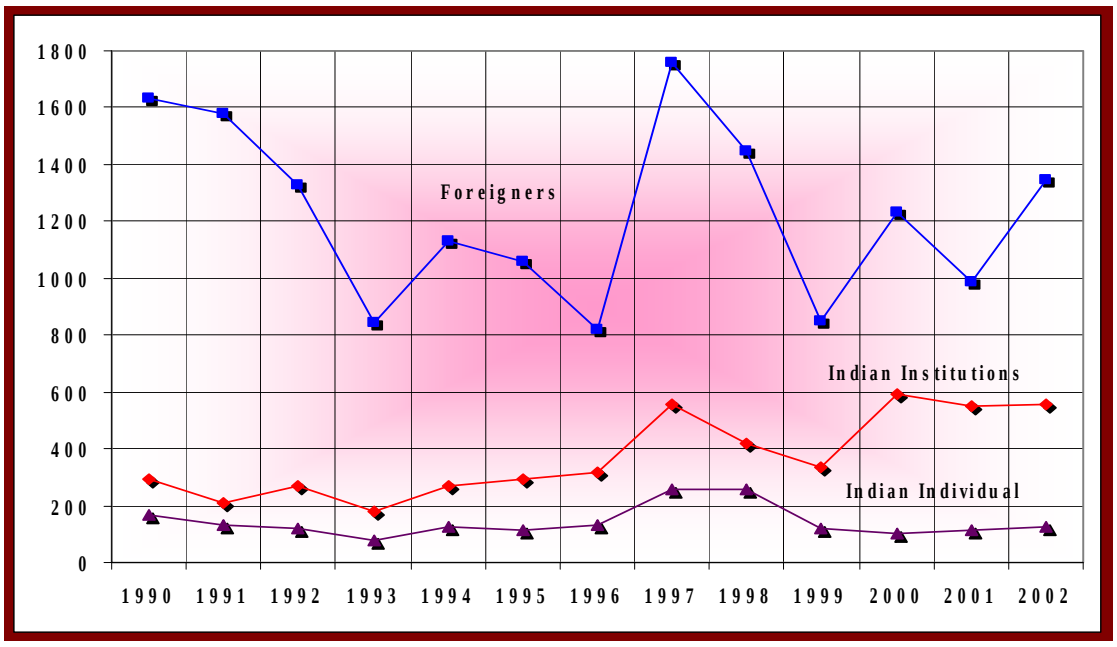
3.3.6 Comparative Activity of Indian Institutions, Foreigners and Indian Individuals Patenting in IPO

a) Overview

Patenting in IPO comprised of patents by Indian institutions, Foreigners and Indian individuals. Unlike USPTO, in IPO the maximum number of patents were granted to Foreigners, followed by Indian institutions and lastly Indian Individuals. Foreigners included both foreign institutions and foreign individuals patenting in IPO. While foreigners had a share of 71% (16009 patents) of total patents in IPO, Indian institutions had a share of 21% and patents by Indian individuals constituted 8% of total patents.

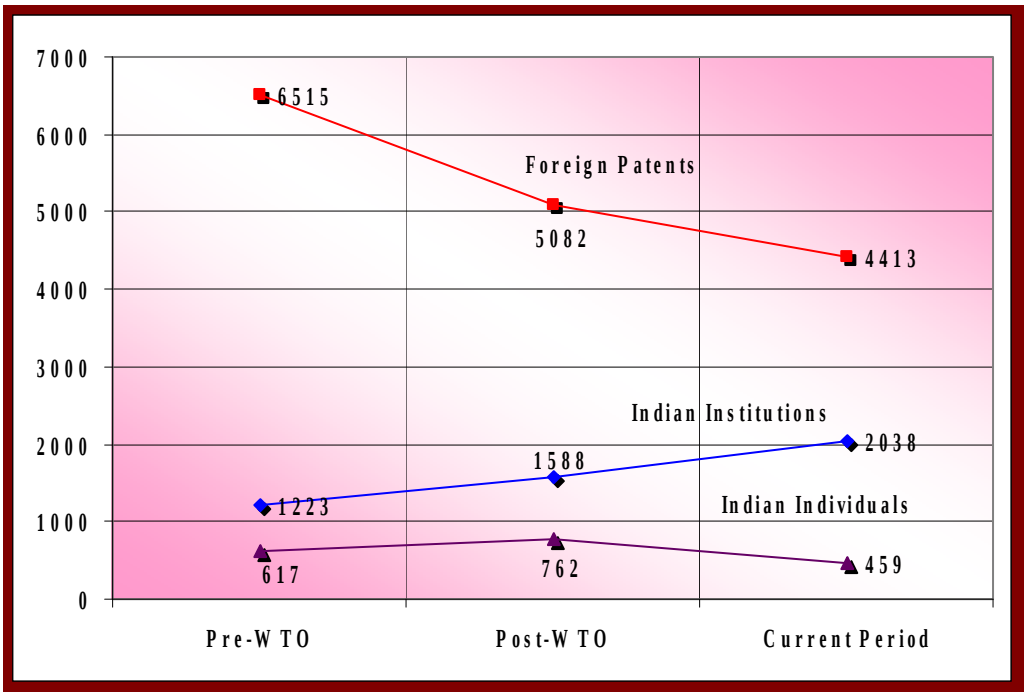
The year 1997 saw the maximum number of patents being granted to foreigners and Indian individuals while for Indian institutions maximum number of patents were granted in the year 2000. Figure 39 demonstrates that in the later periods Indian activity shows increase. Patenting by Foreigners in IPO showed a random decline. The probable reason as highlighted earlier is due to foreigners filing applications through the PCT route and 'Mailbox' provision.

Figure 39: Year wise Patenting Activity of Indian Institutions, Foreigners and Indian Individuals in IPO (1990-2002)



Foreigners followed by Indian institutions and Indian individuals respectively had show maximum activity. Foreigners exhibited maximum activity in pre-WTO period while Indian institutions exhibited maximum activity in the Current period. There was not much change in the patent activity of Indian individuals in pre-WTO and post-WTO period. Some decline was observed in the Current period. However, the Foreign institutions are using PCT and 'Mailbox' provisions to patent in India. As explained earlier (refer Box 2 in this chapter) the patents coming from these routes would take some time to enter the examination process. Thus in the current period there was an apparent decline in foreign patents.

Figure 40: Patenting by all Three Categories of Patents in Three Designated Periods



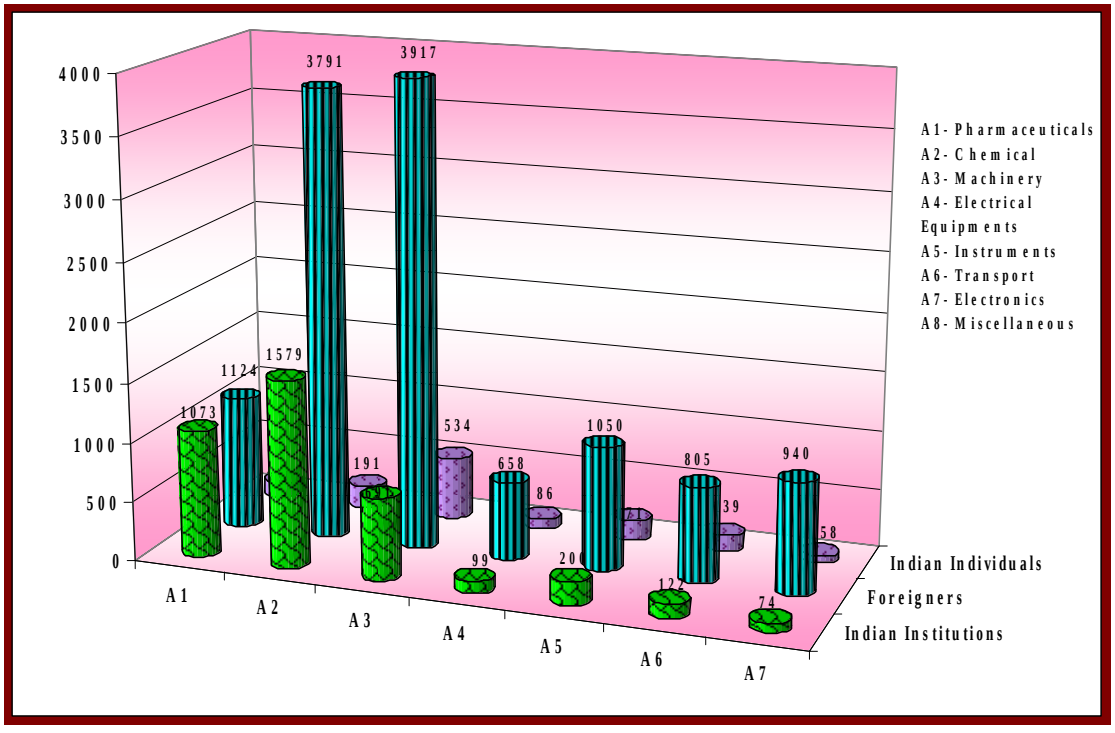
b) Sector Activity

Table 77 and Figure 41 exhibits activity of Indian institutions, Foreigners, and Indian individuals in various sectors.

Table 77: Major Sector-wise Patent Activity Among all Three Categories of Indian patents in IPO (1990-2002)

Major Sectors	Indian Institutions	Foreigners	Indian Individuals
Pharmaceuticals	1073	1124	129
Chemical	1579	3791	191
Miscellaneous	919	3471	494
Machinery	691	3917	534
Instruments	200	1050	171
Electronics	74	940	58
Transport	122	805	139
Electrical Equipment	99	658	86
Biotechnology	130	128	10

Figure 41: Sector Activity by the Three Categories of Patents in the Three Defined Sub-periods



Indian individuals had higher activity in Miscellaneous, Machinery, Instruments and Transport sector. Indian institutions showed highest activity in Chemical and Pharmaceutical sectors whereas foreigners exhibited higher activity in

Electronics. Table 78 exhibits in details the activity of Indian institutions, foreigners, and Indian individuals in the three designated periods.

Table 78: Major Sector-wise Patent Activity in the Three Designated Sub-periods

Sector	Indian Institutions			Foreigners			Indian Individuals		
	90-94	95-98	99-02	90-94	95-98	99-02	90-94	95-98	99-02
Chemical	419	492	668	1588	1178	1025	64	80	47
Pharmaceuticals	221	305	547	397	314	413	24	35	70
Machinery	201	267	223	1630	1282	1005	189	242	103
Electrical Equipment	39	30	30	289	221	148	35	36	15
Instruments	48	71	81	411	343	296	61	67	63
Transport	38	41	43	375	236	194	43	61	35
Electronics	15	17	42	299	345	296	28	15	15
Miscellaneous	234	333	352	1489	1048	934	172	201	121
Biotechnology	32	38	60	54	37	37	1	5	4
TOTAL	1247	1594	2046	6533	5004	4348	617	742	473

4 Overall Indian Patenting Activity, Patenting Activity Post 2002 and International Comparison

4.1 Introduction

The present chapter provides an aggregated picture of the patenting activity by Indian organisations (designated as IOP in this study) in the USPTO and IPO for the period covered in this study (1990-2002).

A brief analysis of post 2002 (2003 & 2004) patenting activity in the USPTO for IOP and FOP was also undertaken to observe the Current patenting trends.

India's patenting activity was compared with some countries (developed and emerging) to have some broad indications of international trends and India's relative position in that context. The following five countries namely: US, Japan, South Korea, Brazil, and China were selected for the above investigation.

4.2 Methodology

The overall Indian patenting activity (1990-2002) was based on the analysis done separately in USPTO and IPO. Patenting activity of IOP and FOP post 2002 covered the period 2003-04 and was restricted to USPTO only. Methodology was similar to that undertaken for investigating IOP in USPTO (refer Chapter 2: Indian Patent activity in the US Patent System).

Indian patenting activity was compared with some developed and emerging economies, to have an assessment in the overall context. Countries were carefully chosen so that the comparison set included countries with comparable patenting activity as well as countries that are technological leaders. This allowed a measure of the extent and depth of patenting activity of the selected countries and helped identify India's strengths and areas that would require attention.

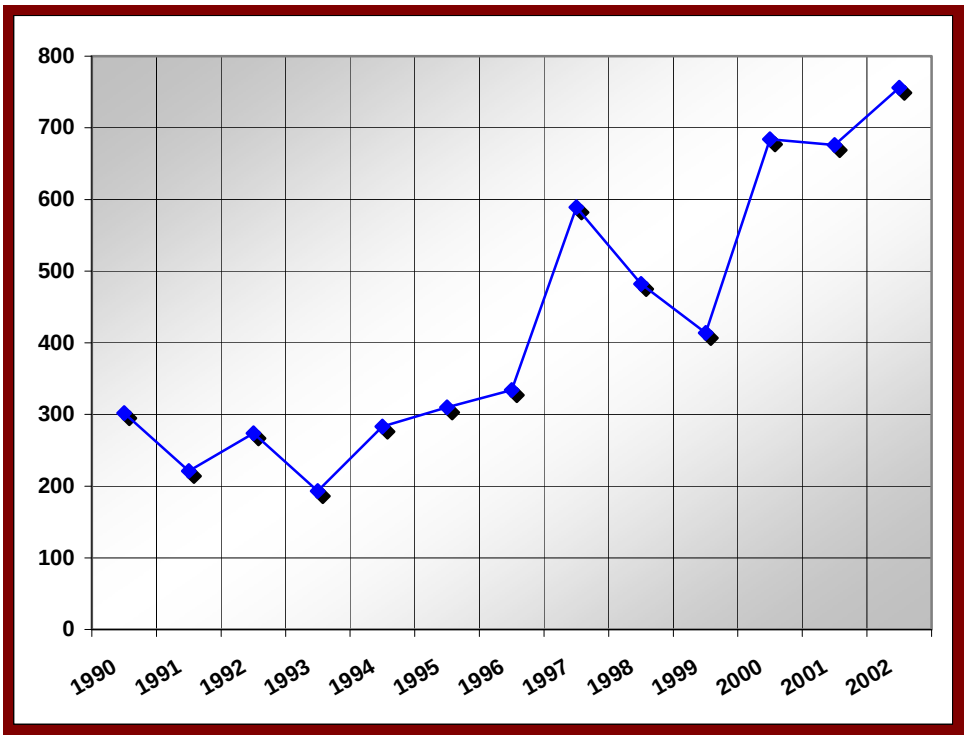
Patents of Japan, Brazil, Korea and China in 44 technological classes were recorded from the online USPTO database. As U.S. patenting activity is available state-wise, U.S. activity in each technological class involved an elaborate exercise of recording patenting activity under each technological class for each U.S. state.

4.3 Results

4.3.1 Overall Activity

There were 5517 patents granted to Indian organisations covering patenting in both the system, in the entire period 1990-2002. To a certain degree, Indian activity on the whole exhibited random behaviour over the years. Figure 42 below exhibits patents granted to Indian organisations.

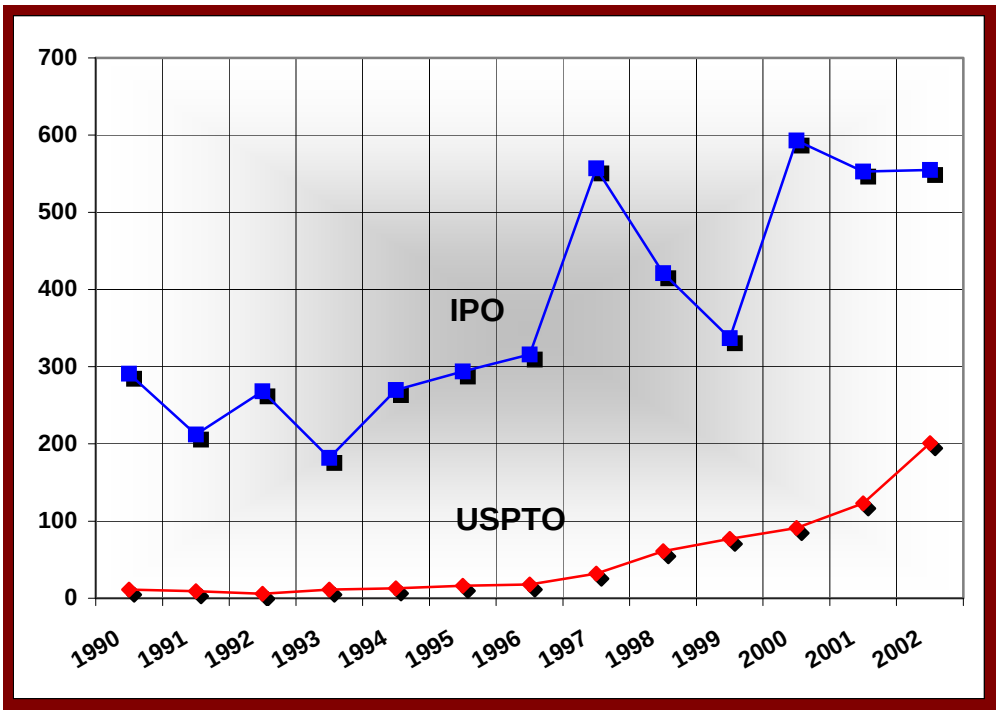
Figure 42: Overall Indian Activity



The substantial increase in activity in the later years can be observed from the figure. The years 2002 and 2001 were the ones with maximum activity whereas 1993 exhibited the least activity. There were 1273, 1715, and 2530 patents respectively in the three sub-periods i.e. Pre-WTO (1990-94), Post-WTO (1995-98), and the Current period (1999-2002). The current period accounted for 46% patents indicating substantial increase in patenting activity.

There were 4848 IOP patents in IPO whereas 669 patents in USPTO. This signifies the significant activity of domestic institutions in IPO. The patenting activity was however random in IPO unlike the consistent growth observed in USPTO. Figure 43 depicts the activity in both systems for the period 1990-2002.

Figure 43: Patenting Activity in Both Systems 1990-2002



From the above figure it can be observed that year 2000 experienced maximum patenting activity in IPO. IOP had contributed around 62% of total patents in USPTO (the rest were owned by Foreign institutions and Indian individuals). IOP contribution was 21% in the overall share in IPO. In IPO majority contribution was by foreigners (71% of the total patenting). The number of patents in the period 1990-94 (Pre WTO), 1995-98 (Post-WTO) and the Current Period (199-2002) in IPO were 1223, 1588, and 2038 respectively. The patenting activity in the similar three periods in USPTO was 50, 127, and 492. Thus there was significant increase in patenting activity in both IPO and USPTO in the Current period in comparison to the earlier two periods.

a) Organisations Involved in Patenting

749 organisations were involved in patenting in IPO whereas only 93 organisations were involved in USPTO. This might be one of the reasons for the difference in number of patents in both the systems. Table 79 indicates the different types of organisations patenting during the entire period (1990-2002) and also during the three designated periods in both IPO and USPTO.

Table 79: Organisations Involved in Patenting Activity in Both Systems

	1990-1994		1995-1998		1999-2002		1990-2002 (Distinct Orgn's)	
	IPO	USPTO	IPO	USPTO	IPO	USPTO	IPO	USPTO
Number of Organisations	265	14	40	28	388	65	749	93

There was a gradual increase in the number of organisations involved in patenting activity in both IPO and USPTO. Only 14 Organisations were involved in patenting activity in more then one sub-period in USPTO whereas 244 organisations had been granted patents at least in more than one sub-period in IPO.

b) Intensity of Patenting in Different Types of Organisations

Industry accounted for maximum number of patents overall (total patents covered by both the systems) i.e. 2927 patents (53% of total patenting activity). 2277 patents were granted to Research institutions constituting 41% of total patents. University accounted for 179 patents (3% of the total) and Special institutes had a share of 2% patents (122 patents). Patenting activity by Non-Scientific Ministries (other ministries/departments) was insignificant and accounted for only 6 patents in the entire period.

Table 80 illustrates the intensity of patenting activity of these different organisations in the two systems: IPO and USPTO.

Table 80: Patents Granted to Different Organisations in IPO and USPTO

Type of Organisation	IPO (% share)	USPTO (% share)
Industry	2673 (55 %)	254 (39%)
Research	1886 (39%)	391 (60%)
University	171 (3%)	9 (1%)
Special Institute	119 (2%)	1 (0.15%)
Other Ministries/ Departments	4 (0.08%)	2 (0.31%)

Industrial firms accounted for majority of patents in IPO whereas research organisations had higher contribution in the overall share in USPTO. Universities

played some role in patenting activity in IPO. Special institutes were granted considerable number of patents (119 patents) in IPO and had insignificant presence in USPTO. Patenting by Non-scientific ministries was insignificant in both systems.

c) Patent Activity by Prolific Organisations

There were a few organisations that accounted for maximum activity in both the systems. In all 23 organisations were identified playing prominent role in overall Indian patenting activity. CSIR played a dominant role in the country's patenting activity. In all 2038 (37%) patents were granted to CSIR. CSIR exhibited its dominance in both the US and Indian patent systems. Hindustan Lever Ltd. (HLL) was granted 565 (10%) patents. Indian Institute of Technology (IIT), Ranbaxy Labs Ltd., Dr. Reddy's Research Foundation, IOCL and DRDO had similar levels of patenting activity. However, IIT's and HLL's activity were restricted to IPO.

Table 81 below illustrates the Indian institutions that exhibited substantial patenting activity (termed as prolific institution in this study) in IPO and USPTO.

Table 81: Prolific Patenting Institutions: IPO and USPTO

Organisation/ Industry	USPTO	IPO	Total patents
Council of Scientific & Industrial Research (CSIR)	378 (55%)	1660 (34%)	2038 (37%)
Hindustan Lever Limited (HLL)	0	565 (12%)	565 (10%)
Indian Institute of Technology (IIT)	0	80 (2%)	80 (1%)
Ranbaxy Laboratories Limited	39 (6%)	36 (7%)	75 (1%)
Dr. Reddy's Research Foundation	35 (5%)	36 (7%)	71 (1%)
Indian Oil Corporation Limited (IOCL)	18 (2%)	43 (9%)	61 (1%)
Defence Research & Development Organization (DRDO)	6	51 (1%)	57 (1%)
Hoechst India Ltd	0	48 (1%)	48 (0.9%)
National Research Development Corporation (NRDC)	7	41 (0.9%)	48 (0.9%)
Indian Petrochemicals Corporation Limited (IPCL)	9	37 (0.8%)	46 (0.8%)
Sree Chitra Tirunal Institute for Medical Sciences & Technology	1	41 (0.9%)	42 (0.8%)
Bharat Heavy Electricals Limited (BHEL)	0	41 (0.9%)	41 (0.8%)
Lupin Laboratories Limited	11	30 (6%)	41 (0.7%)
Steel Authority of India Ltd (SAIL)	0	38 (0.8%)	39 (0.7%)

Organisation/ Industry	USPTO	IPO	Total patents
J. B. Chemicals & Pharmaceuticals Ltd.	0	31 (0.6%)	34 (0.6%)
Indian Jute Industry Research Association	0	30 (0.6%)	30 (0.5%)
Indian Space Research Organization (ISRO)	1	28 (0.6%)	29 (0.5%)
National Council for Cement & Building Material	0	30 (0.6%)	30 (0.5%)
Project & Development (India) Ltd.	0	29 (0.6%)	29 (0.5%)
Panacea Biotech Limited	13 (2%)	9	22 (0.4%)
South India Textile Researh Association (SITRA)	0	21 (0.4%)	21 (0.4%)
National Institute of Immunology (NII)	13 (2%)	6	19 (0.4%)
Dabur Research Foundation	15 (2%)	1	15 (0.3%)

Among the 23 prolific institutions, there were 15 industrial firms, 5 research entities, 2 universities and 1 specialised institute.

BOX 3

Patenting activity of MNC subsidiaries have followed varied approaches. Texas instruments had assigned their patents in USPTO to its Indian subsidiary and some to its parent of the company of the R&D work done in India. Hoechst Akteingesellschaft had assigned their patents in USPTO to its parent company. However, patents in the Indian patent system have been assigned to its Indian subsidiary. Some of these patents were observed to the first filed (Priority patents) in Great Britain.

Hindustan Lever Ltd. (Public Ltd company in India) had also taken this approach. Their USPTO patents have been assigned to its parent company and its patenting filed in India assigned to its Indian subsidiary.

The parent companies of the above MNC's are also active in filing patents in India. Thus it indicates that MNC's are protecting their technologies they feel can be infringed in India, through multiple methods.

d) Collaborative Activity

Jointly owned patents were only a few in numbers in both USPTO and IPO. Dr. Reddy's Research Foundation exhibited maximum collaboration activity. However, a substantial number of its collaborations were with its own subsidiary Reddy-Cheminor in USA. Its other collaborations were with major drug MNC, Novo Nordisk. In IPO this firm exhibited no collaboration activity.

CSIR had 23 collaborations, 14 in USPTO and 9 in IPO. CSIR had developed some important partnerships. The alliance of one of the laboratories of CSIR namely NCL (National Chemical Laboratory) with GE (General Electric) had resulted in the development of a number of joint technologies. Some of the patents emerging from this partnership were assigned to CSIR and some to GE as per terms and agreements. This case study is elaborated in Chapter 5.

Figure 44 exhibits the number of collaborations and the number of organizations involved in collaboration in both systems.

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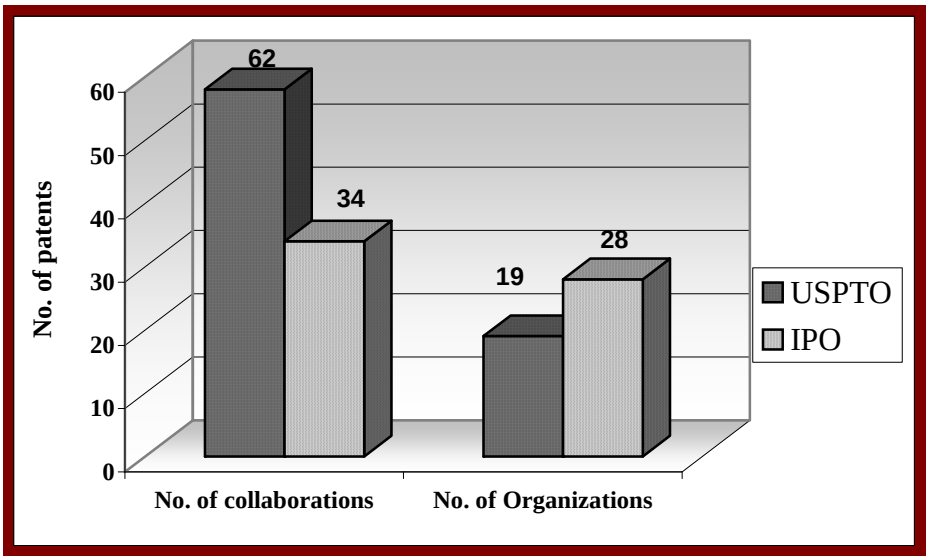
Figure 44: Collaborative Activity in Both Systems



e) Sector Activity

Pharmaceuticals sector was the dominant area of India's patenting activity and accounted for 52% (2863 patents) of total patents (i.e. patents covering both the systems). Chemical was the next major sector with 25% (1798 patents) of total patents. Miscellaneous' and 'Machinery' were the other prominent sectors of Indian patenting activity. Within Chemical sector, the subsectors that experienced major activities were 'Basic chemicals', 'Soaps, detergents and toilet preparations', 'Pesticides and agro-chemical products' and 'Other chemicals'. The subsectors within 'Miscellaneous' that were addressed: 'Food, beverages', 'Basic metals' and 'Non-metallic mineral products'. Table 82 indicates the overall Indian activity in major sectors.

Table 82: Overall Activity in Different Sectors: 1990–2002

Sectors	USPTO (% share)	IPO (% share)	Total patents
Pharmaceuticals	284 (42%)	1579 (32%)	2863 (52%)
Chemical	232 (35%)	1073 (22%)	1405 (25%)
Miscellaneous	65 (10%)	919 (19%)	982 (18%)
Machinery	28 (4%)	691 (14%)	719 (13%)
Instruments	18 (3%)	200 (4%)	218 (4%)

Sectors	USPTO (% share)	IPO (% share)	Total patents
Transport	6 (1%)	122 (2%)	128 (2%)
Electrical Equipment	1 (0.15%)	99 (2%)	100 (2%)
Electronics	9 (1%)	74 (2%)	83 (2%)
Biotechnology*	53 (8%)	130 (3%)	183 (3%)

It can be observed from the Table that in both the systems, maximum patenting activity was in the Pharmaceutical' sector. 'Chemical' sector was the other major sector in which there were significant IOP. Almost all-major sectors exhibited considerable patenting in IPO, unlike USPTO, where certain sectors such as 'Transport', 'Electrical equipment' and 'Instruments' did not exhibit much patenting activity.

The major technological domains that exhibited substantial activity (within sectors) were 'Medicinal preparations of organic ingredients', 'Heterocyclic compounds', 'Micro-organisms compositions', 'Acrylic or carboxylic compounds', 'Chemical or physical processes', 'Non-metallic elements', 'Macromolecular compounds', 'Biocides' and 'Plant reproduction techniques'.

f) Overall activity of CSIR

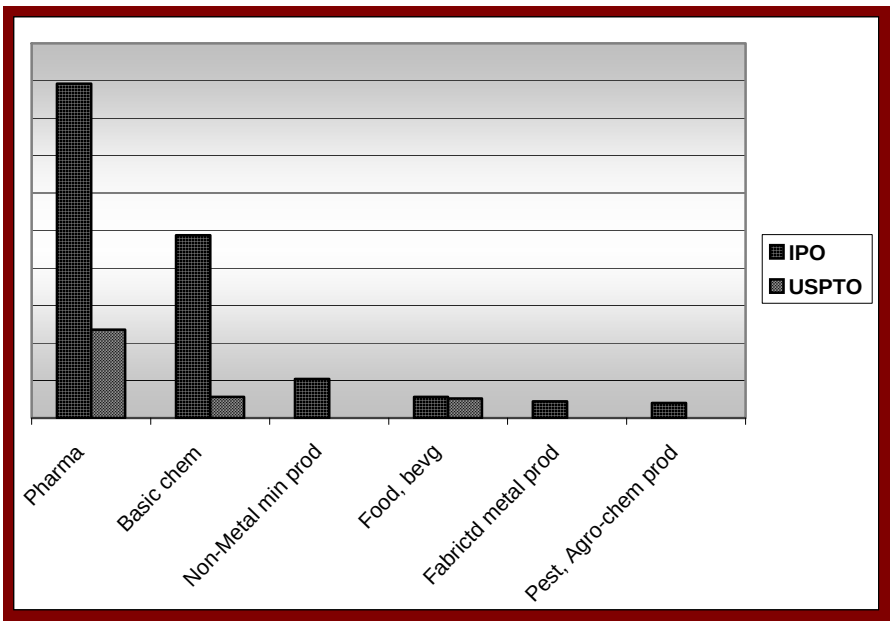
CSIR was the most prolific institution patenting in both systems. 2039 patents were granted to CSIR, which was approx. 37% of total Indian activity (IPO and USPTO). CSIR accounted for 378 patents (57% of total IOP) in USPTO and 1660 (34% of the total IOP) in IPO.

CSIR had 14 collaborative patents in USPTO and 9 in IPO. Its collaborative partners included some major industrial entities such as General Electric, Nova Nordisk (a major drug MNC) and research institutions/universities such as Laboratoire des Materiaux Organiques a Proprietes Speciques (France), University of California. One joint patent in USPTO involved two organisations, National Institute of Cholera & Enteric Diseases and Department of Biotechnology.

CSIR patents in IPO addressed all the 9 major sectors. Chemicals' and 'Pharmaceuticals' were the major sectors covered by CSIR's patents. There was some specificity in patenting activity in the sub-sectors covered under 'Miscellaneous' sector in USPTO and IPO. Basic metals', 'Non-metallic mineral products', 'Food &

beverages' and 'Fabricated metal products' had substantial activity in IPO whereas 'Food & beverages' exhibited major activity in USPTO. The major technological domains of CSIR common to both systems were 'Medicinal preparations', 'Catalyst', 'Polyester', 'Polypeptides', 'Colloids' and 'Preparation of heterocyclic compounds'. Areas that exhibited high degree of activity only in IPO were 'Enzymes', e.g. 'Ligases; proenzymes; compositions thereof', 'Shaped ceramic products', 'Foods or foodstuffs; their preparation or treatment', etc. Figure 45 distinguishes CSIR's activity in USPTO and IPO.

Figure 45: Patenting Activity of CSIR in USPTO and IPO



4.3.2 Indian Patenting Activity in USPTO (2003-04)

There have been substantial amendments in the Indian Patent Act of 1970 that govern the patenting activity in India (Annexure V illustrates the salient features of the various amendments) to make it more uniform with patent systems worldwide. More safeguards have been provided in the Indian Patent Act and scope of patenting has expanded. Product patents would now cover all technological areas. R&D and innovation activity has become more important in this new scenario.

The introduction of product patent in pharmaceutical sector as part of TRIPS agreement would have major impact on domestic market base as well as on exports. Prior to 1970, Indian drug industry accounted for only about 25% of the bulk drugs.

The patent act that came into force from 1971 onwards was a major boost to the Indian drug companies as per this act product patents were not allowed in 'Food', 'Drugs' and 'Agrochemicals'. Majority of multinationals limited their product portfolios to patent expired products or a few selected patented products in this period i.e. post 1971. This resulted in erosion of their market share as local manufacturers developed capabilities to produce product patented through reverse engineering (slight change in process). Domestic companies became dominant player and also put India in an enviable position among developing countries in generic drug formulation.

The direct implications of products patents in pharmaceuticals would be that companies that produce products that fall under patent protection (post 1995) will have to stop manufacturing them or negotiate a licensing agreement with the (foreign) patent holder. The transition will cause a move towards a monopoly market. Chemically identical products that were there in the market would cease to be available. Non-identical products that perform the same function i.e. substitutes would however remain.

Thus in the new scenario, creating proprietary protection through patents would be key to the survival of pharmaceutical firms. Further, many multinational companies are opening their R&D centres in India in different sectors/subsectors. India is looked upon as an emerging market. New products are being introduced that are patent protected. Firms will have to invest in R&D and develop novel products that do not infringe upon the patented products. An expected outcome in this new scenario is increased thrust towards patenting activity. To what extent this has taken place was explored in analysing the Indian activity in US in the period 2003-2004.

Table 83 show the share of the three patent types during the two years 2003-04.

Table 83: Share of Different Categories of Patents during 2003-04

Category of patent	2003	2004	Total
Utility	234	215	449
Design	2	6	8
Plant	6	4	10
Total	242	225	467

The above table reveals that during the years 2003 and 2004 a total number of 467 patents were granted. 242 and 225 patents were granted respectively in 2003 and 2004. Utility patents were as usual the major type of patents with around 96% (449 patents in both years). There were 10 plant patents and 8 design patents in all during this period. There were no design patents in the period 1999-2002. Thus it is encouraging to note that there has been some activity in design patents in 2003-04.

a) Process/Product Patents

Table 84 show the granted patents under different categories.

Table 84: Process/product Patents During the Two Year Period

Year	Process patents	Product patents	Process & Product
2003	125	76	41
2004	116	61	36
Total	241	137	77

As in the earlier 1990-2002 period, majority of the patents granted to Indian organizations during 2003-04 were process patents. Indian Patent Act of 1970 did not allow product patents in 'Pharmaceuticals', 'Food & beverages' and 'Agro-chemicals'. A reliable indication of India's capability can be gauged from India's activity in USPTO, as there were no such restrictions in USPTO. Table 85 exhibits process/product patents owned by Indian entities in these three areas.

Table 85: Product/Process Patents in Pharmaceuticals, Food & Beverages, and Agrochemicals (2003-04)

Sectors/ Type of Patent	Process	Product	Process& Product
Pharmaceuticals	103	58	54
Pesticides, Agrochemical products	3	4	5
Food & beverages	7	7	2

The above table indicate that there has been significant number of product patents granted in 'Pharmaceuticals'. Also there were considerable number of patents with both process and product claims. This provides a positive outlook for Indian pharmaceutical industry in the new TRIPS compliant patent system in India.

b) Organizations Involved in Patenting

95 Indian organizations were involved in patenting activity during 2003 and 2004 whereas 93 organisations were granted patents in the entire 1990-2002 period. There were organisations such as IIT, ICAR that were granted patents in 2003-04. In the sub-periods 1990-94, 1995-98, 1999-2002 there were 14, 28, 65 organisations involved in patenting activity respectively. *The presence of a large number of organisations in patenting activity in 2003-04 as well as the increase in number of new organisations signifies increasing awareness of Indian organisations in patenting in USPTO*. Further, 32 organisations that were involved in patenting activity in the earlier period (1990-2002) were also present in 2003-04. Earlier only 14 organisations were there in more then one sub-period. This also merits attention as it indicates that patenting activity of organisations is changing from earlier one-time activity.

Industrial entities were most active (74 firms), followed by universities (11 university). 7 research institutes and 3 specialised organisations were the other entities involved in patenting activity during this period (2003-04).

c) Intensity of Patenting in Different Types of Organizations

The 7 research institutes involved in patenting activity during the years 2003-04 accounted for 283 patents whereas 74 firms accounted for 115 patents. Research institutions contributed around 60% patents whereas industrial firms accounted for 39% of the total patents. Thus research organisations played dominant role post-2002 in patenting activity in USPTO as in the earlier period. This was mainly due to the dormient activity of CSIR. 11 universities had a total number of 17 granted patents (4% of the total patents) while no patents were granted to non-scientific ministries. Only 3 patents were granted to specialised institutes.

d) Prolific Organizations

CSIR was again the most prolific organization with 272 patents (58% of the total patents). The new additions to the list of prolific organizations were STMicroelectronics and Orchid Chemicals and Pharmaceuticals Ltd., both with 11 patents each. While the former is an MNC, the later is an Indian pharmaceutical company. Table 86 highlights the institutions prolific during this period.

Table 86: Patent Activity of Prolific Institutions

Organization/ Industry	No. of Patents (2003)	No. of Patents (2004)	Total Patents (2003- 2004) (% Share)*
Council of Scientific & Industrial Research	142	130	272 (58%)
Ranbaxy Laboratories Limited	8	12	20 (4%)
Dr. Reddy's Research Foundation	8	7	15 (3%)
STMicroelectronics	7	4	11(2%)
Orchid Chemicals & Pharmaceuticlas	5	6	11(2%)
Dabur Research Foundation	9	1	10 (2%)

** share of total patents during the period 2003-2004*

e) Collaborative Activity

Considerable amount of collaborative activity had taken place during 2003-2004. 27 joint patents were observed in 2003-2004; 11 in 2003 and 16 in 2004. Table 87 illustrates the results.

Table 87: Collaborative Patents: 2003-2004

Organization	Patents (Collaborations)	Collaboration (No. of collaborations)
Council of Scientific & Industrial Research	272 (13)	Gujarat Narmada Valley Fertilizer Co. Ltd. (2)
		Indian Institute of Technology (2)
		Department of Biotechnology (2)
		All India Institute of Medical Sciences (1)*
		Department of Science and Technology (1)*
		Department of Science and Technology & Zandu Pharmaceutical Works Limited (1)*
		Indian Council of Agricultural Research (1) *
		National Center for Cell Sciences (1)
		Sree Chitra Tirunal Institute for Medical Sciences & Technology & Kerala Institute for Research Training and Development Studies of Scheduled (1)*
		Indian Oil Corporation Ltd (1)

Organization	Patents (Collaborations)	Collaboration (No. of collaborations)
Ranbaxy Laboratories Limited	20 (1)	Toyama Chemical Co., Ltd.(1)
Dr. Reddy' s Laboratories Ltd.	15 (7)	Novo-Nordisk A/S (4)
		Reddy-Cheminor, Inc.(2)*
		Dr. Reddy's Laboratories Inc.(1)
University of Delhi	3 (1)	National Diary Development Board(1)
Indian Herbs Research & Supply Company Ltd.	2 (2)	Natreon Inc. (1+1)
Indian Statistical Institute	1(1)	Intel Corporation (1)
University of Allahabad	1 (1)	ISIS Pharmaceuticals, Inc.(1)*
Exide Industries Ltd.	1(1)	Shin-Kobe Electric Machinery Co., Ltd.(1)
Thapar Centre for Industrial Research & Development	1(1)	Biopulping International, Inc.(1)*

** patents under collaboration in 2003*

f) Patenting Activity in Industrial Sector/sub-sectors

Pharmaceuticals' and 'Chemical' were the dominant areas of patenting during 2003-04 also. There were 215 patents (46% of the total patents) in Pharmaceuticals' while 'Chemical' sector accounted for 126 patents (share of 27% of total patents). Biotechnology' sector was also well addressed with 48 patents granted in this area during this period. Other major sectors contributed insignificant number of patents.

The sub-sectors mainly covered under 'Miscellaneous' sector was 'Food & beverages' (24 patents), 'Office machinery & computers' (14 patents) and 'Petroleum products & nuclear fuel' (10 patents).

In the period (1990-2002) there were only 7 patents in 'Office machinery & computers'. There were 3 patents by computer firms, namely STMicroelectronics (2 patents), Texas Instruments (1 patent) and Kudrollis Software Private Limited (1 patent). Thus only one Indian computer firm had patent in this period. CSIR (2 patents), and National Informatics Centre (1 patent) were other two entities that had patents in this area. .However, in this period 2003-04, there were more computer firms granted patents:Geometric Software Solutions Company Limited (2 patents), TCS (1 patent), Satyam Computer Services (1 patent), Sree Ayyanar Spinning & Weaving Mills Limited (1 patent). Only CSIR among the public funded organisations

had undertaken 2 patents in this area. Three MNC's were involved, STMicroelectronics (5 patents), Intel corporation (1 patent), and Silicon Automation System (1 patent).

4.3.3 Foreign Patenting Activity In USPTO (2003-04)

It has been estimated that over the last few years over 100 foreign organisations (mainly MNC's) have opened R&D centres in India. Broadly two types of foreign R&D centres have been established in India. Some are involved in incremental innovations and their main aim is to support the existing products introduced in India. However, some R&D centres such as Texas Instruments, General Electric, IBM are developing new products and are enhancing the technological competitiveness of their parent companies. Patents emerging from their R&D centres in India provide an indication of the extent they have been able to create valuable technologies. Assessment of their patenting trend was done for the period 1990-2002 (refer Chapter 2: Foreign Owned Patents).

The present section provides a broad indications of their patenting activity post 2002 i.e. 2003 & 2004. Table 88 illustrates the overall patenting activity of FOP.

Table 88: Patenting Activity in Three Categories (2003-04)

Category of patent	2003	2004	Total
Utility	97	133	230
Design	2	3	5
Plant	0	0	0
Total	99	136	235

There were 273 patents in the entire period (1990-2002) whereas 235 patents were granted in the period 2003-04. This underscores the significant rise in patenting activity. However, as in the earlier period, majority of the patents were utility patents.

Table 89 illustrates the category of patenting in terms of process/product patents.

Table 89: Process/Product Patents: 2003-04

Year	Process patents	Product patents	Process & product
2003	10	30	57
2004	36	47	51
Total	46	77	108

Majority of the patents covered both product and process claims. The number of product patents was significantly higher then process patents. This was similar to the activity of FOP in the 1990-2002 period. Only a few patents were observed in Pharmaceuticals (9 patents) and Food (1 patent). No patents were granted in Agrochemicals. This indicates that Amendments in the Indian Patent Act that allows product patent in these three areas would not have much effect on the R&D activity of Foreign MNCs in India.

a) Organisations Involved in Patenting Activity

Majority of patenting organisations were by MNC's. Only 7 patents were from other organisations (5 from university and 2 from specialised organisation). Organisations that were most active during this period are illustrated in Table 90.

Table 90: Patent Activity of Prolific Institutions

Organizations	No. of Patents (2003)	No. of Patents (2004)	Total Patents (2003- 2004) (% Share)*
IBM	17	20	37(16%)
Texas Instruments	17	17	34(15%)
GEC	9	10	19(8%)
GE Medical Systems. Global	1	6	7(3%)
HP Development Company	6	7	13(5%)
Uniliver	2	6	8(3%)

b) Sector/Sub-sector of Patenting Activity

Table 91 depicts the patenting activity in the 9 sectors.

Table 91: Patenting Activity in Industrial Sector

Sector	No. of Patents (2003)	No. of Patents (2004)	Total Patents (2003-04)
Miscellaneous	54	66	120
Electronics	19	18	37
Instruments	5	12	17
Chemical	5	10	15
Electrical Equipment	2	9	11
Pharmaceutical	3	6	9
Machinery	3	6	9
Bio Technology	3	2	5
Transport	-	-	-

Miscellaneous (mainly the sub-sector Office Machinery & Computers), Pharmaceuticals and Chemical were the dominant areas of patenting activity of FOP in the 1990-2002 period. However, it can be observed from the above table, the lower activity in the two sectors Chemicals and Pharmaceuticals in 2003-04. Thus shift in patenting activity had taken place towards Electronics and Instruments.

Table 92 exhibits the sub-sectors that had high degree of patenting by FOP.

Table 92: Patenting Activity in Industrial Sector/sub-sectors

Sector/sub-sectors	No. of Patents (2003)	No. of Patents (2004)	Total Patents (2003-04)
Miscellaneous/ Office machinery and computers	48	61	109
Electronics/ Signal transmission , telecommunications	14	14	28
Chemical/ Basic chemical	5	6	11
Instruments/ Medical equipment	3	6	9
Electronics/ Electronic components	5	1	6
Electrical equipments/ Electric Distribution, Control, wire, cable	-	6	6
Instruments/ Measuring instruments	-	5	5

The above table underscores the significant activity in the area "Office machinery and computer's'. This was also the most active sub-sector in the period 1990-2002 accounting for 67 patents. The majority of the Foreign Owned firms in India that were granted patents in USPTO were in the area of computers and communications. This shift in the profile of patenting organisations was visible in the 1999-2002 period itself.

4.3.4 Patents Granted to Indian Institutions in EPO (European Patent Office)

Patents granted to Indian organisations in the European Patent Office (EPO) were also examined in the study for completeness sake as well as to identify whether it is required to cover patent therein in more details. Table 93 illustrates the patents granted to Indian institutions in the EPO.

Table 93: Indian Patenting Activity in the European Patent System 1990-2002

Year	No. of Patents	Assignee
1990	13	CSIR-4, Indian Petrochemicals Coop Ltd-2 Ranbaxy-2
1991	14	CSIR-5; Ranbaxy-3 IPCL-1; Snakaran Natralaya-2
1992	11	CSIR-5; Nat Inst Immunology-2 Vitta; Mallya SC R-1
1993	22	CSIR-15; IPCL-1
1994	19	CSIR-2; VIP Ind Ltd-2 NRDC-2
1995	18	CSIR-5; Nat Inst. Immunology-2 NRDC-2, Sankaran Natralaya-2
1996	17	CSIR-4; IPCL-2, Ranbaxy-3, NRDC-2, IOCL-1, Reddy Research-1
1997	31	CSIR-16, Lupin Lab-3 Panacea Biotech-2 VIP Ltd-11 Reddy Research-1
1998	35	CSIR-13; Ranbaxy-6 Panacea Biotech-2, Reddy Research Foundation-2
1999	61	CSIR-16; dabur-2 Gem Energy-3 Indian Oil Coop-5 NRDC-5, Ranbaxy-3 Reddy Research Foundation-5
2000	59	CSIR-21; Panacea Biotech-5, Reddy Research Foundation-7, Lupin Lab-3Dabur Research Foundation-2 IOCL-2
2001	86	CSIR-14; Panacea Biotech-3 Nat Inst of Immunology-2 Dabur-3, Cipla-3 Reddy Research Foundation-9 Ranbaxy-7, Torrent-4 Vasu Tech Ltd-5
2002	142	CSIR-34 Ranbaxy-19 Dabur-7, Reddy Research Foundation-5

Again organisations that are prominent in USPTO have been granted patents in EPO. There were a few new entrants. These were Sankaran Natralaya and Vasu Tech Ltd. Patenting activity in the EPO were not analysed in further details as most of the patents had priority in the Indian Patent System or USPTO. Thus they have been already covered and analysed.

Majority of granted EPO patents from India had country of priority as India. *This is very important in the context of this study. It points out that reliable estimation of Indian patenting activity in international and domestic patent system can be achieved by covering patents granted in IPO and USPTO*. This validates the approach used in the study for examining Indian patenting activity based on analysis of granted patents in US and India.

4.3.5 Indian Patenting Through PCT (Patent Cooperation Treaty)

Accession to PCT in 1998 has opened another route for Indian institutions/individuals for filing patents in different countries. The PCT provisions helps in filing patent as an international patent through the Indian Patent Office. The countries that the applicant wishes to protect his/her invention is marked as designated country(ies) in the patent document. PCT route allows cost saving, not going through the trouble of filing the patent in each country as well as it maintains priority for atleast 12 months. The PCT filing was uncovered in this study through the examination of WIPO web-site and corresponding creation of in-house database. Table 94 show the patents that were filed from India through the PCT route.

Table 94: Indian Patenting Activity in the PCT: 1999-2002

Year	No. of Patents	Assignee
1999	7	Individuals-4, Dr. Reddy's Research Foundation, Nile Limited,Varma Trafag Limited
2000	54	Dr. Reddy's Research Foundation-7, Dabur Research Foundation-2, Lakshmi Machine Works Limited-2,
2001	122	CSIR-12,Biocon India Limited-5, Panacea Biotec Limited-5, Cipla Ltd.-3, Dabur Research Foundation-3, Nagarjuna Holdings Private Limited-3,
2002	216	CSIR-66, Carborundum Universal Limited-7, Biocon India Limited-6, Orchid Chemicals And Pharmaceuticals Limited-6, Dr. Reddy's Research Foundation-4, Aurobindo Pharma Limited-3, Blue Cross Laboratories Limited-3, Lupin Laboratories Limited-3, Neuland Laboratories Limited-3,

Organisations that had prolific patenting activity in USPTO are again the major players in using patent filing through PCT. However, there are also some new entrants such as Sahajanand Biotech Private Limited, Tejas Networks India Pvt. Ltd, Blue Cross Laboratories Limited, Neuland Laboratories Limited. Aggregate activity in the overall period 1990-2002 is depicted in Table 95.

Table 95: Aggregate Activity in PCT:1990-02

Year	No. of Patents	Assignee
1999-2002	399	CSIR-78, Dr. Reddy's Research Foundation-12, Biocon India Limited-11, Carborundum Universal Limited-7, Orchid Chemicals And Pharmaceuticals Limited-6, Panacea Biotec Limited-5, Dabur Research Foundation-5, Aurobindo Pharma Limited-3, Blue Cross Laboratories Limited-3, Lupin Laboratories Limited-3, Neuland Laboratories Limited-3, Cipla Ltd.-3, Nagarjuna Holdings Private Limited-3, Lakshmi Machine Works Limited-2,Nile Limited-1,Varma Trafag Limited –1

The above Tables (Table 94 and Table 95) underscore the importance of India joining PCT. Organisations are taking advantage of this new route to file patents in multiple countries. CSIR is among the top three organisations in the developing world in filing patents through the PCT route.

4.3.6 International Comparison (USPTO)

Overall Indian activity ranked 21-25 in USPTO over the different periods. USA ranks first and is followed by Japan, Germany, Taiwan, etc. Table 96 illustrates the patents from the selected countries in which at least one of the inventors were from that country.

Table 96: Invented Patents from Selected Countries (1998-2004)

Country	1998	1999	2000	2001	2002	2003	2004
Total patents (USPTO)	166801	170265	176350	184172	184530	187147	181443
USA	98598	102707	106383	108870	107571	109534	104302
India	130	156	184	234	342	444	460
China	133	172	274	473	626	724	951
Japan	32553	32948	33412	35432	36889	37779	37616

Brazil	106	133	136	165	150	209	192
Korea	3429	3740	3561	3853	4100	4246	4770

Close correspondence can be observed between total patents in USPTO and patents invented in which one of the inventors were from USA. This shows the dominance of US inventors in patenting activity. Large gap between US, Japan with other selected countries can also be observed.

Table 97 and Table 98 shows the patents owned (assigned patents) of the selected six countries covering three categories (utility/design/plant) for the period 1998-2002 and 2003-04.

Table 97: Patents Assigned to Six Countries in USPTO (1998-2002)

Country	Utility	Design	Plant	Total Patents
USA	363424	32771	1482	397677
Japan	160720	6896	76	167692
Korea	16789	558	0	17347
Brazil	252	34	0	286
China	362	312	0	674
India	520	3	13	536

Table 98: Patents Assigned to Six Countries in USPTO (2003 & 2004)

Country	Utility	Design	Plant	Total Patents
USA	152166	13611	748	166525
Japan	71003	3096	74	74173
Korea	8020	329	0	8349
Brazil	150	89	0	239
China	363	228	0	591
India	445	8	9	462

Utility patents formed the dominant category of patenting. Utility patents protect the functional characteristics/properties of an invention and commonly

patenting is synonymous with utility patents. However, USPTO allows patenting in both design and plant. The intricacies of these two patenting categories are detailed in Annexure I. Design patents formed an important area of patenting activity in majority of the countries. However, in case of China, it was very prominent with design patents forming the major category of patents. India and Brazil lagged in patenting in this domain.

Patents per year (this is the average patents for the year 1998-2002, 2003-04) indicated that for all the six countries substantial increase was observed in 2003-04. The maximum increase (more then double the patents per year) was observed in the patenting activity of three emerging countries India, China and Brazil.

Around 10,000 plant patents have been granted by USPTO till date. Majority of them have been granted to USA. Japan had a few plant patents whereas countries like Korea, China, and Brazil had none. *Thus India is among one of the few countries having plant patents. All plant patents from India were granted to CSIR.*

a) Sector-wise patenting activity

Table 99 illustrates the patenting activity in different sectors for the selected six countries.

Table 99: Patenting in Major Sectors: 1998-2002

Sector	USA	Japan	South Korea	China	Brazil	India
Electronic Equipment	83499	40208	7441	49	2	7
Office machinery & Computers	63049	37568	3876	16	8	6
Machinery	62212	23426	2453	66	91	17
Miscellaneous	59171	18175	932	71	57	48
Instruments	56359	21047	1401	24	40	16
Pharmaceuticals	39772	5959	437	43	15	245
Chemical	35624	13128	802	76	17	179
Biotechnology	16470	1802	134	11	9	57
Electrical	17863	10083	672	18	18	1
Transport	16020	10452	436	13	19	5

Patenting activity by US gives an indication of patenting trend in different sectors. Electronics equipment' sector had maximum patenting by US in the period 1998-02. Office machinery & computers' and 'Machinery' were the other two sectors with high intensity of patenting (unlike the analysis of IOP, in international comparison 'Office machinery & computers' was identified as a major sector'. This was done keeping in view the intense R&D activity in this area by countries that are technology leaders.). Transport' followed by 'Electrical' sector exhibited the least patenting activity in US. Japan and South Korea also exhibited similar priority like US in patenting in majority of the sectors. Main difference was visible in Pharmaceutical sector where US activity was sixth in sector-wise priority whereas it was ninth in case of Japan and eighth in case of South Korea.

China, Brazil and India had different technological profile then that of the technology leaders (US, Japan and South Korea). Chemical' followed by 'Miscellaneous' (sub-sectors of high activity as identified is highlighted in later part of this chapter) and 'Machinery' were sectors of prominent activity in China. In Brazil, maximum activity was observed in 'Machinery' sector followed by 'Miscellaneous' (activity in various sub-sectors within 'Miscellaneous') and 'Instrumentation' sector. In India, major activity was observed in 'Pharmaceutical' and 'Chemical' sector. Activity was also significant in 'Biotechnology' sector.

b) Sub-sector-wise patenting activity

Table 100 to Table 104 illustrates the aggregated patenting activity in different sub-sectors for the period 1998-2002 in the selected six countries. Apart from 'Optical instruments' where Japan had more patents then US, patenting activity was dominated by US across all the other sub-sectors.

Table 100: Patenting in Electronic Sector

Sub-sectors	USA	Japan	South Korea	China	Brazil	India
Electronic Components	34347	20034	4395	31	1	5
Signal transmission, telecommunications	31482	13182	1929	15	1	2
TV & radio receivers	7570	6992	1117	3	0	0

It can be observed that patenting in 'Electronic components' was a prominent sub-sector of activity in all the countries. However, activity of India and Brazil was insignificant compared to others.

Table 101: Patenting in Machinery Sector

Sub-sectors	USA	Japan	South Korea	China	Brazil	India
Special purpose machinery	21678	8184	655	18	37	5
Non specific purpose machinery	11646	3698	435	12	19	5
Energy machinery	9974	5443	435	13	13	0
Machine & tools	9370	3841	183	11	8	3
Domestic appliances	5508	1612	714	9	3	0
Agricultural & forest machinery	3119	522	26	3	3	4
Weapons & ammunitions	917	26	5	0	6	0

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Activity in 'Special purpose machinery' was prominent among all the other sub-sectors within 'Machinery'. However, Indian activity was not much.

Table 102: Patenting Activity in Miscellaneous Sector

Sub-sectors	USA	Japan	South Korea	China	Brazil	India
Non-metallic mineral products	12088	5189	242	1	6	6
Fabricated metal products	8441	2117	165	7	4	3
Furniture, consumer goods	8241	2421	134	17	1	3
Food & Beverages	5711	671	42	3	1	16
Basic metals	4299	2683	175	3	9	6
Rubber & plastic products	3785	3459	124	10	32	0
Petroleum products, Nuclear fuel	2477	237	17	9	3	7
Paper	1707	726	9	1	0	0
Textiles	654	181	6	0	0	1
Wearing apparel	534	73	6	0	0	0
Wood products	460	53	1	0	0	0
Leather articles	455	73	3	3	0	0
Tobacco products	185	33	1	0	0	0
Watches, clocks	134	259	7	1	0	0

Non-metallic mineral products' was the major sub-sector of activity in US, Japan and South Korea. However, other sub-sectors within 'Miscellaneous' had different priorities in the above three countries. Fabricated metal products' and 'Furniture, consumer goods' were other areas of prominent patenting activity in US. In Japan the other prominent areas were in 'Rubber and plastic products' and 'Basic metals'. In South Korea, other prominent areas were in 'Basic metals' and 'Fabricated metal products'.

The three emerging countries had different areas of prominence. Furniture, consumer goods' and 'Rubber & plastic products' attracted maximum patenting among the different areas within 'Miscellaneous' in China. Rubber & plastic products' was the only area in Brazil that had substantial patenting activity within

'Miscellaneous' sector. On the other hand in India, the area of 'Food & beverages' exhibited maximum patenting activity.

Table 103: Patenting activity in Instruments Sector

Sub-sectors	USA	Japan	South Korea	China	Brazil	India
Medical equipment	26140	3154	138	10	16	3
Measuring instruments	20544	6409	484	6	12	11
Industrial process & control equipment	9541	1277	113	1	1	0
Optical instruments	134	10177	666	7	10	0

Considerable differences were observed among the countries in their patenting priority within 'Instrument' sector. Patenting in 'Medical equipment' was prominent in US whereas maximum patents were in 'Optical instruments' in Japan and South Korea. Like US, China and Brazil had maximum activity in 'Medical equipment'. Indian activity was considerably less in this sector in compared to all the other countries. Measuring instruments' attracted maximum activity in India.

Table 104: Patenting Activity in Chemical Sector

Sub-sectors	USA	Japan	South Korea	China	Brazil	India
Basic Chemical	23675	9958	612	68	12	148
Other Chemicals	6369	2111	131	0	3	11
Pesticides, agrochemical products	3139	715	35	8	1	20
Soaps, detergents, toilet preparations	2232	213	17	0	1	1
Man-made fibres	206	129	7	0	0	0
Paints & Varnishes	3	2	0	0	0	0

Basic chemicals' was the most prominent area of patenting activity within 'Chemical sector' in all the six countries. Activity in 'Other chemicals' was next in prominence for US, Japan and South Korea. Indian activity in 'Chemical' sector was much higher then that of China and Brazil. Pesticides and Agrochemical products' also attracted considerable attention in India

Table 105: Patenting Activity in Electrical Equipment Sector

Sub-sectors	USA	Japan	South Korea	China	Brazil	India
Electric distribution, control, wire, cables	6710	3688	116	2	1	0
Other electrical equipment	4720	1953	225	8	3	1
Electric motors, generators, transformers	2349	2179	164	4	13	0
Accumulator, battery	2101	1612	134	3	0	0
Lighting equipment	1983	651	23	1	0	0

US, Japan and South Korea had similar priorities in addressing different sub-sectors within 'Electrical' sector. China had a few patents in sub-sector 'Other electrical equipment'. Brazil's main activity in this sector was in 'Electric motors, generators, transformers'. India had only one patent in this area.

Table 106: Patenting Activity in Transport Sector

Sub-sectors	USA	Japan	South Korea	China	Brazil	India
Motor vehicle	12477	9414	413	8	19	4
Other transport equipment	3573	1038	23	5	0	2

Most of the patenting in the transport sector by US, Japan and South Korea was in 'motor vehicle'. Brazil had higher activity then China and India in this sector. However, all its patents were restricted to 'Motor vehicle'.

This brief analysis provides some broad indication of the inventive/innovative trends in different sectors/sub-sectors. The dominance of US and Japan can be clearly observed. However, it can be seen that South Korea has emerged as a technology leader in many areas. It was placed in similar technological capability and levels like India, Brazil and China in the 1980s. The results also indicate the emergence of India, China and Brazil in making their presence felt at least in some sub-sectors. This is a positive indication of their technological capabilities.

5 Strategic Options for Commercialisation of Patents in India

5.1 Introduction[1]

CSIR is in a unique position in the country in terms of size and diversity of its patent portfolio, lead it has taken in translating its innovative activity into proprietary knowledge, demonstrating its global presence by protecting its innovations in different countries, creating patent awareness and culture of patenting in the country. Thus it was felt that it would be useful to examine the different initiatives undertaken by CSIR for creating intellectual property and its utilisation.

This chapter is divided under the following major sections. Commercialisation of patent presupposes existence of technology or knowledge market, which is matured enough through competitions among firms for creation of firm specific technological advantage. A developing country like India is characterised by the absence of technological competition and strong market forces. Thus commercialisation of patents in India has to be seen in this context. The section on 'Issues in commercialisation of patents' presents a brief overview of this theme.

In the section on **'**CSIR's efforts in leveraging from its patenting activity', we examine CSIRs initiatives to create the culture of patenting, professional management of its IPR: creation and appropriation. We posit that the main issue is not the number of CSIR patents that had been commercialised (global trend in this regard is always insignificant compared

[1] Resource Persons: Mr V.K. Gupta, Director, NISTADS
Mr Pradosh Nath, Scientist, NISTADS
. Dr V.K. Gupta, Scientist, NISTADS
Mr R.K. Gupta, Head, IPMD (CSIR)

to total number of patents taken), instead the process and the system set up by CSIR to achieve the objective of creating an innovation driven environment where knowledge created by it is protected as well as can be appropriated. In the section on 'Intellectual property management in CSIR: Organisational/Institutional structure' we make a detail assessment of changes that have been undertaken in CSIR to bring in the culture of patenting and steps for plausible appropriation.

In the section on 'Licensing of patents' we discuss the different options undertaken by laboratories to license its technology and present an actual account of licensing undertaken by CSIR. The other sections, 'Case studies of some licensed technology and specific initiatives', 'Intangible benefits', 'New targets and approach' and 'Broad observations, challenges and hurdles' provide further insights of CSIR's efforts towards patent commercialisation. At the end we try to indicate 'Plausible roadmap for future study'.

5.2 Issues in Commercialisation of Patents

Commercialisation of patents should not be examined in isolation. It depends on the technology demand and maturity of the market. A common characteristic of a highly industrialised economy (HIE) is the existence of this type of market. Disruptive technologies define the market and sets benchmarks for competition. Core competence is knowledge that a firm possesses and success is based on how it applies this knowledge in creating novel products for the market.

In an economy where market forces are matured, firms go for high degree of investment in knowledge production with the objective of translating knowledge into innovative products. There are other parallel changes. For example, production patterns are not primarily based on mass

scale production but are more inclined towards product differentiation i.e. novel innovations in an existing product or creation of a completely new innovative product.

In such economies various organisational/institutional structures exist for integrating different actors such as research laboratories, universities and firms. Public-private partnership brings in complementary skills of each other. Many technological products are based on science i.e. science based innovations. Thus research institutions and universities emerge as key drivers in the new economy. Proprietary knowledge is being created in these organisations and various mechanisms (science parks, venture capital, technology transfer offices etc) exist for transfer of technology to firms. New firms are created from university-industry interaction.

Government policies evolve through intense discussion with different partners in the innovation chain. IPR safeguards are strongly implemented. In this type of scenario, patents become an important tool for firms to stay ahead. A firm takes necessary safeguards so that its product(s) do not infringe upon any proprietary knowledge. Licensing, cross-licensing, joint technology development, etc are various options undertaken by firms to rule out any plausible infringement.

In a developing country, India included, the situation is completely different. Market is not based on technological competitiveness i.e. it is not an innovation driven market. Firms are not inclined to invest in R&D, create knowledge that can be embedded in products. Demand for new technology is limited.

In India various actions are being initiated for creating a climate of technological competition. In the new era of globalisation and post WTO, important changes are being undertaken to synergise the economy to meet

new challenges. Firms are realising that they have to invest more in R&D and create proprietary products to survive even in the domestic market. Several amendments to the Copyright Act, creation of a new Trademark Act, a new Design Act and amendments to the Patents Act signals India's intention to confront the new challenges.

In spite of positive intentions of the Government, industry and other actors, the catching up process is not easy. It is very difficult for Indian firms to make the amount of investment in R&D that its counterpart i.e. foreign firms make. There are many other challenges. Reorientation towards an innovation driven environment is likely to take its own time. Thus India can be classified as a country in transition.

5.3 CSIR Efforts in Leveraging from its Patenting Activity

The important role played by CSIR has to be understood in this context. It is simply not a question of how many patents it owns and how much of this has been commercially appropriated. Patenting activity, particularly patenting outside India, was very limited in the early 1990's. CSIR was among a few organizations that had been granted patents in US in this period. There has been a significant change in patenting activity from the post WTO period onwards. This growth had direct correlation with growth of CSIR's patent filing and patents being granted to it. CSIR now accounts for more then 50% of total patents in the country.

CSIR is a public funded organisation with a mandate to maximise benefits for the society. Its actions are not guided by profit motive. At the same time it has to create wealth from the technologies it has developed. CSIR's mission is 'to provide scientific, industrial research and development that maximises the economic, environmental and societal benefit for the people of India'. The underlying emphasis is that R&D to be pursued by

CSIR has to provide traceable and tangible benefits to the economic, environmental or social welfare systems.

CSIR made an important policy decision in 1996 by concretizing a sound Intellectual Property Management Policy (IP Policy). The main objective of this policy (policy statement) is [2]:

> "To maximise the benefits to CSIR from its intellectual capital by stimulating higher levels of innovation through a judicious system of rewards, ensuring timely and effective legal protection of its IP and forging strategic alliances for enhancing the value of its IP".

The IP policy seeks to achieve the above objective by following these strategies: (a) evolve appropriate systems to capture and assess, stimulate and encourage increased creativity and innovation in CSIR to gain advantage; (b) develop skills amongst the scientists to understand, interpret and analyse the techno-legal and business information contained in patents and other documents; (c) use the information acquired from analysis of IP documents to direct and mount strategic R&D programmes; (d) establish systems of recording and documentation of experimental results and data that would be accepted and respected by patenting authorities the world over of the intellectual property generated in the CSIR system; (e) provide the highest level of professional techno-legal services nationally and internationally for securing and protecting the IP generated; (f) manage the portfolio of IP as a business activity; (g) manipulate the patent portfolio, defensively and aggressively to forge strategic alliances/international S&T collaborations, to gain business advantage and ward of competition; and (h) mobilise and influence national thinking on IP related issues and concerns.

The vision document provides broad guidelines for implementing this policy. These plans are detailed under the following main headings: (a)

[2] CSIR Vision document 2001 (1996)

nurturing a strong innovation base in CSIR (b) investing liberally to enhance the skills and knowledge base of scientists (c) identifying and mounting applied research projects after thorough analysis and assessment of techno-legal and business information in related IP documents (d) establishing and enforcing a formal mechanism of recording and authentication of R&D output / results (f) encourage the publication of R&D results in scientific papers after careful consideration of the consequence of IP rights (g) availing the services of high-class national and foreign consultants and attorneys to advise on and to secure IP rights for CSIR (h) monitoring national & international patents and other IP (i) analyzing and assessing techno-legal and business information and market intelligence to identify strategic alliance (j) strengthening the IPMD of CSIR, and (k) mobilizing public opinion and influencing government decision / policy on diverse IP issues

Thus the CSIR IP policy covers different aspects of IPR creation, management and appropriation. Follow up actions to implement the IP policy in CSIR has been taken. Organisational changes that have happened are discussed in the later section. An updated 'Guidelines for Technology Transfer and Utilisation of Knowledge' has been created[3]. This document covers in details CSIR's approach for technology transfer and knowledge exchange with sponsoring agencies, industry, foreign clients, etc. As a bold initiative, within certain terms and conditions, it allows permission for a CSIR laboratory to establish a legally distinct non-profit entity such as Society, Trust, Foundation, and Section 25 Company to exploit/market the knowledge base (products, databases etc) it has created.

[3] Guidelines for Technology Transfer and Utilisation of Knowledge. R&D Planning and Business Development Division – CSIR (2002).

On intellectual property, elaborate guidelines are given in terms of development of intellectual property in CSIR, licensing of intellectual property, pre and post licensing aspects, and financial aspects to be kept in consideration in IPR valuation. Commercial appropriation from technology developed is strongly emphasised. Different methods for technology to be licensed, estimation of the price of intellectual property, and other important aspects that are to be considered in technological negotiation with industry are enumerated in this document.

The outcome of these exercises (creation of IP policy document, different steps taken for implementation of this policy) has been multi-fold. Some of these are as follows:

- It has been instrumental in laying the ground for creating an innovative climate within CSIR. There has been a significant increase in patenting activity in CSIR in both Indian and Foreign patenting systems. CSIR is the most prolific patenting organisation in the country and accounting for more then 50% of the total international patents of India. It is among the top three organisations in developing countries in patent filing through PCT.

- Portfolios in different application areas have been created.

CSIR holds important portfolios in the Chemical sector (polycarbonates, catalyst, colloids, polypeptides), Pharmaceuticals (compounds targeting multiple diseases), Herbal formulations (anti-bacterial/fungal, anti-cancer, anti-malarial, cosmetics), bio-enhancers, food products and processes.

-Organisational/institutional changes have taken place for professional management of IPR (elaborated later in sub-section).

- A number of IPR protected technologies have been licensed

- A system of incentives has been introduced for the scientists.

The incentives covers financial and enhances career development.

- Proper records are maintained by project team during R&D work, etc.

5.4 Intellectual Property Management in CSIR: Organisational/ Institutional Structure

IPMD (Intellectual Property Management Division) is the central coordinating cell in CSIR for facilitating individual laboratories in IPR related activities. The division looks after all techno-legal matters comprising capturing, drafting, filing, prosecution, maintenance and litigation. It provides guidelines, disseminating IPR related news, creating patent awareness, and other related activities for strengthening IPR activity within CSIR. Individual laboratories have their own IPR cells and they act as nodal points therein for IP activity[4].

At the laboratory, Director/Management Council of the laboratory is empowered to take decision regarding licensing of IP in India. In case of networked projects and licensing of IP abroad and for adoption of other models, necessary approval from DG, CSIR is obtained. Individual laboratory enjoys the discretion of directly negotiating with industry for licensing. It can also license its technology through NRDC (National Research and Development Corporation). However, licensing through NRDC would require transfer of ownership rights.

At each laboratory, IPR cell works in close coordination with business development group. IPR cell acts as the interface between IPMD and the laboratory for providing various formal, technical and legal inputs. IPR cell helps the scientists in conducting patent searches, initial drafting, evaluation and assessment of IP and for monitoring infringements. License agreements in general are taken care by the business development group in

[4] Gupta, R.K. (2005) Valorization of Intellectual Property from Public Funded Organizations: A case study of the Council of Scientific &Industrial Research (CSIR), India, Journal of Intellectual Property Rights, 10, 406-412.

each laboratory. Price estimation of the patented technology, terms and agreements with licensor(s), procedures for receiving payments, etc are finalised by the business development group.

Follow up actions are continuously taken to confront new challenges and set higher-level benchmarks. Director General, CSIR provides direction in this regard.

5.5 Licensing of Patents

5.5.1 Different options for Patent Licensing[5]

As a broad policy, knowledge base generated even at the laboratory scale level is applied for patent protection to rule out any misuse (by others) at the commercial level. While licensing patents, the technology/know-how pertaining thereto is actually transferred. The technology transfer process involves demonstration of the process, providing technology transfer document and training. In some cases, further developments of technology, scaling up are undertaken as per licensors requirements. Laboratories in cases of substantial modifications file related patents or go for 'patents of addition' (granted for improvement/modification of already patented technology).

In general laboratories use both modes for patent license; exclusive license (to one individual firm) as well as non-exclusive license (license to number of firms). Filing through PCT route facilitates the process of obtaining multiple protections in different countries. CSIR is among the top three organisations in patent filing through PCT route among developing countries. This is important for

[5] Constructed from inputs received from different CSIR laboratories

future commercialisation of patented technologies in countries where protection is being sought.

CSIR has also used the option of revoking patents that have been licensed. For example two patents that were licensed to M/S Cadilla Pharamceuticals Ltd., Ahmedabad in January 1999 were revoked since the company was unable to commercially exploit the patents within an agreed time limit. The amount received for the two patents was 10 lakhs (5 lakhs for each license). These two patents were:

184770 A process for the production of thermo stable alpha amylase by using a novel recombinant strain of bacillus.

1313DEL99 A process for the isolation of a novel alkalophilic strain of bacillus sphaericus which produces alkaline proteases.

CSIR has in some cases licensed its technology directly to user institution free of cost as technical aid.

Table 107 show the royalty/premium received by CSIR through transfer of IPR technology in the period 2002-03 to 2004-05.

Table: 107 Royal/Premium received by CSIR

Year	2002-03	2003-04	2004-05
Amount	4.2crore	4.4 crore	4.1 crore

Source: IPMD, CSIR

2-3% of CSIR's patents are commercially appropriated. This is comparable to the commercial utilisation of patents in international organisations. (IPMD, CSIR).

5.6 Case Studies of some Licensed Technology and Specific Initiatives

Number of patented technologies transferred by CSIR to industries have resulted in improvement of process, creating new products, improvement in health and safety measures, resulted in strategic alliances, etc. A few of the successful patented technology transferred to industries, alliances created are illustrated[6].

Case Study 1

Research work on polycabonates

National Chemical Laboratory, NCL (a constituent laboratory of CSIR) was able to obtain highly complex patents on its work in the area on polycarbonates in the early 1990s. This work attracted the attention of GE, global R&D leader in this domain and led to an alliance of NCL with GE in 1993. This alliance had been beneficial to both the partners. GE got assignment rights to a number of patents created by NCL. NCL received financial support for the R&D work. It has been estimated that US $8.5 million has been given by GE to NCL. CSIR also had assignment rights to a number of patents that were developed.

One of the important outcome of this alliance was the development of proprietary process for THPE[1,1',1"-Tris(4'-hydroxyphenyl) ethane], a branching agent used in the synthesis of high grade polycarbonates with properties of high transparency ,good mechanical and high parison strength. Patent applications were filed in India and abroad. This broke the monopoly of a single supplier, Hoechst Celanesa,USA THPE valued at around Rs 30 crore over a three year period were exported by from 2001 to 2003. NCL has received US$ 50,000 as license fee and royalty payment of around US $ 1,00,000.

[6] Case studies have been taken from Mashelkar, R.A. (2005) Current Science, 81 (8), pp. 955-965; Gupta, R.K. (2005) Journal of Intellectual Property Rights, 10, pp. 406-412; CSIR Annual Reports; Sen, Nirupa (2003) Current Science, 85(10), pp. 570-574; TKDL User Manual; Laboratory Web-Sites

Case Study 2

Technology for simultaneous production of quality lube oil base stocks and high BMCI extract

The Quality of lube oil base stocks is judged by its basic characteristics like viscosity index, pour point, oxidation stability, color etc. To achieve these characteristics raw lube distillates are subjected to a series of steps those physically removes the undesirable components or chemically modify the components to make them more suitable for lube oil base stocks (LOBS). The first and foremost important step, which is the heart of process, is Solvent Extraction, which selectively removes aromatic hydrocarbons for its simultaneous use as CBFS. The resulting raffinate after dewaxing and hydrofinishing produces quality LOBS.

Indian Institute of Petroleum, IIP (a constituent laboratory of CSIR) along with partners EIL and CPCL jointly developed the NMP based solvent refining technology for extraction of raw lube feedstocks thereby making India, only the second country in the world to own this technology.

IIP – EIL can provide following comprehensive assistance to clients interested in utilization of the technology in terms of feed stock analysis, determination of lube potential, feasibility and design optimization studies, and-Process engineering package. Investment cost: Rs 50-60 Crores for a 0.4 MMTPA unit. IIP-EIL-CPCL are licensor of this technology. IIP-EIL-CPCL licensed this technology to IOC – Haldia to process 350,000 TPA raw lube feedstock. Patent filed in India

Case Study 3
Bioavailability enhancers

The development of bioavailability/ bio-efficacy enhancers was taken up based on clues from Ayurveda by Regional Research Laboratory,

Jammu (a constituent laboratory of CSIR) for reducing the toxicity, long term side effects, etc. A number of molecules are in the development stage. Detail of one of the development process is further elaborated below.

Based on systematic investigations on 'Trikatu' a reputed formulation (containing Piper spp and *Zingiber officinale*) prescribed for a number of ailments in Indian traditional medicine, piperine, a pure alkaloid molecule from Piper spp., having bioavailability/ bioenhancing activity was isolated. Piperine was studied in detail with anti-TB drugs. The major outcome has been the development of a formulation containing 50% reduced dose of rifampicin while retaining the therapeutic efficacy at par with standard (450 mg) dose of rifampicin. Reduced dose formulation (rifampicin+ piperine) has gone through phased multicentric clinical trial upto Phase III. Permission has been obtained from DCG (I) to increase the size of patient population as per RNTCP guidelines.

Case Study 4

Menthol Mint

Research work undertaken by CIMAP (a constituent laboratory under CSIR) in menthol mint has led to the creation of a number of patented technologies. Utility as well as plant patents have been granted to CSIR in USPTO. Utility patent covers mint extraction whereas the plant patents claims new and distinct variety of mint plant with high menthol content, high biomass, high oil yield, tolerance to rust, etc. These patented technologies in the menthol mint have given competitive advantage to India for sustainable leadership for mint essential oils produced for internal use as well as export.

It has also enabled Indian farmers of the entire indo-Gangetic plains to take mint crop without disturbing the prevailing food crop rotational

system. Mint crop can now be taken in this vast area as a bonus crop between April to July after the harvest of rabi food grain crops and before the transplanting of some of the kharif crops such as rice, sorghum, and pigeonpea. The area under production of menthol mint is estimated as 150000 (hectares) and total production of oil was 14000 (tonne). This is indicative of the employment generation and enhancement in rural earning. This gives an assessment of the importance of the technology developed by CSIR.

Case Study 5

Process for conversion of naphtha to gas and gasoline

Indian Institute of Petroleum, IIP (a constituent laboratory of CSIR) has developed a process for conversion of Naphtha to gas and gasoline (NTGG) The process is based on a novel zeolite catalyst, which selectively converts the C5-C6 rich feed stocks to LPG and high octane and low benzene gasoline with very low dry gas yield. The catalyst and the process were developed jointly by IIP and Gas Authority of India Ltd.(GAIL).

IIP prepared the basic engineering package, based on which GAIL started the detailed engineering and construction activities for setting up demonstration unit at Vaghodia ,Gujarat . The plant has been successfully commissioned. The Vaghodia unit has demonstrated the technology successfully and valuable data is being collected for its further scale up and development. A US patent has been granted and four patents are filed in India on NTGG and related processes by IIP.

Some recent patented technologies that are attracting lot of attention are: Anti-malarial drug from CDRI (Central Drug Research Institute) is showing potentiality of enhanced performance in the treatment of malaria. This drug has been licensed for nearly 60 lakhs Rupees (Current Science,

10(5), 572, 2003). Drug 'Asmon' for treatment of asthma. A simple low cost water purification process (makes the water bacteria and virus free). This technology has far reaching impact as the membrane that has been developed can be used with hand pump also.

The above case studies provide only a few cases the IPR protected technologies that have been developed, licensed and are generating wealth for CSIR as well have significant social impact. There are several other success stories of commercialisation of CSIR patents.

Specific Initiatives

A number of initiatives have been taken by CSIR for exploring different strategies and develop long term partnerships, create the culture and awareness of patenting. These can be important tools for future appropriation of patents. Some of these initiatives are illustrated.

- Genomed is a knowledge alliance between an industrial concern Nicolas Piramal India Ltd. and a CSIR Laboratory – IGIB (Institute of Genomics and Integrative Biology). It is based on a model where knowledge is the main commodity and it has been equated like 'equity'. The equity is based on IPR share between Nicolas Piramal and IGIB. The Centre for Genomic Application (TCGA), a core share facility for genomics and proteomics services, has been created at IGIB recently. TCGA is a Public-Private Partnership Project between IGIB and The Chatterjee group. It provides research facilities, infrastructure, and work ambience of international quality, to support R&D institutions, universities, and affiliated to industry, to carry out cutting edge research and to make new discoveries. In future, TCGA plans to render incubation laboratories for start up entrepreneurs and discoverers by making available laboratory

facilities, to scientists of national and international fame, to implement their vision.

- New Millennium Technology Leadership (NIMITLI) has been initiated by CSIR to bring different actors in the innovation chain (R&D organisations, universities, private industry) in a common platform for joint technology development. Technological projects have been mounted in different application areas. In less then three years, 25 path setting technologies have started. These involve partnership of over 50 industries and 150 R&D institutions (research organisations, universities, etc). This program has been met with appreciation from different quarters (see for example Padmanabhan, G. (2003) Growth of biotechnology in India, 85(25), 712-719.

This program is enhancing the degree of cooperation with different entities and is leading to joint technology development. IPR protections are being taken at different stages of the technology development process. As this type of technology development involves complementary skills of different partners, the appropriation of these patented technology is expected to be much higher.

- Journal of Intellectual Property Rights

  This international journal brought out by CSIR provides a platform for researchers to address important issues in IPR. The scope of this journal addresses the heterogeneous community of researchers in the area of IPR Special issues are brought out from time to time. Recently a special issue dealt with Technology transfer with IPR in which various intricacies of licensing, commercialisation, etc were examined. This journal is helping bridge the gap between scientists and other actors in the innovation chain.

5.7 Intangible Benefits

A major motive of patenting activity by an organization is the extent it has been able to economically appropriate from it. However, in many cases there are no direct benefits but other substantial gains. These gains have reflection in other activities of an organization or to the society at large.

Case of US patent on Basmati[7]

US patent 5,663,484 by RICE Tec Inc. covered 20 claims that included claims on a novel rice plant and also various rice lines. Its claims 15-17 were for a rice grain having characteristics similar to those from Indian Basmati rice lines. If legally enforced, this patent would have affected Indian export of basmati to US.

Technical committee constituted under the Task force set up under the Chairmanship of Secretary, Ministry of Industrial Development, comprised of scientists primarily from CSIR and ICAR. The technical committee examined the specification of the granted patents and found that many of the claims of the said patent can be challenged based on prior art evidence**.** Rice Tec withdrew 15 claims (including claims 15-17) and changed the title of the patent from 'Basmati Rice Lines and Grains' to 'Rice lines BAS867, RT1117 and RT1121'.

The outcome of this successful challenge has resulted in safeguarding Indian exports of Basmati grains to US.

Traditional Knowledge Digital Library (TKDL)[8]

CSIR had successfully challenged the US patent No. 5,401,5041 that was granted to two US based Indians on would healing properties of

[7] Mashelkar, R.A. (2005). Intellectual property rights and the third world. Current Science, 81(8), pp. 962.

[8] Mashelkar, R.A. Protecting intellectual property (http;//www.India-seminar.com); Annual Report CSIR 2003-04; TKDL user manual; footnote 6.

turmeric. CSIR provided 32 references to the US patent Office (some of them being more then hundred years old and in Sanskrit, Urdu, and Hindi). This patent was revoked in 1997 ascertaining that there was no novelty in the said patent. This was a landmark case in that this was first time that a patent based on the traditional knowledge of a developing country was successfully challenged. Patents were being filed in international patent systems such as on turmeric, neem, basmati (as elaborated earlier) that infringed upon our traditional knowledge.

With the specific objective of preventing the grant of patents on non-patentable traditional knowledge, Government of India evolved the project of creating Traditional Knowledge digital Library (TKDL). This has been initiated as a collaborative project between National Institute of Science Communication and Information Resources (NISCAIR) (A constituent laboratory of CSIR), Department of AYUSH (Department of Ayurveda, Yoga, Unani, Siddha and Homeopathy) and CGPDTM (Controller General of Patents, Designs and Trade Marks).

The project involves collection of traditional knowledge from Sanskrit and other languages, collation and to be made easily accessible and easily understood to the patent examiners. Traditional knowledge needs to be made accessible to patent examiners by overcoming the language barrier in a format that is easily understood by the patent examiners in major patenting systems. TKDL is being created for 15,0000 traditional medicinal formulation based on Aurveda, Unani & Siddha system of medicine. Current database size is 10 million A4 size pages, which is likely to grow to 30 million pages by 2006. Traditional Language Resource Classification (TKRC) has been evolved for about 5000 subgroups against earlier one Subgroup in International Patent Classification related to medicinal plants i.e. in A61K35/78. In principle WIPO has extended the classification of

medicinal plants to about 200 Subgroups, by introduction of a new Group i.e. A61K36. The database is in digitised patent application format in five international languages English, French, Germany, Spanish and Japanese.

TKDL database is expected to act as a bridge between ancient Sanskrit Slokas and a patent examiner at a global level, since the database will provide information on modern as well as local names in a language and format understandable to patent examiners. It is expected that the gap on lack of prior art knowledge shall be minimized.

5.8 New Targets and Approach

The first phase of capability building, creating patent portfolios in the main technological areas in which CSIR is positioned, creating changes in the organisational structures, and guidelines for covering different phases of the innovation chain has been met to a large extent. For example, The 1996 policy document envisaged for CSIR a portfolio of at least 1000 Indian patents and 500 foreign patents'. The targets like this have been achieved. CSIR's IPR effort has met with appreciation from different quarters, at the international and national level. Prime Minister Dr Manmohan Singh in his address to CSIR Society Meeting, 25 May, 2005 appreciated the efforts made by CSIR in IPR creation and valorisation from it. He especially emphasised the initiative taken by CSIR to launch a formal IP policy as early as 1996, and rich dividends it has paid.

The next phase is the phase of consolidation of its IPR portfolio and appropriation from this. A number of steps have been initiated to leverage from the intellectual property CSIR has created. CSIR is now systematically making efforts for the valorisation of its IP portfolio by forming partnership with international IP licensing firms, exploring licensing opportunities with IP attorneys internationally. CSIR is involving management institutes,

international agencies to discuss and evolve new mechanism for technology transfer of its patented technologies. A case in point was the recently held CSIR-WIPO workshop to discuss the intricacies of licensing agreements and approaches to be taken[9]. This workshop has made important recommendations. These recommendations were particularly pertinent:

(a) Formulation of MTA (Material Transfer Agreement) in consultation with all the sectors in which CSIR is operating. In the process of technology transfer with IPR, this type of agreement will help define the rights of the licensor and the licensee with respect to the materials and any derivatives that are transferred.

(b) Revaluate technologies/ processes/ know-hows/ designs developed in CSIR labs that have not yet been licensed/ commercialised.

This internal exercise would help in pointing out further steps that may be required to be taken for making the technology developed more viable.

(c) Formulate flexible policy for pricing of technology for the purpose of commercialisation and avoidance of procedural delays.

(d) Introduce R&D Management Studies under CSIR-Deemed University curriculum with subjects such as R&D Project Proposal Evaluation; R&D Project Management ;IP Management ; Innovation Management ;R&D Business Management ; Knowledge Management; Portfolio Management ; Technology Valuation and Evaluation ; Risk Analysis.

5.9 Broad Observations, Challenges and Hurdles

[9] Proceedings of the CSIR-WIPO Workshop on Negotiating Technology Licensing Agreements, 4-8 July 2005. Organised by World Intellectual Property Organisation and Council of Scientific and Industrial Research.

This pilot study brings out the importance of having an IPR policy for an organization, strategies and plans for its implementation. CSIR had an IP policy in place that helped create an innovative climate. Organisational and institutional changes had taken place to implement this policy. The IP policy provided strategy and implementation plan to achieve the objective of increasing patenting activity, creating patent portfolio's, provide proper management of IPR and facilitate the process of appropriation. This document was created at the early phase, when India's patenting in foreign patent system had just started. This gave CSIR the advantage of starting early. This policy document provided direction, setting targets and other benchmarks.

Follow up actions were undertaken keeping in view the strategies and goals that it wanted to achieve as stated in the policy document. This led to changes in the organisational structure and in developing a system for negotiating with different actors in the innovation chain. In developing an IP policy, it is important to design it keeping in view the type of organization. In CSIR case, it is a public funded organization that has social responsibilities. Thus its IP policy would not be like that of a business entity.

The study has also shown that commercialisation has to be understood in a broad context. Along with tangible benefits there are important intangible benefits as well as long term societal benefits. Characteristics of a market play an important role. It is much easier for value to be attached to an intangible commodity such as patent in a highly technologically competitive market. On the other hand, in a less technology driven market, an R&D driven organisation/business entity has to orient the industry and the market to appreciate the importance of a patented technology.

A more exhaustive study is however required to come to a general conclusion of the extent and depth of patents commercialisation activity in CSIR. It would also be important to collect exhaustive information on patents licensed, payments received, and further information on the licensed patent technologies (whether the technology has gone in for production/commissioning, etc). Follow up of the firms that has taken the license would provide details on this. Laboratories that have gone for royalty sharing on production/commissioning of the patented technology would also have details on this.

Financial burden in IPR protection internationally can be very heavy. As regards patents, for example expenses for legal and technical expertise excluding translation fees constitute a large component of the estimated overall cost of patent grant and maintenance. This cost ranges from US $10,000 to US $20,000 for a patent granted in US.

Major challenges for CSIR[10] are (a) generate substantial resources and sustain such resource for the protection of IP, (b) go about valorization of IP nationally and internationally, (c) attract private investments in R&D, and (d) adopt best practices in IP management and licensing.

Drafting a patent specification is a specialised activity and it is difficult to have resource persons in this area in the country. Worth of a patent increases many folds if it is difficult to infringe. The potential customer has no choice in these situations but to approach the patent for license. CSIR has to initiate human resource development in different aspects of patenting process, and creating teams that can negotiate with different clients. IPMD Cell of CSIR in close collaboration with laboratories has initiated this process of developing a pool of skilled manpower.

5.10 Plausible Roadmap for Future Study

[10] Gupta, R.K. (2005). Journal of Intellectual Property Rights, (10), pp. 406-412.

To our knowledge there is only one recent study by Waterfall Institute of Technology Transfer (WTT)[11] that has made an attempt to explore the issue of patent commercialisation in India in some details. Although the above study was limited in scope as it was based on random sample of patents, it provided some insights of commercialisation of patents in India. The study undertook a detailed examination in terms of the status regarding the commercial exploitation of the selected patents.

In was found that different approaches can be used for systematic collection of patent commercialisation data. These are briefly described.

- Data on working of patents that are available till 1996 in the IPO (Indian Patent Office) can provide an initial dataset for further examination.
- Patent office in Kolkata has a register of patents where assignments made are recorded. Change of assignment is done when there is complete transfer of rights. This can provide some clues of technology being commercialised.
- NRDC keeps record of technologies in national laboratories that are transferred to the Industry. In fact NRDC is a transfer agent in transferring technologies/know-how. From this data, technologies that were patented can be extracted.
- Company reports can be useful to track the commercialisation process.
- CSIR and other public sectors have records that can be accessed to track the commercialization of patents.
- These efforts have to be supplemented with survey (questionnaire and direct visit) to get the full details.

[11] Commercialisation of patents in India (2004). Study submitted to Department of Science & Technology by Waterfalls Institute of Technology Transfer.

Exhaustive examination of patent commercialisation in India has not been undertaken. A study of this type would have to understand the possible limitations and how to address them.

- Data of Indian patents commercialisation is not readily available.

As per the rules of the patent office, the statement regarding the working of the patented invention on commercial scale in India, every patentee or his assignee has to submit this information regularly every year to the patent office. The Mumbai patent office is given responsibility for consolidating all this information on a regular basis. Such information is broadly segregated into two categories: worked commercially and not worked commercially.

Patent office does not have details on patents being worked. Patents being worked cover along with patents commercialized, the other different parameters: licensed granted, released through NRDC, R&D in progress, Lab scale working, bench scale working, pilot plant level, prototype stage finally commissioned/in-production. Thus from the data on working of patents that are provided by the patent office, it is not possible to know whether actual commercialization of the said patent has taken place. Further, this data is available only up to 1996.

- Patent commercialization requires different levels of examination

Translating the patent for an invention to a successful product can involve number of important steps. These can broadly be placed under: further R&D, rigorous testing at the laboratory and bench scale, pilot plant level, and prototype stage. For patented drug to be introduced in the market it has to pass through different stages (pre clinical trials and clinical trials) to determine its therapeutic potential/ efficacy, non-toxicity, dosage form, etc.

Only after the completion of the above stages a product/process or a drug can be produced on a commercial scale.

The said invention may not show the desired results at a particular stage of development and thus even if it satisfies the technological merits, the product may not be commercially viable. The above developmental process can itself lead to number of patents. The inventor may not go through all the above steps and can license the technology to others. Individual inventor(s) or research organizations/universities generally have this approach. They do not have the complementary strengths to develop the technology.

Public funded research organizations have their limitations in developing the technology to the pilot/prototype levels where it can show the full potentiality of the invention. License at an early stage of development is mainly the option they can exercise and thus from this only a partial indication the commercialization of the patented technology can be derived. On the other hand, private entities either have in house capability of exploiting their patents or cross-license their patents. In India, majority of the patenting from private entities are by pharmaceutical firms. They have licensed some of their molecules to international drug majors. However, full extent of the success of their commercialisation can be visible only after 8-10 years as gestation period for a drug to be introduced in the market generally takes this much time. These are some of the caveats to be kept in consideration while examining the process of commercialisation of patents.

6 Summary, Conclusions, Implications and Recommendations

The study explored the different aspects of patenting activity in India by empirical investigation of Indian patents granted in US and India. The main focus of the study was on Indian organisations patenting in the two systems (these patents were classified as India Owned Patents). Patenting activity of foreign organisations in India and patenting by Indian individuals were also covered to provide an overall picture of patenting activity in India. In the Indian patent system, foreigners patenting in India (mainly this covered foreign institutions from other countries and a few foreign individuals) were also investigated.

The later half of the study period was important in the context of major changes in the Indian Patent Act of 1970 that occurred from 1999 onwards. WTO-TRIPS Agreement, Paris Convention, PCT, and Budapest Treaty mainly influenced these changes. Through PCT, 17,833 applications had entered national phase (i.e. in the Indian Patent Office) from 1998 onwards and are being examined. Product patents in Food, Drugs and Agro-chemicals were allowed to be filed; and are to be opened from January 1, 2005 for examination. This provision called 'Mailbox' provision has resulted till date approx. 12000 applications. However, patents coming from these two routes (PCT and 'Mailbox') provisions had little impact for this study as only a few PCT patents had been accepted till 2002 by the Indian Patent Office.

6.1 Indian Patenting in USPTO

There were 1051 patents by India in USPTO during the period covered by this study: 1990-2002. This included patenting under all the three different categories: India Owned (assigned to Indian organizations), Foreign Owned (invented in India and owned by foreign organisations), and "Unassigned". "Unassigned" Indian patents were those patents that were invented by Indian Individuals and they had the rights of these patents. Of the 1051 patents by India, 669 were India Owned Patents (IOP), 273 were Foreign Owned Patents (FOP) and rest 109 belonged to the Unassigned category. *Thus a substantial number of*

patents i.e. 26% of the total patents that were invented in India were owned by foreign entities.

6.1.1 India owned patents (IOP)

There was significant growth in patenting activity in the current period, 1999-2002. Out of 669 patents, 492 patents were in the current period representing 74% of the total patents. Out of the 669 IOP in US, 332 had priority country (first filing) in US, and 266 in India. *The substantial number of Indian patents granted in U.S. having country of priority in the US is an encouraging trend as it shows that Indian organisations are gaining confidence in their invention and are hoping to get technological advantage by first filing in US*.

Out of 669 IOP, 645 were utility patents, 13 plant patents, and 11 design patents (protecting ornamental features). *Plant patenting is a small domain of patenting activity in USPTO, and India's patenting activity in this area is encouraging*.

Majority of the patents granted to Indian organisations were process patents. In percentage terms, around 50% of the India Owned Patents were process patents, 25% patents were both process and product patents, and the rest 22% were product patents. *The increase in product patents from the post-WTO onwards (i.e. from 1995) is a healthy trend.* Appreciable activity in terms of product patenting in 'Pharmaceuticals', 'Agro-chemicals', and 'Food' provides an indirect indication of the capability of Indian firms in undertaking innovation activity that can lead to product patents filing after the introduction of product patents in these three areas in India.

In all only 92 organizations were granted patents during the period 1990-2002. The number of organizations involved in patenting activity exhibited significant growth in the current period (1999-2002). 73 firms, 10 research institutes, 7 universities, 2 non-scientific ministries, and 1 specialised institute were involved in patenting activity. Among the 73 industries, 59 were Indian private industry, 9 MNC's, and 5 PSU. Pharmaceutical/biotechnology firms were prominently involved in patenting activity. Only one firm was from the computer industry. Patenting in embedded software, software's involved in communication (signal processing, etc), and in computer hardware (VLSI, digital decoders, etc) are allowed by USPTO. *The lack of patenting in US in this*

technological domain by industrial firms in India points out to the lack of innovation/invention activity therein.

Only a few organisations were involved in patenting activity and also the patenting activity across the organizations exhibited a skewed pattern. Fifty organizations had 1 patent and fifteen had 2 patents for the overall period, 1990-2002. Only eight organizations had more than 10 patents and they accounted for 78% of all patents. These organisations were: CSIR (378), Ranbaxy Lab (39), Dr Reddy's Research Foundation (35), Dabur (13), Indian Oil Corporation Ltd (18), National Institute of Immunology (13), Panecea Biotech (13), and Lupin Labs (11). 7 Indian universities were involved in patenting activity during the period entire period i.e. 1990-2002. Out of 669 IOP, 62 patents were collaborative patents comprising 9% of the total patents.

India Owned Patents had addressed all the 9 technology sectors. However, out of 43 technology sub-sectors, patenting activity was observed in 26 sub-sectors only. 'Pharmaceutical' and 'Chemicals' were the major areas of India's patenting activity, with 42%, and 34% of the total patents belonging to these two areas. There was not much patenting activity in the sectors 'Electronics', and 'Electrical equipments'. *There were 53 patents in Biotechnology, majority of them in the current period (46 patents).* This indicates that innovation activity is taking place in this high technology science based area, which is mainly dominated by advanced technology leaders.

Out of 669 IOP, 262 were cited (i.e., 39% of patents received citations) and remaining 407 patents did not receive any citation. The 262 cited patents attracted 820 citations. There were 0.8 citations per patent. Most of the patents attracted one or two citations. Only a few patents attracted majority of citations indicating their technological significance. Out of 378 patents of CSIR, 120 attracted citations. Total citations received by them were 364. Citing between IOP was not much.

The technology profile of firms patenting in India are very similar. The low levels of citations of each others patents plausibly points out to the lack of interest among firms in India of the technology developed internally. Self-citations also played an important role. CSIR had self-cited itself 76 times, Reddy's Research Foundation 37 times, Panacea Biotech 25 times and IOCL had cited itself 11 times.

Out of 669 IOP, 103 patents were cited in journal articles. These 103 patents received 176 citations in all. Citation intensity of Indian patents in journals was 0.27. 68 patents of CSIR were cited in journals. These were cited 130 times in all. Citation in journals per patents of CSIR was 0.34. IPCL had the highest citation intensity in journals, 1.11. Five of there 9 patents were cited 10 times in journals. IOP attracting citations from journals are an indication of their scientific significance.

6.1.2 Foreign Owned Patents (FOP)

273 patents were assigned to 96 foreign institutions. Out of these 273 patents, majority of them were from industry (266 patents). The rest were from federal government (4 patents) and university (3 patents). Most of the patents were assigned to USA (68%) followed by Germany (16%). The prominent foreign institutions owning the patents were: Texas Instruments (40 patents), Hoechst Aktiengesellschaft (30 patents), GEC (26 patents), and IBM (17 patents).

Miscellaneous' sector was prominent and constituted (31%) of the total activity followed by 'Pharmaceuticals' (27%), 'Chemicals' (14%) and 'Electronics' (11%). Sub-sector 'Office machinery and computers' was the most prominent under 'Miscellaneous'. Electrical digital data processing', 'Pulse technique', and 'Recognition devices' were the most active within this i.e. 'Office machinery and computers'. In 'Pharmaceuticals', 'Preparation for medical purposes', and 'Heterocyclic compounds' were the most active patenting areas. In 'Chemicals, 'Basic chemicals' was the active area. Within this patenting activity was prominent under 'Macromolecular compounds'.

Product patent constituted the dominant category of patents, as out of 264 utility patents, 203 patents were product patents. This included 106 patents that were both process and product patent. The total process patents were 167 and included 61 patents that were only process patents.

6.1.3 Unassigned patents

Along with 'Pharmaceuticals' and 'Chemicals', "Unassigned" patents also addressed 'Machinery', 'Instruments', and 'Transport' sector. 'Food & beverages' were the main area of activity in the 'Miscellaneous' sector.

6.1.4 Comparative Trends (USPTO)

IOP and FOP patents exhibited increase in their patenting activity over the years. Unassigned category exhibited random activity. Significant patenting activity was observed in the current period 1999-2002. Utility patents were the dominant type of patents in all three categories. There were a few joint patents indicating that collaboration activity among organisations were not much. 13 plant patents were granted to IOP and 3 plant patents to "Unassigned" category. FOP did not have any plant patents. In India Owned Patents process patents was the major category of patenting whereas product patents formed the dominant area of patenting in Foreign Owned Patents.

In the IOP, prominent activities were in the sectors: 'Pharmaceuticals', 'Chemicals' and 'Machinery'. FOP exhibited higher activity in 'Miscellaneous' (Office machinery and computers), 'Electronics' and 'Electrical equipment'. Unassigned category had maximum number of patents in the 'Transport' sector. Major distinction between IOP and FOP patents was observed in the areas 'Instruments' and 'Office machinery & computers'. FOP exhibits high degree of activity in these areas unlike IOP and "Unassigned" patents.

The change in the focus of foreign organisations patenting in India was observed from the post-WTO period. Similar to patenting activity by Indian institutions, foreign institutions had undertaken patenting in 'Pharmaceuticals' and 'Chemicals' in the pre-WTO period (1990-94). There were 'Pharmaceutical' majors like Hoechst involved in this activity. However, in the later period the dominance shifted towards computers and electronics MNC's. This resulted in high degree of innovation activity in these two areas as reflected by a substantial number of patents in 'Office Machinery & computers' as well as in areas of 'Signal processing', etc.

6.2 Indian Patenting Activity in IPO

There were 22,695 patents accepted by IPO during the period 1990-2002. Foreigners (majority of them foreign institutions) had maximum share of patenting activity, 16009 patents constituting 71% of the total patents accepted by IPO. Domestic organizations had 4848 patents i.e. 21% of the share and rest 1838 patents were by Indian individuals.

6.2.1 India Owned Patents

Patenting activity in the three sub-periods were 1223 (Pre-WTO), 1558 (Post-WTO), and 2038 (Current period). 749 domestic organizations were involved in patenting activity. However, like USPTO only a few organizations accounted for majority of patents. 167 institutes (22%) had more than 3 patents, 126 had 2 patents, and 411 institutes had only 1 patent.

The top 20 entities had approximately 60% share of patents. CSIR was the most prolific organization with 1660 patents (34% share). The other prolific institutes were HLL (565), IIT (81), DRDO (51), Hoechst India (48), IOCL (43), BHEL (41), NRDC (41), Sree Chitra Tirunal Institute for Medical Sciences & Technology (41), SAIL (38), IPCL (37), Dr Reddy Lab. (36), and Ranbaxy (36). Institutions like IIT, IARI were important additions to the list of patenting institutions in IPO. Unlike USPTO, universities exhibited some degree of patenting activity in IPO. 171 patents (approx. 3% patents) were granted to 21 universities. Universities acquired around 54% patents during the current period indicating an increasing awareness in universities towards patenting activity.

Like USPTO, 'Pharmaceutical' and 'Chemical' sectors were the major areas of patenting activity. High activity was also observed within the 'Miscellaneous' sector (sub-sectors 'Food & beverages', 'Basic metals', 'Non-metallic mineral products' and 'Fabricated metal products'). Unlike USPTO, considerable activity was also observed within the sectors 'Machinery' and 'Instruments'. Except for sub-sectors, 'Tobacco products', and 'Publishing & printing', all the other 41 sub-sectors had some patenting activity. Similar to USPTO, 'Basic chemicals', 'Non-metallic mineral products', 'Food & beverages', 'Basic metal's' were the sub-sectors that exhibited high degree of patenting activity. 'Soaps and detergents', 'Pesticides and agrochemical products', 'Special purpose machinery' were some of the other sub-sectors were patenting activity was substantial.

6.2.2 Foreign Organisations Patenting in India

Patenting by foreigners in IPO constituted 71% of the total patents (16009 patents) in the period 1990-2002. Patenting activity exhibited decline in the post-WTO period. In

real terms this was not the case as foreigners had taken two other routes for filing patents in India (i) through PCT, and (ii) 'Mailbox' provision allowed in IPO. These patents were not accounted in this period.

USA was the prominent country (share of 38% in the overall patents by foreigners) that was granted patents in IPO. Germany followed next with around 14% patents being granted to institutions from this country. Foreign filing was also prominent from France, Japan and Switzerland each contributing approximately 7% of the total patents. The above five countries had a share of 72% of the total patents by foreigners in the entire period.

Unlike Indian patenting activity in IPO, foreigners had substantial patenting activity in 'Instruments', 'Electrical equipments', and 'Electronics' sectors.

6.2.3 Individuals patenting in IPO

Machinery was the most important sector of activity of individuals in IPO. Further a large number of individuals had patents in 'Miscellaneous' sector. Fabricated metal products followed by 'Rubber & plastic products' were the most prominent activity within the 'Miscellaneous sector.

6.3 Overall Activity of IOP

There are 5517 patents granted to Indian institutions in the US and Indian patent system in the period 1990-2002. The current period (1999-2002) exhibited maximum patenting activity. Majority of patenting activity was in IPO (4848 patents). Patenting activity was skewed in both the systems. However, there was much larger number of organisations involved in IPO. 21 universities were involved in patenting activity in IPO whereas only 7 universities were granted patents in USPTO. CSIR was the most prolific patenting institution in both the systems. Jointly owned patents were few overall. Chemical and Pharmaceutical were the major areas of patenting activity.

6.4 Patenting Activity of IOP in 2003-04 (USPTO)

Substantial patenting activity was observed in 2003-2004. There were 467 patents during this period in comparison to only 669 patents in the entire period 1990-2002. 95

organisations were granted patents during this two-year period and were more then the total organisations involved in patenting during 1990-2002. This included 63 new organisations. University were involved in much larger number (11 universities were granted patents). CSIR with 272 patents was again the most prolific institution. Pharmaceuticals' and 'Chemicals' were again the major areas of patenting activity. Biotechnology', 'Food & beverages' and 'Office machinery & computers' exhibited considerable activity.

6.5 International Comparison

Overall Indian patenting activity ranked 21-25 in USPTO over the different periods. USA ranked first followed by Japan, Germany, Taiwan, etc. Utility patents were the most common category of patenting activity by majority of the countries in USPTO. Design patents also formed an important area of patenting activity in majority of the countries. However, in China design patents formed the major category of patents. India like Brazil had only a few design patents.

Patents from USA, Japan, and Germany addressed all the sectors/sub-sectors. Majority of sectors/sub-sectors were also addressed by Korean and Chinese patents. In India and Brazil patents were concentrated in few sectors/ sub-sectors only. Indian patenting activity in biotechnology was encouraging and was comparable to that of Korea. Around ten thousand plant patents have been granted by USPTO till date. Majority of them have been granted to USA. Japan had a few plant patents whereas countries like Korea, China, and Brazil had none. India was one of the few countries having plant patents.

6.6 Strategic Options for Commercialisation of Patents in India

Examination of strategy undertaken by CSIR for IPR brings out the importance of having an Intellectual Property Management Policy (IP policy). The articulation of IP policy by CSIR in 1996 and actions undertaken to implement this policy was instrumental in creating an innovation climate within the organisation. It helped CSIR to achieve the objective of increasing patenting activity, creating patent portfolio's, provide proper management of IPR and facilitate the process of appropriation.

6.7 Relevance of this Study

The study has mainly achieved the following outcomes.

- Detailed statistics of Indian patenting in IPO and USPTO has been covered for the period 1990-2002. The statistics generated and analyzed can be comparable to country patent statistics brought out by OECD, EPO, European commission, etc. This should help in proper assessment and reporting of Indian patenting activity in national and international reports, articles, etc.
- Patents have been linked to ISIC (Internal Standard Industrial Classification) using concordance index between IPC (International Patent Classification) and ISIC. This allows examination of patents in various sectors/ sub sectors. The patent data can be correlated with trade statistics using ISIC-SITC (Standard International Trade Classification) concordance table.
- Patenting trends can be observed for the entire period (1990-2002) and in three sub-periods pre-WTO (1995-1998), post-WTO (1995-98), and the Current period (1999-2002). Patenting activity post 2002 (i.e. 2003-2004) is separately highlighted. Trends are distinguishable under organization types, collaboration activity, process and product patents, sector/sub-sector activity, patenting by university, etc.
- Impact of patents (this pertains to patents of Indian institutions granted in US) have been analysed in terms of patent cited by other patents/journals. This provides an indirect measure of technological significance (cited by patents) or scientific significance (cited by journals) of patents by Indian institutions.
- Distinct characteristics of patenting activity in India can be observed as patents are distinguished in three categories (a) patenting by Indian institutions, (b) patenting by foreign institutions (i.e. institutions involved in R&D activity in India), and (c) patenting by Indian Individuals. This provides a broad indication of the strengths of R&D efforts of Indian and foreign institutions in India.
- This study provides basis for future studies to examine the causality and other interventions that can strengthen Indian patenting activity.
- As a spin–off of this study, a value added bibliographic patent database with various search facilities of Indian patenting activity in IPO (Period 1990-2002), and

USPTO (Period 1990-2004) has been created. This can be useful for examining trends, gaps, patents cited (in USPTO), patents in various sub-sectors, institution wise grouping, etc.

6.8 Main Implications of the Study

Changes in the Indian Patent Act allowing product patents in 'Pharmaceutical' sector will have substantial impact on Indian Pharmaceutical Industry as drugs that fall under patent protection post 1995 will have to be withdrawn. The study has revealed that patenting in pharmaceuticals is a prominent feature of Indian patenting activity. Indian firms/research organisations have also been granted product patents in pharmaceuticals in US (as product patents in pharmaceuticals are allowed in US). This is a positive indication of India's preparedness in the new patent governed pharmaceutical industry. However, this activity has to involve more organisations i.e. firms, research organisations, and universities.

A few research organizations and firms played a major role in patenting activity. Except for CSIR, limited patenting activity was observed from other scientific agencies. Scientific agencies such as ICAR, ICMR have now articulated intellectual property management policy. This should help in IPR creation, management and appropriation in these agencies.

CSIR is among a few organisations having plant patents in their patenting portfolio. Multiple protections of their utility patents through design or plant patents (wherever applicable) will make CSIR's patent difficult to infringe. CSIR has undertaken strategic initiatives in this direction.

Only a few patents were the outcome of joint cooperation. A number of programs have been initiated by scientific agencies especially CSIR, DST, DBT involving joint technology development through participation of research laboratories, universities and firms. This should lead to proprietary knowledge creation and subsequent patenting.

Indian universities are beginning to participate in patenting activity, at least in the IPO. However, their activity is limited in the USPTO. For participation of more universities in IPR activity, necessary incentives, infrastructure and other resources are required to be created. University Grant Commission has created an intellectual property

management document that among other issues related to IPR has provided guidelines for establishing National IPR Facilitation Centre. This centre would be expected to create awareness, facilitate and promote filing of patents and management of IPRs from the university system in the country. This initiative is a step in the right direction.

Foreign R&D institutions in India are patenting in advanced/emerging technological areas such as 'Computers' and 'Communications'. Indian firms in these areas exhibited insignificant patenting activity in spite of the presence of large number of firms in this domain.

Some Indian owned patents were cited by other patents and in journals. These cited patents broadly indicate that they are getting noticed and have technological significance (cited by patents) or scientific significance (cited by journals).

Some organizations like CSIR, Ranbaxy, Dr Reddy's laboratory are building up portfolio's (number of related patents addressing an application area). This is important in the context of appropriation from patenting activity.

CSIR's IPR Policy has provided strategy and implementation plan to achieve the objective of increasing patenting activity, creating patent portfolio's, provide proper management of IPR and facilitate the process of appropriation.

Substantial increase in patenting activity Post 2002 (2003-04) in USPTO was observed. Indian organisations are also using PCT route for filing international applications. Substantial increase in patents granted to Indian institutions in EPO was also observed. Overall significant increase in the number of new organisations involved in patenting activity post 2002 signifies increasing awareness and thrust of Indian organisations in patenting activity.

6.9 Recommendations

Recommendation 1

Patent data (of applications filed and granted) in Indian Patent Office by resident and non-resident inventors should be made available by the patent office. Online access with various search features should be incorporated in this database. This data needs to be

updated regularly. This will help in providing correct assessment of Indian patenting activity. Further it can be used by patent examiners, applicants, researchers etc in examining the different aspects of patent document as per their requirement.

Recommendation 2

Patent office and other agencies that are involved in creating patent awareness should highlight the various types and scope of patenting that are available in different countries for proprietary protections. In the context of patenting in US, apart from utility patents, patenting is possible in design (protecting ornamental features), and plant patents (protecting plant varieties). Software-related inventions (and mathematical algorithms in general) are patentable in US.

Recommendation 3

Importance of protecting the inventive activity is to be addressed at the research level in universities itself. NAAC should take patenting activity in universities as one of the criterion in ranking universities/departments.

Recommendation 4

Special incentives should be given for research groups that have a well-defined research focus leading to innovation activity. They should be stakeholders in any appropriation that results from innovation activity.

Recommendation 5

Foreign owned patents (patents invented in India but assigned to foreign institutions, mainly MNCs) have demonstrated substantial activity in 'computer & communications', and 'electronics'. Lack of Indian patenting activity in these areas should be addressed.

Recommendation 6

Drafting a patent specification, negotiating with the patent examiners (especially when a patent is filed in a foreign patent system), following the different procedures of

the patent office requires experience and skill. This type of facility within institutions like universities, SME's etc is to be created.

The above constraint needs to be addressed urgently by establishing specialized set-ups, providing special incentives within scientific agencies, universities, etc. Agencies like TIFAC, NRDC are required to play a more proactive role to support these institutions as well as SME's in patenting activity. CSIR's experience in this area should also be extended especially to major scientific agencies. The above initiatives should help in increasing patenting activity across institutions.

Recommendation 7

There were only a few patents as a result of joint collaboration between different organizations. Major scientific agencies CSIR, DST, DBT, etc have initiated a number of network programs for joint technology development involving research laboratories, universities and industries. These programs are steps in the right direction. Other institutions should replicate these types of efforts.

Recommendation 8

Awareness should be created in organisations that exhibit substantial patenting activity to direct their R&D and innovation efforts in specific applications / target areas and protecting them appropriately through patents. A number of related patents covering a specific technology (patent portfolio) are able to give monopoly to an organisation resulting in plausible appropriation.

Recommendation 9

Organisations should evolve their own IPR policy. This policy should be able to guide an organisation in IPR creation, management and deriving economic benefits and other returns. Policy should be designed keeping in view the mandate and mission of the organisation. CSIR's IP policy, strategy and implementation plan can provide necessary directions particularly to other scientific agencies.

Recommendation 10

Amendment in the patent act has extended the scope of patenting. Firms, research organisations, universities have to invest more in R&D and protect their innovations through patents in the new emerging scenario. Patenting through PCT has shown substantial increase in recent years. Thus future study is required to investigate the post 2002 scenario in details.

Recommendation 11

Investigation is required to probe the factors that have helped firms to undertake patenting, constraints faced by them and related issues. Detailed analysis is also required to uncover the reasons of lack or low levels of patenting activity in some major institutions.

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Annexure I

Patenting In US

A Brief Overview of Rules and Regulations

United States Patent and Trademark Office (USPTO), a federal agency under Department of Commerce – USA, is primary agency for accepting and processing patent and trademark applications filed in US. USPTO maintains an online database for applications filed, and patents granted in US. Under U.S. law, a patent owner cannot assert rights against a potential infringer until a patent is actually issued. U.S. is one of the few countries that follow the "first to invent" doctrine. *If two applicants seek protection for the same invention, priority may be established not by filing date but by invention date. The invention date may be established using materials such as the laboratory notebook.* There are three categories of patents granted by the United States Patent and Trademark Office (USPTO): utility patents, design patents and plant patents. They cover different types of inventions, have somewhat different requirements for issuance, and are valid for different lengths of time.

a) Utility Patents

Utility patents are by far the most common patents, and are what is usually meant when the simple term patent is mentioned. Products of all types, chemical compositions and processes, manufacturing methods, electronic circuitry, computer software and biotechnology as well as business methods are but a few of the types of inventions which can be protected by utility patents. The principal attribute a utility patent is that it describes and claims the structure, composition, or operation of a products or process invention. In other words, it defines what the invention is and how it works. A utility patent includes a specification, which provides a detailed description of the

invention, including identifying the best mode (best version), which is then contemplated by the inventor. It usually includes drawings illustrating the various components or steps of the invention. The specification may also include description of different versions, or embodiments, of the invention. Chemical and biological inventions often require inclusion of many examples to illustrate fully all variations of the invention and its operation. Manufacturing methods and end uses must also be described if those have not been previously known. The specification and drawing remain substantially unchanged as the application moves through the examination process before an examiner in the USPTO.

At the end of a utility patent are claims, which define the patents owner's legal rights in the patented invention. The law gives the patent owner the right "to prevent others from making, using, selling, offering for sale or importing" the patented invention during the life of the patent. Therefore the claims are a critical part of the patent, since the patent cannot be infringed by products or processes which are not within the scope at least one of the claims of the patent. Commonly claims are often changed and narrowed significantly during the USPTO examination process, usually to differentiate over prior inventions cited by patent examiner or meet objections raised by the Examiner, so that the scope of the amended claims which appear in the final issued patent is often significantly more limited then what that patent's specification might suggest.

b) Design Patent

Design patent differ from utility patents in that a design patent covers only the ornamental appearance of a useful products. The design patent, therefore, covers what the product look like, not what it is or what it does, and therefore cannot be used for anything, which does not have an ornamental appearance. Design patents can, however, be granted on new

versions of old classes of products, if they have unique and innovative appearances as compared with the prior products in the class.

The design elements, which are claimed to be unique and distinctive, must be ornamental and not functional in the structure of the product. Design patents, since they are directed to the product's ornamental appearance, are compost almost entirely of drawings of the product showing different views of the product's appearance. The minimal text in the specification merely identifies each figure in the drawings, and there is only a single claim, which in wording dictated by the USPTO rules. Examination of a design patent application involves the Examiner's comparison of the appearance of the claimed designed with the appearances of similar design of previous products. Any prior product that looks similar to the claim product may affect the patentability of design of the claim product, even though the old and new products may be intended for different uses. Design patent have a term of 14 years from the date of the patent's issuance.

c) Plant Patent

Plant patent are a small category of patents, which protect type of certain plants, such as flowers, fruits, shrubs and vines. A plant patent consist of a text describing the botanical characteristic of the plant, including size, flower and leaf colours and shapes, growth habit, and growing seasons and locations. It also includes colour photographs or paintings of the plant and a single formalized claim. The inventor is the person who has first reproduced and grown the plant. Plant patents have a term of 20 years from the initial filing date of the first patent application from which the patent claims priority. About 10,000 plant patents have been issued so far.

Patents to plants which are stable and reproduced by asexual reproduction, and not a potato or other edible tuber reproduced plant, are provided for by Title 35 United States code, Section 161 which states:

- Whoever invents or discovers and asexually reproduces any distinct and new variety of plants, including cultivated sports, mutants, hybrids, and newly found seedlings, other than a tuber propagated plant or a plant found in an uncultivated state, may obtain a patent therefore, subject to the conditions and requirements of title.

Title relating to patents for inventions shall apply to patents for plants, except as otherwise provided. This means that the plant patent must also satisfy the general requirements of patentability. The subject matter of the application would be a plant which developed or discovered by applicant, and which has been found stable by asexual reproduction.

Annexure II

Plant Patents Granted to India in USPTO (1990-2002)

Patent Number - PP13,418
Patent Granted- 2002
Title- Gladiolus hybrid plant named `Palampur Queen`
Assignees- Council of Scientific and Industrial Research (New Delhi, IN)
Patent Filed- 2001

Patent Number - PP13,417
Patent Granted - 2002
Title - Gladiolus hybrid plant `Brick Beauty`
Assignees - Council of Scientific and Industrial Research (New Delhi, IN)
Patent Filed - 2001

Patent Number - PP13,353
Patent Granted - 2002
Title - Gladiolus plant named `Anurag`
Assignees - Council of Scientific and Industrial Research (New Delhi, IN)
Patent Filed - 2001

Patent Number - PP13,336
Patent Granted - 2002
Title - High yielding and stable plant of Cymbopogon flexuosus called `Chirharit`
Assignees - Council of Scientific and Industrial Research (New Delhi, IN)
Patent Filed - 2000

Patent Number - PP13,279
Patent Granted - 2002
Title - Mint plant named `Saksham`
Assignees - Council of Scientific and Industrial Research (New Delhi, IN)
Patent Filed - 2000

Patent Number - PP13,203
Patent Granted - 2002
Title - High yielding stable plant of Rosa damascena, called `Ranisahiba`
Assignees - Council of Scientific and Industrial Research (New Delhi, IN)
Patent Filed - 2000

Patent Number - PP13,110
Patent Granted - 2002
Title - Lippia alba plant named `Bhurakshak`
Assignees - Council of Scientific and Industrial Research (New Delhi, IN)
Patent Filed - 2000

Patent Number - PP12,997
Patent Granted - 2002
Title - `Jal Pallavi`, water logging tolerant Cymbopogon winterianus
Assignees - Council of Scientific & Industrial Research (New Delhi, IN)
Patent Filed - 1999

Patent Number - PP12,791
Patent Granted - 2002
Title - Novel, high yielding stable Mentha arvensis plant named `Damroo`
Assignees - Council of Scientific & Industrial Research (New Delhi, IN)
Patent Filed - 2000

Patent Number - PP12,426
Patent Granted - 2002
Title - Mint plant named `Kosi`
Assignees - Council of Scientific and Industrial Research (New Delhi, IN)
Patent Filed - 1998

Patent Number - PP12,425
Patent Granted - 2002
Title - Pelargonium graveolens plant named `Narmada`
Assignees - Council of Scientific and Industrial Research (New Delhi, IN)
Patent Filed - 2000

Patent Number - PP10,935
Patent Granted - 1999
Title - Mini plant Mentha arvensis `Himalaya`
Assignees - Council of Scientific & Industrial Research (New Delhi, IN)
Patent Filed - 1997

Patent Number - PP12,030
Patent Granted - 2001
Title - Hybrid mint plant named `Neerkalka`
Assignees - Council of Scientific and Industrial Research (New Delhi, IN)
Patent Filed - 1998

Annexure III

Indian Patents Highly Cited by Other Patents (1990-2002)

Patent Number - 5,254,568
Patent Granted - 1993
Title - Benzopyrans as antiestrogenic agents
Assignees - Council of Scientific & Industrial Research (New Delhi, IN)
Patent Filed - 1992
Citation Received: 45 Citations

Patent Number - 5,266,659
Patent Granted - 1993
Title - Solid state process for the preparation of high molecular weight poly(arylcarbonate)s from amorphous oligomer
Assignees - Council of Scientific & Industrial Research (New Delhi, IN)
Patent Filed - 1992
Citation Received : 11 citations

Patent Number - 5,368,835
Patent Granted - 1994
Title - Process for production of synthesis gas by oxidative conversion of methane or natural gas using composite catalysts
Assignees - Council Of Scientific & Industrial Research (New Delhi, IN)
Patent Filed - 1993
Citation received : 14 citations

Patent Number - 5,326,372
Patent Granted - 1994
Title - Prosthetic heart valve assembly
Assignees - Kalke Mhatre Associates (Bombay, IN)
Patent Filed – 1992
Citation received : 11 citations

Patent Number - 5,411,927
Patent Granted - 1995
Title - Process of preparing composite catalysts for production of synthesis gas by oxidative conversion of methane or natural gas
Assignees - Council of Scientific & Industrial Research (New Delhi, IN)
Patent Filed - 1992
Citation Received : 11 citations

Patent Number - 5,616,593
Patent Granted - 1997
Title - Compositions containing piperine
Assignees - Cadila Laboratories Limited (Ahmedabad, IN)
Patent Filed - 1994
Citation Received- 18 Citations.

Patent Number - D386,691
Patent Granted - 1997
Title - Watch case
Assignees - Titan Industries Limited (Bangalore, IN)
Patent Filed - 1996
Citation Received : 18 citations

Patent Number - D391,516
Patent Granted - 1998
Title - Earring
Assignees - Fine Jewellery (India) Ltd. (Bombay, IN)
Patent Filed - 1996
Citation Received : 19 citations

Patent Number - 5,782,940
Patent Granted - 1998
Title - Process for the preparation of alumina abrasives
Assignees - Carborundum Universal Limited (Madras, IN)
Patent Filed - 1997
Citation Received- 15 Citations.

Patent Number - 5,861,415
Patent Granted - 1999
Title - Bioprotectant composition, method of use and extraction process of curcuminoids
Assignees - Sami Chemicals & Extracts, Ltd. (Bangalore, IN)
Patent Filed - 1997
Citation Received- 10 Citations.

Annexure IV

Indian Patents Highly Cited by Journals (1990-2002)

Patent Number- 5,080,121
Patent Granted - 1992
Title- Process for the preparation of a new polymer useful for drag reduction in hydrocarbon fluids in exceptionally dilute polymer solutions
Assignees- Council of Scientific & Industrial Research (New Delhi, IN)
Patent Filed - 1990
Citation Received : Cited by 5 journals.

Patent Number - 5,219,813
Patent Granted - 1993
Title - Process for the preparation of novel molecular sieves
Assignees - Council of Scientific & Industrial Research (New Delhi, IN)
Patent Filed - 1992
Citation Received : Cited by 14 journals.

Patent Number - 5,306,854
Patent Granted - 1994
Title - Two step process for production of liquid hydrocarbons from natural gas
Assignees - Council of Scientific & Industrial Research (New Delhi, IN)
Patent Filed - 1992
Citation Received : Cited by 5 journals.

Patent Number - 5,932,752
Patent Granted - 1999
Title - Process for the C-C bond forming reaction using solid acid catalysts
Assignees - Council of Scientific and Industrial Research (New Delhi, IN)
Patent Filed - 1996
Citation Received : Cited by 5 journals.

Patent Number - 6,027,708
Patent Granted - 2000
Title - Process for the synthesis of flyash based zeolite-Y
Assignees - Council of Scientific & Industrial Research (New Delhi, IN)
Patent Filed - 1998
Citation Received : Cited by 7 journals.

Annexure V

Patenting In India

A Brief Overview of Rules and Regulations

a) Introduction

The patent office, under the Department of Industrial Policy & Promotion, Ministry of Commerce & Industry, performs the statutory duties in connection with the grant of patents for new inventions and registration of industrial designs in India. Patent offices are located at Kolkata (Head office), Mumbai, Chennai and Delhi. Each of the patent office has their territorial jurisdiction for receiving patent applications and subsequent actions on that.

b) International Treaties

India is member-state of World Intellectual Property Organisation **(WIPO)**, an International Organisation, responsible of the promotion of the protection of intellectual property throughout the world. India is a member of the following International Organisations and Treaties in respect of Patents:

a) World Trade Organisation (WTO) with effect from 01-01-1995.

b) Convention establishing World Intellectual Property Organisation (WIPO).

c) Paris Convention for the protection for the Industrial Property with effect from Dec. 7, 1998.

d) Patent Cooperation Treaty (PCT) with effect from Dec. 7, 1998.

PCT is an international filing system that is accessible in accordance with PCT. When a PCT application is filed in one of the member-states of the PCT, this is legally in effect equivalent to filing in all PCT member states, which have been designated in the application. Patent right is granted only by the particular member country after entering the national phase in that country on receipt of application. Thus by joining

this treaty, it is possible for Indian applicants to file patent application through PCT and designate countries where protection for their invention is sought. Similarly, foreign applications that designate India as designated state in PCT applications would be entering the national phase.

e) Budapest Treaty with effect from 17th December, 2001.

This treaty covers international recognition of the deposit of microorganisms for the purposes of patent procedure and regulations. As per requirement of this treaty, a list of authorized depository institutions have been notified by the Government of India for depositing the biological materials mentioned in the specification at the time of filing a patent application.

India continues to play a leading role among developing countries in all international forays, including the above. India has been very active in WIPO over recent years, particularly in expressing the concerns of developing countries. India chaired the inaugural meeting of the Standing Committee on Information Technologies (SCIT) in 1998 and most recently chaired the Information Technology Projects Working Group (ITPWG) of SCIT at its inaugural meeting in Geneva. India has also participated in other activities of WIPO including meetings on the harmonization of trade marks laws and patent laws, settlement of Intellectual Property Disputes, etc.

c) Amendments in Indian patent rules

The Indian Patent Act, 1970, essentially governs the patenting provisions in India. The Patents Amendment Act of 1999 and 2002, the Patents Rules-2003, 2004-Ordinance and Patent Bill 2005 amended the above act. The primary motive behind these amendments was the requirement of India to comply with the TRIPS provisions. Table 1A

highlights the major changes incorporated in the Patent Act of 1970 by the various amendments.

Table 1A: Amendments Incorporated in Indian Patent Act 1970

Indian Patent Act of 1970	TRIP's	Patent amendment act
Only process not product patents in food, medicines, chemicals	Process and product patents in almost all fields of technology	To be fully implemented as per TRIPS in 2005. (Patent Bill 2005)
Term of patents 14 years; 5-7 years chemicals, drugs	Term of patent 20 years	Now confirms to TRIPS requirement (Patent Act 1999)
Compulsory licensing and licensing of drugs	Limited compulsory licensing, no licensing of right	Now confirms to TRIPS requirement
Several areas excluded from patents (method of agriculture, any process for medicinal, surgical or other treatment of humans, or similar treatment of animals or plants to render them free of disease or increase economic value of products)	Almost all fields of technology patentable. Plant varieties excluded from patent protection, but confusion exists on protection in some areas of agriculture and biotechnology	Uses the exception allowed by TRIP's. Rules out the patenting of living things or non-leaving substances occurring in nature, and further rejects the patenting of animal and plants.
Government allowed to use patented invention to prevent scarcity	Very limited scope for governments to use patented inventions	Now confirms to TRIPS requirement

Source: Indian Patent Act 1970 and Rules 1991, GATT agreements: results of the Uruguay Round, World Trade Centre, January 1995, Patent Act 1999, Patent Bill, 2002, Patent Rules 2003, Patent Ordinance 2004 and Patent Bill 2005.

Some of the other outcomes of the amendments are:

- Processes for diagnostic and therapeutic treatment of plants has now been considered as patentable. (2003 Rules)
- The source of geographical origin of biological material used in invention is required to be disclosed in the invention (2002 Amendment). A list of Authorized Depository Institutions have been notified in the gazette of India, Part II, Section 3 for depositing the biological materials mentioned in the specification at the time of filing a patent application.

- Request for examination introduced. (2002 Amendment)

  All the patent application in which First Examination Report have not been issued on or before 19th May 2003 will now be examined in serial order in which the request for examination is filed.
- Provision for allowing Paris Convention Priority has been extended to group or union of countries inter governmental organizations, therefore, 12 months priority will also be available to applications filed in EPO, ARIPO, OAPI and EAPO.
- Due to adherence to the PCT convention, around 17833 applications have entered national phase from 1998 onwards (i.e. in the Indian patent office) and are being examined.
- As per the transition period, product patents in food, drugs and agro—chemicals were filed during the transition period. This provision called 'Mailbox' provision has resulted till date approx. 12000 application. These patents have been opened now for examination.

New Ground of opposition introduced:

- Non-disclosure or wrongly mentioning the source of geographical origin of biological material used in invention. (2002 Amendment)
- Anticipation having regard to the knowledge oral or otherwise available within the local indigenous community in India or elsewhere. (2002 Amendment)

Excludes from patenting

- A method of agriculture or horticulture
- Any process for the medicinal, surgical, curative purpose of humans or animals

- Invention relating to atomic energy falling under sub-section (1) of section 20 of the Atomic Energy Act (production, control, use or disposal of atomic energy)
- Patent protection to plant varieties. But provides protection through "protection of plant varieties and farmer's rights act of 2001." However, protection is available through patents for various plant related/derived products (plant extracts, various compositions derived from plant products).

Like most countries, in India priority is established strictly by filing date. The subsequent filing of the application in different countries and the subsequent granted patents on an invention are referred as "patent equivalents". A group of patent equivalents make up a patent family. Member of a closely related family have a common priority application number and date. Subsequent applications must be made within one year (6 months for design patents), to seek protection to the "priority application date" (as per Paris convention). Being member of "PCT", Indian institutions can also take advantage of priority filing.