

Mapping S&T Innovations:
Analysis of the Patents Obtained in Indian Patent Office

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Phase III

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Executive Summary

Technology and innovation are the two key factors in economic growth. Patents are the key motivators for innovators. With the coming of liberalized economies, World Trade Organization and Trade Related Intellectual Property Rights, patents have taken a more important place. Inculcating the habit of innovation and ownership of intellectual property is a challenge some of the newly industrialized countries, including India, are facing. In this background, the current study attempts a holistic analysis of patented technologies in Indian Patent Office (IPO). The existing analyses largely address specific sectors such as pharmaceuticals and chemistry related patents. The current study is more inclusive and provides a panoramic view of the patents in IPO.

Specific objectives of the study were the following:

1. Patenting trends of Indian and foreign entities as a whole in Indian Patent Office (IPO).
2. Country-wise / assignee-wise trends, based on the patents they have obtained in India.
3. Technology-wise comparisons and analysis of patents granted to Indian and foreign entities locally.
4. Patenting strategies of the major patenting countries based on technology schema adopted from the existing literature.
5. In depth analysis of a few specific technology areas to infer possible implications of foreign patents on local market.

The study adopted the following methodology:

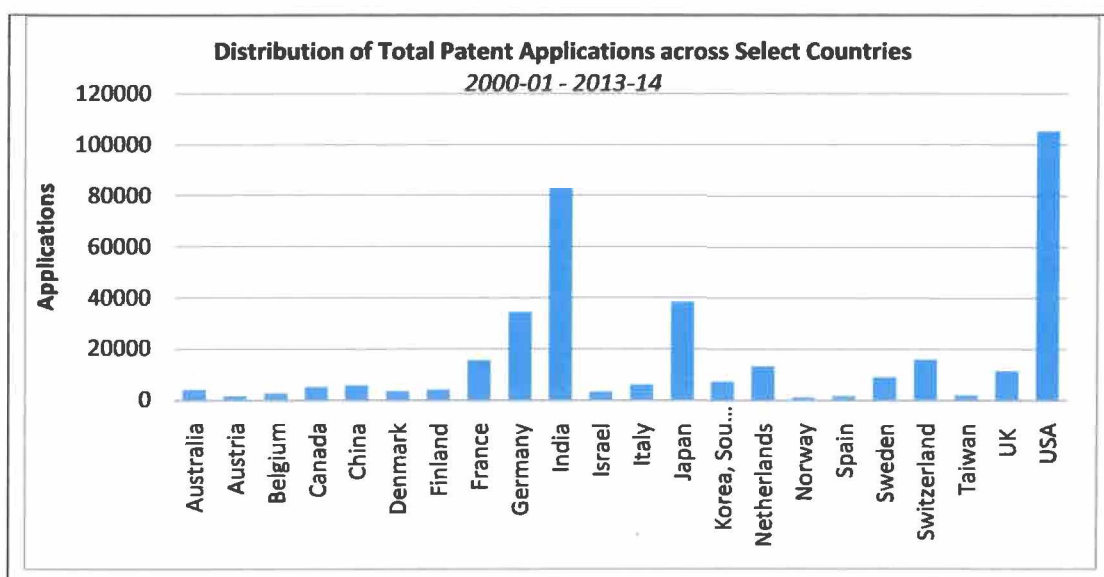
- Patents granted by the IPO during 2001-2014 period was obtained from the IPO database available in the public domain (<http://ipindiaonline.gov.in/patentsearch/search/index.aspx>)
- The records were recreated in a local database constructed for the purpose of analysis.
- The patents were grouped on IPC classes, sub-classes to understand the subject wise distribution of patents granted.
- The patents were grouped on the assignees to know who owns the patents, both on a country basis and on the firms.
- Patents were also grouped on the subject schema which facilitated comparison of the Indian and foreign patents in a set of technologies.
- Patent application data were obtained from Annual Reports of the Controller General of Patents, Designs, Trademarks, and Geographical Indications (CGPI).
- After discerning the patenting trends of different patenting countries, three case studies were done to understand the nature of patents under the technology, their impact on local market and the assignees who own the patents.
- Experts in the field were interviewed for reactions for possible policy lessons in our context.

The study presents three case studies namely, patents on transportation, telecommunication, and medical devices. The report also analyses the trend of technology dependence of Indian enterprises, by considering royalty, licence fee payments in different sectors.

With the Amendment of Indian Patents Act to comply with TRIPS agreement coming into force in 2005, the applications received for award of patents have taken a giant leap. During the period of analysis (2000-01 - 2013-14) applications were received from 137 countries. Applications from the US topped the list with 105,215 of them. Other countries in the top bracket include India, Japan, Germany, France, Switzerland, Netherlands, and Sweden. The second cluster of countries include China, South Korea, Italy, Canada, Finland, Australia, Denmark, Israel, Belgium, Taiwan, Spain, Austria and Norway. Applications through PCT route (National Phase Applications) dominate the trend and have marginalized those thorough normal and convention mode. Preliminary analysis by the IPO shows that applications relating to innovations in mechanical engineering top of the list, followed by chemicals, computer / electronics, drug, electrical engineering technologies, biotechnology in that order. The US stands apart as a group of its own, with the host country, India, standing second. The trend indicates Indian market potential sensed by leading countries. The year 2005 is the year which marks a steep upward trend.

IPO has received patent applications from 137 countries from 2000-01 onwards. Twenty-five countries have filed more than 100 applications during the period covered. Of these, eight have filed more than 1,000 applications including all the three categories. These countries are France, Germany, India, Japan, Korea, Sweden, the U.K., the U.S.A.

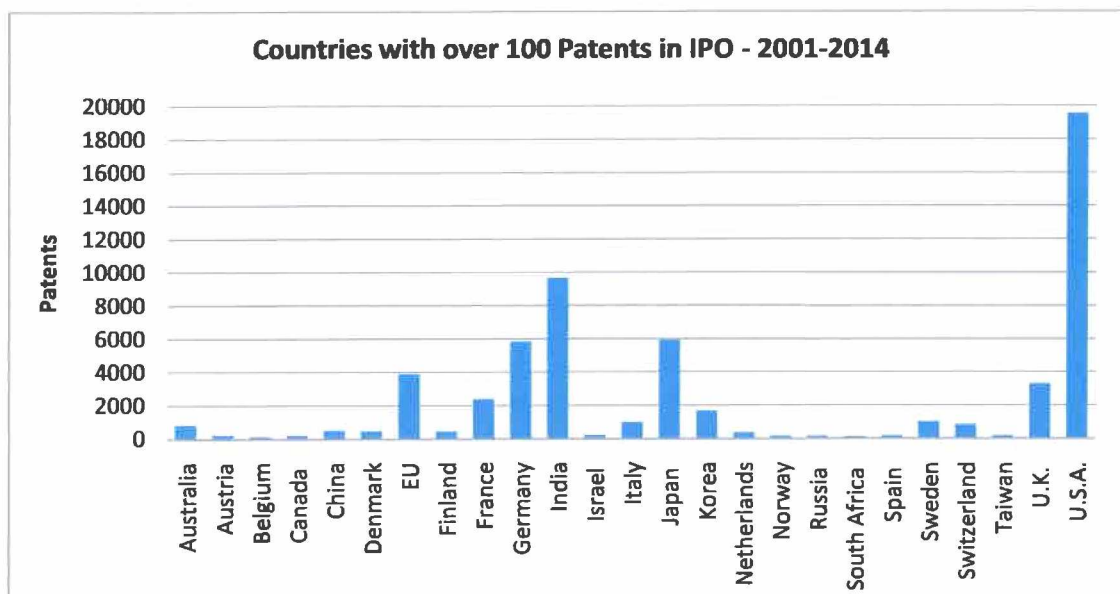
Twelve other countries make up the second cluster of applicants. These include Austria, Australia, Belgium, China, Canada, Denmark, Finland, Israel, Italy, South Korea, Spain, and Taiwan. The general trend, among most of these countries, is the rapid growth of PCT applications in the National Phase.



The figures indicate a rapid pace of examination and for the period as a whole the success rate has been 51.7% of the total. It was also noticed that a large number of applications are abandoned prior to examination. The success rate will be higher when we consider this factor.

IPO has granted patents to assignees from 110 countries during the 2001-2014 period. Top 10 countries - UK, France, Korea, Sweden, Switzerland, US, India, Japan, Germany, convention patents from EU make up 90% of the

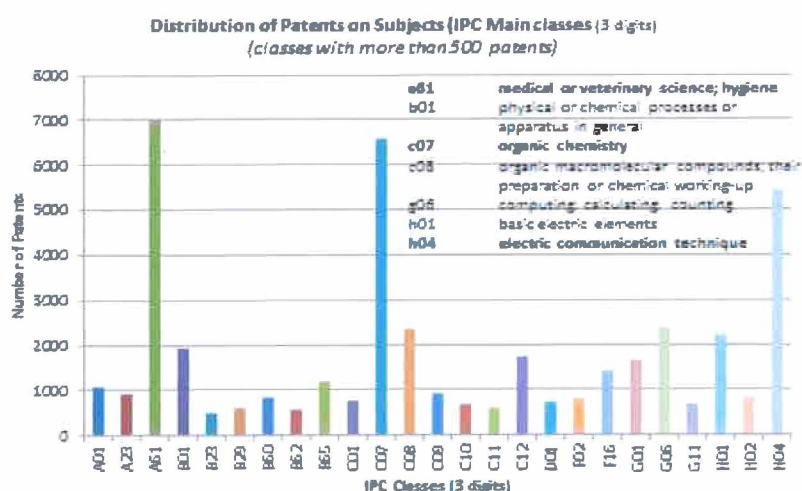
patents granted. Only 25 countries have more than a total of 100 patents during 2001-2014 period. Most of the other countries are minor players in Indian innovation space. There is a considerable foreign domination among the patents granted.



Mechanical and chemical engineering patents figure on the top followed by electronics, drugs, electrical engineering, biotechnology and others.

A Closer look at the subject-wise trend reveals that IPO granted patents fall in all the eight main divisions of International Patent Classification, 122 out of 130 IPC classes, and 625 out of 654 sub-classes. However, in most of these subjects the patent presence is very small. At the IPC class level, three classes make up top 25% of the patents - A61 (Medical or veterinary science; hygiene ...), C07 (Organic chemistry), H04 (Electric communication technique ...). Second quartile includes patents on G06 (Computing; calculating ...), C08 (Organic macromolecular compounds; their preparation or chemical working-up; compositions based thereon, H01 (Basic electric elements ...), B01 (Physical or chemical processes or apparatus in general), C12 (Biochemistry; microbiology; enzymology; mutation or genetic engineering). Third quartile consists of 15 broad subjects. The patent distribution is highly skewed at the level of broad subject categories.

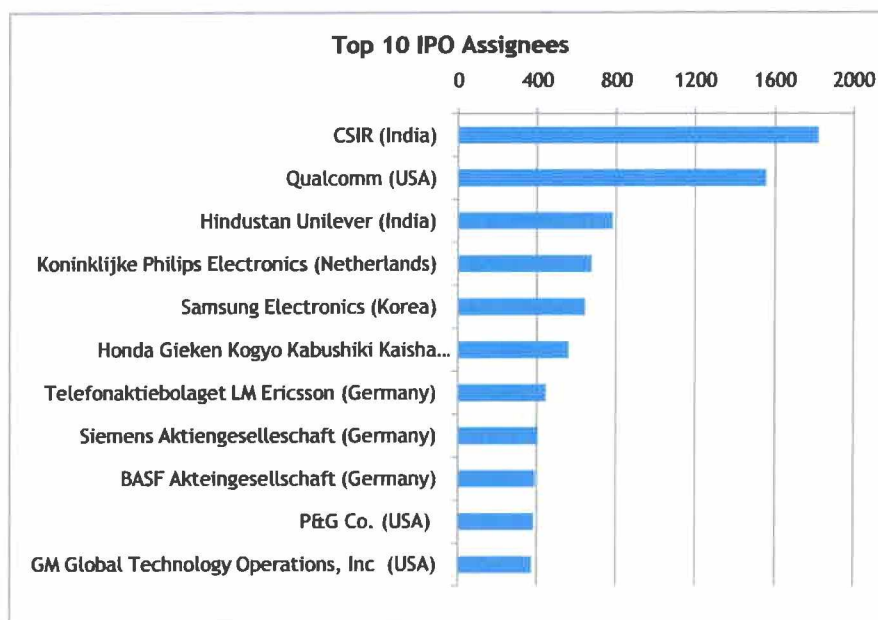
At the IPC sub-class level six relatively narrower subjects make up the first quartile - A61K (Preparations for medical, dental, or toilet purposes), C07D (Heterocyclic compounds), C07C (Acyclic or carbocyclic compounds (macromolecular compounds) C08; production of organic compounds by electrolysis or electrophoresis), G06F (Electric digital data processing), H04L (Transmission of digital information), C12N (Micro-organisms or enzymes; compositions thereof) - followed by 22 in the second quartile, and 69 in the third. Even at the sub-class level the patent availability is much skewed. A few subjects dominate the innovation scene in the country.



More elaborate analysis of the data, taking into account 201 sub-classes with 50 or more patents in them, show that the US dominate 60% of these technologies, followed by India in 14.5% of the sub-classes. Germany, Japan and Korea are the most patent holders in the rest of the sub-classes. Indian technology space in its various components is dominated by the US entities. Yet, we get only a select set of patents filed / granted by IPO, on overlapping subjects.

India's comparative technology strength in IPO viewed from ISI-OST- INPI classification indicate that we are relatively better in chemicals related technologies with 19% of the total patent ownership, followed by mechanical engineering (16.1%) and instrumentation (15.5%). We own only 7.7% of the patents that come under the broad head electrical engineering, which includes telecom, IT methods, semiconductors, etc. On the whole nearly 84% of the patents, making up major technologies, are owned by foreigners. The analysis shows that we have not carved any niche technology strength in domestic front. We tend to compete where other countries have dominated the technology scene.

There is a skewed distribution of patents among the assignees, through 12,830 enterprises, 365 universities, and 429 research institutes, along with nearly 3000 inventor assigned patents figure in our database.



Only 65 entities own more than 100 patents for the 2001-2014 period. The top assignees are Council of Scientific and Industrial Research, Qualcomm, Hindustan Unilever Ltd, Phillips, Samsung, Honda, Ericsson, Siemens, BASF, P&G and GM Global. Nearly 70% of the patent owners in IPO own only one patent, and nearly 90% of assignees own three or less patents. Patent ownership is diffused and most of them may not make much impact on the technology scene of the country.

Eight per cent of the assignees own 50% of the patents, 14% of the assignees own 50% of the patents at sub-class level. 75% of the patents fall under 8 IPC classes.

List of Assignees who own 100 or more Patents during 2001-2014				
CSIR	IBM	Astrazeneca		Aloys Wobben
Qualcomm	BHEL	IITS	CIBA	Praxair
Hindustan Unilever	Motorola	Silverbrook	Akzo Nobel	DRDO
Philips	LG	Maschinenfabrik	Sanofi Aventis	Panasonic
Samsung	Shell		Syngenta	Aventis
Honda	F Hoffmann Roche	Dow Global	Sumitomo	Canon
Ericsson	Sony	Du Pont	LG Chem Ltd	Mitsubishi
Siemens	Matsushita	Blackberry	Exxonmobil	Schneider Electric
BASF	Intel	Tata Steel	Institut Francais Du Petrole	

P&G	Samsung India	Bosch	Eli Lilly	TVS
GM	Nokia	Bayer	Janssen Pharmaceutica	Colgate
	Novartis	3M	Hewlett-Packard	Outokumpu
	General Electric	SAIL	UOP	Johnson & Johnson

The study also attempted three case studies. It could be noticed that medical device sector is dominated by the entities from the USA, with India following. Most of the patents taken are in the low or low moderate risk levels.

There has been a spurt in medical device manufacturing in India. From 2001-01 to 2012-13 it has grown more than six-fold. Yet, the imports have also grown more or less in the same measure. Most of the patents in low risk level are the consumer goods like pads, absorbents etc. We see a trend where the patents occupy the technologies with high volume trade. Imports still seem to dominate the high risk device end.

Patents in telecom reflect a more sordid story. Despite telecom industry being a high growth sector with teledensity growing from 3.58% in 2001 to 78.16% in 2015 and mobile economy itself contributing US \$ 400 billion to Indian GDP, our technology strength as reflected in patent ownership seems to be low. Internet and mobile telephony have brought a whole host of technology requirements both at hardware and software ends. Two sub-classes - H04Q (Selecting (the network) methods, circuits, or **apparatus** for establishing selectively a connection between a desired number of stations) and **H04B** (Transmission of information-carrying signals) dominate the patented technologies in IPO among the 3000 patents on telecom. Qualcomm, Ericsson, Samsung Electronics, Motorola, Nokia, LG, Matsushita, Huawei are the dominant players in this innovation space, with Qualcomm being the ahead in the bunch. There are nearly 500 patent owners holding only one or two patents each. Qualcomm dominates the scene both on network selection and transmission technologies. Indian presence in the telecom patent scene is negligible. There has been a steep rise in the payment towards royalty, IT enabled service charges pertaining to backend operations of the mobile telephone economy in the country.

In transportation sector, land vehicles have attracted most of the patents during the post 2001 period in IPO. Japanese enterprises stand first in the list of countries owning them, followed by India, the USA, Germany and others. Analysis of this data indicates a diffused patent ownership in the technology with Honda figuring prominently. More detailed look at the patents show that Honda ownership is in IPC sub-classes B62J which are more in the nature of accessories to the land vehicles. Yet, with patents which distinguish the vehicles of this class and innovation to suit the local needs, the company has been able to dominate the market. This has also come at a time when the demand for such vehicles has risen dramatically. These patents in IPO have added to the company strategy of moving away from joint venture with Hero Motors. Indian competition in this innovation space has come from TVS and to a small extent from Bajaj, Tata Motors and others.

The analysis also goes into the royalty and licence fees payment by Indian enterprises in different sectors. The data reinforces our dependence on the foreign technologies, particularly in consumer goods and high growth sectors like cosmetics, automobile, telecom among others.

The analysis shows that there is an urgent need to spread awareness of innovation in technology and ownership of this intellectual property. This is required more to get a firm grip on the local market to start with. In most of the countries' domestic patent holdings are dominated by the host country. It is essential to aim for that in IPO as well. New IPR Policy of 2015 seems to take this need earnestly and sets out to make a new beginning.

1 Introduction

In a globalized world with fewer trade barriers and free flow of new technologies and products across the countries, innovation has taken a prime place. Innovativeness can help place a country in an advantageous position in the continuum of global players. Patents are at the heart of realizing nations' ability to convert knowledge into wealth and in turn accomplishing desired social goals. Patenting system has contributed to orderly exploitation of invention in the fields of technology. The system is gaining importance in international trade, in investment decisions, in economic relations, and in economic growth itself.

Generally speaking, the patent system is designed to encourage technological innovation by rewarding intellectual creativity. The system is based on the premise that innovators are more likely to invent, and disclose the knowledge to the public, when supported by a system that assures the innovator the rights on their invention. Patents secure their owners the rights to exclude others from making, using, selling or importing an innovation. The patent system is a social contract between the applicant and society at large.

Patents can serve different purposes, depending on the holders' objectives. They can be used to preserve the holders' market dominance by preventing competitors from adopting patented inventions. Conversely, patents can also be licensed to third parties to encourage the adoption of inventions (ITU, 2014; Alikhan, S and Mashelkar, R 2004). National economic development strategies need to ensure effective management and protection of intellectual property rights (IPR) as also national creators and innovators. Strong national IPR also helps in attracting foreign direct investments (FDI), technology transfer and licensing.

Across the world, countries have entered into several treaties for enhancing competitive strategies. Important among them are Paris Convention for Protection of Intellectual Properties (1883), administered by World Intellectual Property Organization (WIPO), the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) in force from 1995 and administered by World Trade Organization (WTO), Patent Cooperation Treaty (PCT) adopted in 1970 and in force from 1978. PCT, for instance, facilitate national creators and innovators in having multi-country registration of their patents. India has signed these treaties in the interest of a strong IPR regime.

ASCI has conducted two extensive studies on Mapping of S&T Innovations. These studies examined the relative strengths and patenting strategies of countries. The countries examined included Brazil, China, Israel, India, Ireland, Korea, South Africa and Taiwan. Based on the understanding from the initial study, more intense analysis was carried out for an extended period of 2001-2010 focusing on China, Israel, and India. Patents obtained by India in IPO during the same period were also included in the analysis. The second study included several case studies which traced the growth of innovation and patenting on select technologies.

The studies have, among other things, brought out at length the policies adopted by countries to enhance innovation, growth of assignee, inventor base as also subject coverage of patents. The study also went into the technology focus and captured the innovation strategies as they manifest. A set of case studies examined the countries' relative position in the world and how they engineered their way up to their respective current position on the given technology. The study pointed to two different innovation options, one taken by Israel - where the

focus is to invent on cutting edge level of the technology and license the same, and the other by Chinese - where the emphasis is on building numbers and expanding the breadth of the subject coverage mainly to facilitate their manufacturing base.

Though India has fared much better locally in patenting innovations during the last decade, other countries including the US, Japan, China and others are increasing their patent footprint in the country. This process has been facilitated by the treaties like the PCT we have signed. Preliminary look at the patent applications flow in the post-2000-01 period shows a marked change in the trend for technology ownership in the country. As there is increasing liberalization of the economy and persistent call for investments from abroad, it is essential to take a closer look at the patents being granted to the foreign entities, the firms showing interest in India and the technologies being patented by those firms. It is also important for us to analyze the technology ownership pattern the patents fall into as a whole, and also their country-wise distribution. This is particularly important for us as these patents will have an impact on our industrial sector, as there could a tendency of the domestic firms getting sidelined in the long run. Such an understanding helps us in redirecting our R&D and innovation policies.

Despite the importance of this topic there has not been any comprehensive analysis of these trends. The studies have mostly focused on pharma and chemical sciences. Some of these include: Basant, Rakesh (2010); Balaji, Jayashree (2003); Rau B S (2012); Mueller, Janice M. (2007). Some other studies, away from this focus, are published by Mittal & Singh (2006), Sastry, Kalpana R, et al (2010). The current study is particularly important in the context of the amendments brought about to the Patents Act of 1970, in 2005, to comply with the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). The following section summarizes the Amendments adopted in the Indian Patents Act of 1971.

Patents (Amendment) Act, 2005

With the Patents (Amendment) Act, 2005 India's patent laws moved towards TRIPS compliance. The 2005 Act implemented a number of important changes. The most significant of these was the extension of patent term to twenty years. Prior to this amendment, Indian process patents lasted only for shorter period of five years from sealing or seven years from the date of the patent, while the term of all other types of patents (e.g., mechanical devices) was fourteen years from the date of the patent. (Mueller, Janice M. 2007)

Another notable aspect of the 2005 amendments was formal recognition in India's Patents Act of the accession to two leading international intellectual property treaties administered by the United Nations, affiliated World Intellectual Property Organization - TRIPS and PCT.

As required by TRIPS, India brought its laws into compliance with the provisions of the Paris Convention for the Protection of Industrial Property, which came into force in India on December 7, 1998. Under this India had to abide by the Convention's national treatment principle. This forbids discriminatory treatment of foreign applicants, as well as its right of priority. Inventor could now file for the patent on the invention in India for which they have already filed for patent in their home country. These applications have to be made within 12

months from the date of their original application. They are given the original priority date for the purposes of the grant.

Also, as of December 7, 1998, India has been a party to the Patent Cooperation Treaty (PCT). As a PCT signatory, India had to begin accepting national phase filings of international applications originally filed abroad under the PCT and designating India. Previously patent applications could only be filed directly with the Indian Patent Office. Product Patents for Pharmaceutical Substances was accepted in the Amended Act for the first time since 1972. Section 4 of the Patents (Amendment) Act, 2005, the cornerstone provision for bringing India's patents law into compliance with TRIPS, repealed the pre-existing statutory prohibition on the patenting of claims directed to "substances intended for use, or capable of being used, as food or as medicine or drug, or . . . relating to substances prepared or produced by chemical processes (including alloys, optical glass, semi-conductors and inter-metallic compounds)."

The immediate impact of this fundamental expansion of patentability in India was a huge influx of product patent applications awaiting examination. About 9,000 mailbox applications were filed with the IPO during the TRIPS transition period of January 1, 1995 to December 31, 2004 claiming substances capable of use as food, medicine or drug. Mail box applications refer to TRIPS requirement for countries, not providing product patents in pharmaceuticals and chemical inventions to put in a mechanism for accepting product patent applications from 1 January 1995. Such applications were to be examined for grant of patents, after suitable amendments in the national patent law were made. This mechanism of accepting product patent applications was referred to as "mailbox" mechanism. (<http://www.indianpatents.org.in/faqpat.htm#48>)

During the first eighteen months of the new patents regime, i.e., January 1, 2005 to June 30, 2006, summaries of approximately 6,700 of those mailbox applications were published. The Indian Patent Office began taking up the mailbox applications for examination in January 2005. The first pharmaceutical product patent to issue under India's new patents regime was granted in March 2006 to Hoffman-La Roche for its Hepatitis C therapy sold under the brand name Pegasys (IN198952).

Section 2(1) (j) of India's Patents (Amendment) Act, 2002 now defines an "invention" as "a new product or process involving an inventive step and capable of industrial application" to expressly incorporate the TRIPS-mandated "inventive step" criteria of patentability into the definition of an invention.

The previous version of the statute had omitted the inventive step criterion and had defined "invention" as, any new and useful- (i) art, process, method or manner of manufacture; (ii) machine, apparatus or other article; (iii) substance produced by manufacture, and includes any new and useful improvement of any of them, and an alleged invention.

India's new definition of invention - "a new product or process involving an inventive step and capable of industrial application" - also compresses the categories of patentable subject matter to simply "products and processes," in accordance with TRIPS. In contrast with the U.S. patent law, the new Indian definition of an invention omits

“discoveries.” This is, however, consistent with the European approach, which expressly excludes “discoveries” from patentability.

TRIPS does not further define the criteria of novelty, inventive step, and industrial applicability, however, leaving member countries the flexibility to fashion their own understandings thereof. Less technologically advanced countries may prefer to set higher standards of novelty and inventive step in order to preserve and enhance competition without violating minimum international standards. India has exercised this flexibility by adopting a unique but rather ambiguous definition of the inventive step requirement. According to the new Patents Act, inventive step now means “a feature of an invention that involves technical advance as compared to the existing knowledge or having economic significance or both and that makes the invention not obvious to a person skilled in the art.”

India has adopted a “non-obviousness-plus” standard. In order to be patentable, the invention must be (1) non-obvious to a person skilled in the art, but in addition, it must also (2) involve technical advance as compared to the existing knowledge or have economic significance or both. By bringing in new “technical advance” and “economic significance” criteria onto the standard non-obviousness requirement, India has been criticized for implementing a “vague and arbitrary” definition that fails to “reflect the distilled stock of knowledge” on what non-obviousness means.

In addition to defining “invention” as discussed above, the Patents Act, 1970 (2005) also includes a separate definition of “new invention.” First made part of the Act by the 2005 amendments, a “new invention” is defined as: [A]ny invention or technology which has not been anticipated by publication in any document or used in the country or elsewhere in the world before the date of filing of patent application with complete specification, i.e. the subject matter has not fallen in public domain or that it does not form part of the state of the art. The intent of this definition appears to be the elimination of any geographic limitations on the source of prior art. In other words, India appears to be adopting a system in which an invention must be novel not only as compared with what was previously published or used in India, but also novel with respect to earlier publications or uses in any foreign country. This worldwide scope for prior art is entirely consistent with the standards of the European Patent Convention.

However, the “new invention” definition is not incorporated into or referred to in any other section of the new Patents Act. In fact, other provisions of the Act appear to affirmatively prohibit the consideration of foreign uses (as opposed to foreign publications) of inventions as prior art. For example, the extent of an Indian patent examiner’s inquiry for anticipation includes searches of documents published worldwide but makes no mention of prior use (in India or elsewhere). Pre-grant opposition may be based on prior public knowledge or use of an invention “in India,” but foreign uses are not mentioned. Post-grant oppositions operate under the same restrictions. (<http://www.nalsarpro.org/CL/Articles/InDepthAnalysisofIndianPatentLaw.pdf>)

With the above understanding the changes brought about to the Patents Act, the research analyzed the Indian patents database. The following were the specific objectives of the research:

Objectives

The study aimed at understanding the following:

1. Patenting trends of Indian and foreign entities as a whole in Indian Patent Office (IPO).
2. Country-wise / assignee-wise trends, based on the patents they have obtained in India.
3. Technology-wise comparisons and analysis of patents granted to Indian and foreign entities locally.
4. Patenting strategies of the major patenting countries based on technology schema adopted from the existing literature.
5. In depth analysis of a few specific technology areas to infer possible implications of foreign patents on local market.

Methodology

The following methodology was adopted in data gathering and analysis:

- Patents granted by the IPO during 2001-2014 period was obtained from the IPO database available in the public domain (<http://ipindiaonline.gov.in/patentsearch/search/index.aspx>)
- The records were recreated in a local database constructed for the purpose of analysis.
- The patents were grouped on IPC classes, sub-classes to understand the subject wise distribution of patents granted.
- The patents were grouped on the assignees to know who owns the patents, both on a country basis and on the firms.
- Patents were also grouped on the subject schema which facilitated comparison of the Indian and foreign patents in a set of technologies.
- Patent application data were obtained from Annual Reports of the Controller General of Patents, Designs, Trademarks, and Geographical Indications (CGOP).
- After discerning the patenting trends of different patenting countries, three case studies were done to understand the nature of patents under the technology, their impact on local market and the assignees who own the patents.
- Experts in the field were interviewed to obtain their reactions, and possible policy lessons in our context.

Organization of the Report

The report is organized under following chapters:

1. Introduction
 2. Patent Application Trends
 3. Patent Grant Trends
 4. Subject-wise Analysis
 5. Assignee-wise Analysis
- Case Studies

6. Medical Devices
7. Transportation
8. Telecommunication
9. Do We Need Patented Technologies?
10. Summary and Conclusions

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2 Patent Application Trends

With the coming of WTO and the compliance to TRIPS the IPR scenario around the world has dramatically transformed. India took a ten year moratorium on implementation of TRIPS related issues and amended the Patents Act of 1971. The Amendment to the Act brought in the possibility of product patenting which was not hitherto permissible in our Patents Act in certain technologies.

Adoption of TRIPS provisions has facilitated greater inflow of patent applications. Presented in this chapter are the data relating to growth of patent applications of different types, countries of their origin, and also information on leading entities which have filed applications since 2001.

Types of patent applications

Indian Patent Office (IPO) accepts the following types of patent applications:

Provisional Application

A provisional application is a temporary application which is filed when the invention is not finalized and is still under experimentation.

Ordinary Application

An application for patent filed without claiming any priority or reference to any other application under process in the office is called an ordinary application. An ordinary application must accompany complete specifications and claims.

Convention Application

An application filed in the Patent Office, claiming a priority date based on the same or substantially similar application filed in one or more of the convention countries are called a convention application. In order to get convention status, applicant should file the application in the Indian Patent Office within 12 months from the date of first filing of a similar application in the convention country. Section 2(1)(d), 133, 134 of the Indian Patents Act govern this provision.

At present, India is a member of WTO, a member country in the Paris Convention, and a contracting state to the Patent Cooperation Treaty (PCT). Any country, union of countries or inter-governmental organizations which are members/contracting states to the above convention/treaty/agreement are convention countries for the purposes of the Indian Patent Act.

National Phase Applications under Patent Cooperation Treaty

National Phase Applications under PCT, commonly referred to as PCT application is an international application governed by the Patent Cooperation Treaty, and can be validated in up to 142 countries.

PCT is a multilateral treaty that was concluded in Washington in 1970 and entered into force in 1978. It is administered by the International Bureau of the World Intellectual Property Organization (WIPO). The PCT facilitates obtaining protection for inventions in any or all of the PCT contracting countries. It provides for filing of one patent application ("the international application"), with effect in several countries, instead of filing several separate national and/or regional patent applications.

The PCT procedure consists of two main phases. It begins with the filing of an international application and ends (in the case of a favorable outcome for the applicant) with the grant of a number of national and/or regional patents, hence the terms "international phase" and "national phase."

The international phase consists of five stages. The first three occur automatically for all international applications and the last two are optional. The first three steps consist of -

- filing of the international application by the applicant and its processing by the "receiving office",
- establishment of the international search report and written opinion by one of the "International Searching Authorities", and
- publication of the international application together with the international search report by the International Bureau of WIPO.

The fourth step includes establishment of a supplementary international search which may be carried out by one or more of the International Searching Authorities.

The third step includes communication of the published international application and the international search report and, where applicable, the supplementary international search report(s), as well as the international preliminary report on patentability by the International Bureau to the national (or regional) offices in which the applicant wishes to obtain a patent on the basis of his international application. The communication occurs upon request by the designated office to the International Bureau.

On completion of the international phase, further action is required before and in each of the national (or regional) offices which the applicant wishes to grant him a patent on the basis of international application. There are time limits within which those steps must be taken if the application is to proceed in the national phase.

PCT National Phase Application

When an international application is made according to PCT designating India, an applicant can file the national phase application in India within 31 months from the international filing date or the priority date (whichever is earlier).

Patent of Addition

When an applicant feels that he has come across an invention which is a slight modification of the invention for which he has already applied for or has obtained patent, the applicant can go for patent of addition if the invention does not involve a substantial inventive step.

Divisional Application

When an application made by an applicant claims more than one invention, the applicant on his own or to meet the official objection may divide the application and file two or more applications, as applicable for each of the inventions. This type of application, divided out of the parent one, is called a Divisional Application.

(<http://www.ipindia.nic.in/ipr/patent/manual/HTML%20AND%20PDF/Manual%20of%20Patent%20Office%20Practice%20and%20Procedure%20-%20html/Chapter%203.htm>)

The study has considered the patent applications data as provided in the annual reports of the Controller General of Patents, Designs, Trademarks, and Geographical Indications (CGPI).

Table below shows the cumulative number of applications from 2000-01 to 2013-14 filed in the IPO in three categories.

Table 2.1 Cumulative figure of patent applications 2000-01-2013-14

	Normal	Convention	PCTNational Phase
United States	5408	19313	80494
Japan	1955	9031	27527
Germany	1405	6848	26144
Switzerland	1242	2652	12091
France	794	2553	12326
Netherlands	234	1002	12177
United Kingdom	337	2054	9150
India	80275	342	2269
Sweden	115	808	8310
Korea, South	766	1691	4979
Italy	197	1382	4568
China	289	900	4834
Canada	127	1095	4010
Finland	243	337	3754
Australia	87	809	3430
Denmark	78	436	3075
Israel	65	381	2899
Belgium	36	257	2681
Taiwan	944	1029	230
Spain	59	236	1471

Austria	41	275	1489
Norway	8	235	1037
Ireland	75	183	628
South Africa	18	126	646
Singapore	75	96	625
Brazil	38	101	485
Russia	20	103	531
New Zealand	11	79	466
Luxembourg	8	78	492
Other European countries	20	22	384
Swaziland	34	122	203
Hungary	4	40	311
Malaysia	39	56	252
Iceland	93	55	81
Hong Kong	47	84	92
EP Countries		185	2
Mexico	6	13	184
Czech Republic	5	36	139
Liechtenstein	4	53	119

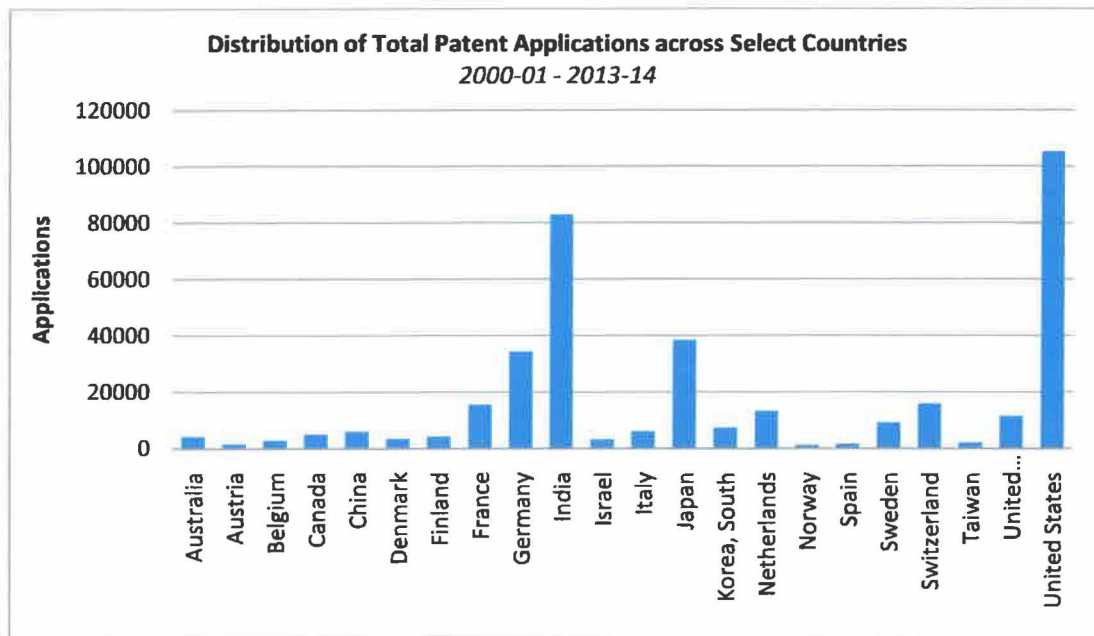
Greece	3	35	126
Poland	4	19	161
Bermuda	11	13	126
Saudi Arabia	11	2	139
Cyprus	13	24	99
Portugal	3	11	115
Slovenia		11	107
Barbados	4	25	82
Cuba	1	19	92
Turkey	2	17	97
Thailand	39	29	39
Other Asian Countries	16	12	65
Bahamas	6	19	66
Other countries of North / South America	15	18	58
Argentina	17	21	45
Malta	1	2	60
Croatia		11	44
United Arab Emirates	16	8	39
Virgin Islands	0	7	74
British Virgin Islands	1	2	48
Panama	2	10	36
West Indies	18	2	24
Chile	2	3	46
Slovakia	2	8	32
Ukraine	0	7	36
Cayman Islands	2	8	50
Pakistan	1	30	3
B V Island	6	24	0
Other African Countries	5	4	21

Latvia	0	1	28
Belarus	20	2	4
Estonia		4	23
Mauritius	9	6	10
Monaco		2	27
Costa Rica		4	16
Philippines		6	13
Venezuela	4	3	12
Channel Island	1	7	10
Sri Lanka	5	5	15
Bulgaria	3	3	16
Seychelles	7	2	12
Colombia		1	16
Egypt	2	1	14
Kazakhstan	2	1	12
Romania		1	14
Uzbekistan	1	13	1
Belize	3	1	12
Indonesia	1	5	10
Nepal	4	4	3
Yugoslavia	2	1	8
Uruguay	2	1	7
Paraguay			9
Afghanistan	2		5
Azerbaijan		2	4
Gibraltar	1		7
Vietnam	1	1	9
British Virginia			6
Jamaica		3	2
San Marino	3		2
Ashmore& Cartier Islands	4		29
British West Indies	1	1	2
Iran			4

Peru			5
Samoa	2	4	4
Tunisia			7
Bangladesh		1	4
Chinese Taipei		1	2
Kenya		1	3
Kuwait	1	2	2
Oman	3		
Sao Tome and Principe	3		
Algeria			2
Aruba	1		3
Bhutan	3		
British Isles			2
Brunei	1		1
Grenada			2
Jordan		1	4
Morocco		1	1
Saint Vincent & the Grenadines			2

Sierra Leone	2		
Turkmenistan	2		
Yemen			2
Armenia		1	
Bahrain	1		
Burkina Faso			1
El Salvador			1
Gabon			1
Guatemala			1
Korea, North	1		1
Lebanon			1
Lithuania		1	
Mali		1	
Nigeria	1		1
Qatar			3
Rome	1		
Saint Kitts and Nevis	1		
Zambia	1		

Graph 2.1

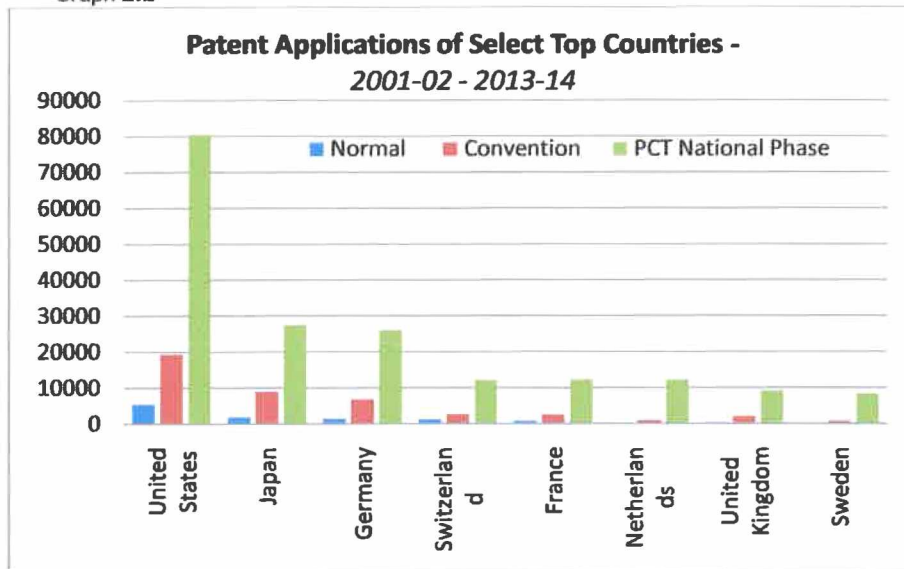


IPO has received patent applications from 137 countries from 2000-01 onwards. Twenty-five countries have filed more than 100 applications during the period covered. Of these, eight have filed more than 1,000 applications including all the three categories. These countries are France, Germany, India, Japan, Korea, Sweden, the U.K., the U.S.A. European Union applications, separately as an independent category, total over 3,000 in the same period.

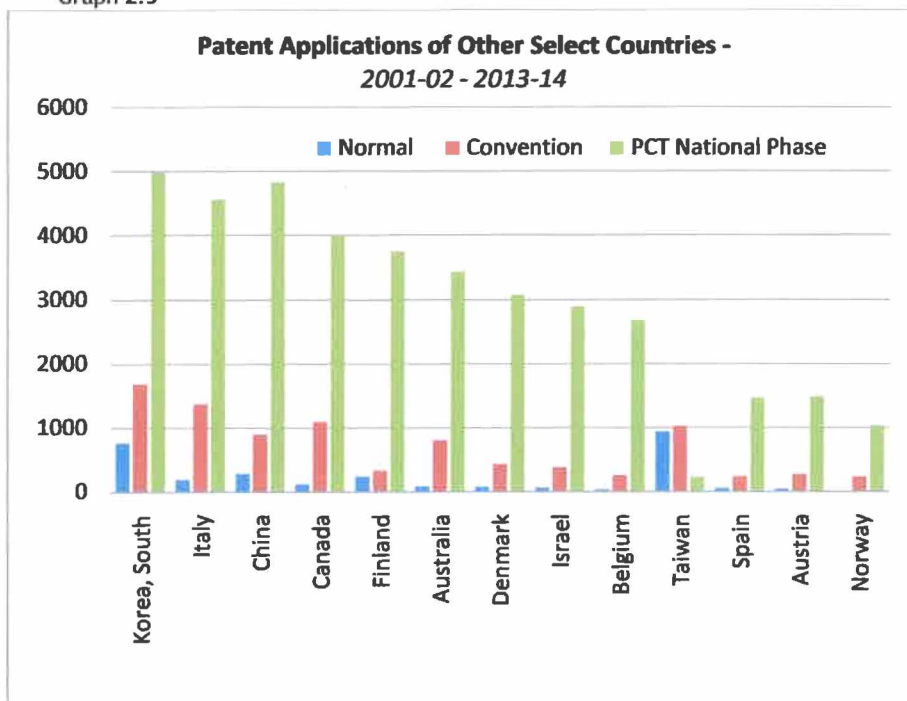
Twelve other countries make up the second cluster of applicants. These include Austria, Australia, Belgium, China, Canada, Denmark, Finland, Israel, Italy, South Korea, Spain, and Taiwan. The general trend, among most of these countries, is the rapid growth of PCT applications in the National Phase. Excepting Japan, Germany, Switzerland and the United States, normal applications in IPO from foreign countries are on the decline. Some late entrants to the top list of applicants - South Korea and Taiwan - have filed considerable number of normal phase applications. The United States is the leading patent applicant topping the list. With nearly 72,000 applications from 2000-01 to 2013-14 the U. S. entities' interest in patenting their innovation is more than that of the host country India. Germany and Japan with around 23,000 applications during the same period group together, albeit far behind the U.S. France, Switzerland, and the Netherlands bunch together with over 10,000 application search during the 2000-01-2013-14 period.

The numbers indicate that there is considerable interest in patenting innovations in India across the countries. With the coming of WTO and standardization of patenting procedures, there has been a surge in patent applications from different countries. Growth of applications from Japan and China is particularly noteworthy. In both the cases, there is a steady growth in applications year after year during the period under consideration. However, the US has been in the lead. In fact, it is in a league of its own.

Graph 2.2



Graph 2.3



The study also explored as to the business entities / organizations which are in the lead in applying for patents in the recent years. Data obtained from the annual reports of the Office of the CGOP reveal that entities dealing with telecom, electronics, followed by pharmaceuticals - all of them of foreign origin - are in the lead. The list is indicative of the current technologies and consumer interest areas in the country.

Table 2.2 Top Foreign Patent Applicants

Patent Applications	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Alcatel Lucent			269			222
Astrazeneca AB (205)	190					
BASF SE (471)		222	304	346	343	304
General Electric Co. (7)	174			439	342	260
Koninklijke Philips Electronics NV		852	627	1101	647	839
Microsoft Corp		220	301	253		
Nokia Corp	173	267				
Novartis AG	226	203				
Panasonic Corp					251	
Procter & Gamble Co	157					
Qualcomm Inc.	252	852	1153	1192	1034	1062
Robert Bosch GMBH		244	284		297	375
Sharp Kabushiki Kaisha			277	436	260	
Siemens Aktiengesellschaft		234	249	351	318	249
Sony Corp		296	302	455	276	263
Sony Ericsson Mobile Corp	104					
Telefonaktiebolaget Lm Ericsson	176	242	449	381	413	386
Thomson Licensing	221					
ZTE Corp				286		

Source: CGOP Annual Reports

Graphs 2.1 depict the growth of applications of select countries over the years. The data indicate that on the whole the US has been the leading player from 2000-01 onwards. There is a surge in patent applications received from all the top countries and more so from the US after 2005. This is a direct impact of opening of PCT route for filing applications.

Subject-wise Trend of Applications

It is of interest to know the broad subject-wise trend of applications. IPO categorises the applications into eight broad categories. This data taken from the CGOP Annual Reports indicate that applications relating to mechanical engineering, computer & electronics are in the lead in recent years. This is followed by those on chemicals, drugs and electrical engineering in the recent years. There has been a decline in bio-technology related applications. Also patents in general category saw a surge in 2005 and after that has declined in numbers. Yet, our main stay seems to be chemical engineering and drug related applications, the volumes which have held steady over the years.

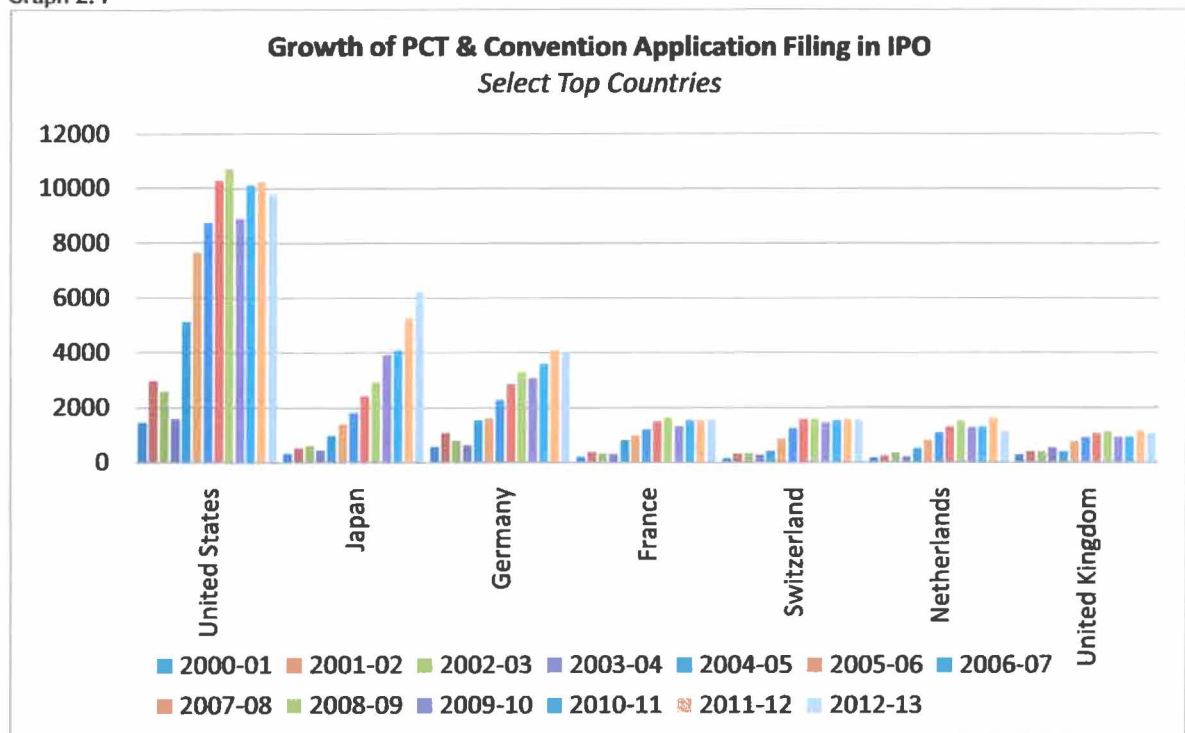
Table 2.3 Subject-wise distribution of patent applications

Applications									
	Chemical	Drug	Food	Electrical	Mechanical	Comp./Electronics	Biotechnology	General	
2002-03	776	966	119	690	1,257		46	562	

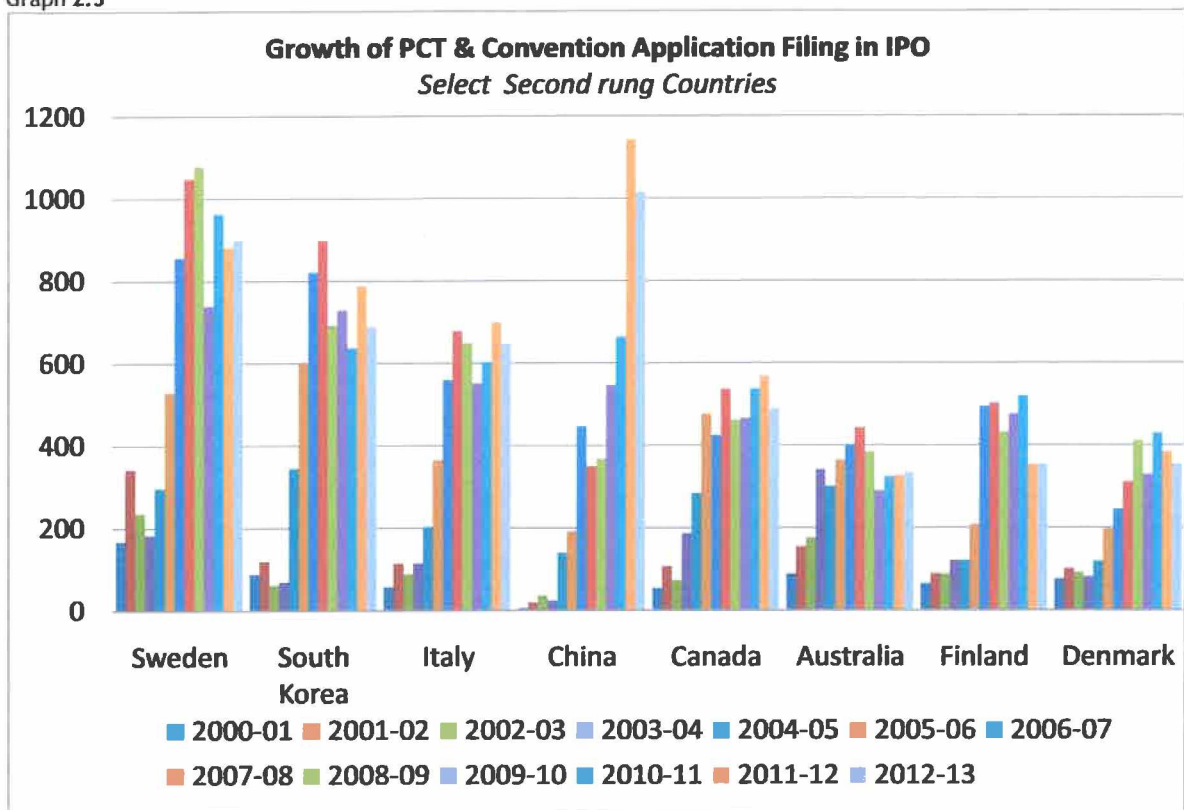
2003-04	2,952	2,525	123	2,125	2,717		23	2,148	
2004-05	3,916	2,316	190	1,079	3,304	2,787	1,214	2,659	
2005-06	5,810	2,211	101	1,274	4,734	5,700	1,525	3,150	
2006-07	6,354	3,239	1,223	2,371	5,536	5,822	2,774	1,621	
2007-08	6,375	4,267	233	2,210	6,424	4,842	1,950	7,110	
2008-09	5,884	3,672	340	2,319	6,360	7,063	1,844	2,946	
2009-10	6,014	3,070	276	2,376	6,775	7,646	1,303	885	
2010-11	6,911	3,526	315	2,719	7,782	9,594	1,497	1,017	
2011-12	6,698	2,762	294	4,160	9,716	4,225	788	822	
2012-13	6,812	2,954	452	3,568	10,198	4,424	832	1,561	
2013-14	6,769	2,507	387	4,371	11,318	4,410	647	652	
	65,271	34,015	4,053	29,262	76,121	56,513	14,443	25,133	

Source: CGOP Annual Reports

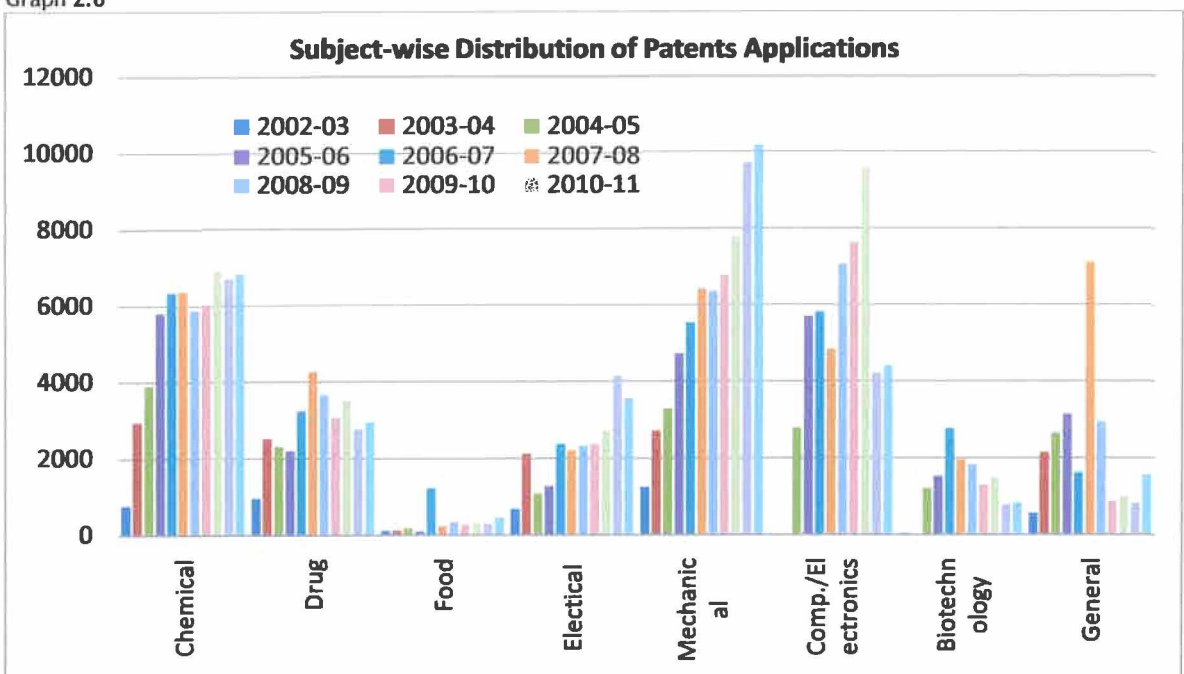
Graph 2.4



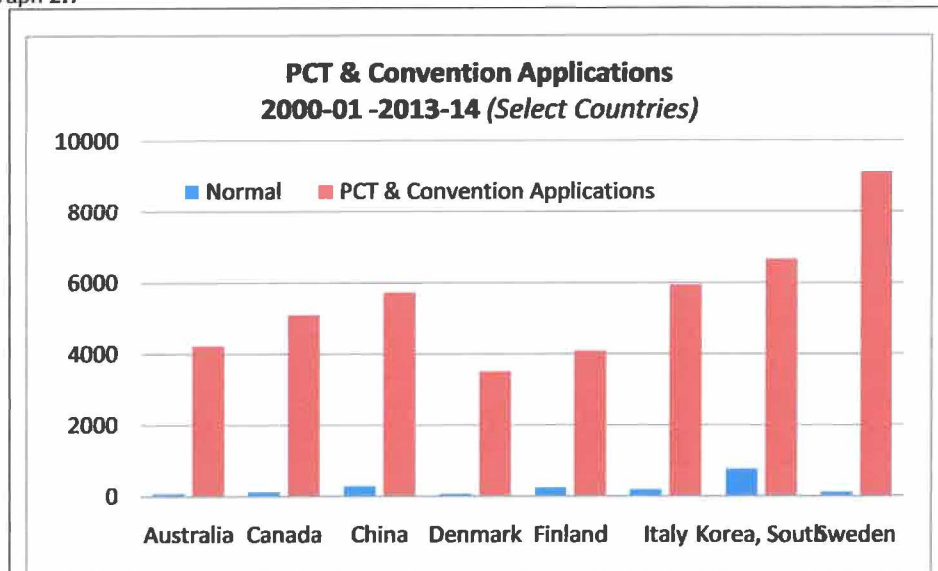
Graph 2.5



Graph 2.6



Graph 2.7



On the whole it could be concluded that patenting activity has been on the surge in India. Most of the applications have come from foreign countries and that too through PCT route. The year 2005 has been the departure point in growth of applications. However, the number of applications is not yet comparable with the leading patenting organizations like US PTO, EPO and Japan Patent Organization. The volume of applications in USPTO, for instance, is ten-fold more than that of India. Patent examination and award of rights is a challenge that IPO faces, considering the growth of applications. The new trend also poses the new challenge of protection of innovations.

3 Patent Grants

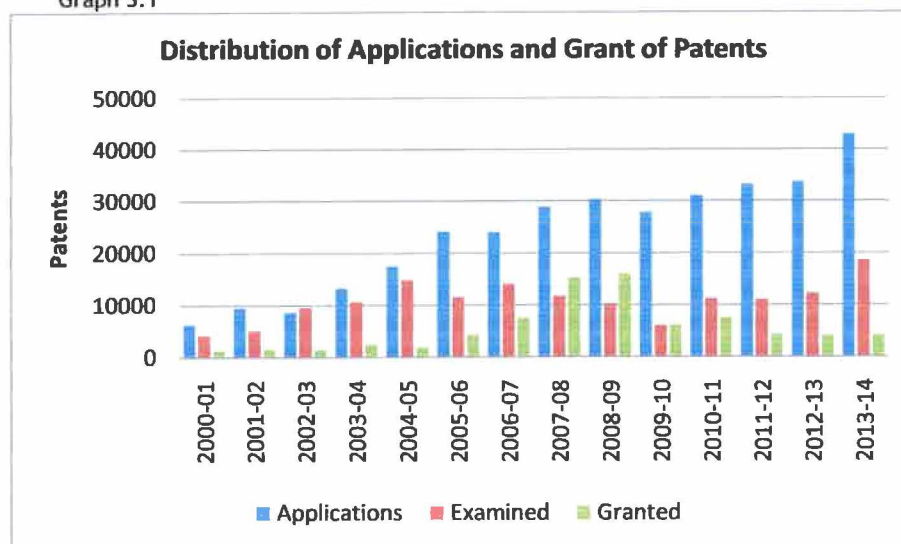
We have noted that there is a distinct trend of increase in the patent applications from 2001 onwards. The USA, among other countries, has increased the filing considerably through PCT and convention application routes. The trend of applications through PCT route has been steady from most countries which file for patents in India. It is interesting to compare the patent grants with applications. The Table 3.1 indicates that as the number of applications is on the rise, there is also a slow and steady increase in the patent grant. Yet, the pace of examination and grant has not been able to match the patent filings in IPO. The trend here refers to volume of transactions and not the nature of the patent applications filed or granted.

Table 3.1 Table Showing Applications and Grants

	Total Applications (Normal + Conventional + PCT)	Total Examined	Total Grants	Applications By Indian Entities	% of the Total Applications	Grants to Indian Entities	% of Grants to Indian Entities
2000-01	6,332	4,264	1,318	2,233	35.27	399	30.27
2001-02	9,500	5,104	1,591	2,403	25.29	654	41.11
2002-03	8,627	9,538	1,379	2,714	31.46	494	35.82
2003-04	13,282	10,709	2,469	3,227	24.30	945	38.27
2004-05	17,457	14,813	1,911	4,010	22.97	764	39.98
2005-06	24,184	11,569	4,320	4,721	19.52	1,396	32.31
2006-07	24,047	14,119	7,539	5,510	22.91	1,907	25.30
2007-08	28,890	11,751	15,261	6,296	21.79	3,173	20.79
2008-09	30,391	10,296	16,061	6,425	21.14	2,541	15.82
2009-10	27,858	6,069	6,168	7,262	26.07	1,725	27.97
2010-11	31,015	11,208	7,509	8,312	26.80	1,273	16.95
2011-12	33,275	11,031	4,381	8,921	26.81	699	15.96
2012-13	33,767	12,268	4,126	9,911	29.35	716	17.35
2013-14	42,951	18,615	4,227	10,941	25.47	634	15.00
Source: CGOP Annual Reports							

Over the years, the success rate of patent grant has been 51.7% of the total. A large chunk of the applications are either abandoned or rejected in the examination process. The data shows that the examination and the grant have been slow over the years. The years 2007-08 and 2008-09 though have been exceptions. Though the proportion of the Indian applications have ranged from 20% to 29% of the total in the post 2005 period, the corresponding proportion of grants have come down considerably.

Graph 3.1



In all, the patent data taken from various annual reports reveal that applications were received from 137 different countries from 2001 onwards. However, the data available in the public domain database about the grant refers to 110 countries. The following is a list of total number of patents granted to different countries from 2001 to 2014 period, as indicated by the IPO public domain database.

Table 3.2 Patents granted to countries 2000-01 - 2013-14

Country	Patents granted				
U.S.A.	19526	Argentina	77	Ukraine	4
India	9643	New Zealand	77	Georgia	4
Japan	5901	Hungary	51	Bahamas	3
Germany	5832	Ireland	41	Morocco	3
EU Convention	3898	Luxembourg	40	Kazakhstan	3
U.K.	3313	Malaysia	35	Uruguay	3
France	2381	Cuba	33	Latvia	3
Korea	1677	Czech Republic	22	Romania	3
Sweden	1034	Slovenia	21	Serbia	2
Italy	991	Croatia	19	Swaziland	2
Switzerland	852	Mexico	17	Cameroon	2
Australia	845	Poland	16	Bulgaria	2
China	533	Greece	16	Indonesia	2
Denmark	495	Chinese Taipei	13	British West Indies	2
Finland	467	Turkey	10	Curaçao	2
Netherlands	385	Thailand	10	Philippines	2
Austria	257	UAE	9	Cayman Islands	2
Israel	243	Democratic People's Republic	9	Belize	2
Canada	230	Hong Kong	9	Estonia	2
Norway	186	Ice Land	8	Belarus	2
Spain	186	Egypt	7	Kyrgyz Republic	2
Taiwan	180	Slovakia	6	Zimbabwe	2
Belgium	138	Portugal	6	Zambia	2
Russia	138	Sri Lanka	6	Sweden	1
South Africa	135	Chile	6	British Virgin Islands	1
Brazil	86	Samoa	6	Barbados	1
Singapore	78	Mauritius	5	Uganda	1
		Liechtenstein	4	Uzbekistan	1
				Trinidad and Tobago	1

Sweden	1
British Virgin Islands	1
Barbados	1
Uganda	1
Uzbekistan	1
Trinidad and Tobago	1
Nepal	1
Jamaica	1
Antigua and Barbuda	1

Gibraltar	1
Ghana	1
Macedonia	1
Congo	1
El Salvador	1
Channel Island	1
Pakistan	1
Qatar	1
Republic of Moldova	1

Costa Rica	1
Kazakhstan	1
Saudi Arabia	1
Monaco	1

Table 3.3 presents the Indian and foreign patents granted over the years. Foreign patents have always been more than the local ones and this trend has become more so in the recent years. As could be seen from the figures, 2006-07, 2007-08 received considerable attention in grant process. The numbers, however, have come down in the recent years. This data pertains to reporting years April to March of the reporting years.

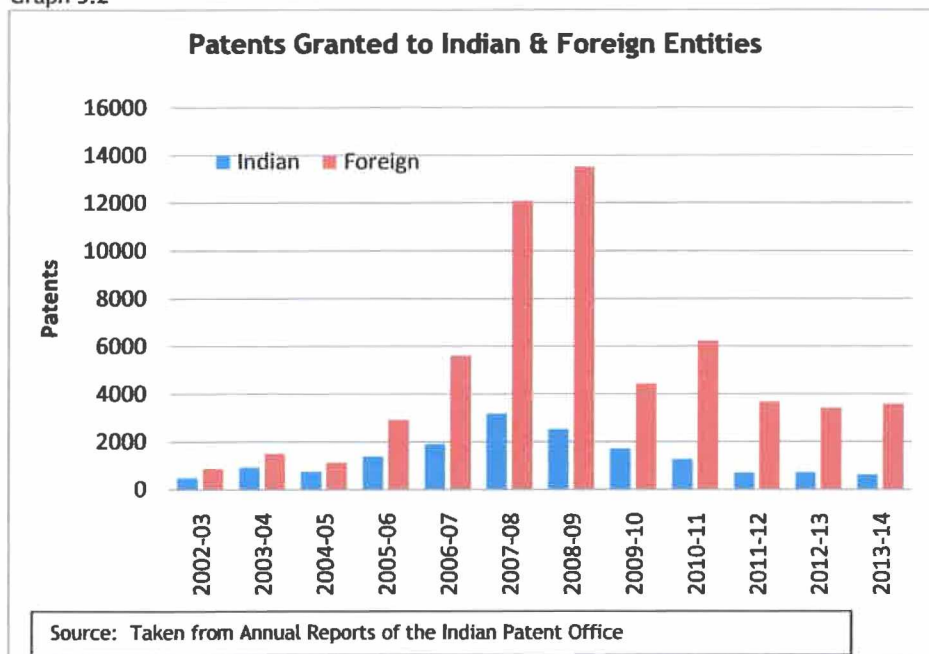
Table 3.3 Patents granted and analysed in the study

Patents Granted			Patents Analyzed in the Study			
	Indian	Foreign		Total	Indian	Foreign
2002-03	494	885	2003	147	32	115
2003-04	945	1,524	2004	448	122	326
2004-05	764	1,147	2005	1,182	226	956
2005-06	1,396	2,924	2006	3,201	863	2,338
2006-07	1,907	5,632	2007	9,576	1,608	7,968
2007-08	3,173	12,088	2008	12,360	1,855	10,505
2008-09	2,541	13,520	2009	8,999	1,347	7,652
2009-10	1,725	4,443	2010	6,715	1,091	5,624
2010-11	1,273	6,236	2011	4,749	680	4,069
2011-12	699	3,682	2012	3,986	626	3,360
2012-13	716	3,419	2013	3,284	548	2,736
2013-14	634	3,593	2014	5,709	645	5,064

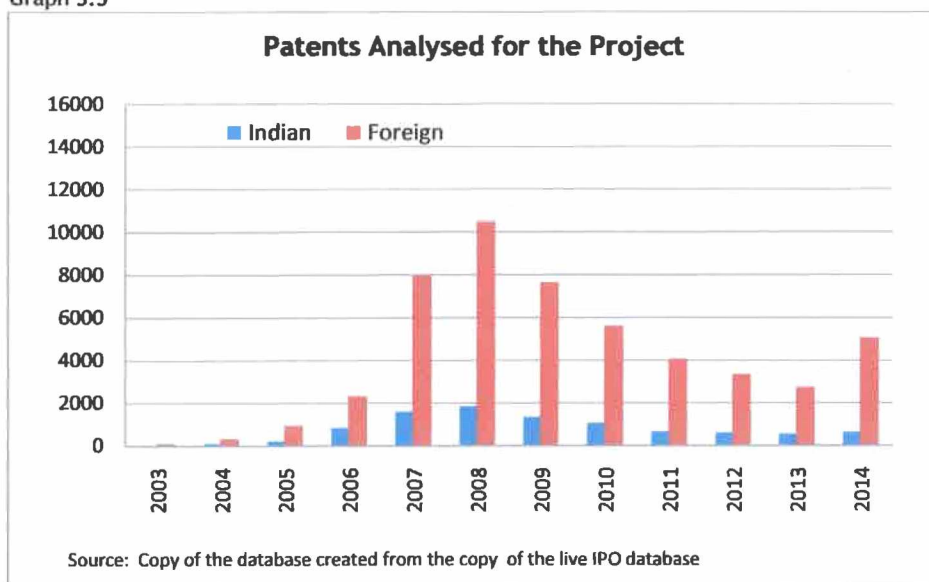
Source: CGOP Annual Reports

Distribution of the Patents analyzed in the current project is presented in Table 3.3. This data pertains to the records available in the IPO public access database. Careful verification has indicated that there is a problem of completeness of the database in terms of records and to an extent the data quality. Some inconsistencies in data quality is to be expected in all textual databases, but the IPO database perhaps has more problems on this count. The analysis of the data extracted from the live database is treated on calendar year basis. The difference in the availability of records, and the total as per the Annual Reports indicate a gap in the availability of the details. However, as could be seen, the overall annual trend of the patents granted and analyzed in this study is the same. The years 2007 and 2008 are the peak ones and there is a gradual decline in numbers. The year 2014 has again shown a spurt. The difference is also because the figures relating to the patent data used in the analysis is annualized on calendar years, and Patent Office data is presented on financial year basis. Due to our inability to capture the complete grant data, the results could be construed to indicate only dominant trends.

Graph 3.2



Graph 3.3



Country-wise Grant of Patents

It is interesting to see the trend of patent assignment to top eight foreign countries, namely France, Germany, Japan, Korea, Sweden, Switzerland, the U.K and the USA. The figures indicate that the grant of patents peaked for all these countries during 2007-2009 period and has been on the decline then after. An upward trend is again noticeable in 2014. The 2007-2009 surge could be due to the grant of patents to mailbox applications filed during the 2001-2005 period.

Graph 3.4

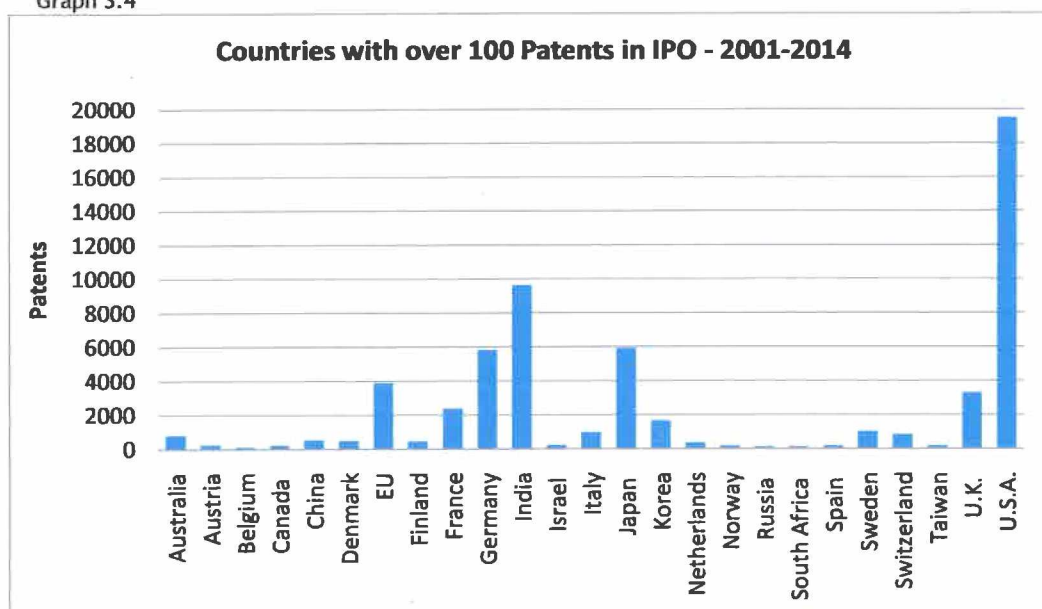
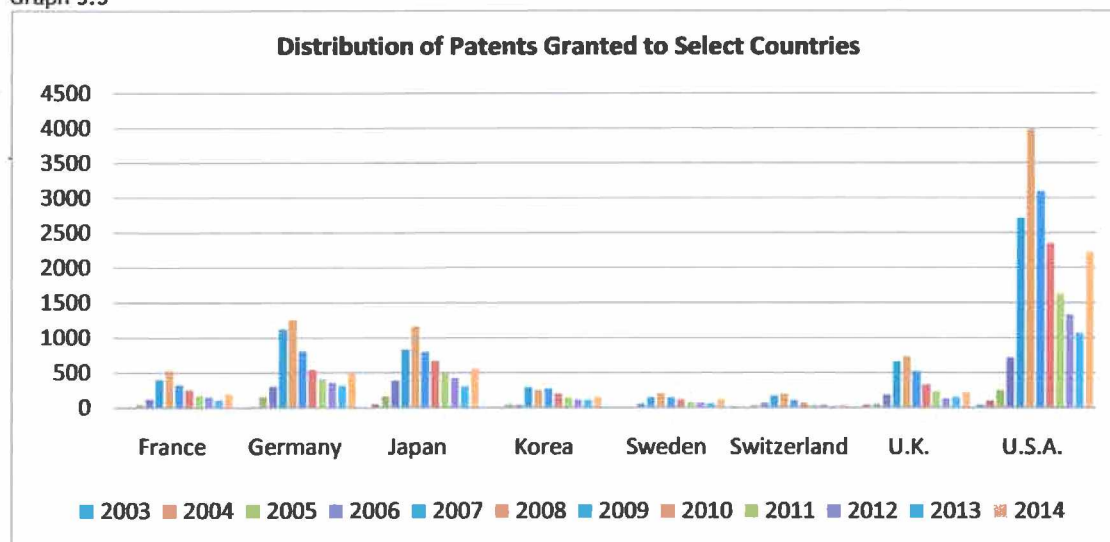


Table 3.4 Year-wise Distribution of Patents Granted to Select Countries

	France	Germany	Japan	Korea	Sweden	Switzerland	U.K.	U.S.A.
2003	10	5	12	1		17	11	40
2004	22	22	52	6	7	16	42	101
2005	49	164	168	52	10	38	54	254
2006	124	310	392	44	54	66	190	720
2007	406	1123	837	295	152	175	659	2712
2008	540	1260	1166	258	210	203	738	3983
2009	330	810	805	279	150	110	523	3099
2010	255	547	679	211	118	68	337	2355
2011	175	417	487	148	83	43	235	1629
2012	158	363	430	116	72	44	138	1332
2013	113	316	307	111	59	27	157	1070
2014	199	495	566	156	120	45	229	2231

Graph 3.5



Subject-wise Trend of the Patent Grants

Annual reports of the COGP have documented over the years the broad subject-wise distribution of patent grants. Given below are the figures compiled for 12 years where such data is made available. The Reports do not, however, indicate the basis of classification. Eight broad groupings also give us an indication of the subject on which patents are being filed. During the period 2002-03 to 2013-14 the applications are more in mechanical and chemical engineering, closely followed by computers/ electronics. Drugs, with 34,015, stand at fifth position in the list.

The analysis of the subject-wise focus of patents on specific technologies is presented at International Patent Classification (IPC) Class and Sub-class and Sub-group levels in later part of the report.

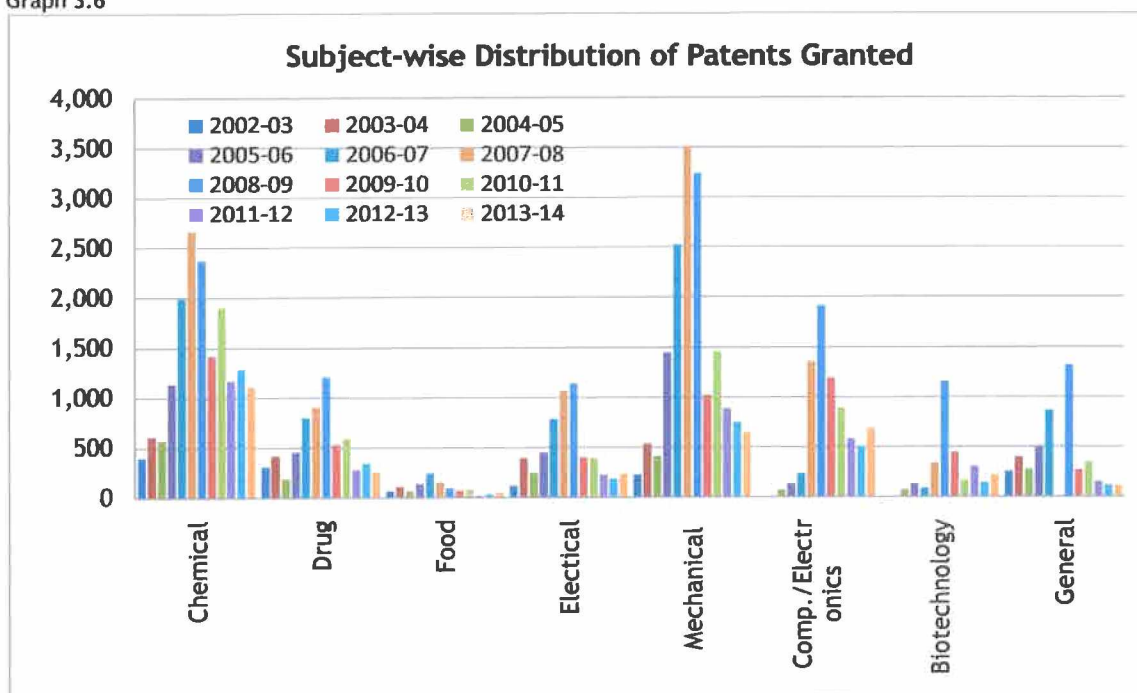
Mechanical engineering and chemical engineering have got the most patents granted. These are followed by drugs, electrical engineering with 5000 to 6000 patents. The next in the order is inventions of general category. Patents granted in bio-technology and food come towards the end.

The proportion of success of patent grant to application, in these subjects on the whole, stands at 20%. This proportion varies from subject to subject. The success rate is higher for chemical engineering inventions (25.5 %) followed by food (28.2%), mechanical engineering (21.9 %), biotechnology (21.2%), drug (18.5 %), general inventions (18.4 %). The success is the least in electronics / computer science, in which figures workout to be (13.4 %). These are, however, broad trends and cannot be predicting factor for individual applications. This could also be a reflection of examiner availability and patents pending for examination.

Table 3.5 Subject wise Distribution of Patents Granted

	Chemical	Drug	Food	Electrical	Mechanical	Comp./Electronics	Biotechnology	General
2002-03	399	312	67	118	228			255
2003-04	609	419	110	396	539			401
2004-05	573	192	67	245	414	71	71	278
2005-06	1,140	457	140	451	1,448	136	136	497
2006-07	1,989	798	244	787	2,526	237	89	869
2007-08	2,662	905	154	1,067	3,503	1,357	341	
2008-09	2,376	1,207	97	1,140	3,242	1,913	1,157	1,318
2009-10	1,420	530	72	404	1,024	1,195	449	273
2010-11	1,899	596	84	394	1,458	892	165	350
2011-12	1,168	282	21	228	888	584	309	153
2012-13	1,289	344	37	188	749	510	144	121
2013-14	1,111	256	51	237	645	690	220	112
	16,635	6,298	1,144	5,655	16,664	7,585	3,081	4,627

Graph 3.6

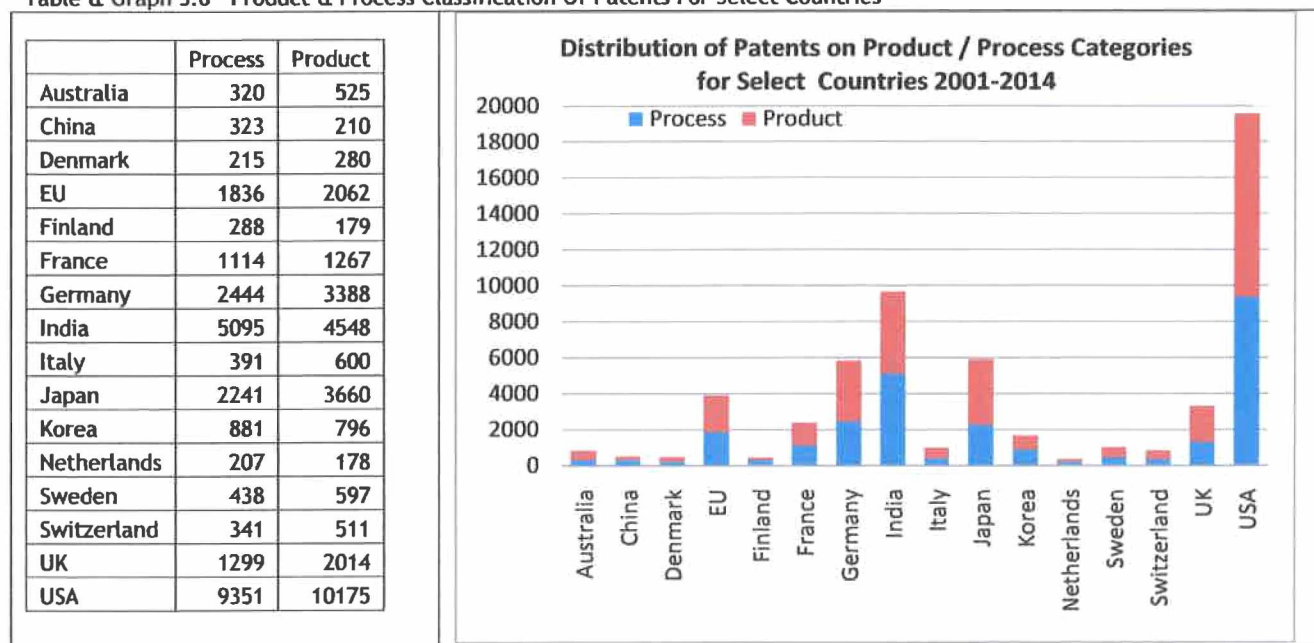


Process and Product Patents

The patents were also analysed to find out whether the invention patented refers to product or process. In fact, this issue of product versus process turns out important as the original Patents Act of 1971 had made that distinction, and had disallowed product patents in chemistry related patents. There could be several patents which would include both method and product related information. In the present analysis they were categorized

under process. The data indicate more or less even distribution of patents in these categories. This is also true of most of the countries which have relatively large number of patents in IPO.

Table & Graph 3.6 Product & Process Classification Of Patents For Select Countries



The above analysis suggests that the IPO needs to adopt an improved method of subject categorization for reporting. There is also a need to make the public domain database complete and consistent in data presented. The errors in the data need a careful look and correction, lest the current efforts would remain unappreciated.

4 Subject-wise Analysis

This chapter presents a subject-wise distribution of patents granted by IPO from 2001-14 period. Subject details of patents were derived from the International Patent Classification (IPC) codes attributed to patents indicating the specific technology the innovation addresses.

IPC categorises the patentable technologies into eight main divisions. The complete classification code consists of four components below each main division, namely class, sub-class, group and sub-group. Class represents the broad subject; sub-group the narrowest of the specification. IPC currently divides the patentable innovations into 130 classes. Sub-class numbers are narrower subjects under the identified classes. Currently there are 639 sub-classes. Groups and Sub-groups represent much narrower and specific subject the innovation could fall under given sub-classes. Currently there are 7,402 Groups and 64,332 Sub-groups in IPC.

Three different approaches were adopted to examine the subject-wise distribution of IPO granted patents.

1. Clustering at IPC class and sub-class levels with the distribution divided on quartiles.
2. Categorization of the patent sub-classes into four categories - A B C D - based on the availability of patents in a defined range. This grouping also enables to understand the Indian ownership of patents and the country's relative strength in each of the sub-class.
3. The sub-classes with over 1,000 patents were analyzed in depth to know our strength vis-à-vis foreign assignees at group/ sub-group levels.

Distribution of Patents

Patents assigned by IPO, considered in the analysis, fell under all the main divisions of IPC. Further they could be grouped under 122 classes - the first level classification of the main divisions. Eight main classes are not represented in the portfolio during the year 2001-14. The subject coverage of the patents granted are extensive, though the distribution across the main classes is not even.

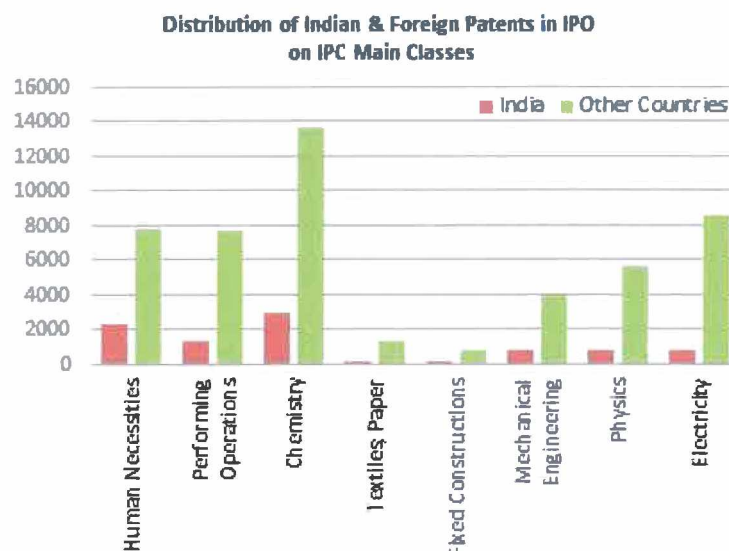
During the post 2001 period patents assigned to Indian entities by IPO have remained around 10-20%, in all the eight main classes of the IPC. Patents on chemistry dominate the innovations opted for protection. This is followed by electricity, human necessities, performing operations, in that order. Classes dealing with mechanical engineering and fixed construction have received less attention. Relatively higher Indian ownership of patents is to be seen in chemistry, human necessities, (which include drugs and pharmaceuticals) and performing operations. We have granted relatively a few patents under the main divisions - fixed constructions and textiles; paper.

Table 4.1 Distribution of Patents on IPC Main Divisions

	IPC Main Division	India	Other Countries	Total	India (%)	Foreign (%)
A	Human Necessities	2273	7785	10058	22.60	77.40
B	Performing Operations	1384	7752	9136	15.15	84.85
C	Chemistry	2927	13685	16612	17.62	82.38
D	Textiles; Paper	197	1383	1580	12.47	87.53
E	Fixed Constructions	199	825	1024	19.43	80.57
F	Mechanical Engineering	764	3936	4700	16.26	83.74

G	Physics	767	5643	6410	11.97	88.03
H	Electricity	767	8611	9378	8.18	91.82
Total		9278	49620	58898	15.75	84.25
• Some patent records did not have the IPC code related information						

Graph 4.1

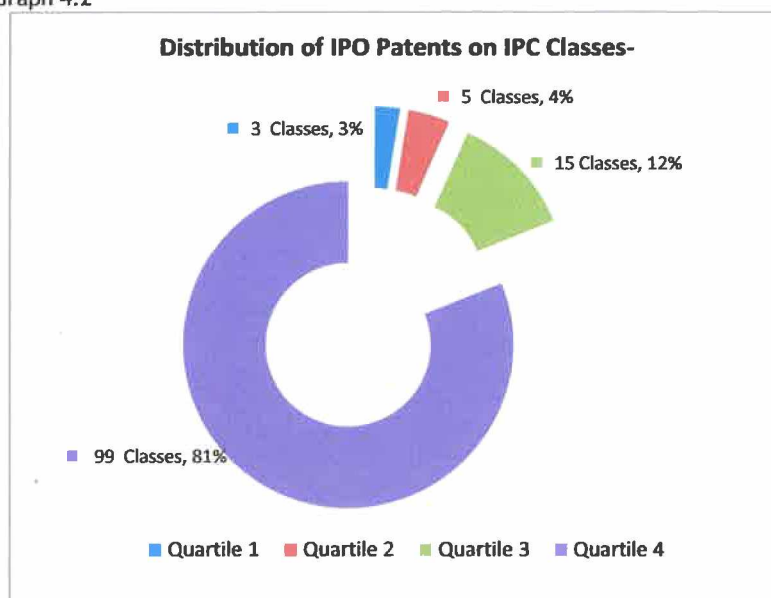


IPC Class-wise Distribution

To understand the nature of subject-wise distribution, the patents were arranged under IPC classes in descending order and the list was divided on quartiles. The graph 4.2 shows skewness in the subject-wise distribution.

On the whole patents considered in the analysis falls under 122 broad subjects, with A61[*Medical or veterinary science; hygiene*], C07 [*Organic chemistry*], and H04 [*Electric communication technique*]making up all the patents in quartile 1 - top 25% of the patents. Quartile 2, i.e. the next 25% of the patents, includes five classes, namely G06 [*Computing; calculating*], C08 [*Organic macromolecular compounds; their preparation or chemical working-up; compositions based thereon*], H01 [*Basic electric elements ...*], B01[*Physical or chemical processes or apparatus in general*], C12[*Biochemistry; microbiology; enzymology; mutation or genetic engineering...*]. Quartile 3 consists of 15 classes with patents ranging from 1687 to 595 in the classes. The last quartile has as many as 99 classes and 13 of them have less than 20 patents in a subject. Within the last quartile two classes have only two patents each. Subject wise distribution even at the top level division is much skewed with top 75% of the patents falling under just 23 broad subjects.

Graph 4.2

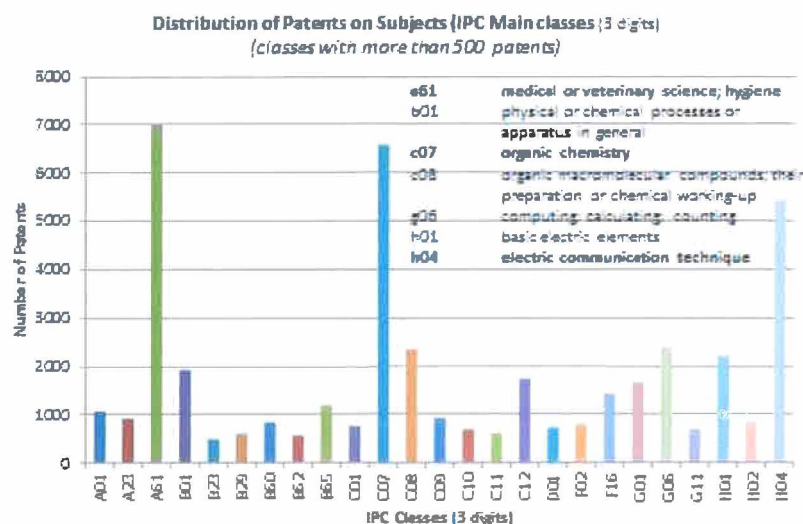


There are 12 broad topics with over 1000 patents granted in the post-2001 period. These are the following:

IPC Class		Patents
A01	Agriculture; forestry; animal husbandry ...	1073
A61	Medical or veterinary science; hygiene ...	6996
B01	Physical or chemical processes or apparatus in general	1910
B65	Conveying; packing; storing, etc.	1170
C07	Organic chemistry ...	6569
C08	Organic macromolecular compounds; their preparation or chemical working-up; compositions based thereon	2343
C12	Biochemistry; microbiology; enzymology; mutation or genetic engineering ...	1728
F16	Engineering elements or units; thermal insulation in general ...	1405
G01	Measuring instruments, other indicating or recording devices ...	1668
G06	Computing; calculating ...	2405
H01	Basic electric elements ...	2190
H04	Electric communication technique ...	5438

The graph 4.3 represents the broad subjects which have 500 or more patents.

Graph 4.3



Complete list of IPC classes with 50 or more patents is given below.

IPC Class	patents	Details
A01	1073	agriculture; forestry; animal husbandry; hunting; trapping; fishing
A21	61	baking; equipment for making or processing doughs; doughs for baking
A23	933	foods or foodstuffs; their treatment, not covered by other classes
A24	68	tobacco; cigars; cigarettes; smokers' requisites
A41	51	wearing apparel
A44	91	haberdashery; jewelry
A45	59	hand or travelling articles
A46	63	Brushware
A47	358	furniture; domestic articles or appliances; coffee mills; spice mills; suction cleaners in general
A61	6996	medical or veterinary science; hygiene
A62	63	life-saving; fire-fighting
A63	71	sports; games; amusements
B01	1910	physical or chemical processes or apparatus in general
B02	124	crushing, pulverising, or disintegrating; preparatory treatment of grain for milling
B03	63	separation of solid materials using liquids or using pneumatic tables or jigs; magnetic or electrostatic separation of solid materials from solid materials or fluids; separation by high-voltage electric fields
B05	280	spraying or atomising in general; applying liquids or other fluent materials to surfaces, in general
B07	50	separating solids from solids; sorting

B21	360	mechanical metal-working without essentially removing material; punching metal
B22	380	casting; powder metallurgy
B23	508	machine tools; metal-working not otherwise provided for
B24	148	grinding; polishing
B25	71	hand tools; portable power-driven tools; handles for hand implements; workshop equipment; manipulators
B26	130	hand cutting tools; cutting; severing
B27	52	working or preserving wood or similar material; nailing or stapling machines in general
B28	70	working cement, clay, or stone
B29	597	working of plastics; working of substances in a plastic state in general
B32	335	layered products
B41	438	printing; lining machines; typewriters; stamps
B42	85	bookbinding; albums; files; special printed matter
B60	857	vehicles in general
B61	139	railways
B62	551	land vehicles for travelling otherwise than on rails
B63	78	ships or other waterborne vessels; related equipment
B64	82	aircraft; aviation; cosmonautics
B65	1170	conveying; packing; storing; handling thin or filamentary material
B66	191	hoisting; lifting; hauling
B67	66	opening or closing bottles, jars or similar containers; liquid handling
C01	753	inorganic chemistry
C02	344	treatment of water, waste water, sewage, or sludge
C03	364	glass; mineral or slag wool
C04	394	cements; concrete; artificial stone; ceramics; refractories
C05	71	fertilisers; manufacture thereof
C06	56	explosives; matches
C07	6569	organic chemistry
C08	2343	organic macromolecular compounds; their preparation or chemical working-up; compositions based thereon
C09	903	dyes; paints; polishes; natural resins; adhesives; compositions not otherwise provided for; applications of materials not otherwise provided for
C10	704	petroleum, gas or coke industries; technical gases containing carbon monoxide; fuels; lubricants; peat
C11	612	animal or vegetable oils, fats, fatty substances or waxes; fatty acids therefrom; detergents; candles
C12	1728	biochemistry; beer; spirits; wine; vinegar; microbiology; enzymology; mutation or genetic engineering
C21	366	metallurgy of iron
C22	480	metallurgy; ferrous or non-ferrous alloys; treatment of alloys or non-ferrous metals
C23	315	coating metallic material; coating material with metallic material; chemical surface treatment; diffusion treatment of metallic material; coating by vacuum evaporation, by sputtering, by ion implantation or by chemical vapour deposition, in general; inhibiting corrosion of metallic material or incrustation in general

C25	196	electrolytic or electrophoretic processes; apparatus there for
C07	182	organic chemistry
D01	712	natural or man-made threads or fibres; spinning
D02	87	yarns; mechanical finishing of yarns or ropes; warping or beaming
D03	94	weaving
D04	124	braiding; lace-making; knitting; trimmings; non-woven fabrics
D05	55	sewing; embroidering; tufting
D06	264	treatment of textiles or the like; laundering; flexible materials not otherwise provided for
D21	182	paper-making; production of cellulose
E01	116	construction of roads, railways, or bridges
E02	117	hydraulic engineering; foundations; soil-shifting
E03	64	water supply; sewerage
E04	245	building
E05	161	locks; keys; window or door fittings; safes
E21	255	earth or rock drilling; mining
F01	463	machines or engines in general; engine plants in general; steam engines
F02	799	combustion engines; hot-gas or combustion-product engine plants
F03	281	machines or engines for liquids; wind, spring, or weight motors; producing mechanical power or a reactive propulsive thrust, not otherwise provided for
F04	342	positive-displacement machines for liquids; pumps for liquids or elastic fluids
F15	53	fluid-pressure actuators; hydraulics or pneumatics in general
F16	1405	engineering elements or units; general measures for producing and maintaining effective functioning of machines or installations; thermal insulation in general
F17	67	storing or distributing gases or liquids
F21	66	lighting
F22	59	steam generation
F23	240	combustion apparatus; combustion processes
F24	173	heating; ranges; ventilating
F25	325	refrigeration or cooling; combined heating and refrigeration systems; heat pump systems; manufacture or storage of ice; liquefaction or solidification of gases
F27	102	furnaces; kilns; ovens; retorts
F28	142	heat exchange in general
G01	1668	measuring; testing
G02	405	optics
G03	144	photography; cinematography; analogous techniques using waves other than optical waves; electrography; holography
G04	51	horology
G05	191	controlling; regulating

G06	2405	computing; calculating; counting
G07	140	checking-devices
G08	138	signalling
G09	206	educating; cryptography; display; advertising; seals
G10	211	musical instruments; acoustics
G11	701	information storage
H01	2190	basic electric elements
H02	823	generation, conversion, or distribution of electric power
H03	430	basic electronic circuitry
H04	5438	electric communication technique
H05	297	electric techniques not otherwise provided for
H04	73	electric communication technique

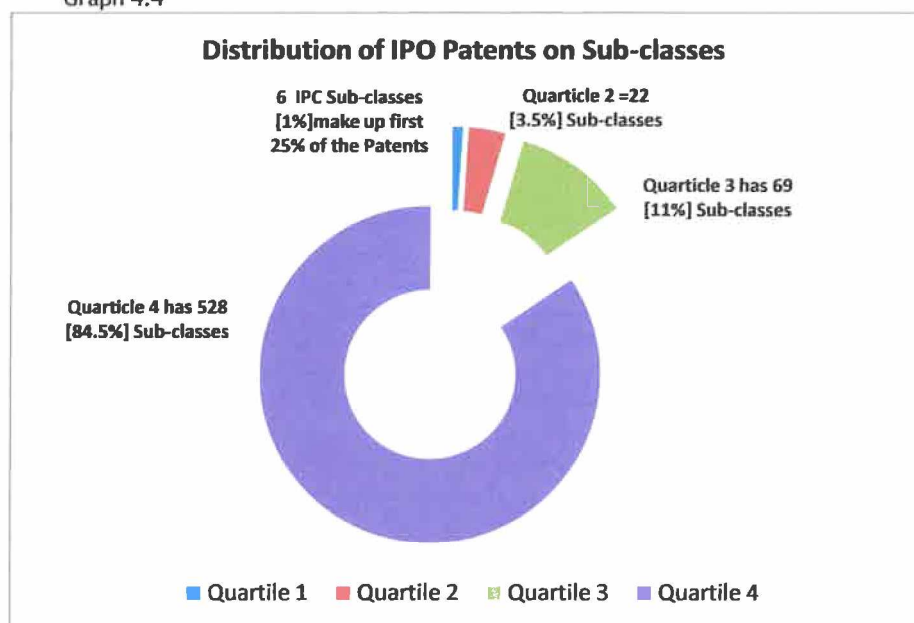
IPC Subclass-wise Distribution

IPO has granted patents on 625 sub-classes indicating broad technologies covered under IPC classes. Our subject spread at this level is just 10 short of the possible patentable topics. Eight of these have over 1,000 patents each. A61K (Preparations for medical, dental, or toilet purposes) has as many as 4,741 is the technology which has been patented the most. Others in the more than 1,000 patents category are IPC Sub-classes C0FD, C07C, G06F, H04L, H04Q, C12N and H04B.

As was done in the case of distribution under IPC classes, the total patents in the sub-classes were arranged in descending order. The most number of patents in a sub-class during the period was 4,741 and the least 1. To understand the nature of distribution the list was divided on the quartiles. Each quartile consisted just 14,493 patents falling in one or the other IPC sub-class.

Only six sub-classes make up the first quartile of patents under consideration. The second quartile consists of 22 sub-classes. Thus, 50% of the patents fall in a little over 3% of the subjects. Quartile 3 consists of 69 sub-classes making up 5% of the total. An overwhelming number of 528 (84.5%) of the sub-classes under which patents are granted fall in the fourth quartile. Thus, distribution of patents at sub-class level is also extremely skewed. A few subjects dominate the patents granted by the IPO. One-third of these subjects, making up 207 sub-classes have less than 10 patents each. The details of the top 28 IPC sub-classes that fall in the top 50% of the patents are given below.

Graph 4.4



IPC sub-class	Patents	Details of the sub-class
A61K	4741	Preparations for medical, dental, or toilet purposes
C07D	3101	Heterocyclic compounds
C07C	2223	Acyclic or carbocyclic compounds (macromolecular compounds C08; production of organic compounds by electrolysis or electrophoresis
G06F	1930	Electric digital data processing
H04L	1686	Transmission of digital information, e.g. Telegraphic communication
C12N	1118	Micro-organisms or enzymes; compositions thereof
H04Q	1105	Selecting (switches, relays, selectors)
H04B	1069	Transmission
B01J	948	Chemical or physical processes, e.g. Catalysis, colloid chemistry; their relevant apparatus
H04N	828	Pictorial communication, e.g. Television
B01D	803	Separation
A01N	744	Preservation of bodies of humans or animals or plants or parts thereof
C08F	669	Macromolecular compounds obtained by reactions only involving carbon-to-carbon unsaturated bonds
G01N	659	Investigating or analysing materials by determining their chemical or physical properties
C07K	653	Peptides
G11B	650	Information storage based on relative movement between record carrier and transducer
B65D	624	Containers for storage or transport of articles or materials, e.g. Bags, barrels, bottles, boxes, cans, cartons, crates, drums, jars, tanks, hoppers, forwarding containers; accessories, closures, or fittings there for; packaging

		elements; packages
A61B	549	Diagnosis; surgery; identification
C08G	548	Macromolecular compounds obtained otherwise than by reactions only involving carbon-to-carbon unsaturated bonds
C11D	531	Detergent compositions; use of single substances as detergents; soap or soap-making; resin soaps; recovery of glycerol
A61M	499	Devices for introducing media into, or onto, the body
H01L	481	Semiconductor devices; electric solid state devices not otherwise provided for
A61F	458	Filters implantable into blood vessels; prostheses; devices providing patency to, or preventing collapsing of, tubular structures of the body, e.g. stents; orthopaedic, nursing or contraceptive devices; fomentation; treatment or protection of eyes or ears; bandages, dressings or absorbent pads; first-aid kits
C08L	453	Compositions of macromolecular compounds
C01B	445	Non-metallic elements; compounds thereof
B29C	438	Shaping or joining of plastics; shaping of substances in a plasticstate, in general; after-treatment of the shaped products, e.g. Repairing
H01M	430	Processes or means, e.g. Batteries, for the direct conversion of chemical energy into electrical energy
C04B	385	Lime; magnesia; slag; cements; compositions thereof, e.g. Mortars, concrete or like building materials; artificial stone; ceramics

To examine the distribution in a more conservative mode, the patents falling in sub-classes were grouped into four categories, namely A (500 or more patents in a sub-class); B (300-500 patents); C (100-300) and D (50-100). This analysis also took in to consideration Indian holdings in each of the sub-class, proportion that Indian holdings make up, as also the country that holds the most under the category, with proportion of the total holding.

The sub-classes included in this classification had at least 50 patents. Such an analysis, it was felt, would give us relative strength of Indian entities, in various groups of subjects patented upon.

	Patents in the group	No. of sub-classes	Patents obtained by Indian entities
A > 500	25,179	20	3,416 (13.57%)
B --300-500	6,768	17	1,149 (16.98%)
C--100-300	13,606	79	1,902 (13.98%)
D--50-100	6,880	97	1,053 (15.31%)

The above distribution suggests that Indian patent strength in four categories range from 13.57% to 16.98%. The distribution also suggest the skewness in terms of a few select sub-classes having most of the patents. Twenty IPC sub-classes in the top order have as many as 48.02% of the total patents.

A more detailed picture of the sub-classes and patent holding in them is presented below:

	IPC Sub Class No.	countries	Total patents	Indian patents	% Indian	Country with largest holding	country which holds more than 20% of these patents
A	A01N	20	744	126	16.9	25.5 USA	24.9 Germany
A	A61B	29	549	62	11.3	50.1 USA	
A	A61K	47	4741	1137	24	36.8 USA	

A	B01D	34	803	110	13.7	34.1 USA	
A	B01J	32	948	114	12	32.8 USA	
A	B65D	35	624	69	11.1	26.3 USA	
A	C07C	37	2223	396	17.8	25.9 USA	
A	C07D	34	3101	462	14.9	27.0 USA	
A	C07K	27	653	57	8.7	40.4 USA	
A	C08F	23	669	80	12	34.4 USA	
A	C08G	23	548	71	13	35.4 USA	
A	C11D	20	531	57	10.7	37.1 USA	28.6 UK
A	C12N	35	1118	152	13.6	39.1 USA	
A	G01N	26	659	146	22.2	36.0 USA	
A	G06F	31	1930	146	7.6	59.7 USA	
A	G11B	25	650	7	1.1	2805 USA	27.2 EU and 25.5 S.Korea
A	H04B	24	1069	33	3.1	55.5 USA	
A	H04L	35	1686	104	6.2	54.2 USA	
A	H04N	24	828	44	5.3	41.1 USA	
A	H04Q	24	1105	43	3.9	58.5 USA	

It could be noted that in the above category in all the 20 sub-classes USA has obtained the most number of patents by a country. Other countries with substantial holdings are Germany (24.9% of the total in A01N), the UK (with 28.6% of the total in C11D), EU and South Korea with 27.2% and 25.5% respectively, in technologies relating to G11B.

In grouping B, with patents ranging from 300- 500 in a sub-class, we can see that Indian assignees have one-third or more patents granted in three of the total 17. More than 20% of the total patents can also be seen in two other sub-classes. On the whole Indian possession in this group as a whole is nearly 17% of the total. The US is in the lead in all the other, excepting for the two - D01H and H01H - where German entities have the lead among others.

B	A23L	22	483	171	35.4	India	24.84 USA
B	A61F	30	458	51	11.1	49.56 USA	
B	A61M	27	499	56	11.2	37.47 USA	
B	B29C	28	438	31	7.1	24.89 USA	
B	B32B	25	332	58	17.5	37.65 USA	
B	C01B	23	445	91	20.4	29.66 USA	
B	C02F	30	336	111	33	India	24.4 USA
B	C04B	24	385	152	39.5	India	21.6 USA
B	C08L	25	453	63	13.9	30.0 USA	
B	C10G	18	333	35	10.5	47.1 USA	
B	C22C	23	301	71	23.6	India	20.3 Japan

B	D01H	16	344	42	12.2	56.7 Germany	
B	F16H	20	358	35	9.8	45.0 USA	20.9 Japan
B	H01H	24	361	46	12.7	21.3 Germany	20.8 France
B	H01L	23	481	51	10.6	49.7 USA	
B	H01M	19	430	55	12.8	39.7 USA	
B	H04M	24	331	30	9.1	48.3 USA	

There are 79 sub-classes in the grouping C, which have total number of patents granted during 2001-14 period ranging from 100 to 300 in a sub-class. Indian share in these classes range from a high of 45.6% of the total in A47J to a low of 0 in sub-class H03M. In two sub-classes our patent possession is one-third of the total, and in 13 of these we have over 20% of the patents in the sub-class. On the whole foreign possession in these groups is 86.4% of the total. The USA is again in the lead in most of these subjects as well, with Japan, Germany holding the lead position in some of them. Korea and Switzerland mark their presence with substantial holdings in this category in some technologies.

C	A47J	15	114	52	45.6	India	
C	A61L	24	283	33	11.7	42.4 USA	
C	A61P	16	111	40	36	India	23.4 USA
C	B01F	21	105	9	8.6	29.5 USA	
C	B02C	18	109	26	23.9	India	
C	B05B	18	147	26	17.7	30.1 USA	21.4 France
C	B05D	12	102	22	21.6	37.3 USA	
C	B21B	15	161	28	17.4	49.1 USA Germany	
C	B21D	18	107	18	16.8	17.8 USA	
C	B22D	20	239	31	13	19.2 USA	
C	B23B	16	115	21	18.3	India	
C	B23K	19	195	47	24.1	33.3 USA	
C	B41J	12	263	13	4.9	46.0 USA	
C	B60K	17	189	28	14.8	37.0 Japan	
C	B60R	16	153	29	19	35.3 Japan	
C	B62D	17	152	35	23	32.9 Japan	
C	B62J	9	165	10	6.1	83.0 Japan	
C	B62K	10	117	25	21.4	60.7 Japan	
C	B65B	20	164	34	20.7	India	
C	B65G	22	126	27	21.4	India	20.6 USA
C	B65H	20	230	19	8.3	49.1 Germany	
C	B66B	11	117	3	2.6	44.4 EU	
C	C01F	13	109	36	33	India	23.9 USA
C	C01G	19	126	50	39.7	India	

C	C03B	15	181	19	10.5	40.9 USA	
C	C03C	14	173	18	10.4	34.7 France	23.7 USA
C	C07F	21	255	33	12.9	35.7 USA	
C	C07H	22	217	28	12.9	35.0 USA	
C	C08J	18	232	36	15.5	31.5 USA	
C	C08K	20	290	31	10.7	40.7 USA	
C	C09B	10	228	28	12.3	21.1 USA	
C	C09D	18	288	37	12.8	29.2 USA	
C	C09K	17	191	33	17.3	34.0 USA	
C	C10L	18	145	36	24.8	35.9 USA	
C	C10M	15	119	19	16	35.3 USA	
C	C12P	21	220	59	26.8	26.8 USA	
C	C12Q	20	272	45	16.5	47.8 USA	
C	C21B	16	141	22	15.6	India	
C	C21D	13	142	36	25.4	India	20.4 Japan
C	C22B	21	161	43	26.7	India	
C	C23C	19	270	38	14.1	23.3 Japan	
C	D01F	14	100	7	7	34.0 USA	20.0 Germany
C	D01G	11	154	40	26	32.5 Switzerland	31.2 Germany
C	E21B	18	211	20	9.5	48.3 USA	
C	F01N	11	138	11	8	34.8 Japan	21.0 Germany 25.4 USA
C	F02B	21	140	30	21.4	30.0 Japan	23.6 USA
C	F02D	14	193	16	8.3	42.5 Japan	27.5 USA
C	F02M	15	255	37	14.5	42.7 Japan	
C	F03D	21	179	25	14	53.6 Germany	
C	F04B	18	156	21	13.5	25.6 USA	21.8 Korea
C	F16C	13	125	13	10.4	31.2 USA	29.6 Germany
C	F16D	16	244	29	11.9	31.6 USA	
C	F16K	25	190	47	24.7	31.6 USA	
C	F16L	23	176	16	9.1	24.4 USA	
C	F25B	13	115	17	14.8	33.9 Japan	29.6 USA
C	F25D	14	117	22	18.8	25.6 Korea	
C	G01F	15	164	23	14	40.9 USA	23.8 Germany
C	G01R	19	186	36	19.4	28.0 USA	
C	G01S	14	159	11	6.9	68.6 USA	
C	G02B	21	275	30	10.9	36.0 USA	
C	G05B	15	117	16	13.7	35.9 USA	26.5 Germany
C	G06K	22	233	16	6.9	40.3 USA	

C	G06T	13	136	3	2.2	44.1 USA	
C	G10L	15	183	8	4.4	48.6 USA	
C	H01B	16	126	18	14.3	38.9 USA	
C	H01F	14	110	21	19.1	32.7 USA	
C	H01J	16	134	10	7.5	21.6 Germany	20.1 USA
C	H01Q	17	167	14	8.4	32.9 USA	
C	H01R	20	217	25	11.5	25.3 USA	
C	H02H	19	108	16	14.8	25.9 USA	
C	H02K	22	283	41	14.5	27.6 Japan	
C	H03M	16	181		0	35.9 USA	22.7 Korea
C	H04J	16	205	11	5.4	50.7 USA	
C	H05B	22	133	16	12	29.3 USA	22.6 Germany
C	H05K	20	123	13	10.6	35.8 USA	20.3 Germany

Category D has 97 IPC sub-classes with patents ranging from 50-100. 15.31% of the total 6880 in this category is owned by Indian entities and the majority of the patents are granted to foreign assignees. We have a high patent share of over one-third of the total in seven sub-classes and in 21 sub-classes more than one-fifth of the total. All the same, overall foreign ownership in these sub-classes which have patents ranging from 50 -100 is as high as 84.7% of the total. The USA dominates here as well, with Germany, Israel, Japan and Sweden appearing in others.

D	A01G	17	57	18	31.6	India	
D	A01H	15	63	21	33.3	44.4 USA	
D	A01K	17	51	17	33.3	India	23.5 USA
D	A01M	13	55	23	41.8	India	
D	A23C	11	54	16	29.6	India	25.9 USA
D	A23F	12	74	29	39.2	India	
D	A23G	14	99	12	12.1	24.2 EU	20.2 USA
D	A23K	15	67	10	14.9	31.3 USA	
D	A44B	10	68	3	4.4	50.0 Japan	
D	A46B	11	57	5	8.8	45.6 USA	
D	A47C	15	60	12	20	40.0 USA	
D	A61C	19	76	13	17.1	40.8 USA	
D	A61J	14	83	12	14.5	27.7 USA	
D	A61N	18	85	7	8.2	50.6 USA	
D	B21C	9	50	9	18	38.0 Germany	
D	B22F	14	86	13	15.1	33.7 Sweden	20.9 USA
D	B23C	10	52	3	5.8	28.8 Israel	25.0 Germany
D	B23Q	12	57	10	17.5	21.1 Germany	

D	B24B	12	76	24	31.6	India	26.3 USA
D	B24D	11	61	4	6.6	77.0 USA	
D	B26B	13	87	7	8	51.7 USA	
D	B29B	11	60	7	11.7	25.0 Germany	23.3 USA
D	B29D	15	95	8	8.4	44.2 USA	
D	B41F	13	74	5	6.8	28.4 Germany	
D	B41M	9	68	7	10.3	26.5 Japan	25.0 USA 20.6 Germany
D	B42D	12	58	6	10.3	48.3 Germany	
D	B60C	13	79	8	10.1	38.0 France	
D	B60G	11	53	7	13.2	32.1 USA	
D	B60T	10	84	28	33.3	India	
D	B62M	8	68	10	14.7	58.8 Japan	
D	B67D	13	56	12	21.4	33.9 USA	
D	C07B	10	86	26	30.2	India	
D	C07J	15	80	13	16.3	18.8 UK	
D	C08B	17	98	16	16.3	20.4 USA	
D	C09C	12	99	7	7.1	30.3 Germany	28.3 USA
D	C09J	14	78	13	16.7	34.6 USA	
D	C10B	10	55	14	25.5	25.5 USA	
D	C11B	14	59	24	40.7	India	
D	C12M	14	53	11	20.8	India	
D	C21C	13	82	30	36.6	India	20.7 Germany
D	C25B	15	78	6	7.7	20.5 Italy	
D	C25D	12	63	9	14.3	28.6 USA	20.6 Germany
D	CO7D	17	76	14	18.4	21.7 USA	
D	D01D	14	90	3	3.3	53.3 Germany	20.0 USA
D	D02G	10	64	6	9.4	26.6 Germany	26.6 USA
D	D03D	14	60	6	10	26.7 Germany	
D	D04B	13	50	1	2	18.0 USA	
D	D04H	14	71	5	7	31.0 USA	23.9 France
D	D06F	16	73	9	12.3	27.4 Japan	
D	D06M	9	63	8	12.7	31.7 USA	
D	D21F	9	72	4	5.6	83.3 USA	
D	D21H	11	61	4	6.6	26.2 USA	
D	E01B	13	64	14	21.9	14.2 USA	
D	E04B	20	77	9	11.7	26.0 USA	
D	E04C	19	56	15	26.8	India	
D	E05B	18	85	24	28.2	India	21.2 USA

D	F01D	15	84	18	21.4	27.4 USA	
D	F01L	10	65	9	13.8	46.2 Japan	29.2 USA
D	F02C	12	59	9	15.3	40.7 USA	
D	F03B	16	77	29	37.7	India	
D	F04C	12	83	4	4.8	32.5 USA	26.5 Japan
D	F04D	15	93	18	19.4	15.4 USA	
D	F16B	12	80	7	8.8	31.3 Germany	30.0 USA
D	F16F	13	62	9	14.5	32.3 USA	25.8 Japan
D	F16J	13	69	12	17.4	37.7 USA	
D	F17C	14	56	7	12.5	41.1 USA	
D	F22B	10	50	12	24	28.0 Germany	
D	F23D	2	54	3	5.6		
D	F24F	19	83	17	20.5	20.5 USA	20.5 Japan
D	F25J	7	75	6	8	54.7 USA	
D	F27B	15	62	17	27.4	India	
D	F28D	14	50	10	20	30.0 USA	
D	F28F	12	76	10	13.2	27.6 USA	
D	G01B	14	69	15	21.7		
D	G01L	15	74	11	14.9	33.8 USA	
D	G01M	10	51	14	27.5	31.4 USA	
D	G01V	11	82	11	13.4	48.8 USA	
D	G02C	11	60	5	8.3	73.3 USA	
D	G02F	11	68	7	10.3	27.9 USA	
D	G07F	18	64	15	23.4	India	
D	G08B	14	85	23	27.1	31.8 USA	
D	G09F	18	56	11	19.6	26.8 USA	
D	G09G	12	92	4	4.3	51.1 USA	
D	H02B	14	77	7	9.1	42.9 Germany	
D	H02G	20	67	7	10.4	19.4 USA	
D	H02J	15	91	12	13.2	26.4 Japan	
D	H02M	14	95	14	14.7	27.4 USA	
D	H02P	14	92	20	21.7	India	20.7 USA
D	H03K	14	72	16	22.2	38.9 USA	
D	H04R	13	68	7	10.3	45.6 USA	

The USA dominates the patent possession in India in most of the technologies that make up the four groups.

In 55 of the 205 subclasses identified to have patent presence of more than 50 in IPO database in the post 2000 period, Indian entities collectively own more patents than other countries. On the whole Indian ownership of the patents among the 205 patent clusters is 14.5%.

India is only a marginal player even within the country in technology ownership in the subjects on which there is a considerable number of patents

Indian patent holdings dominate in some of the sub-classes, such as A47J (kitchen equipment ...) where we own 45.6% of the patents, A01M (catching, trapping or scaring of animals) where Indian holdings are 41.8%) and C11B (producing, e.g. by pressing raw materials or by extraction from waste materials) where we have 40.7% of the total patents. These are closely followed by C04B (lime; magnesia; slag; cements; compositions thereof), C01G (compounds containing metals)where our holdings border 40% mark.

Indian patenting efforts was also examined, in terms of its focus, independent of the trends for the total database of patents granted. It was found that in 30 of the sub-classes we have over 50 patents. All these 30 correspond with the larger clustering as discussed earlier. Sixteen of these subjects are among the 20 which make up cluster A with 500 or more patents in an IPC sub-class. Indian efforts have been to patent on the subjects in which the global community also has shown interest in IPO. So also, the country has obtained more than 50 patents on 11 of the 16 subjects grouped under B. The trend is not the same in other two categories. In fact, we do not have substantial number of patents in those topics otherwise grouped as C and D.

The above trend shows that our research and innovation has been largely following the global interest in Indian technology space. We have not been able to carve out a niche technology area where we can dominate the local market.

The following are 30 subclasses India has over 50 patents each

A	A61K	1137
A	C07D	462
A	C07C	396
A	C12N	152
A	G01N	146
A	G06F	146
A	A01N	126
A	B01J	114
A	B01D	110
A	H04L	104
A	C08F	80
A	C08G	71

A	B65D	69
A	A61B	62
A	C11D	57
A	C07K	57
B	A23L	171
B	C04B	152
B	C02F	111
B	C01B	91
B	C22C	71
B	C08L	63
B	B32B	58

B	A61M	56
B	H01M	55
B	A61F	51
B	H01L	51
C	C12P	59
C	A47J	52
C	C01G	50

The Table4.2 gives another view of the distribution of patents on IPC codes. The data reinforces a long tail of holdings on subjects with fewer patents. All the patents awarded by the IPO are included in this distribution.

Table 4.2 Clustering on IPC Classes

No. of patents	IPC code
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>4000	1
3000-4000	1
2000-3000	1

1000-2000	6
900-999	1
800-899	2

700-799	1
600-699	5
500-599	3

400-499	8
300-399	9
200-299	21
100-199	54

90-99	11
80-89	15
70-79	17
60-69	24

50-59	23
40-49	38
30-39	40
20-29	59

10-19	96
<10	966

It is already seen that 12 IPC classes have over 1,000 patents each. These classes deal with subject categories which are in the nature of consumer goods, essential product patents, electronic/ communication equipment, and mechanical engineering products relating to automobile functioning. The patents could be seen as essential / sought after technologies. In the forthcoming section the report looks at the narrower subject categories under IPC classes which have over 500 patents each. This analysis will indicate the narrower subject coverage of the patents and relative strength of our portfolio.

The IPC subjects which have over 1000 patents at IPC class level include the following:

IPC Class	Subjects represented by IPC Class	Patents Granted in IPO	Distinct Assignees	Countries represented by the Assignees	USPTO patents in the overlapping IPC Class and period
A01	Agriculture; forestry; animal husbandry ...	1,073	537	34	69,299
A61	Medical or veterinary science; hygiene ...	6,996		59	261,324
B01	Physical or chemical processes or apparatus in general	1,910	910	39	57,185
B65	Conveying; packing; storing, etc.	1,170	662	38	63,386
C07	Organic chemistry ...	6,569	1,827	46	129,308
C08	Organic macromolecular compounds; their preparation or chemical working-up; compositions based thereon	2,343	802	36	57,460
C12	Biochemistry; microbiology; enzymology; mutation or genetic engineering ...	1,728	971	42	71,281
F16	Engineering elements or units; thermal insulation in general ...	1,405	686	32	75,245
G01	Measuring instruments, other indicating or recording devices ...	1,668	872	34	194,609
G06	Computing; calculating ...	2,405	831	31	443,911
H01	Basic electric elements ...	2,190	921	38	345,106
H04	Electric communication technique ...	5,438	813	43	326,928

These 12 broad IPC categories make up 57.8% of the total patents considered in the study. Three classes, namely medical and veterinary science (A61), organic chemistry (C07), and H04 electronic communication technologies have very high concentration of patents. There are over 40 countries which have obtained patents in each of these categories. Presence of a large number of countries is to be noticed in A61 which total 59. There are 2998 distinct assignees of the patents. More detailed analysis of these clusters is taken up in the subsequent sections of this chapter.

Other IPC classes which have high concentration of patents are the following:

		Patents Granted in IPO	Distinct Assignees	Countries represented by the Assignees	USPTO patents in the overlapping IPC Class and period
B23	Machine tools; metal-working not otherwise provided for	508	278	25	33,873
B29	Working of plastics; working of substances in a plastic state in general	597	374	30	29,069
B60	Vehicles in general	857	352	29	77,335
B62	Land vehicles for travelling otherwise than on rails	551	158	25	22,866
C01	Inorganic chemistry	753	364	26	12,742
C09	Dyes; paints; polishes; natural resins; adhesives; compositions not otherwise provided for; applications of materials not otherwise provided for	903	368	23	28,777
C10	Petroleum, gas or coke industries; technical gases containing carbon monoxide; fuels; lubricants; peat	704	315	27	9,620
C11	Animal or vegetable oils, fats, fatty substances or waxes; fatty acids there from; detergents; candles	612	130	24	8,561
C22	Metallurgy; ferrous or non-ferrous alloys; treatment of alloys or non-ferrous metals	480	237	28	7,721
D01	Natural or man-made threads or fibres; spinning	712	176	24	3,827
F01	Machines or engines in general; engine plants in general; steam engines	463	209	26	29,009
F02	Combustion engines; hot-gas or combustion-product engine plants	799	279	28	36,012

The above 24 IPC classes make up 71% of the patents granted by IPO during the period of analysis. There is high level of concentration of patents in a relatively few subject categories. It is also to be observed that IPO own only a small share of the patents on these technologies during the overlapping period by USPTO.

A further breakup of the patent classes show that A01 - Agriculture; forestry; animal husbandry ... has two small clusters with 50 or more patents on the subject. The following Table gives details of the patent clusters on the subject.

A01G	57	Horticulture; cultivation of vegetables, flowers, rice, fruit, vines, hops, or seaweed; forestry; watering
A01N	744	Preservation of bodies of humans or animals or plants or parts thereof

A01H	63	New plants or processes for obtaining them
A01K	51	Animal husbandry; new breed of animals
A01M	55	Catching, trapping or scaring of animals

A01N represent technologies relating to preservation of food or food stuff; preparation of medical, dental or toilet purposes which kill or prevent the growth of or proliferation of unwanted organisms, pest repellent or attractants, make up three-fourths of the patents in the class (A01). Bayer, BASF, Syngenta, Sumitomo, Du Pont, and Monsanto figure prominently in these patent holdings. Some of these patents are also obtained by the subsidiaries of these companies in India. These patents are essential for agricultural applications and hence enjoy an assured market. Eleven different entities with different country affiliation have 10 or more patents in this subclass. Most of these are foreign chemical companies in business. Only exception in the top list is CSIR, which was assigned during 2001-2014 20 patents on this chemical technology. On the whole 17% of these patents have Indian affiliation. There seems to be a large dependence on foreign technology here. Some of the patents indicative of this subclass are as follows:

Method for producing pesticidal tablet for electric heating vaporization [204296]
A process of making aqueous antimicrobial hygienic coating composition [207822]
Method for subterranean termite control by applying an arylpyrrole [208755]
Pest control sheet [208950]
An ingestible composition and method for prolonging the useful life of enteral feeding tubes [209537]
A method and an apparatus for producing high-function water containing ultra-fine gold particles [209781]
A synergistic insecticidal composition containing chloronicotynyle and organophosphorus compounds [211250]

Other four subjects consisting horticulture, new plants, plant reproduction, animal husbandry and catching, trapping or scaring of animals, make up most of the other patents in the class.

As could be seen A01G, H, K and M have fewer patents and these are obtained by entities from varied countries giving less scope for clustering with a fewer assignees. Indian entities appear in the top few who have been granted the patents.

IPC class A61 dealing with medical and veterinary science has the most number of patents granted under an IPC class. This subject accommodates 1,913 unique sub-groups under which patents have been obtained in IPO during 2001-2014 period. This is a subject in which there is considerable Indian interest and our entities have obtained 20.5% of the patents granted. Nine of the subclasses under this title have more than 50 patents

A61B	549	Diagnosis; surgery; identification
A61C	76	Dentistry; apparatus or methods for oral or dental hygiene
A61F	458	Filters implantable into blood vessels; prostheses; devices providing patency to, or preventing collapsing of, tubular structures of the body,
A61J	83	Containers specially adapted for medical or pharmaceutical purposes; devices or methods specially adapted for bringing pharmaceutical products into particular physical or administering forms; devices for administering food or medicines orally; baby comforters; devices for receiving spittle
A61K	4741	Preparations for medical, dental, or toilet purposes
A61L	283	Methods or apparatus for sterilising materials or objects in general; disinfection, sterilisation, or deodorisation of air; chemical aspects of bandages, dressings, absorbent pads, or surgical articles; materials for bandages, dressings, absorbent pads, or surgical articles

A61M	499	Devices for introducing media into, or onto, the body
A61N	85	Electrotherapy; magnetotherapy; radiation therapy; ultrasound therapy
A61P	111	Specific therapeutic activity of chemical compounds or medicinal preparations

A 61K - preparation of medical, dental or toilet - with 4741 patents forms an important cluster in which both Indians and foreign companies have obtained patents. Forty-seven countries are represented under this class covering France, Germany, India, Japan, UK, and the USA, all of them with over a hundred patents each, and Australia, Belgium, Canada, China, Cuba, Denmark, Israel, Italy, Korea, Sweden, Switzerland, Spain and the Netherlands possessing patents in double digits. The assignees which dominate in this technology in IPO context are CSIR (168 patents), Hindustan Unilever Ltd., Novartis, F. Hoffmann-La Roche AG, with over 50 patents each, and a host of other companies.

In fact, there have been several clusters of patents among the sub-groups under this heading. These include:

A61K31/00	284	Medicinal preparations containing organic active ingredients
A61K35/78	194	
A61K9/00	156	Medicinal preparations characterised by special physical form
A61K9/20	114	
A61K9/16	84	Medicinal preparations characterised by special physical form • Agglomerates; Granulates; Microbeadlets
A61K47/48	131	Medicinal preparations characterised by the non-active ingredients used the non-active ingredient being chemically bound to the active ingredient
A61K39/395	58	Medicinal preparations containing antigens or antibodies • Antibodies; Immunoglobulins; Immune serum,

However, patents in most of the other sub-groups represented under this sub-class are far fewer and mostly below ten. Some of the representative patent titles are as follows:

- *A process for preparing a pharmaceutical composition for treatment of diabetes mellitus and conditions associated with diabetes mellitus [189275]*
- *An improved process for the preparation of high yielding technical dry amorphous, oil-free powder containing 10 to 17% azadirachtin[189274]*
- *A process for the preparation of a novel synergistic herbal composition useful in the treatment of acute hepatitis e infection [189316]*
- *A process for preparing a solution composition for use in an aerosol inhaler [189317]*
- *An improved process for the simultaneous preparation of a mixture of menthones and menthols form thymol[190583]*
- *A process for the preparation of enantionmerically pure d-(-)-3-acetylthio-2-methylpropanoic acid [191586]*
- *improved process for the preparation of drug from the seeds of caesalpinia bonducella for the treatment of type 2 diabetes mellitus [192100]*

A61 B - diagnosis, surgery, identification - have attracted 549 patents. This sub-class in itself is represented by 29 countries, including Australia, Germany, India, Japan, Switzerland, and the USA, with over 20 patents each, and France, Israel, the U.K. with 10 to 20 patents each.

Medical devices (A61F) such as prostheses, filters implantable in blood vessels (stents) and along with these devices (A61M) for introducing media into or on to the body, containers for collecting, storing or administering blocks / medical fluids, surgery, chemical aspects of surgical articles, devices for producing sleep etc., make up nearly 1,000 patents. This sub-class has a high concentration of foreign companies obtaining patents. India's share in

these two broad classes is around 11% of the total. Considering these devices are essential requirements on a daily basis in medical treatment, the technology dependence of the country is very glaring.

Medicinal preparations, medical instruments dealing with special therapies like radiation, ultrasound, electrotherapy, magnetic therapy are also part of the patents under A61N. Some of the entities in this group are Phillips Electronics, Alza Corporation, BioPhoretic Therapeutic Systems, etc. The patents are far fewer compared to the demand and requirements in this technology.

Class B01 - Physical or chemical processes or apparatus in general has 1910 assigned patents during 2001-2014 period. These patents are in the sub classes such as the following:

IPC Sub-Class	Patents granted	Details
B01D	803	Separation
B01F	105	Mixing - Dissolving / Emulsifying / Dispersing
B01J	948	Chemical and physical processes

As could be seen, there is a high level of clustering of patents in two subclasses. Of the total in this sub-class - B01D - 13.7% of these are Indian. In all 34 countries and nearly 500 entities, including business companies have taken interest in these technologies. Australia, Finland, France, Germany, India, Japan, the Netherlands, U.K., and the U.S.A., are in the forefront.

Major assignees include Praxair technology inc., Air products and chemicals inc, Donaldson company, inc, Shell international research maatschappij B. V, BASF Aktiengesellschaft, Bharat Heavy Electricals Limited, EmitecGesellschaft fur Emissionstechnologie MBH, UHDE GMBH, apart from CSIR.

B01J -Chemical and physical processes has 376 sub-groups under which we have granted patents. Thirty-two countries have obtained patents in sub-class B01J. France, Germany, India, Japan, UK, the USA, and patents of EU make most of the lot with at least 50 patents each. These countries are assigned nearly 90% of the patents in this subject. In fact, the USA has over 300 patents in this sub-class.

BASF Aktiengesellschaft, Institut Francais du Petrole, Shell International Research Maatschappij B.V., UOP Llc, Johnson Matthey Plc, Engelhard Corporation, Albemarle Netherlands B.V., Exxonmobil Chemical Patents Inc., BP Chemicals Limited, Evonik Degussa GmbH, Methanol Casale S.A., Celanese International Corporation, Dow Global Technologies Llc., Urea Casale S A

Representative titles under this subject are as follows:

- *A catalyst for hydrotreating fraction oils and a process for preparing the same [202380]*
- *A process for preparing a phosphonite ligand [201037]*
- *process to produce organometal catalyst composition [201126]*
- *A process for preparing an alkoxylation catalyst [201440]*
- *A process for the preparation of a sorbent composition [201454]*
- *A honeycomb body in particular a catalyst body for exhaust cleaning systems of motorcycles or diesel application [201966]*
- *A method for continuous monitoring and control of monomer conversion in emulsion polymerization [202349]*

B65 - Conveying, packing, storing etc., have as many as 1,170 patents in the analysed patent database.

Among these patented technology clusters could be noticed in five sub-classes:

B65B	164	Machines, apparatus or devices for, or methods of, packaging articles or materials; unpacking
B65D	624	Containers for storage or transport of articles or materials, e.g. Bags, barrels, bottles, boxes, cans, cartons, crates, drums, jars, tanks, hoppers, forwarding containers; accessories, closures, or fittings therefor; packaging elements; packages
B65G	126	Transport or storage devices, e.g. Conveyors for loading or tipping, shop conveyor systems or pneumatic tube conveyors
B65H	230	Handling thin or filamentary material, e.g. Sheets, webs, cables
B65B	117	Machines, apparatus or devices for, or methods of, packaging articles or materials; unpacking

Among these B65D - containers for storage of articles like bags, bottles, crates, drums accessories, closures and fittings - make up almost 60% under this IPC class. These are also technologies which are of daily use in business. The Indian and foreign representations in the group of patents work out to 11.1% and 88.9% respectively. Among the foreign patents most are obtained by companies from the USA (170), Germany (86), UK (70), Italy (30), France (25), Japan (25) and 14 other countries. Over a hundred companies are in the fray who have patented under this sub-class. Focke & Co, Germany, Protechna SA, Germany, Valois SA, France, P&G, USA and a host of others. Some of the representative patents are listed below:

- *A sealing device [189785]*
- *A device for continuously incorporating precisely metered powdered material such as carbon black into an elastomer [190414]*
- *An assembly for holding a liquid [190767]*
- *A security closure for bottles and the like [191549]*
- *Random dumped packing element [191551]*

B65H - handling thin or filamentary materials have as many as 230 patents. Some of the patents in this sub-class are as follows:

- *A paper presentation apparatus for an automated teller machine [191413]*
- *A passbook transport apparatus [192546]*
- *A device for monitoring and controlling the tension of a yarn [192626]*
- *A process and an apparatus for producing a wound yarn package [193001]*
- *A method for joining textile yarns for restoring their continuity in a winding unit [193149]*
- *A yarn sensor [193157]*

B65 B which makes up apparatus / devices for packaging articles also represent a substantial cluster with 164 patents.

B65 G with 126 patents includes transport or storage devices, like conveyors for loading or tipping.

Thus, conveying, storing and related technologies, with 86% foreign domination occupy space which is of importance in business and industry on a regular basis.

C07 organic chemistry

Main division C has the most number of granted patents by the IPO during 2001-2014 period. Within the broad category, C07 - organic chemistry; C08 - organic molecular compounds; and C12 - biochemistry have over 1000 patents each. IPC Class C01 (organic chemistry) has 753 patents, C09 (dyes, paints, polishes etc) products/ processes used in industrial chemistry has 903 patents, C10 (petroleum, gas or coke, fuels, lubricants etc) has 704 patents, and C11 which deal with animal or vegetable oils, fats used in detergents etc has 612 patents in the database considered for the analysis.

Essentially main division C has several clusters of patents. On the whole Indian patents under this broad heading makes up 27.5% of the total. As to the foreign presence in this technology, countries such as France, Germany, Japan, the UK, the USA, and other EU countries dominate the scene. In all, 71 countries, other than India, have obtained one or more patents under this broad subject category.

The major clusters within class C07 are C07C which include patent on Acyclic or carbocyclic compounds. Production of organic compounds by electrolysis or electrophoresis.

Grouped under C07D are hetero-cyclic compounds. Modern society is dependent on synthetic heterocycles for use as drugs, pesticides, dyes, and plastics. A closer look at this class shows that in all about a thousand unique technologies have been patented on. Mostly the technologies have emanated from the USA (850) India (486), Japan, Germany, UK, France, all of them with over 100 patents each in the sub-class. The companies in the scene are F. Hoffmann-La Roche AG, Astrazenec, Janssen Pharmaceuticals, Novartis, Eli Lilly, Bayer Crop Science, BASF, Sumitomo Chemicals & Pharmaceuticals Ltd., and over 850 others. Indian patents on the subject are from entities such as CSIR, Dr. Reedy's Laboratories, Natco Pharma and others. In all, Indian footprint comes to 15.8% of the total, under this subject group.

C07	274	Organic chemistry
C07B	86	General methods of organic chemistry; apparatus there for
C07C	2223	Acyclic or carbocyclic compounds (macromolecular compounds C08; production of organic compounds by electrolysis or electrophoresis
C07D	3101	Heterocyclic compounds
C07F	255	Acyclic, carbocyclic, or heterocyclic compounds containing elements other than carbon, hydrogen, halogen, oxygen, nitrogen, sulfur, selenium or tellurium
C07H	217	Sugars; derivatives thereof; nucleosides; nucleotides; nucleic acids
C07J	80	Steroids
C07K	653	Peptides

Most of these patents identify a definite process. In general, these technologies seem to be our strong point. In sub-classes C07B, C07C, C07D and C07K CSIR is the top patent holder or in the second position. Hindustan lever Ltd., among other Indian entities has also obtained small number of patents on these subjects. However, these technologies are the most competed ones and a large number of pharma companies from across the country have

obtained patents. Some of the representative titles listed gives an understanding of the lab based research orientation of these patents.

- *A process for preparing 3,5-diarylpyrazoles derivative [193044]*
- *A process for the preparation of pure citalopram [193192]*
- *A process for preparing 3-(hydroxy-pentylidene)-5-nitro-3h-benzofuran-2-one [193200]*
- *Obtaining caprolactam by hydrolytic cleavage of molten polycaprolactam [193226]*
- *A composition useful for the detecting carbondioxide [193286]*
- *A process for preparing a chlorobenzoxazole [193376]*
- *A high pressure non-catalytic process for producing melamine [193391]*

Class C08 - organic macro molecular compounds, their preparation or chemical working up, composites based there on.

The sub-classes on subject on which the patents have been obtained are as follows:

C08B	98	Polysaccharides; derivatives thereof
C08F	669	Macromolecular compounds obtained by reactions only involving carbon-to-carbon unsaturated bonds
C08G	548	Macromolecular compounds obtained otherwise than by reactions only involving carbon-to-carbon unsaturated bonds
C08J	232	Working-up; general processes of compounding; after-treatment not covered by subclasses
C08K	290	Use of inorganic or non-macromolecular organic substances as compounding ingredients
C08L	453	Compositions of macromolecular compounds

All these are products of industrial chemistry. The country affiliation of the entities which have obtained these patents are the USA, Germany and the UK. Assignees that have major presence in this sector are Dow Global Technologies, BASF AG, Univation Technologies, Exxon Mobil, Akzo Nobel, Unilever, CIBA, Borealis Technologies, and others. Indian footprint in this class is to be seen in the patents obtained by CSIR.

Representative patents in this class are as follows:

- *A process for making a resin additive for a liquid paint [202033]*
- *Process for the preparation of finely divided rubbers [202628]*
- *A process for the production of finely divided, pulverulent rubber powder [203274]*
- *A scorch retardant crosslinking composition and a process for producing the same [204253]*
- *Thermoplastic moulding compositions [204546]*
- *A process for preparing a naphthopyran compound 3 [205520]*
- *A process of producing an unvulcanized rubber masterbatch and a composition suitable for making the same [205613]*

IPC Class C12 deals with subjects such as biochemistry, beer, spirits, microbiology, enzymology, mutations etc.

The patents in this IPC Class are represented by the following sub-classes:

C12M	53	Apparatus for enzymology or microbiology
C12 N	1118	Micro-organisms or enzymes; compositions thereof
C12P	220	Fermentation or enzyme-using processes to synthesise a desired chemical compound or composition or to separate optical isomers from a racemic mixture
C12Q	272	Measuring or testing processes involving enzymes or micro-organisms

In all, the IPC class C12 has 84% patents with foreign ownership. The companies in the lead are Novozymes, Monsanto Technologies, Crop Design NV, Syngenta, and the CSIR.

C12N which has the largest number of patents in this class deals with biocides, pest repellents, plant growth regulators, microorganisms, viruses, fermentates etc. These technologies are in use in agricultural operations.

Thirty-five different countries have obtained patents under this sub-class. Some patents obtained by Monsanto and Crop Design are listed below as representative technologies.

- *A composition for the treatment of unsown seed [212195]*
- *A process for making an iminodiacetic acid compound from a monoethanolamine substrate [212227]*
- *A process for preparing a downstream processable ammonium glyphosate paste and a dry granular herbicidal composition [212346]*
- *A method for treating a transgenic corn seed [214292]*
- *Methods for transforming plants to express bacillus thuringiensis delta-endotoxins [214436]*
- *A process for preparing ammonium glyphosate powder and a process for preparing a dry granular formulation comprising the same [215427]*
- *A process of manufacturing an amino carboxylic acid salt [215460]*

IPC F16 which deals with Effective functioning of machines or installations, their insulation has 1400 patents. This class has eight clusters with over 50 patents. These include the following:

F16	116	Engineering elements or units; general measures for producing and maintaining effective functioning of machines or installations; thermal insulation in general
F16b	80	Devices for fastening or securing constructional elements or machine parts together,
F16C	125	Shafts; flexible shafts; mechanical means for transmitting movement in a flexible sheathing; elements of crankshaft mechanisms; pivots; pivotal connections; rotary engineering elements other than gearing, coupling, clutch or brake elements; bearings
F16D	244	Couplings for transmitting rotation
F16F	62	Springs; shock-absorbers; means for damping vibration
F16H	358	Gearing
F16J	69	Pistons; cylinders; pressure vessels in general; sealings
F16K	190	Valves; taps; cocks; actuating-floats; devices for venting or aerating
F16L	176	Pipes; joints or fittings for pipes; supports for pipes, cables or protective tubing; means for thermal insulation in general

As could be seen all these patents fall under manufacturing processes. Within these, the technology 'gearing' (F16H) has got the maximum patents granted. The countries in the picture are Germany, Italy, Japan, Korea, UK, and the USA, apart from India. The industrial houses that have obtained patents include GM Global Technology Operations, Honda, Hyundai Motor Co., Eaton Corporation, Yamaha, Kubota Corporation, and others. The proportion of foreign vs Indian ownership works out to 90:10 in this sub-class.

F16D deals with technologies associated with transmitting, rotation, clutches, break etc. These are the technologies in automobile industry, apart from their application in shop floor of manufacturing units.

- *Vehicle driveline clutch employing ball ramp actuator [193710]*
- *Constant velocity joint [193836]*
- *Friction brake subassembly and a method of fabricating a friction brake subassembly [193893]*

- *Preparation of metal-ceramic friction composites [198715]*
- *Vehicle driveshaft assembly [194251]*
- *Quick fit clutch release carbon thrust ring assembly cut-open two piece type for tractors [198119]*

G main division has 11.45% of the total patents. Among the classes two clusters that stand out are:

G06 - computing, calculating, counting - has as many as 2405 patents. G01 - measuring testing - has 1668 Patents. Together these two broad technology groupings have 63.5% of the patents within the main division G.

G01 - measuring, testing has 1608 patents. The patents include measuring instruments, recording devices of analogue construction, signaling or control devices. Eight sub-groups under this broad title have a cluster of patents ranging from 51-659 as shown below.

G01B	69	Measuring length, thickness or similar linear dimensions; measuring angles; measuring areas; measuring irregularities of surfaces or contours
G01F	164	Measuring volume, volume flow, mass flow, or liquid level; metering by volume
G01L	74	Measuring force, stress, torque, work, mechanical power, mechanical efficiency,
G01M	51	Testing static or dynamic balance of machines or structures; testing of structures or apparatus, not otherwise provided for
G01N	659	Investigating or analysing materials by determining their chemical or physical properties
G01R	186	Measuring electric variables; measuring magnetic variables
G01S	159	Radio direction-finding; radio navigation; determining distance or velocity by use of radio waves; locating or presence-detecting by use of the reflection or re-radiation of radio waves; analogous arrangements using other waves
G01V	82	Geophysics; gravitational measurements; detecting masses or objects; tags

On the whole Indian footprint in these broad groups of technologies is 19.7%, and the foreign companies make up 81.3 % of the total. The companies that have major presence in this technology are Qualcomm Inc., Micromotion (US), General Electric, GM Global, Endress & Hauser Flowtec AG, among others. In all 872 entities have patent presence in this technology from 34 different countries.

G01N deals with measuring or testing processes other than immunoassay, involving enzymes or microorganisms. Further analysis indicates that 659 patents under this class fall in 251 narrower unique sub-categories within the technology. Most of these patents have foreign footprint and Indian patents in this category have come from assignees such as CSIR, Tata Steel, IITs, and others.

G01R - measuring electric variables; measuring magnetic variables also show a trend similar to the one stated above. The foreign companies in the picture in the context of this technology are GE, Qualcomm Inc. K Philips Electronics, GE Yokogawa, and others.

G01F - measuring volume, flow, liquid level etc., also show a similar trend as it manifests for the precision instruments technologies in general. Indian patents among the total of 164 in this class are 10% (16 patents) and 16 different entities have obtained patents some of which are assigned to inventors themselves. Foreign companies relevant in the context are Micro Motion Inc., Endress & Hauser Flow Tee, AG, Emerson Electrics, and others.

G01S with 159 patents include technologies such as radio navigation, radio direction finding, determining distance or velocity by use of radio waves etc. The countries in the picture of patents in this technology are the USA, Germany, Japan, UK. Fourteen countries, including India own patents in this sub-class. Some of the patents in the context are as follows:

- *A system for the correction of multipath errors in a telecommunication device location system [209788]*
- *A method and apparatus for measuring time related to satellite data messages [210564]*
- *Satellite positioning system augmentation with wireless communication signals [210625]*
- *A method and apparatus for calculating the position of a satellite and locating the same [211171]*
- *Method and apparatus for determining the location of a remote station in a CDMA communication network [211936]*
- *A method for improving sensitivity of a global positioning system (GPS) receiver [211995]*

G06 - computing, calculating counting. This class covers simulators which are concerned with mathematics of computing, simulators which demonstrated through computing the function of apparatus or of a system and image data processing or generation.

Most of the patents (80%) under this class fall under G06 - electric digital data processing. 30 different countries own patents and the USA has a dominant presence with 56.5% of the total. Patent clusters under this category are held by companies such as Qualcomm Inc, International Business Machines Corporation, Intel Corporation, K. Philips Electronics, Samsung Electronics, Oracle International Corporation, among others.

Even the two other classes G06K (recognition of data; presentation of data) (233), G06T (image data processing or generation, in general) (136) also show a dominant presence of foreign companies in patent ownership. Some of the titles are listed below to indicate the nature of technologies patented under this head.

- *Apparatus and method for identifying and scaling images. [213434]*
- *Method and system for determining a lattice of points suitable for a simulation [214301]*
- *Information recording/processing devices and machine/system controlling devices equipped with fingerprint sensors [214404]*
- *Method and apparatus to generate pixel data of an image [214969]*
- *Distortion-free image contrast enhancement apparatus [217854]*
- *A method and apparatus for watermark detection [220983]*
- *Video-information encoding method and video-information decoding method [218738]*

Computing is the most used technology in this information age. Patents are also under 421 distinct narrower subjects. Indian presence in this technology is seen in patents such as the following:

- *Pattern Based Comparison And Merging of Model Versions [Tata Consultancy Services Limited [235638]*
- *Method And System For Enabling Representation of Uml Class Diagram In A Lisp Format And Design Pattern [Indian Institute of Technology [250303]*
- *Remote Monitoring System For Computers In A Network [Vinciti Networks Private Limited [217074]*
- *System, Method of Generation And Use of Bilaterally Generated Variable Instant Passwords Syed Ibrahim Abdul Hameed Khan Abdul Rahman [243187]*
- *A Method, System And Apparatus To Seamlessly Manage And Access Files Across Multiple Devices [Allgo Embed Systems Private Limited [243102]*
- *A Microcontroller Based Firing Card Device For Power Control of Electrostatic Precipitator [Bharat Heavy Electricals Limited [237774]*

- *Web Enabled Data Concentrator For Real Time Units Communicable Over Rs485-Std Modbus Protocol [Larsen &Toubro Limited [237792]*

On the whole IPC main division G - Physics - has 6410 patents granted, 88% of which are of foreign origin.

IPC main division H refers to electricity. This division has the third most number of patents granted with 9,378 in the database. This subject has over 90% of the total patents of foreign origin. Two classes with over 1,000 patent cluster are H01 (basic electric elements) and H04 (electric communication technique). Sub-classes under these with patent clusters of over 50 numbers are discussed in later part of the chapter.

H01	2190	Basic electric elements ...
H04	5438	Electric communication technique ...

H01 deals with basic electric elements. Technologies considered under this broad class are -

- *Cables; conductors; insulators; selection of materials for their conductive, insulating or dielectric properties, Resistors; Magnets; inductances; transformers; selection of materials for their magnetic properties*
- *Capacitors; capacitors, rectifiers, detectors, switching devices, light-sensitive or temperature-sensitive devices of the electrolytic type*
- *Electric switches; relays; selectors; emergency protective devices*
- *Semiconductor devices; electric solid state devices not otherwise provided for*

H01B	126	Cables; conductors; insulators; selection of materials for their conductive, insulating or dielectric properties
H01C	28	Resistors
...		

On the whole H01B has 79 different technologies (sub-groups) patented on during 2001-14 period

Patents in H04 fall under seven sub-classes and each are having more than 50 patents.

H04B	1069	Transmission
H04J	205	Multiplex communication
H04L	1686	Transmission of digital information
H04M	331	Telephonic communication
H04N	828	Pictorial communication
H04Q	1105	Selecting
H04R	68	Loudspeakers, microphones, gramophone pick-ups or like acoustic electro mechanical transducers; deaf-aid sets; public address systems

Most of the patents under electric communication are relating to technologies of relatively recent origin and the foreign companies' footprint is large and definite. Top list of companies that loom large in the context are Qualcomm Inc., Samsung, Motorola, and Telefon AG LM Ericsson. Countries in the list are dominated by the USA, followed by China, Finland, France, Germany, India (279), Japan, Korea, Sweden, UK, and EU patents all of which possess more than 100 patents each in this category from IPO. Technologies such as transmission of digital information, selection (switches, relays, selectors, essential for network and wireless communication) form part of this class.

H04L the largest of the clusters of patents has as many as 239 sub-groups under which 1,686 patents are categorized.

The patents under this class are invariably relevant, cutting edge and essential for running the communication infrastructure of today. Other major patented technologies under this category are electric machines (H02K) circuit arrangements (H02H) apparatus for conversion between AC and DC or between DC and DC (H02M) control or regulation of electric motors (H02P), coding - Decoding, code conversion (H03M). A selection of these sub-classes are taken up as cases for analysis and presented in a later chapter.

It was also noticed that there are 13 IPC main classes which have assigned patents in the range of 500-1000. These classes fall under all the main divisions with four each from main division B and C and one each in A, D, F, G and H.

A23	933	Foods, foodstuff, their treatment
B23	508	Machine tools
B29	597	Working on plastics
B60	857	Vehicles in general
B62	551	Land vehicles for travelling
C01	753	Inorganic chemistry
C09	903	Dyes, paints, polishes ...
C10	704	Petroleum, gas, or coke industries
C11	612	Animal or vegetable oils, fats, fatty substances
D01	712	Natural or man-made threats ...
F02	793	Combustion engines
G11	701	Information storage
H02	823	Generation of electric power

A 23 - food, and their treatment - has over 900 patents assigned to the category. A23L - food, non-alcoholic beverages - has nearly 500 patents granted. The companies in the picture include Nestle, Hindustan Unilever, Cadbury, Pepsico, CSIR and several others.

A23G (cocoa products; confectionery; chewing gum; ice-cream; preparation thereof) also has close to 100 patents assigned to the related innovations.

A23C	54	Dairy products,
A23F	74	Coffee; tea; their substitutes; manufacture, preparation, or infusion thereof
A23G	99	Cocoa; cocoa products; confectionery; chewing gum; ice-cream; preparation thereof
A23K	67	Feeding-stuffs specially adapted for animals; methods specially adapted for production thereof
A23L	483	Food, non-alcoholic beverages

Patents on food products are obtained by assignees totaling 379 in all. Assignees on the top of the list include Council Of Scientific & Industrial Research (141), Hindustan Unilever Limited (102), Societe Des Produits Nestle S A (44), Nestec S.A (26), Hindustan Lever Limited (25), DSM IP Assets B V (23). There are as many as 32 countries that figure in the list. The following are examples of IPO patents under these sub-classes:

- *Chewing gum in powder form and a method of preparation [224980]*
- *Method for stabilizing liquid nutritional products and products so stabilized [224847]*

- *Coffee aroma recovery process and aroma product* [224629]
- *A nutritional supplement which contain slightly negatively charged non-digestible polysaccharides* [224607]
- *A process of reduction of odour in oils or fats* [225280]
- *Composition comprising bioenhancers for inhibition of browning of whole wheat* [224338]
- *Frozen dessert* [224174]
- *Particulate composition comprising phytosterols for use as creamer and/or whitener* [224169]

The trend indicates that either we are not innovative in new edible products and related technologies or very conservative in patenting them.

Main division B under four classes - B23, B29, B60, B62 together have 2,513 patents. They fall in the technology categories namely, machine tools, working on plastics, vehicles in general, and land vehicles for travelling. A careful division of the number of patents under these four classes show the following:

B 23 Machine tools

B23C	52	Milling
B23K	195	Soldering
B23Q	57	Details, components, or accessories for machine tools,
B29B	60	Preparation or pretreatment of the material to be shaped; making granules or preforms; recovery of plastics or other constituents of waste material containing plastics
B29C	438	Shaping or joining of plastics; shaping of substances in a plastic state, in general; after-treatment of the shaped products,
B29D	95	Producing particular articles from plastics or from substances in a plastic state
B60C	79	Vehicle tyres; tyre inflation; tyre changing; connecting valves to inflatable elastic bodies in general; devices or arrangements related to
B60G	53	Vehicle suspension arrangements
B60K	189	Arrangement or mounting of propulsion units or of transmissions in vehicles; arrangement or mounting of plural diverse prime-movers in vehicles
B60R	153	Vehicles, vehicle fittings, or vehicle parts, not otherwise provided for
B60T	84	Vehicle brake control systems or parts thereof; brake control systems or parts thereof, in general
B62D	152	Motor vehicles; trailers
B62J	165	Cycle saddles or seats; accessories peculiar to cycles and not otherwise provided for
B62K	117	Cycles; cycle frames; cycle steering devices; rider-operated terminal controls specially adapted for cycles
B62M	68	Rider propulsion of wheeled vehicles or sledges; powered propulsion of sledges or cycles; ...

We can notice that there is considerable interest shown in technologies such as soldering (B23K), shaping plastics (B29C), arrangement of propulsion units (B60K), vehicle fittings (B60R), (B62D), accessories for cycles (B62J), and other devices associated with 2 wheeler vehicles (B62K). All these subclasses have over 100 patents each assigned during the last decade.

A look at these technologies falling under mechanical engineering show that companies such as Honda Motor Co. (299), Lincoln Global (27), GM Global Operations (22), Toyota, Yamaha and others have obtained patents and there is not much of Indian presence in this space. The Indian companies that figure are Tata Motors (27), BHEL (22), and six hundred others with just a handful of patents each. In all only 19.8% of the patents are owned by Indian entities. Excepting for Honda the ownership of these technologies is sparsely spread among several stakeholders. A detailed analysis of class B62 is presented in later part of the report.

Four main classes under Division C forming part of Basic Materials Chemistry make up nearly 3,000 patents. These deal with inorganic chemistry (C01), dyes, paints, polishes (C09), Petroleum, gas, or coke industry (C10) and animal or vegetable oils (C11).

The listing below present the description of patents in the sub-classes of C01, C09, C10, and C11. Subjects such as non-metallic elements (C01B), cracking hydraulic oils(C10G), detergent (C11D) have over 300 patents each. The sub-classes under C09 viz, B, D, K all have near to or more than 200 patents in the respective categories. In all, the four sub-classes under examination have 160 Indian patentees and have obtained 459 patents. CSIR has 188 patents in this category, followed by Tata Steel, Steel Authority of India Ltd., Indian Institutes of Technology together, and Bharat Heavy Electricals Ltd., in smaller numbers. On the whole the technology ownership in the category is led by the USA with 732 patents, followed by France, Germany, Japan, the UK all of which have over a hundred patents each.

C01B	445	Non-metallic elements
C01F	109	Compounds of metal
C01G	126	Compounds containing metals not covered elsewhere
C09B	228	Organic dyes
C09C	99	Treatment of inorganic materials, other than fibrous fillers, to enhance their pigmenting or filling properties
C09D	288	Coating compositions, e.g. Paints, varnishes or lacquers; <u>filling pastes</u> ; chemical paint or ink removers; inks; correcting <u>fluids</u> ; wood stains; pastes or solids for colouring or printing;
C09J	78	Adhesives; non-mechanical <u>aspects</u> of adhesive processes in general; adhesive processes not provided for elsewhere;
C09K	191	<u>Materials</u> for applications not otherwise provided for; applications of <u>materials</u> not otherwise provided for
C10	52	Petroleum, gas or coke industries; technical gases containing carbon Monoxide; fuels; lubricants; peat
C10B	55	Destructive distillation of carbonaceous materials for production of gas, coke, tar, or similar materials
C10G	333	Cracking hydrocarbon oils; production of liquid hydrocarbon mixtures, e.g. By destructive hydrogenation, oligomerisation, polymerisation
C10L	145	Fuels not otherwise provided for; natural gas; synthetic natural gas obtained by processes not covered by subclasses
C10M	119	Lubricating compositions
C11B	59	Producing, e.g. By pressing raw materials or by extraction from waste materials, refining or preserving fats, fatty substances,
C11D	531	Detergent compositions; use of single substances as detergents; soap or soap-making; resin soaps; recovery of glycerol

Four other main classes D01, F02, G11, H02 have over 700 patent awards each. A closer look into them reveals the following:

Under D01 which deals with textile shas patents on spinning threads, mechanical apparatus, chemical features in the manufacture of manmade filaments preliminary treatment of fibers and spinning & threads. D01H - spinning and threading has over 300 patents.

D01D	90	Mechanical methods or apparatus
D01F	100	Chemical feature in the manufacture of man-made filaments
D01G	154	Preliminary treatment of fibers
D01H	344	Spinning or twisting

F02 has four sub-classes with over 50 patents relating to combustion engines. The patents assigned deal with gas turbine plants, controlling combustion engines and over 250 patents on ways of supplying material for combustion engines in general.

F02B	140	Internal-combustion piston engines; combustion engines in general
F02C	59	Gas turbine plants
F02D	193	Controlling combustion engines
F02M	255	Supplying combustion engines in general ...

Under the main class G11 most of the patents are under the subclass G11B, 650 in all. Information storage based on relative movement between record carrier and transducers. This subject falls under information technology.

G11B	650	Information storage based on relative movement between record carrier and transducers

Lastly H02 - electric power- has eight sub-classes with over 50 patents. H02H (emergency protective circuit arrangements) and H02K (dynamo-electric machines) have nearly 400 patents together. Indian presence among these sub-classes amount to 14.6% of the total, and could be seen mainly in the companies such as BHEL, with 16 patents and is second in this category to General Electricals Co, which own 22 patents. Thirty-three other Indian assignees in the list own one or two patents each. The US based entities own 25.3% of these patents, followed by Japanese assignees (20.4%).

H02B	77	Boards, substations, or switching arrangements for the supply or distribution of electric power
H02G	67	Installation of electric cables or lines, or of combined optical and electric cables or lines
H02H	108	Emergency protective circuit arrangements
H02J	91	Circuit arrangements or systems for supplying or distributing electric power; systems for storing electric energy
H02K	283	Dynamo-electric machines
H02M	95	Apparatus for conversion between ac and ac, between ac and dc, or between DC and DC
H02P	92	Control or regulation of electric motors, electric generators or dynamo-electric converters; controlling transformers, reactors or choke coils

The distribution of patents also shows that there are nearly 30 sub-classes with assigned innovations ranging from 100-500 in the database used for the analysis. These subclasses with clusters of patents fall under all the divisions, excepting D. Six in all in division B, 10 in C, five subclasses in F, three in H and, two in G. patents in this range under A and E divisions fall in one sub-class each.

A47J	114	Kitchen equipment; coffee machine
B05B	147	Spraying apparatus
B05D	102	Process for applying liquids
B21B	161	Rolling of metals
B22D	239	Casting of metals
B41J	263	Selective printing mechanisms

B66B	117	Elevator, escalators ...
C02F	336	Treatment of water, sewage / sludge
C03B	181	Manufacture/ shaping of glass
C03C	173	Chemical composition of gas
C04B	385	Mortars/ concrete or like building materials
C21B	141	Manufacture of iron or steel
C21C	82	Processing of pig iron
C21D	142	Modifying the physical structure or ferrous metals
C22B	161	Production / refining of metals
C22C	301	Alloys
C23C	270	Coating of metallic materials
E21B	211	Earth or rock drilling
F01N	138	Gas flow silencers or exhaust apparatus
F03D	179	Wind motors
F25B	115	Refrigerators machines, plants or system
F25D	117	Refrigerators, cold rooms, ice boxes, cooling
G05B	117	Control or regulating systems in general
G02B	275	Optical elements, systems or apparatus
G10L	183	Speech analysis or synthesis, speech recognition
H03M	181	Coding, decoding or code conversion
H05B	133	Electric heating, electric lighting not otherwise provided for
H05K	123	Printing circuits

Apart from these clusters of patented technologies there are 13 others with patents over 50, but less than 100 (highest is 76) is sub-classes that fall under all main divisions except C.

Other IPC sub-classes of interest in the context are listed below. All these sub-classes have 50 (but less than 100) or more assigned patents under the heading.

A46B	57	Brushes
B24B	76	Machine/ devices/ processes for grinding or polishing
B41M	68	Printing / duplicating
B42D	58	Book, book covers
D02G	69	Crimping or curling fibers
D03D	60	Woven fabrics, methods of weaving
D04B	50	Knitting
D06F	73	Laundrying, drying, ironing
D21F	72	Paper making machines
E04B	77	General building constructions
E05B	85	Locks, accessories, handcuffs
F28F	76	Details of heat exchange or heat transfer apparatus
G09F	56	Displaying advertisement signs
H04R	68	Loud speaker microphones

Patents under B42D and D02G include the following:

- *A greeting card* [210948]
- *Security element for documents, bank notes, security paper and the like* [210950]
- *A tamper-evident form* [213864]

- *An improved expandable book cover [254992]*
- *Security element having a viewing-angle dependent aspect [257090]*
- *A method and an apparatus for stuffer box crimping a multifilament yarn [212854]*
- *A device for the air treatment of yarn in a yarn channel. [213416]*
- *A method for producing a heat-resistant crimped yarn [214628]*
- *Heat-resistant crimped yarn [219947]*

Brushes - A46 B - for instance is represented by 17 distinct assignees. Colgate (USA) has most of the patents, with GlaxoSmithKline Consumer Healthcare GMBH & Co KG (UK) and Hindustan Lever Limited chipping in four each. Excepting for five patents owned by Indian entities, the rest have foreign affiliation. The following are a few titles of patents from this sub-class:

- *Abrush for washing an object, particularly for washing automobiles [238475]*
- *Cleaning brush, particularly tooth brush [201446]*
- *Tool for cleaning surfaces [261444]*
- *Method and apparatus for the manufacture of brushes and brushes manufactured by the same. [207372]*

On the whole patents assigned in India are far fewer compared with those granted in the better known patent offices elsewhere. This could possibly be due to the patent regime we followed till 2005, and also the definition of innovation adopted by our Patent Act 2005. There is a spurt in the assigned patents that we could see after 2005 - when India came under TRIPS compliant regulations. At the individual technology levels, as indicated by IPC classes and sub-classes, foreign patent holdings in IPO is way ahead of the local entities collectively. The US based entities have definite edge in a majority of the technology focus.

Comparative Technology Strength

The study also attempted comparison of a much broadly defined technology classification of patents obtained in India. For the purpose the revised schema suggested by ISI-OST-INPI for country comparison was adopted (Schmoch, 2008). This method classifies the technologies under five broad headings. Each of these five headings, representing a broader subject / technology, is a conglomeration of a set of IPC sub-class numbers. Data extracted by adopting this schema gives an understanding of the relative strength encompassing a group of associated subjects.

Table 4.3 presents are the broad subjects and the associated IPC class numbers representing them. Total number of patents, Indian representation in the total has also been presented in the Table.

The analysis suggests that the strength of the patents assigned by Indian patent office lies in technologies relating to Chemistry, which makes up almost 50% of the total. This is followed by electrical engineering, and mechanical engineering, with about 11,000 patents each make up approximately 40% of the total. Instrumentation technologies and others make up the rest of the patents granted by IPO in the post-2000 period.

Within chemistry, organic fine chemistry, pharmaceuticals, basic materials chemistry, materials chemistry, macromolecular chemistry, biochemistry, chemical engineering and surface coating technologies have over 1000 patents each. Indian share on the whole on these technologies is 19% of the total. Indian patent share, in almost all the sub-components under the head chemistry is more than the overall proportion of Indian patents to total

granted by IPO. Among these, patents relating to pharmaceuticals make up 24% of the total, and are the highest in any technology category. We own high proportion of the total patents in food chemistry (32% of the total), materials metallurgy (25.1%), and environmental technology (26%).

Under the heading electrical engineering, it is telecommunication which has been assigned the maximum number of patents followed by electrical machinery, computer technology, digital communication, and AV technology, India's share in all these categories is relatively small. Most of the patents in this category are obtained by the USA, South Korea and other countries.

Mechanical engineering related patents make up 20% of the total. Overall share of foreign assignees is 82% in this category. Included in this category are transport, machine tools, special machines, textile and paper making machines.

Instruments, as a technology category, stand fourth in the ranking. On the whole, foreign companies own 84.5% of the total patents. Though the numbers are small, our share in 'measurement' related technologies is almost 20% of the total.

Lastly, other technologies include consumer goods, furniture, and civil engineering. The total number of patents granted under this category is limited, and Indian share in this is 15.8% of the total.

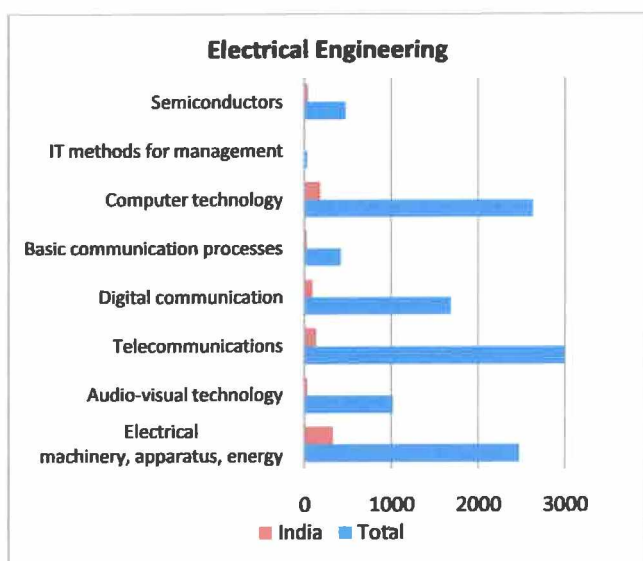
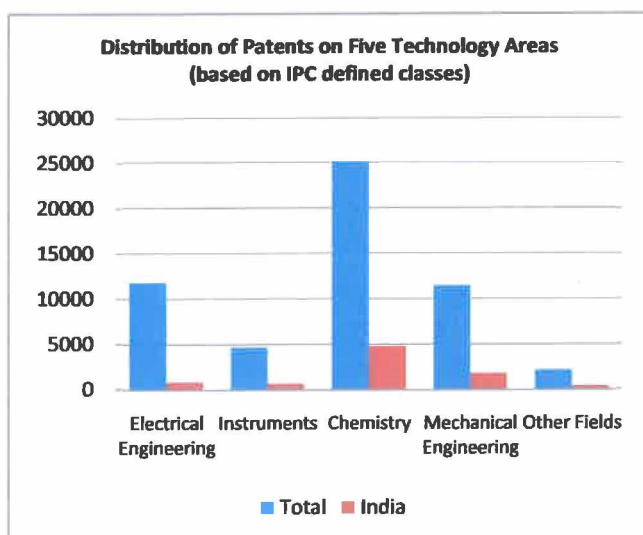
As is reflected in the total patents assigned, our innovation strength seems to be mainly in chemistry and to an extent in mechanical engineering.

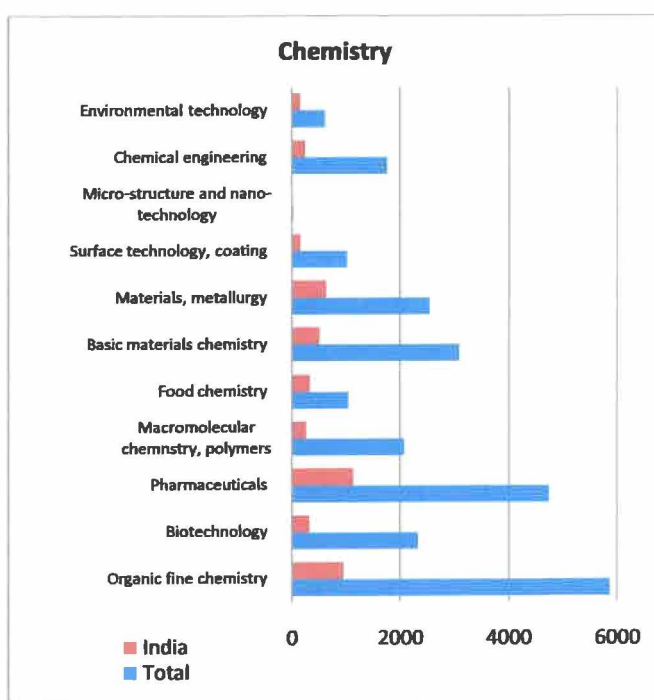
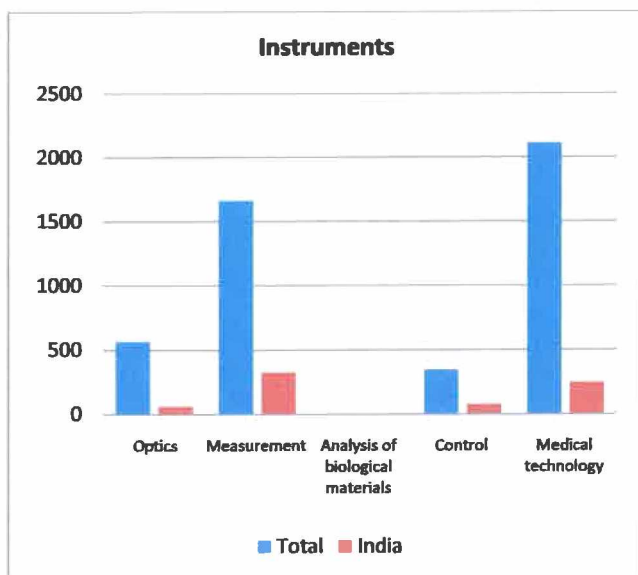
Table 4.3 ISI-OST-INPI for country comparison IPC-based technology classification				
		Relevant IPC Codes	Total	Indian Share (%)
Electrical Engineering			11786	907(7.7)
Electrical machinery, apparatus, energy	The field primarily covers the non-electronic part of electrical engineering.	F21#, H01B, H01C, H01F, H01G, H01H, H01J, H01K, H01M, H01R, H01T, H02#, H05B, H05C, H05F, H99Z	2481	334 (13.5)
Audio-visual technology	Audio-visual technology is largely equivalent to consumer electronics.	G09F, G09G, G11B, H04N-003, H04N-005, H04N-009, H04N-013, H04N-015, H04N-017, H04R, H04S, H05K	1025	43 (4.2)
Telecommunications	This is a very broad field covering a variety of techniques and products.	G08C, H01P, H01Q, H04B, H04H, H04J, H04K, H04M, H04N-001, H04N-007, H04N-011, H04Q	3004	144 (4.8)
Digital communication	This technology border between telecommunications and computer technology. A core application of this technology is the internet.	H04L	1686	104 (6.2)
Basic communication processes	It covers very basic technologies such oscillation, modulation, resonant circuits, impulse technique, coding/decoding. These techniques	H03#	430	35 (8.1)

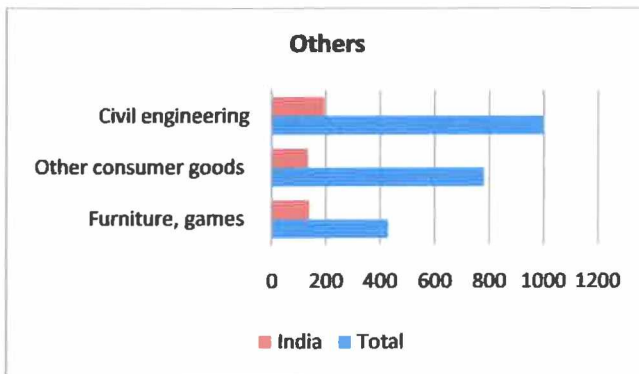
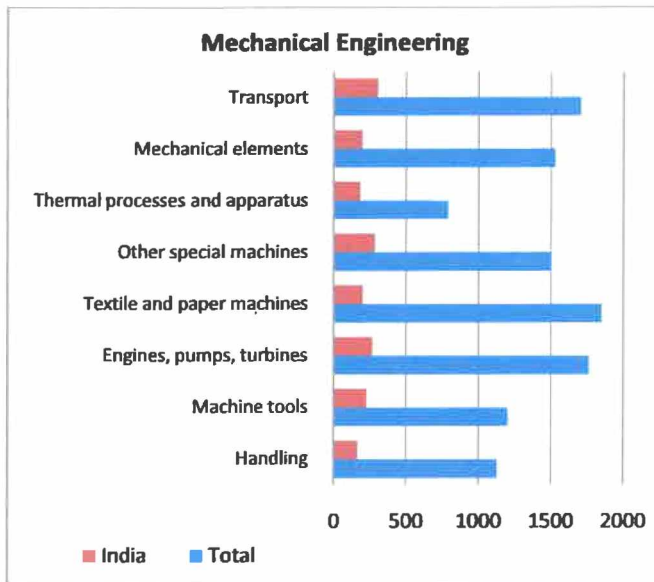
	are used in telecommunications, computer technology, measurement, control.			
Computer technology	The core area of C06F (Electrical digital processing) is defined in a very technical way (Arrangement for programme control, methods and arrangements for data conversion	(G06# not G06Q), G11C, G10L	2637	193 (7.3)
IT methods for management	Data processing methods, specially adapted for administrative, commercial, financial, managerial, supervisory or forecasting purposes". This field represents software for these special purposes.	G06Q	42	3 (7.1)
Semiconductors	The field comprises semiconductors including methods for their production. Integrated circuits or photovoltaic elements belong to this field. The field includes microstructural technology (B81), as the number of applications in this sub-field is too small for a separate field.	H01L	481	51 (10.6)
Instruments			4688	725 (15.5)
Optics	Optics covers all parts of traditional optical elements and apparatus, but also laser beam sources.	G02#, G03B, G03C, G03D, G03F, G03G, G03H, H01S	569	66 (11.6)
Measurement	This grouping includes a broad variety of different techniques and applications.	G01B, G01C, G01D, G01F, G01G, G01H, G01J, G01K, G01L, G01M, (G01N not G01N-033), G01P, G01R, G01S; G01V, G01W, G04#, G12B, G99Z	1662	328 (19.7)
Analysis of biological materials	Primarily refers to the analysis of blood for medical purposes. In many cases, biotechnological methods are addressed.	G01N-033	0	0 (0.0)
Control	The field covers elements for controlling and regulating electrical and nonelectrical systems and referring test arrangements, traffic control or signaling systems etc.	G05B, G05D, G05F, G07#, G08B, G08G, G09B, G09C, G09D	346	80 (23.1)
Medical technology	Medical technology is generally associated with high technology. However, a large part of the class A61 refers to less sophisticated products and technologies such as operating tables, massage devices, bandages etc.	A61B, A61C, A61D, A61F, A61G, A61H, A61J, A61L, A61M, A61N, H05G	2111	251 (11.9)
Chemistry			25138	4788(19.0)
Organic fine chemistry	Applications in organic chemistry primarily refer to pharmaceuticals.	(C07B, C07C, C07D, C07F, C07H, C07J, C40B) not A61K, A61K-008, A61Q	5872	959 (16.3)
Biotechnology	Biotechnology a crosscutting or generic technology.	(C07G, C07K, C12M, C12N, C12P, C12Q, C12R, C12S) not A61K	2327	329 (14.1)
Pharmaceuticals	Refers to an area of application, not a technology. Cosmetics are	A61K not A61K-008	4741	1137 (24.0)

	explicitly excluded from the field; these represent about 10 percent of all applications classified in A61K.			
Macromolecular chemistry, polymers	This field contains the chemical aspects of polymers.	C08B, C08C, C08F, C08G, C08H, C08K, C08L	2081	269 (12.9)
Food chemistry		A01H, A21D, A23B, A23C, A23D, A23F, A23G, A23J, A23K, A23L, C12C, C12F, C12G, C12H, C12J, C13D, C13F, C13J, C13K	1051	336 (32.0)
Basic materials chemistry	Primarily covers typical mass chemicals such as herbicides, fertilizers, paints, petroleum, gas, detergents etc.	A01N, A01P, C05#, C06#, C09B, C09C, C09F, C09G, C09H, C09K, C09D, C09J, C10B, C10C, C10F, C10G, C10H, C10J, C10K, C10L, C10M, C10N, C11B, C11C, C11D, C99Z	3087	523 (16.9)
Materials, metallurgy	Includes all types of metals, ceramics, glass or processes for the manufacture of steel.	C01#, C03C, C04#, C21#, C22#, B22#	2546	638 (25.1)
Surface technology, coating	The coating of metals, generally with advanced methods represents the core of this field. It covers electrolytic processes, crystal growth and apparatus for applying liquids to surfaces.	B05C, B05D, B32#, C23#, C25#, C30#	1024	170 (16.6)
Micro-structure and nano-technology	Covers micro-structural devices or systems, including at least one essential element or formation characterized by its very small size. It includes nano-structures having specialized features directly related to their size.	B81#, B82#	32	11 (34.4)
Chemical engineering	Consists of technologies at the borderline of chemistry and engineering. It refers to apparatus and processes for the industrial production of chemicals.	B01B, B01D-000#, B01D-01##, B01D-02##, B01D-03##, B01D-041, B01D-043, B01D-057, B01D-059, B01D-06##, B01D-07##, B01F, B01J, B01L, B02C, B03#, B04#, B05B, B06B, B07#, B08#, D06B, D06C, D06L, F25J, F26#, C14C, H05H	1761	256 (14.5)
Environmental technology	Encompasses a variety of different technologies and applications, in particular filters, waste disposal, water cleaning, gas-flow silencers and exhaust apparatus, waste combustion or noise absorption walls.	A62D, B01D-045, B01D-046, B01D-047, B01D-049, B01D-050, B01D-051, B01D-052, B01D-053, B09#, B65F, C02#, F01N, F23G, F23J, G01T, E01F-008, A62C	616	160 (26.0)
Mechanical Engineering			11468	1844 (16.1)
Handling	Comprises elevators, cranes or robots, but also packaging devices.	B25J, B65B, B65C, B65D, B65G, B65H, B66#, B67#	1128	167 (14.8)
Machine tools	Refers to turning, boring, grinding, soldering or cutting with a focus on metals.	B21#, B23#, B24#, B26D, B26F, B27#, B30#, B25B, B25C, B25D, B25F, B25G, B25H, B26B	1202	230 (19.1)

Engines, pumps, turbines	This field covers non-electrical engines for all types of applications. Mostly dominated by automobiles.	F01B, F01C, F01D, F01K, F01L, F01M, F01P, F02#, F03#, F04#, F23R, G21#, F99Z	1763	270 (15.3)
Textile and paper machines	Includes machines for specific production purposes. Textile and food machines represent the most relevant part of these machines.	A41H, A43D, A46D, C14B, D01#, D02#, D03#, D04B, D04C, D04G, D04H, D05#, D06G, D06H, D06J, D06M, D06P, D06Q, D99Z, B31#, D21#, B41#	1852	203 (11.0)
Other special machines	Refers to turning, boring, grinding, soldering or cutting with a focus on metals.	A01B, A01C, A01D, A01F, A01G, A01J, A01K, A01L, A01M, A21B, A21C, A22#, A23N, A23P, B02B, C12L, C13C, C13G, C13H, B28#, B29#, C03B, C08J, B99Z, F41#, F42#	1497	285 (19.0)
Thermal processes and apparatus	Applications such as steam generation, combustion, heating, refrigeration, cooling or heat exchange.	F22#, F23B, F23C, F23D, F23H, F23K, F23L, F23M, F23N, F23Q, F24#, F25B, F25C, F27#, F28#	791	184 (23.3)
Mechanical elements	Fluid-circuit elements, joints, shafts, couplings, valves, pipe-line systems or mechanical control devices. The focus is on engineering elements of machines such as joints or couplings.	F15#, F16#, F17#, G05G	1530	200 (13.1)
Transport	All types of transport technology and applications with dominance of automotive technology.	B60#, B61#, B62#, B63B, B63C, B63G, B63H, B63J, B64#	1705	305 (17.9)
Other Fields			55286	8732 (15.8)
Furniture, games	Consumer goods are a mix of many different technologies, all of them with low quantitative weight.	A47#, A63#	429	139 (32.4)
Other consumer goods	Primarily represents less research-intensive sub-fields.	A24#, A41B, A41C, A41D, A41F, A41G, A42#, A43B, A43C, A44#, A45#, A46B, A62B, B42#, B43#, D04D, D07#, G10B, G10C, G10D, G10F, G10G, G10H, G10K, B44#, B68#, D06F, D06N, F25D, A99Z	780	134 (17.2)
Civil engineering	Covers construction of roads and buildings as well as elements of buildings such as locks, plumbing installations or strong rooms for valuables.	E02#, E01B, E01C, E01D, E01F-001, E01F-003, E01F-005, E01F-007, E01F-009, E01F-01#, E01H, E03#, E04#, E05#, E06#, E21#, E99Z	997	195 (19.6)
			55286	8732 (15.8)







India owned patents are present in all the major technology categories, though to a limited extent. The ownership ranges from 4.2% of the total (AV technology) to 34.4% of the total (microstructure and nanotechnology) in broad technology groupings. On the whole domestic ownership is 15.8% of the patents granted across technology groupings in the post-2000 period.

Patents on sub-fields in Chemistry like Food Chemistry, Pharmaceuticals, organic fine chemistry are the areas where we tend to be competing.

We have not taken home advantage within India on technology ownership.

The following broad points emerge from the analysis:

- On the whole, patents granted by IPO cover all the IPC divisions, and most of the IPC classes and sub-classes.
- There is a high degree of clustering at the IPC class and sub-class levels resulting in highly skewed distribution of patents.

- Even when we consider at individual sub-class levels with 50 or more patents in them, relative Indian strength comes out only in 15.8% of the total. The US scores a high with a substantial patent strength in 60% of these categories. Japan and Germany have relative advantage in select technologies.
- Most of India's patents are in the areas / technologies in which other leading innovative countries are competing.
- Foreign entities, considering the limited numbers, seem to be selective in their applications, and also file patents on technologies where there is a possibility of fair market demand.
- Only a few foreign entities innovate with Indian consumer in mind.
- There is a lot of scope for Indian innovativeness and there is also a need for carving out niche areas where local innovativeness can dominate.

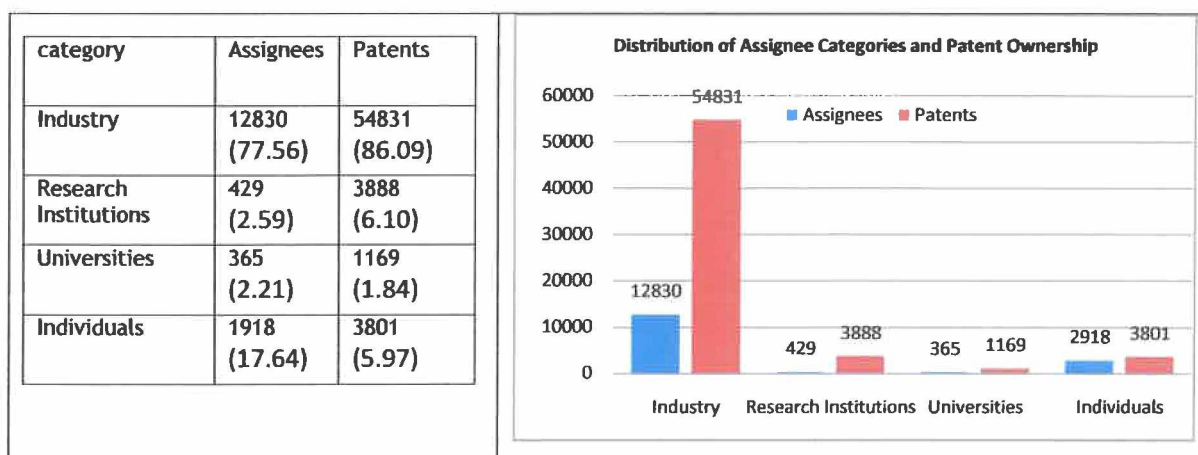
Schmoch, Ulrich (2008) *Concept of a Technology Classification for Country Comparisons1 Final Report to the World Intellectual Property Organisation (WIPO)*. Fraunhofer Institute for Systems and Innovation Research, Karlsruhe, Germany
http://www.wipo.int/export/sites/www/ipstats/en/statistics/patents/pdf/wipo_ipc_technology.pdf

5 Assignees-wise Analysis

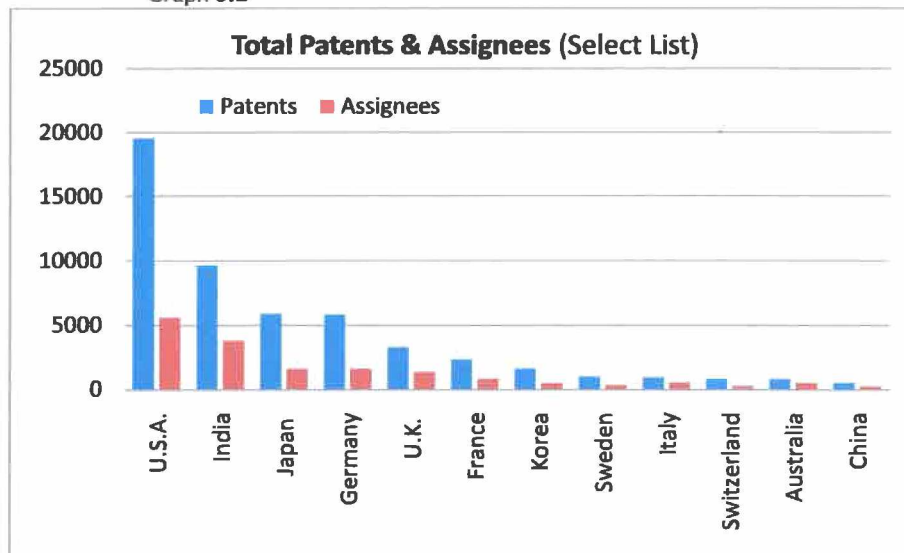
It has been noted in the previous chapter that there is a skewed distribution of patents on subjects in IPO. A few technologies have garnered most of the innovative products / process space. Foreign holders dominate the patent scene in the country on majority of the technologies. The present chapter analyses the patent holdings by assignees, including identifying the major foreign patent owning entities, extent of ownership, holding size, subjects, and the pattern of distribution.

As many as 16,542 distinct entities have obtained patents in IPO representing 101 countries during the 2001-14 period. USA dominates the scene with 32.4% of these assignees, India stands in the second place. Other countries with substantial number of assignees are Australia, China, France, Germany, Italy, Japan, Korea, and Switzerland. Among the total assignees during the period 12,830 were from industry, 365 universities and 429 research institutions. There are 2,918 individuals (inventor assigned patents) who have been assigned the patents. Most of the assignees fall under the category industry and they also own 86.1% of the patents, followed by Research Institutions and individual assignees. (Table 5.1)

Table & Graph 5.1 Assignee-wise Patent Distribution

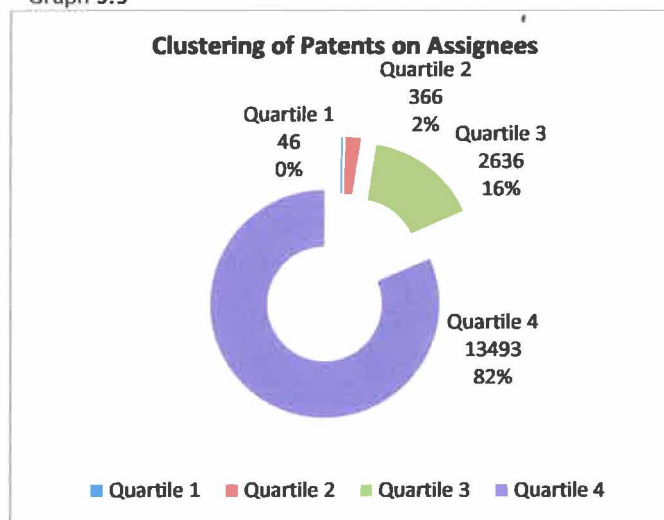


Graph 5.2



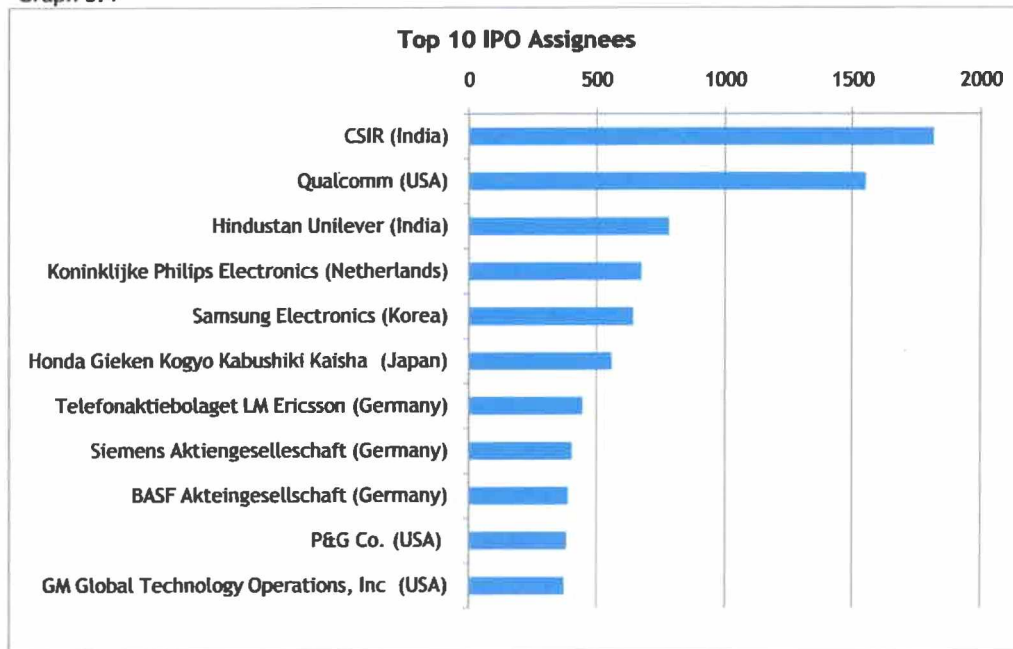
To understand assignee-wise distribution patents were grouped under assignees in descending order and the list was divided on quartiles. The results indicate that there is a highly skewed distribution of patents among the assignees. The top 25% (quartile 1) of the patents are owned by 146 assignees making up 0.28% of the total; the quartile 2 by 2.21%; the quartile 3 by 15.94%; and the last quartile has as many as 13,493 making up 81.57% of the assignees who own one or more patents in IPO during 2001-2014.

Graph 5.3



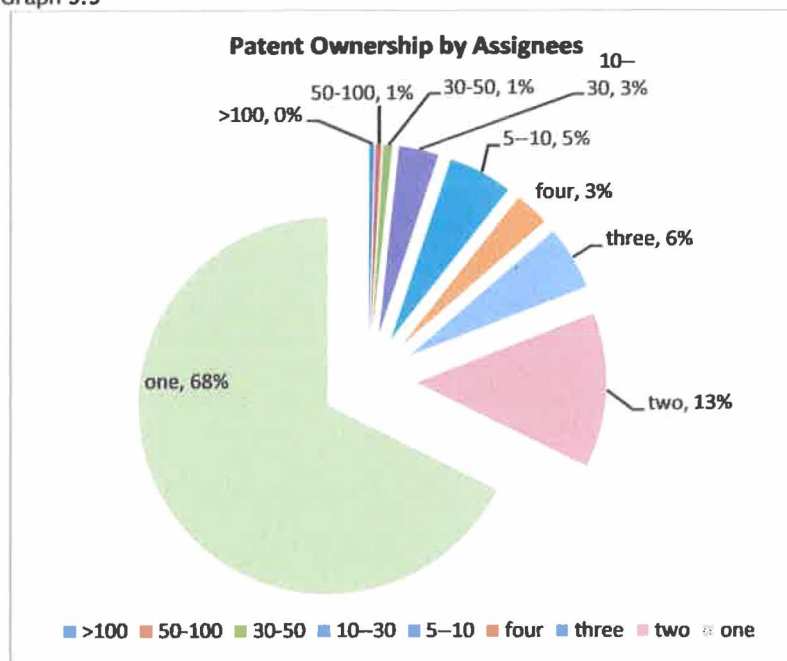
Top 10 assignees include three from the USA, three from Germany, one each from South Korea and the Netherlands, and two of Indian origin. Cumulatively assignees from top 10 countries make up 89.8% of the total patents during the period.

Graph 5.4

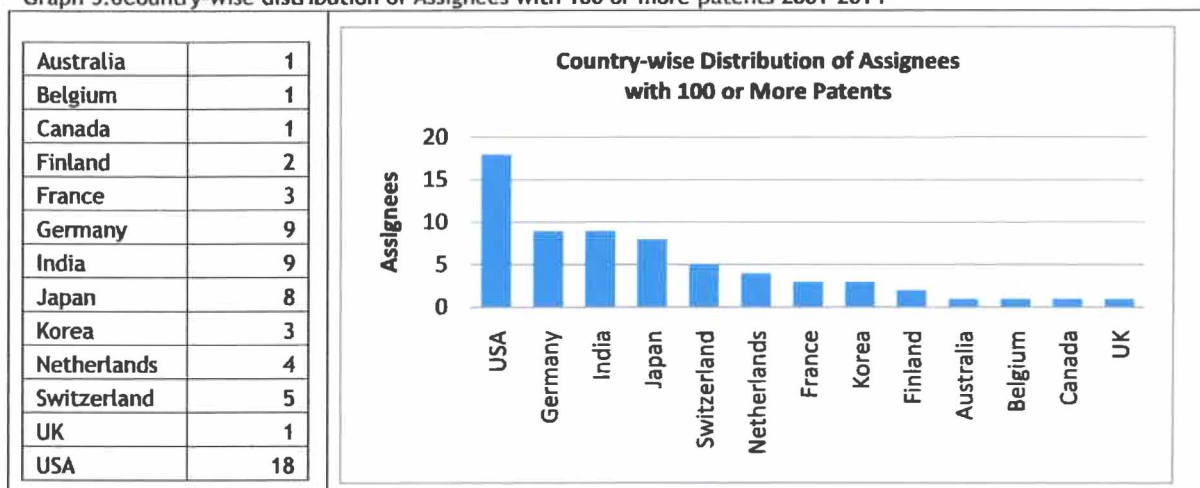


Only a fraction of the total entities that have been granted patents have more than 100 each against their name. The distribution of these patents across assignees indicates that 68% of the total own only one patent in IPO during the years covered in the analysis. Thirteen percent own two patents, 6% three patents. The patent ownership is spread across a large base. Only a relatively small number own 50 or more patents in IPO.

Graph 5.5



Graph 5.6 Country-wise distribution of Assignees with 100 or more patents 2001-2014



Search in the database of patents granted in the post-2001 period shows that 65 entities, inclusive of business entities, academic organizations, own over 100 patents each. These companies have origin in the US (18), Germany (9), Japan (8), Switzerland (5), Korea (3), Finland (2), France (3), and one each from Australia, Belgium, Canada, and the UK. Eight of these organizations are of Indian origin. These are CSIR, Hindustan Unilever Limited, Bharat Heavy Electricals Limited, Samsung India Software Operations Private Limited, Indian Institutes of Technology collectively, Tata Steel Limited, Steel Authority Of India Limited, Defence Research & Development Organisation, and TVS Motor Company Limited.

The trend of patents granted so far shows that but for essential technologies like drugs, pharmaceuticals, transportation, chemicals, and, of late, telecommunication, interest in Indian technology market space seems to be marginal.

The distribution of assignees was examined in conjunction with the IPC classes and sub-classes associated with the patents. For the purpose the database was queried on assignees and their patent ownership on subjects, as indicated by the IPC codes. These classes and sub-classes indicate the subject scope of the innovation. The results point to the extent of patent clustering on subjects in conjunction with their ownership. A fewer subjects and also a relatively few assignees indicate a focused ownership of innovations, which could be strategic in nature. More number of owners for the same number of subject spread (IPC class base) would mean scattered patent possession, impact of which could only be limited.

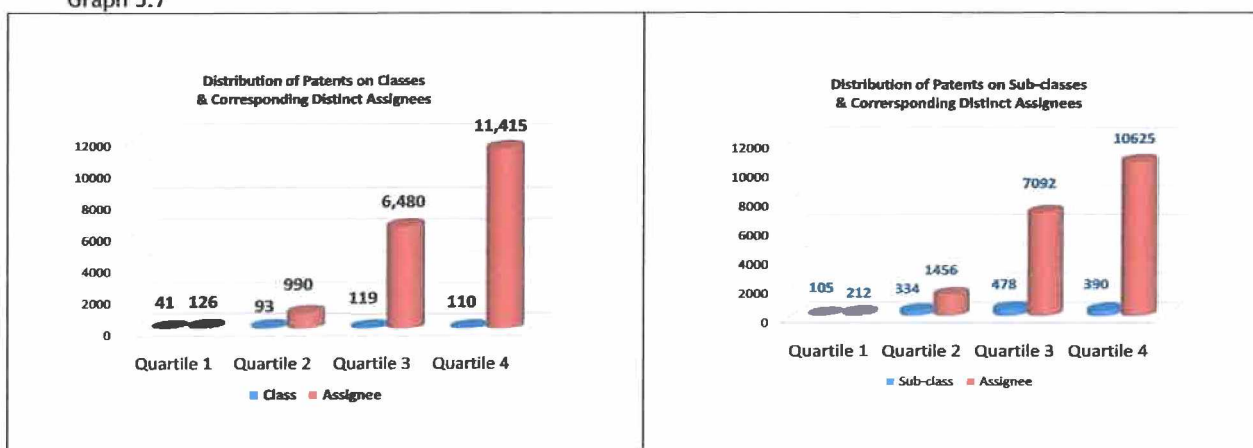
For the purposes of analysis, the data was ordered in descending order on subject - classes / sub-classes - along with the assignees. The resultant list was divided on quartiles each of them representing 25% of the patent ownership and corresponding subject of innovation. Each quartile consisted of around 14 500 patents. The first quartile of patents divided on IPC classes represented 41 classes (33.6%) with 126 owners (~.01 %) Graph 5.7. The second quartile 93 classes and 990 owners, and the third quartile 119 classes and 6480 distinct patent owners. The last quartile had patents representing 110 classes owned by 11, 415 assignees. The distribution indicates that there

is a high level of focus on a few subjects, and also these are owned by a relatively small number of assignees. Quartile 3 and 4 also show that there are also patents in fewer numbers on a wider range of classes, including those in Quartile 1 and 2 owned by a larger base of assignees.

Trend similar to the one observed for IPC class in subject distribution and ownership could also be noticed for IPC sub-class wise distribution. A smaller base of subjects and smaller set of owners appear in Quartile 1, compared with the distribution in quartiles 3 and 4. The distribution may have implication for availability of innovations and their impact in technology space in the country. The above analysis leads to the following conclusions:

- Patents ownership in IPO is highly skewed
- 8% of the assignees make up 50% of the patents at the IPC class level
- 14% of the assignees make up 50% of the patents at the IPC sub-class level
- 75% of the patents fall under 8 IPC Classes
- 30 sub-classes make up 50% of the patents assigned by IPO during 2001-2014 period.

Graph 5.7



The following sections present details of the foreign assignees who have obtained 100 or more patents in the post-2001 period, and the IPC based subject categories of the patents obtained by them. Minimum of five patents was taken as the cut off in a given IPC sub-classes. The description also gives a brief account of the business entities as obtained from the publicly available sources such as respective company websites, Wikipedia pages, and others.

The following are the top patent holders with 100 or more patents in IPO during the period covered in the study.

Council of Scientific & Industrial Research	1819	India
Qualcomm Inc	1554	USA
Hindustan Unilever Ltd.	782	India
Koninklijke Philips Electronics N.V	675	Netherlands
Samsung Electronics Co.	643	Korea
Honda Gieken Kogyo Kabushiki Kaisha	560	Japan
Telefonaktiebolaget Lm Ericsson	446	Germany

Siemens Aktiengesellschaft	404	Germany
BASF Akteingesellschaft	389	Germany
Procter & Gamble Co	383	USA
GM Global Technology Operations, Inc	373	USA
Thomson Licensing	372	France
Honda Motor Co Ltd	363	Japan
International Business Machines Corporation	350	USA
Bharat Heavy Electricals Ltd.	347	India
Motorola Inc	300	USA
LG Electronics Inc	299	Korea
Shell International Research Maatschappij B. V	282	Netherlands
F Hoffmann La Roche AG	267	Switzerland
Sony Corporation	266	Japan
Matsushita Electric Industrial Co	253	Japan
Intel Corporation	253	USA
Samsung India Software Operations Private Ltd	249	India
Nokia Corporation	244	Finland
Novartis AG	233	Switzerland
General Electric Co	227	USA
Astrazeneca AB	214	UK
Indian Institute of Technology	206	India
Silverbrook Research Pty Ltd	205	Australia
Maschinenfabrik Rieter AG	198	Germany
Dsm Ip Assets B.V	193	Netherlands
Dow Global Technologies LLC	193	USA
E. I. Du Pont de Nemours and Co	193	USA
Research In Motion Ltd	186	Canada
Tata Steel Limited	184	India
Robert Bosch GmbH	181	Germany
Bayer CropScience AG	181	Germany
3M Innovative Properties Co	181	USA
Steel Authority Of India Ltd	179	India
Bayer Aktiengesellschaft	164	Germany
CIBA Speciality Chemicals Holding Inc	164	Switzerland
Akzo Nobel N V	154	Netherlands
Sanofi Aventis Deutschland GmbH	147	France
Syngenta Participations AG	138	Switzerland
Sumitomo Chemical Co	132	Japan

LGChem Ltd	129	Korea
Exxonmobil Chemical Patents Inc	128	USA
InstitutFrancais Du Petrole	127	France
Eli Lilly and Co	124	USA
Janssen Pharmaceutica N. V.	123	Belgium
Hewett-Packard Co	123	USA
UOPLlc	123	USA
AloysWobben	121	Germany
Praxair Technology Inc	118	USA
Defence Research &Development Organisation	114	India
Panasonic Corporation	112	Japan
Aventis Pharmaceuticals Inc	111	USA
Canon Kabushiki Kaisha	110	Japan
Mitsubishi Denki Kabushiki Kaisha	109	Japan
Schneider Electric Industries S A	107	Germany
Ciba Holding Inc	107	Switzerland
TVS Motor Company Ltd	104	India
Colgate Palmolive Co	103	USA
Outokumpu Technology Oy	100	Finland
Johnson &Johnson Vision Care Inc	100	USA

3M

The 3M Company, formerly known as the Minnesota Mining and Manufacturing Company, is an American multinational conglomerate based in Minnesota.

3M produces more than 55,000 products, including: adhesives, abrasives, laminates, passive fire protection, dental and orthodontic products, electronic materials, medical products, car-care products electronic circuits, and optical films. 3M has operations in more than 65 countries including 29 international ones with manufacturing operations and 35 ones with laboratories.

3M technology ownership in India is in medical devices and consumer goods. In all the company owns 181 patents.

3M owns over 8,500 patents in the USPTO and over 61,000 across the world, as per the EPO's global patent database. During 2001-2014 period the company has obtained 172 US patents on A61F IPC class itself. 3M's patent ownership in IPO seems to be need based to protect and market its product

A61F	12	filters implantable into blood vessels; prostheses; devices providing patency to, or preventing collapsing of, tubular structures of the body, e.g. stents; orthopaedic, nursing or contraceptive devices; fomentation; treatment or protection of eyes or ears; bandages,
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		dressings or absorbent pads; first-aid kits
A44B	11	buttons, pins, buckles, slide fasteners, or the like
A61K	10	preparations for medical, dental, or toilet purposes
G02B	10	optical elements, systems, or apparatus
B29C	8	shaping or joining of plastics; shaping of substances in a plastic state, in general; after-treatment of the shaped products, e.g. repairing
C08F	8	macromolecular compounds obtained by reactions only involving carbon-to-carbon unsaturated bonds
B32B	7	layered products, i.e. products built-up of strata of flat or non-flat, e.g. cellular or honeycomb, form
C09J	6	adhesives; non-mechanical aspects of adhesive processes in general; adhesive processes not provided for elsewhere; use of materials as adhesives
C09D	5	coating compositions, e.g. paints, varnishes or lacquers; filling pastes; chemical paint or ink removers; inks; correcting fluids; wood stains; pastes or solids for colouring or printing; use of materials there for
G02F	5	devices or arrangements, the optical operation of which is modified by changing the optical properties of the medium of the devices or arrangements for the control of the intensity, colour, phase, polarisation or direction of light, e.g. switching, gating, modulating or demodulating; techniques or procedures for the operation thereof; frequency-changing; non-linear optics; optical logic elements; optical analogue/digital converters
B05B	5	Spraying apparatus; atomising apparatus; nozzles
A61M	5	Devices for introducing media into, or onto, the body
	181	

AkzoNobel manufactures and markets a wide range of coatings and specialty chemicals. Along with the other group companies of ICI Plc in India, it sponsored the establishment of the ICI India Research and Technology Centre in Thane in 1976. Over the years, it saw more consolidation, restructuring and divestment.

AkzoNobel the Company deals in coatings and chemicals. It is a global leader in decorative paints and the largest manufacturer of performance coatings. It also makes a variety of specialty chemicals.

AKZO NOBEL		
C08F	21	macromolecular compounds obtained by reactions only involving carbon-to-carbon unsaturated bonds
C08G	18	macromolecular compounds obtained otherwise than by reactions only involving carbon-to-carbon unsaturated bonds
C01B	14	non-metallic elements; compounds thereof
C09D	14	coating compositions, e.g. paints, varnishes or lacquers; filling pastes; chemical paint or ink removers; inks; correcting fluids; woodstains; pastes or solids for colouring or printing; use of materials there for
B01J	8	chemical or physical processes, e.g. catalysis, colloid chemistry; their relevant apparatus
C07D	8	heterocyclic compounds
C07C	8	acyclic or carbocyclic compounds
C08K	7	use of inorganic or non-macromolecular organic substances as compounding ingredients
H01L	5	semiconductor devices; electric solid state devices not otherwise provided for
A61K	5	preparations for medical, dental, or toilet purposes

C25B	5	electrolytic or electrophoretic processes for the production of compounds or non-metals; apparatus there for
D21H	5	pulp compositions
	180	

Akzo Nobel patents are mostly in chemistry, including top clusters of them dealing with macro molecular chemistry, basic materials chemistry, and organic fine chemistry. Interestingly the company also owns patents on semiconductor. These patents include the following:

- *A method of manufacturing a photovoltaic foil supported by a carrier colored solar cell unit*
- *A process for manufacturing a solar cell foil*
- *Process for manufacturing a solar cell unit using a temporary substrate*
- *Profiled photovoltaic roofing panel*

All the above falling under the IPC sub-class H01L

Aloys Wobben is a German electrical engineer and entrepreneur. Wobben founded the wind turbine manufacturer, Enercon, in 1984. He has made the company as the fifth largest in the sector behind Vestas of Denmark, Goldwind of China, GE and Spain's Gamesa. It consisted as much as 60% of the market in Germany.

Aloys Wobben		
F03D	69	Wind motors
H02J	9	Circuit arrangements or systems for supplying or distributing electric power; systems for storing electric energy
	121	

AstraZeneca, headquartered in the UK, span the entire value chain of a medicine from discovery, early- and late-stage development to manufacturing and distribution, and the global commercialisation of primary care, specialty care-led and specialty care medicines.

AstraZeneca's primary focus is on three important areas of healthcare: cardiovascular and metabolic disease; oncology; and respiratory, inflammation and autoimmunity. They are also active in the infection, neuroscience and gastrointestinal disease areas.

AstraZeneca operates in more than 100 countries.

AstraZeneca		
C07D	105	heterocyclic compounds
A61K	45	preparations for medical, dental, or toilet purposes
C07C	13	acyclic or carbocyclic compounds
G01N	6	investigating or analysing materials by determining their chemical or physical properties
	190	

AstraZeneca's main strength of the patents is in pharmaceuticals and technologies dealing with organic fine chemistry. The company has also forays into measurement, that is analyzing materials by determining their chemical or physical properties.

AstraZeneca has obtained over 29,000 patents globally and 1,368 in USPTO. As we can see the company's Indian IP ownership is only a fraction of their total strength.

In IPO during 2001-14 period AstraZeneca's patents deal with heterocyclic compounds. A heterocyclic compound or ring structure is a cyclic compound that has atoms of at least two different elements as members of its ring(s). Some of the patents under this class obtained by AstraZeneca are as follows:

- *Novel thiazolo[4,5-d] pyrimidine compounds*
- *Novel compounds*
- *A process for optical purification of omeprazole*
- *A process for the preparation of an amide derivative of a 3-phenyl-3,4-dihydroquinazolin-4-one-compound*

BASF SE is the largest chemicals producer in the world and is headquartered in Ludwigshafen, Germany. The BASF Group comprises subsidiaries and joint ventures in more than 80 countries and operates six integrated production sites and 390 other production sites in Europe, Asia, Australia, Americas and Africa. In the 1960s, BASF's production abroad was expanded and plants were built in India, among others. Following a change in corporate strategy in 1965, greater emphasis was placed on higher-value products such as coatings, pharmaceuticals, pesticides and fertilizers.

BASF operates in a variety of markets. Its business is organized in the segments chemicals, plastics, performance products, functional solutions, agricultural solutions, and oil & gas. BASF was a pioneer in manufacturing and developing biodegradable plastic, namely, Ecoflex.

BASF produces a range of performance chemicals, coatings and functional polymers. BASF's Functional Solutions segment consists of the Catalysts, Construction Chemicals and Coatings divisions. BASF's pesticide division supplies agricultural products and chemicals. The BASF Plant Science subsidiary produces the Amflora genetically modified potato.

BASF		
C07C	103	acyclic or carbocyclic compounds
A01N	90	preservation of bodies of humans or animals or plants or parts thereof
C07D	48	heterocyclic compounds
C08G	31	macromolecular compounds obtained otherwise than by reactions only involving carbon-to-carbon unsaturated bonds
B01J	27	chemical or physical processes, e.g. catalysis, colloid chemistry; their relevant apparatus
C12N	18	micro-organisms or enzymes; compositions thereof
B01D	16	separation

C01B	12	non-metallic elements; compounds thereof
A61K	11	preparations for medical, dental, or toilet purposes
C09B	10	organic dyes or closely-related compounds for producing dyes; mordants; lakes
A01N	7	preservation of bodies of humans or animals or plants or parts thereof
C07F	7	acyclic, carbocyclic, or heterocyclic compounds containing elements other than carbon, hydrogen, halogen, oxygen, nitrogen, sulfur, selenium or tellurium
C12P	6	fermentation or enzyme-using processes to synthesise a desired chemical compound or composition or to separate optical isomers from a racemic mixture
C08F	5	macromolecular compounds obtained by reactions only involving carbon-to-carbon unsaturated bonds
	471	

BASF's total patent ownership in India during the period of analysis was 471. The assigned patents are in the subjects relating to chemistry, including organic fine chemistry, basic materials chemistry, chemical engineering, molecular chemistry, including polymers, The company also owns Indian patents on pharmaceuticals. BASF'S Indian patents are only a fraction of its over 100,000 patents worldwide and 16,460 in the USPTO alone.

Bayer AG is a German multinational chemical and pharmaceutical company headquartered in Germany. Bayer's primary areas of business include human and veterinary pharmaceuticals; consumer healthcare products; agricultural chemicals and biotechnology products; and high value polymers.

In 2004, Bayer HealthCare AG acquired over-the-counter Pharmaceutical Division of Roche Pharmaceuticals.

In March 2008, Bayer HealthCare announced an agreement to acquire the portfolio and OTC division of privately owned Sagmel, Inc.

Bayer partnered on the development of the radio therapeutic Xofigo with M/s Algeta.

Bayer		
A01N	142	preservation of bodies of humans or animals or plants or parts thereof
C07D	92	heterocyclic compounds
C07C	29	acyclic or carbocyclic compounds
A61K	23	preparations for medical, dental, or toilet purposes
C08L	22	compositions of macromolecular compounds
C08G	20	macromolecular compounds obtained otherwise than by reactions only involving carbon-to-carbon unsaturated bonds
C12N	19	micro-organisms or enzymes; compositions thereof
G01N	17	investigating or analysing materials by determining their chemical or physical properties
C08K	11	use of inorganic or non-macromolecular organic substances as compounding ingredients
C07K	7	peptides
C12Q	6	measuring or testing processes involving enzymes or micro-organisms
C25B	5	electrolytic or electrophoretic processes for the production of compounds or non-metals; apparatus there for
	475	

Bayer also deals with chemical products. It has a wider portfolio of activities and the patents in IPO. Bayer's innovations are in the technologies relating to basic materials chemistry, organic fine chemistry, molecular chemistry. Pharmaceuticals, special machinery, innovations on surface coating, biotechnology are in the company's total patent holdings of over 100,000 world over.

Bayer CropScience has products in crop protection, non-agricultural pest control, seeds and plant biotechnology. In addition to conventional agrochemical business, it is involved in genetic engineering of food.

In 2002, Bayer AG acquired Aventis (now part of Sanofi) CropScience and fused it with their own agrochemicals division to form Bayer CropScience.

Bayer Material Science is a supplier of high-tech polymers, and develops solutions for a broad range of applications relevant to everyday life. Bayer's several business interests are reflected in its range of patents.

Some of the patents of the company in IPO under the sub-class A01N are as follows:

- *Rodenticidal bait system*
- *Oil-in water emulsion formulation of insecticides*
- *Oil based suspension concentrates*
- *Herbicidal compositions for controlling undesired harmful plants*
- *selective herbicidal composition based on 1-[2-chloro-phenyl]-4-(n-cyclohexyl-n-ethyl-aminocarbonyl)-1,4-dihydro-5h-tetrazol-5-one and propanil*
- *Composition for controlling animal pests containing cyclodepsipeptide compound*
- *A method for repelling arthropods*

Bharat Heavy Electricals Ltd (BHEL) is an integrated power plant equipment manufacturer and one of the largest engineering and manufacturing company of its kind in India engaged in the design, engineering, manufacture, construction, testing, commissioning and servicing of a wide range of products and services for the core sectors of the economy. BHEL also has a widespread overseas footprint in 76 countries with cumulative overseas installed capacity of BHEL manufactured power plants nearing 10,000 MW including Malaysia, Oman, Libya, Iraq, the UAE, Bhutan, Egypt and New Zealand. BHEL makes an R&D investment of over 2.5% of the turnover, which is substantially high from Indian industry. standards. BHEL has established 14 Centres of Excellence, which includes Simulators, Computational Fluid Dynamics, Permanent Magnet Machines, Intelligent Machines and Robotics, Nano-technology, Advanced Transmission Systems, Control & Instrumentation, Advanced Fabrication Technology, and others.

BHEL		
B23K	18	Soldering or unsoldering; welding; cladding or plating by soldering or welding; cutting by applying heat locally, e.g. Flame cutting; working by laser beam
H02K	16	Dynamo-electric machines
F01D	11	Non-positive-displacement machines or engines
B01D	10	SEPARATION (separating solids from solids by wet methods)
F03D	9	Wind motors
G01R	9	Measuring electric variables; measuring magnetic variables

H01L	9	Semiconductor devices; electric solid state devices not otherwise provided for
B03C	8	Magnetic or electrostatic separation of solid materials from solid materials or fluids; separation by high-voltage electric fields
F22B	7	Methods of steam generation; steam boilers
F16K	7	Valves; taps; cocks; actuating-floats; devices for venting or aerating
F03B	7	Machines or engines for liquids
F02C	6	Gas-turbine plants; air intakes for jet-propulsion plants; controlling fuel supply in air-breathing jet-propulsion plants
F23C	6	Methods or apparatus for combustion using fluid fuel or solid fuel suspended in air
H01H	5	Electric switches; relays; selectors; emergency protective devices
F04D	5	Non-positive-displacement pumps
F28F	5	Details of heat-exchange or heat-transfer apparatus, of general application
G06F	5	Electric digital data processing

BHEL technologies span around machine tools, engines, turbines, analysis and measurement, electrical energy, electrical solid state devices, thermal processes and others.

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Robert Bosch GMBH is a German multinational engineering and electronics company headquartered in Germany. It is the world's largest supplier of automotive components.

Bosch's core products are automotive components (including brakes, controls, electrical drives, electronics, fuel systems, generators, starter motors and steering systems), industrial products (including drives and controls, packaging technology and consumer goods) and building products (including household appliances, power tools, security systems and thermo technology).

Bosch has more than 350 subsidiaries across over 60 countries and its products are sold in around 150 countries. About 60% of Bosch's worldwide annual sales are produced in automotive technology. Bosch invented the first practical magneto, an early ignition electrical source. Bosch was an early manufacturer of Anti-lock Braking System, and Bosch is a leader in such specialized fields as traction control systems, the Electronic Stability Program, body electronics, and oxygen sensors, injectors and fuel pumps.

Bosch is a leading player in car stereo systems and in-car navigation systems. The company supplies hybrid diesel-electric technology to automakers.

Bosch's packaging technology division plans, designs, manufactures and installs packaging lines for manufacturers of pharmaceutical, confectionery, food, and similar products. Bosch is one of the largest supplier of packaging technology. The company is one of the largest manufacturers of portable power tools worldwide.

In 2009 Bosch was the leader in terms of numbers of patents at the German Patent and Trade Mark Office (GPTO) with 3,213 patents.

Robert Bosch GMBH		
B60S	30	servicing, cleaning, repairing, supporting, lifting, or manoeuvring of vehicles, not otherwise provided for
F02M	29	supplying combustion engines in general with combustible mixtures or constituents thereof
F02D	16	controlling combustion engines
H04L	10	transmission of digital information, e.g. telegraphic communication
F23Q	9	ignition
G06F	9	electric digital data processing
H02K	6	dynamo-electric machines
B60T	5	vehicle brake control systems or parts thereof; brake control systems or parts thereof, in general
F02P	4	ignition, other than compression ignition, for internal-combustion engines; testing of ignition timing in compression-ignition engines
B65B	4	machines, apparatus or devices for, or methods of, packaging articles or materials; unpacking
	182	

Bosch's innovations patented in IPO are in mechanical engineering, combustion engines, electrical machinery, and material handling related technologies. Though Bosch holds over 100,000 patents world over and over 20,000 in the USPTO alone, the company's Indian IP ownership is miniscule of its total technology strength.

Some of the patents under the sub-class B60S are the following:

- *Wiper blade for windows or lenses of motor vehicles* [202385]
- *Connecting piece for connecting a wiper blade to a wiper arm* [201800]
- *Wiper arm* [211542]
- *A spoiler for a window wiper blade* [211575]
- *A wiper blade for windows ,especially those of motor vehicles* [212795]
- *Wiper blade for panes, in particular of motor vehicles, and method for producing such a blade* [212806]
- *A wiping strip for windscreen wipers* [212872]
- *A connection piece for connecting a wiper blade to a wiper arm* [212879]

Canon Inc. is a Japanese multinational corporation specialized in the manufacture of imaging and optical products, including cameras, camcorders, photocopiers, steppers, computer printers and medical equipment. The *Business Solutions* division of Canon offers multi-functional printers, black and white and color office printers, large format printers, scanners, black and white and color production printers, as well as software to support these products. Lesser known Canon products include medical, optical and broadcast products, including ophthalmic and x-ray devices, broadcast lenses, semiconductors, digital microfilm scanners, and handy terminals.

Canon		
B41J	20	typewriters; selective printing mechanisms, i.e. mechanisms printing otherwise than from a forme; correction of typographical errors
G03G	13	electrography; electrophotography; magnetography
H04N	9	pictorial communication, e.g. television

C09D	8	coating compositions, e.g. paints, varnishes or lacquers; filling pastes; chemical paint or ink removers; inks; correcting fluids; woodstains; pastes or solids for colouring or printing; use of materials therefor
H01L	7	semiconductor devices; electric solid state devices not otherwise provided for
G06F	6	electric digital data processing
	109	

Canon's portfolio in IPO includes innovations in printing, optics, telecommunications, related semiconductor devices and control operations coming under the purview of electrical engineering. The company's world patent ownership is over 100,000 and in the USPTO the company has nearly 60,000 patents. Canon's Indian patent ownership is a small portion of its total patent strength.

Ciba - BASF subsidiary - is a chemical company based in Switzerland - "Chemische Industrie Basel". This BASF subsidiary makes products in the following areas: agriculture, automotive, construction & pipes, electronic materials, extractive & process technologies, home & fabric care, inks & graphics, lubricants, monomers & water soluble polymers, packaging, paints and coatings, paper, personal care, photo & digital imaging, plastics & rubber, textiles & fibers, water treatment.

The company considers its pharma, plant protection, and additives division primary businesses. Pharmaceuticals, the single largest operating unit, ranked among the world's top five. The corporation's leading product is Voltaren, an anti-rheumatic drug. Ciba's Pharmaceuticals unit also claimed the second most popular smoking cessation patch, Habitrol.

Ciba-Geigy's Self Medication, Diagnostics, and Ciba Vision units were recognized by the corporation as growth enterprises. Self Medication was expanded with the 1992 acquisition of Fisons' North American business, and the purchase of Triton Diagnostics boosted the Diagnostics group. Ciba Vision's contact lenses, lens care products, and ophthalmic medicines ranked number two worldwide.

Ciba-Geigy's Seeds and Composites units were considered long-term investments. In 1990, the company announced that it had successfully inserted marker genes into corn cells that produced fertile plants and passed the new traits on to viable seeds. The company thereby entered the race to genetically engineer plants with the most attractive traits.

The core industrial businesses of Ciba-Geigy in the early 1990s included textile dyes, chemicals, pigments, polymers, and mettlertoledo scales.

Ciba is one of the five largest chemical companies in the world. And, while it is widely diversified within the industry, it has maintained a steady emphasis on sophisticated chemicals—whether they are pharmaceuticals, plastics, pigments, or pesticides.

Ciba		
C09B	71	organic dyes or closely-related compounds for producing dyes; mordants; lakes

C07D	39	heterocyclic compounds
C08K	40	use of inorganic or non-macromolecular organic substances as compounding ingredients
A61K	29	preparations for medical, dental, or toilet purposes
C07C	26	acyclic or carbocyclic compounds
C08F	26	macromolecular compounds obtained by reactions only involving carbon-to-carbon unsaturated bonds
C11D	24	detergent compositions; use of single substances as detergents; soap or soap-making; resin soaps; recovery of glycerol
C07F	12	acyclic, carbocyclic, or heterocyclic compounds containing elements other than carbon, hydrogen, halogen, oxygen, nitrogen, sulfur, selenium or tellurium
A01N	6	preservation of bodies of humans or animals or plants or parts thereof
C08L	6	compositions of macromolecular compounds
D21H	6	pulp compositions; preparation thereof
D06M	6	treatment, not provided for elsewhere in class d06, of fibres, threads, yarns, fabrics, feathers or fibrous goods made from such materials
	416	

Basic materials chemistry, organic and molecular chemistry make up most of the top bunch of patents of CIBA. The company also owns patents on paper making. The total number of patents in IPO suggest that CIBA has a large number of patents in assorted fields in small numbers. BASF acquired CIBA in 2009 and has integrated their operations.

This company's portfolio in only chemistry related technologies, which includes in the context, chemistry relating to basic materials, molecular and organic fine chemistry. The company also has a set of patents on pharmaceuticals under the IPC sub-classes A01N, A61K.

The Council of Scientific & Industrial Research (CSIR) has a dynamic network of 38 national laboratories, 39 outreach centres, 3 Innovation Complexes and 5 units. CSIR's R&D base has nearly 4600 active scientists supported by about 8000 scientific and technical personnel.

CSIR covers a wide spectrum of science and technology - from radio and space physics, oceanography, geophysics, chemicals, drugs, genomics, biotechnology and nanotechnology to mining, aeronautics, instrumentation, environmental engineering and information technology. It provides technological intervention in many areas including environment, health, drinking water, food, housing, energy, farm and non-farm sectors.

CSIR is Pioneer of India's intellectual property movement and has majority of US patents granted to any Indian R&D organization. On an average CSIR files about 200 Indian patents and 250 foreign patents per year. Amongst its peers in publicly funded research organizations in the world, CSIR is a leader in terms of filing and securing patents worldwide. The scientific staff of CSIR constitutes around 4% of India's scientific manpower but they contribute to 10% of India's scientific outputs.

CSIR		
C07C	185	Acyclic or carbocyclic compounds
A61K	172	Preparations for medical, dental, or toilet purposes
A23L	94	Foods, foodstuffs, or non-alcoholic beverages
C04B	84	Lime; magnesia; slag; cements; compositions thereof, e.g. Mortars, concrete or like building materials; artificial stone; ceramics
C07D	74	Heterocyclic compounds
C12N	56	Micro-organisms or enzymes; compositions thereof
B01J	51	Chemical or physical processes, e.g. Catalysis, colloid chemistry; their relevant apparatus
C01B	44	Non-metallic elements; compounds thereof
C02F	38	Treatment of water, waste water, sewage, or sludge
G01N	38	Investigating or analysing materials by determining their chemical or physical properties
C08F	33	Macromolecular compounds obtained by reactions only involving carbon-to-carbon unsaturated bonds
C01G	33	Compounds containing metals
C22B	29	Production or refining of metals
B01D	26	SEPARATION (separating solids from solids by wet methods)
C08G	25	Macromolecular compounds obtained otherwise than by reactions only involving carbon-to-carbon unsaturated bonds
C12P	23	Fermentation or enzyme-using processes to synthesise a desired chemical compound or composition or to separate optical isomers from a racemic mixture
C08L	23	Compositions of macromolecular compounds
C01F	22	Compounds of the metals beryllium, magnesium, aluminium, calcium, strontium, barium, radium, thorium, or of the rare-earth metals
A01N	20	Preservation of bodies of humans or animals or plants or parts thereof
H01M	17	Processes or means, e.g. Batteries, for the direct conversion of chemical energy into electrical energy
C09K	16	Materials for applications not otherwise provided for; applications of materials not otherwise provided for
C09B	15	Organic dyes or closely-related compounds for producing dyes; mordants; lakes
C07K	15	peptides (peptides containing β -lactam rings C07D; cyclic dipeptides not having in their molecule any other peptide link than those which form their ring, e.g. Piperazine-2,5-diones
C10G	14	Cracking hydrocarbon oils; production of liquid hydrocarbon mixtures, e.g. By destructive hydrogenation, oligomerisation, polymerisation
C11B	14	Producing, e.g. By pressing raw materials or by extraction from waste materials, refining or preserving fats, fatty substances, e.g. Lanolin, fatty oils or waxes; essential oils; perfumes
C14C	14	Treating skins, hides or leather with chemicals, enzymes or micro-organisms, e.g. Tanning, impregnating or finishing; apparatus there for; compositions for tanning
H01L	13	Semiconductor devices; electric solid state devices not otherwise provided for
B32B	13	Layered products, i.e. Products built-up of strata of flat or non-flat, e.g. Cellular or honeycomb, form
C22C	13	Alloys
C09D	12	Coating compositions, e.g. Paints, varnishes or lacquers; filling pastes; chemical paint or ink removers; inks; correcting fluids; wood stains; pastes or solids for colouring or printing; use of materials there for
A61P	11	Specific therapeutic activity of chemical compounds or medicinal preparations
C07B	11	General methods of organic chemistry; apparatus there for (preparation of

		carboxylic acid esters by telomerisation
C12Q	11	Measuring or testing processes involving enzymes or micro-organisms
C08J	11	Working-up; general processes of compounding; after-treatment
A23J	11	Protein compositions for foodstuffs; working-up proteins for foodstuffs; phosphatide compositions for foodstuffs
C10M	10	Lubricating compositions
C07F	9	Acyclic, carbocyclic, or heterocyclic compounds containing elements other than carbon, hydrogen, halogen, oxygen, nitrogen, sulfur, selenium or tellurium
A23N	9	Machines or apparatus for treating harvested fruit, vegetables, or flower bulbs in bulk, not otherwise provided for; peeling vegetables or fruit in bulk; apparatus for preparing animal feeding-stuffs
C11D	8	Detergent compositions; use of single substances as detergents; soap or soap-making; resin soaps; recovery of glycerol
C03C	8	Chemical composition of glasses, glazes, or vitreous enamels; surface treatment of glass; surface treatment of fibres or filaments from glass, minerals or slags; joining glass to glass or other materials
E21C	8	Mining or quarrying
A23B	7	Preserving, e.g. By canning, meat, fish, eggs, fruit, vegetables, edible seeds; chemical ripening of fruit or vegetables; the preserved, ripened, or canned products
C10L	7	Fuels not otherwise provided for; natural gas; synthetic natural gas obtained by processes not covered by subclasses c10g or c10k; liquefied petroleum gas; use of additives to fuels or fires; fire-lighters
C08K	7	Use of inorganic or non-macromolecular organic substances as compounding ingredients
A23D	7	Edible oils or fats, e.g. Margarines, shortenings, cooking oils
C08B	7	Polysaccharides; derivatives thereof
A21D	7	Treatment, e.g. Preservation, of flour or dough for baking, e.g. By addition of materials; baking; bakery products; preservation thereof
A01H	6	New plants or processes for obtaining them; plant reproduction by tissue culture techniques
B05D	6	Processes for applying liquids or other fluent materials to surfaces, in general
E21D	6	Shafts; tunnels; galleries; large underground chambers (soil-conditioning or soil-stabilising materials)
G01F	6	Measuring volume, volume flow, mass flow, or liquid level; metering by volume
A23F	6	Coffee; tea; their substitutes; manufacture, preparation, or infusion thereof
C23F	5	Non-mechanical removal of metallic material from surfaces
C06B	5	Explosive or thermic compositions ; manufacture thereof; use of single substances as explosives
C08C	5	Treatment or chemical modification of rubbers
G06F	5	Electric digital data processing
C23C	5	Coating metallic material; coating material with metallic material; surface treatment of metallic material by diffusion into the surface, by chemical conversion or substitution; coating by vacuum evaporation, by sputtering, by ion implantation or by chemical vapour deposition, in general
H01G	5	Capacitors; capacitors, rectifiers, detectors, switching devices, light-sensitive or temperature-sensitive devices of the electrolytic type
C01D	5	Compounds of alkali metals, i.e. Lithium, sodium, potassium, rubidium, caesium, or francium
C25D	5	Processes for the electrolytic or electrophoretic production of coatings; electroforming
C25C	5	Processes for the electrolytic production, recovery or refining of metals; apparatus there for
	1819	

CSIR's innovations cover a wide span of technologies including organic fine chemistry, macromolecular chemistry, basic materials chemistry, biotechnology, chemical engineering, pharmaceuticals, food chemistry, thermal processes, metallurgy, environmental technology, instrumentation, electrical apparatus, materials processing, semiconductors, surface technology and others.

Defence Research & Development Organisation (DRDO) works under Department of Defence Research and Development of Ministry of Defence. DRDO does R&D on defence Systems and undertakes design & development leading to production of weapon systems. With a network of 52 laboratories, which are engaged in developing defence technologies covering various fields, like aeronautics, armaments, electronics, land combat engineering, life sciences, materials, missiles, and naval systems, DRDO is India's largest and most diverse research organisation. The organisation includes around 5,000 scientists.

DRDO		
A61K	12	Preparations for medical, dental, or toilet purposes
A23L	6	Foods, foodstuffs, or non-alcoholic beverages; their preparation or treatment, e.g. Cooking, modification of nutritive qualities, physical treatment
C12N	5	Micro-organisms or enzymes; compositions thereof
	114	

DRDO innovations seem to be diffused and have not focused on specific technologies. However, we do notice a small cluster of their patents on food chemistry and pharmaceuticals.

The following are some of the patents obtained by DRDO

- *A process for preparation of shelf-stable pre-cooked dal in the form of soft-small granules noodles* [189173]
- *A process for the preparation of a light weight ceramic composite material for use in bullet proof panels/shelters* [190748]
- *A process of preparation of iron aluminides* [191064]
- *A process for the preparation of polyaniline salt* [191276]
- *An improved pencil with reusable extension attachment* [193328]
- *A herbal namkeen tea powder and a process for the preparation thereof* [241184]
- *A process for anaerobic biodegradation of human waste at low temperature* [241466]
- *A transmit and receive module for active phased array antenna* [241683]

The Dow Chemical Co. is an American multinational chemical corporation headquartered in Michigan, United States. It is the second-largest chemical manufacturer in the world by revenue. It ranked third in the world by chemical production in 2013.

Dow manufactures plastics, chemicals, and agricultural products. The company has presence in about 160 countries. The company has seven different major operating segments, with a wide variety of products made by each one. Dow sells directly to end-users primarily in the human and animal health and consumer products markets.

Dow is a large producer of plastics. It is also a major producer of ethylene oxide, various acrylates, surfactants, and cellulose resins. It produces agricultural chemicals including the pesticide Lorsban and consumer products including Styrofoam. Performance plastics make up 25 percent of Dow's sales with many products designed for the automotive and construction industries.

The Performance Chemicals segment produces chemicals and materials for water purification, pharmaceuticals, paper coatings, paints and advanced electronics.

Dow Chemical Co.		
C08F	37	macromolecular compounds obtained by reactions only involving carbon-to-carbon unsaturated bonds
C08G	20	macromolecular compounds obtained otherwise than by reactions only involving carbon-to-carbon unsaturated bonds
C08L	20	compositions of macromolecular compounds
C07C	13	acyclic or carbocyclic compounds
C08J	12	working-up; general processes of compounding; after-treatment
B01J	10	chemical or physical processes, e.g. catalysis, colloid chemistry; their relevant apparatus
C07D	9	heterocyclic compounds
B01D	8	separation
C07F	6	acyclic, carbocyclic, or heterocyclic compounds containing elements other than carbon, hydrogen, halogen, oxygen, nitrogen, sulfur, selenium or tellurium
C09J	5	adhesives; non-mechanical aspects of adhesive processes in general; adhesive processes not provided for elsewhere; use of materials as adhesives
	197	

Dow Global's innovations and assigned patent rights in India deal with technologies relating to basic chemistry, macro molecular aspects, chemical engineering and organic chemistry.

E. I. du Pont de Nemours and Company, commonly referred to as DuPont, is an American chemical company. DuPont developed many polymers such as Vespel, neoprene, nylon, Corian, Teflon, Mylar, Kevlar, Zemdren, M5 fiber, Nomex, Tyvek, Sorona and Lycra. DuPont developed Freon (chlorofluorocarbons) for the refrigerant industry, and later more environmentally friendly refrigerants. It developed synthetic pigments and paints including Chroma Flair. In 2014, DuPont was the world's fourth largest chemical company.

Du Pont businesses are organized into the following five categories, known as marketing "platforms": Electronic and Communication Technologies, Performance Materials, Coatings and Color Technologies, Safety and Protection, and Agriculture and Nutrition.

DuPont has 150 research and development facilities located in China, Brazil, India, Germany, and Switzerland in a diverse range of technologies for many markets including agriculture, genetic traits, biofuels, automotive, construction, electronics, chemicals, and industrial materials.

E. I. du Pont de Nemours and Co		
C07C	21	acyclic or carbocyclic compounds

C08G	19	macromolecular compounds obtained otherwise than by reactions only involving carbon-to-carbon unsaturated bonds
C07D	18	heterocyclic compounds
A01N	14	preservation of bodies of humans or animals or plants or parts thereof
D01D	10	mechanical methods or apparatus in the manufacture of man-made filaments, threads, fibres, bristles or ribbons
C09K	7	materials for applications not otherwise provided for; applications of materials not otherwise provided for
C08L	6	compositions of macromolecular compounds
C08F	5	macromolecular compounds obtained by reactions only involving carbon-to-carbon unsaturated bonds
C12N	5	micro-organisms or enzymes; compositions thereof
D02G	5	crimping or curling fibres, filaments, yarns, or threads; yarns or threads
D01F	5	chemical features in the manufacture of man-made filaments, threads, fibres, bristles or ribbons; apparatus specially adapted for the manufacture of carbon filaments
	187	

IPO portfolio of Du Pont is dominated by basic chemistry, organic chemistry, macro molecular chemistry. Other patents deal with very specialized applications of chemistry to products / processes, and more recently biotechnology, textiles, and related processes.

World over Du Pont owns over 100, 000 patents and nearly 16,000 in the USPTO alone. Du Pont's USPTO holdings in the post 2001 period totals 5,297. Its India patent ownership is only a few specialty innovations.

Eli Lilly and Company is an American global pharmaceutical company. The company also has offices in Puerto Rico and 17 other countries. Their products are sold in approximately 125 countries.

Among other specialties, Eli Lilly was the first company to mass-produce penicillin, the Salk polio vaccine, and insulin, including one of the first pharmaceutical companies to produce human insulin using recombinant DNA. Eli Lilly is also the world's largest manufacturer and distributor of psychiatric medications.

In 1977 Lilly ventured into medical instruments with the acquisition of IVAC Corporation, which manufactures vital signs, and intravenous fluid infusion monitoring systems. Lilly also purchased Cardiac Pacemakers Incorporated, a manufacturer of heart pacemakers in 1977.

Eli Lilly and Co		
C07D	51	heterocyclic compounds
A61K	33	preparations for medical, dental, or toilet purposes
C07K	12	peptides
C07C	8	acyclic or carbocyclic compounds
	122	

Eli Lilly's holdings in IPO are in the area of pharmaceuticals, biotechnology and processes relating to organic chemistry. The company owns over 46,000 patents world over in different patent offices.

Ericsson (Telefonaktiebolaget L. M. Ericsson) is a Swedish multinational provider of communications technology and services. The company's offerings comprise software and infrastructure in ICTs for telecom operators and other industries, including traditional telecommunications. The company also deals with Internet

Protocol networking equipment, mobile and fixed broadband, cable TV, IPTV, and video systems. Ericsson has a market share of about 35% in the 2G/3G/4G mobile network infrastructure market.

The company works in more than 180 countries. Ericsson holds approximately 100,000 granted patents, including many in the field of wireless communications. Its USPTO patents in the post-2001 period exceeds 10,000.

Ericsson has an estimated 40 percent share of the world's mobile market.

Ericsson is a supplier of GSM equipment to many major operators. It is a pioneer in the emerging 3G standards and associated technologies.

Telefonaktiebolaget LM Ericsson		
H04L	141	transmission of digital information, e.g. telegraphic communication
H04Q	101	selecting (switches, relays, selectors h01h; wireless communication networks h04w)
H04B	42	transmission
H04M	19	telephonic communication
G06F	18	electric digital data processing
H01Q	13	aerials
G10L	7	speech analysis or synthesis; speech recognition; speech or voice processing; speech or audio coding or decoding
H03M	6	coding, decoding or code conversion, in general
H04J	5	multiplex communication
	429	

Ericsson's patents in IPO are exclusively in digital communication, telecommunication, and computer technology.

Exxon is a well-known brand of motor fuel and related products by ExxonMobil.

EXXON		
C08F	33	macromolecular compounds obtained by reactions only involving carbon-to-carbon unsaturated bonds
C07C	31	acyclic or carbocyclic compounds
C10G	29	cracking hydrocarbon oils; production of liquid hydrocarbon mixtures, e.g. by destructive hydrogenation, oligomerisation, polymerisation
B01J	17	chemical or physical processes, e.g. catalysis, colloid chemistry; their relevant apparatus

C08L	16	compositions of macromolecular compounds
C01B	11	non-metallic elements; compounds thereof
C08K	9	use of inorganic or non-macromolecular organic substances as compounding ingredients
F25J	5	liquefaction, solidification, or separation of gases or gaseous mixtures by pressure and cold treatment
	218	

Exxon's Indian patents are chemistry related, inclusive of basic materials, organic and macro molecular fields. It also spans innovations in chemical engineering.

The following are some of the Exxon's representative patents in IPO:

- *A latex composition and process for preparation thereof* [196961]
- *A process for liquefying a pressurized gas stream rich in methane* [198144]
- *Method to control a lubricant production* [201587]
- *A method for displacing pressurized liquified gas from containers* [203041]
- *A method for producing a distillate fuel heavier than gasoline* [203656]
- *A container suitable for storing pressurized liquified natural gas, a method of constructing the same, a system and method for producing and storing pressurized liquified natural gas* [204590]

General Motors Company, commonly known as GM, is an American multinational corporation that designs, manufactures, markets and distributes vehicles and vehicle parts and sells financial services. General Motors produces vehicles in 37 countries.

General Motors does business in more than 120 countries. The company is currently among the world's largest automakers by vehicle unit sales.

GM R&D is a network of six laboratories, six science offices, and collaborative relationships in over twelve countries including working relationships with universities, government groups, suppliers, and other partners from across the globe.

GM Global		
F16H	90	gearing
F02D	32	controlling combustion engines
F01N	19	gas-flow silencers or exhaust apparatus for machines or engines in general; gas-flow silencers or exhaust apparatus for internal-combustion engines
B60K	18	arrangement or mounting of propulsion units or of transmissions in vehicles; arrangement or mounting of plural diverse prime-movers in vehicles; auxiliary drives for vehicles; instrumentation or dashboards for vehicles; arrangements in connection with cooling, air intake, gas exhaust or fuel supply of propulsion units in vehicles
H01M	18	processes or means, e.g. batteries, for the direct conversion of chemical energy into electrical energy
F02M	16	supplying combustion engines in general with combustible mixtures or constituents thereof
B60W	16	conjoint control of vehicle sub-units of different type or different function; control systems specially adapted for hybrid vehicles; road vehicle drive control systems for purposes not related to the control of a particular sub-unit

F16D	11	couplings for transmitting rotation
H02K	9	dynamo-electric machines
G06F	8	electric digital data processing
H02M	8	apparatus for conversion between ac and ac, between ac and dc, or between dc and dc, and for use with mains or similar power supply systems; conversion of dc or ac input power into surge output power; control or regulation thereof
F02B	7	internal-combustion piston engines; combustion engines in general
H02P	7	control or regulation of electric motors, electric generators or dynamo-electric converters; controlling transformers, reactors or choke coils
F01L	7	cyclically operating valves for machines or engines
B60T	5	vehicle brake control systems or parts thereof; brake control systems or parts thereof, in general
	371	

GM's innovations assigned patents in India relate to mechanical elements, environmental technology associated with engines, engine exhaust. The company also owns patents in electrical machinery, control apparatus and related technologies, including computer technology. Worldwide GM Global owns more than 36,000 patents, and 8500 in the US PTO alone. GM's Indian patent ownership seems to be highly selective.

F. Hoffmann-La Roche Ltd. (Roche) is a research-focused Swiss healthcare company that operates under two divisions: Pharmaceuticals and Diagnostics. The company has operations in more than 150 countries. It is one of the leading providers of biopharmaceuticals, cancer medicines and in vitro diagnostics systems. Its major products include medicines to treat cancers, brain diseases, viral and bacterial infections, debilitating diseases, cardiovascular and metabolism diseases; point-of-care testing devices; analyzers; blood glucose meters; laboratory information, workflow and data management software; and instruments and reagents for life science research. Roche offers its products and services to hospitals, commercial diagnostic laboratories, healthcare professionals, researchers and pharmacists.

Roche deals with chemical products. Accordingly its innovations centre on the technology. These include products and processes dealing with pharmaceuticals, biotechnology, instruments dealing with measurement of chemical properties. The company also has patented technologies dealing with organic chemistry.

Roche owns over 22,000 patents worldwide and their India share is relatively selective.

Hoffman		
C07D	135	heterocyclic compounds
A61K	62	preparations for medical, dental, or toilet purposes
C07C	34	acyclic or carbocyclic compounds
C07K	15	peptides
C12N	8	micro-organisms or enzymes; compositions thereof
C07H	6	sugars; derivatives thereof; nucleosides; nucleotides; nucleic acids
C12Q	6	measuring or testing processes involving enzymes or micro-organisms; compositions or test

		papers there for; processes of preparing such compositions; condition-responsive control in microbiological or enzymological processes
C07D	5	heterocyclic compounds
G01N	5	investigating or analysing materials by determining their chemical or physical properties
	296	

Hoffman deals with chemical products. Accordingly the innovations centre around the technology. These include products and processes dealing with pharmaceuticals, biotechnology, instruments dealing with measurement of chemical properties. The company also has patented technologies dealing with organic chemistry.

Hindustan Unilever Limited (HUL) is India's largest fast moving consumer goods company with a heritage of over 80 years in India and touches the lives of two out of three Indians.

With over 35 brands spanning 20 distinct categories such as soaps, detergents, shampoos, skin care, toothpastes, deodorants, cosmetics, tea, coffee, packaged foods, ice cream, and water purifiers, the Company is a part of the everyday life of millions of consumers across India. Its portfolio includes leading household brands such as Lux, Lifebuoy, Surf Excel, Rin, Wheel, Fair & Lovely, Pond's, Vaseline, Lakmé, Dove, Clinic Plus, Sunsilk, Pepsodent, Closeup, Axe, Brooke Bond, Bru, Knorr, Kissan, Kwality Wall's and Pureit.

HUL is a subsidiary of Unilever, one of the world's leading suppliers of FMCGs with strong local roots in more than 100 countries. Unilever has 67.25% shareholding in HUL.

The company spends over € 1 billion on R&D annually, with over 6000 people contributing to R&D in regions across the globe. The company files between 250 and 350 new patent applications a year, and owns over 20 000 patents worldwide.

Hindustan Unilever Ltd.		
C11D	188	Detergent compositions; use of single substances as detergents; soap or soap-making; resin soaps; recovery of glycerol
A61K	166	Preparations for medical, dental, or toilet purposes
A23L	42	Foods, foodstuffs, or non-alcoholic beverages
A23F	22	Coffee; tea; their substitutes; manufacture, preparation, or infusion thereof
A23G	22	Cocoa; cocoa products, e.g. Chocolate; substitutes for cocoa or cocoa products; confectionery; chewing gum; ice-cream; preparation thereof
B65D	13	Containers for storage or transport of articles or materials, e.g. Bags, barrels, bottles, boxes, cans, cartons, crates, drums, jars, tanks, hoppers, forwarding containers; accessories, closures, or fittings therefor; packaging elements; packages
C07C	11	Acyclic or carbocyclic compounds
A23D	10	Edible oils or fats, e.g. Margarine, shortenings, cooking oils
C02F	8	Treatment of water, waste water, sewage, or sludge
A45D	7	Hairdressing or shaving equipment; manicuring or other cosmetic treatment
A61Q	7	Specific use of cosmetics or similar toilet preparations
B01D	6	Separation

d06m	5	Treatment of fibres, threads, yarns, fabrics, feathers or fibrous goods made from such materials
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HUL's innovations are in the fields of basic materials chemistry, cosmetics, organic fine chemistry, food chemistry, thermal processes and even technologies relating to handling.

Honda Motor Co., Ltd. is a Japanese public multinational corporation primarily known as a manufacturer of automobiles, motorcycles and power equipment.

Honda has been the world's largest motorcycle manufacturer since 1959, as well as the world's largest manufacturer of internal combustion engines measured by volume, producing more than 14 million internal combustion engines each year. Honda became the second-largest Japanese automobile manufacturer in 2001. Honda is the eighth largest automobile manufacturer in the world.

Aside from their core automobile and motorcycle businesses, Honda also manufactures garden equipment, marine engines, personal watercraft and power generators, among others. Since 1986, Honda has been involved in artificial intelligence/robotics research. They have also ventured into aerospace with the establishment of GE Honda Aero Engines in 2004 and the Honda HA-420 Honda Jet.

Honda		
B62J	127	cycle saddles or seats; accessories peculiar to cycles and not otherwise provided for, e.g. article carriers or cycle protectors
B62K	65	cycles; cycle frames; cycle steering devices; rider-operated terminal controls specially adapted for cycles; cycle axle suspensions; cycle sidecars, fore cars, or the like
B60K	49	arrangement or mounting of propulsion units or of transmissions in vehicles; arrangement or mounting of plural diverse prime-movers in vehicles; auxiliary drives for vehicles; instrumentation or dashboards for vehicles; arrangements in connection with cooling, air intake, gas exhaust or fuel supply of propulsion units in vehicles
F02M	41	supplying combustion engines in general with combustible mixtures or constituents thereof
B62M	36	rider propulsion of wheeled vehicles or sledges; powered propulsion of sledges or cycles; transmissions specially adapted for such vehicles
F02B	33	internal-combustion piston engines; combustion engines in general
F02D	32	controlling combustion engines
F01N	31	gas-flow silencers or exhaust apparatus for machines or engines in general; gas-flow silencers or exhaust apparatus for internal-combustion engines
F16H	28	gearing
F01L	26	cyclically operating valves for machines or engines
B60R	26	vehicles, vehicle fittings, or vehicle parts, not otherwise provided for
F01P	25	cooling of machines or engines in general; cooling of internal-combustion engines
B62D	18	motor vehicles; trailers
F16D	16	couplings for transmitting rotation
F02F	15	cylinders, pistons, or casings for combustion engines; arrangements of sealings in combustion engines
F01M	15	lubricating of machines or engines in general; lubricating internal-combustion engines; crankcase ventilating
B60Q	14	arrangement of signalling or lighting devices, the mounting or supporting thereof or circuits

		therefor, for vehicles in general
F02N	13	starting of combustion engines
F02P	11	ignition, other than compression ignition, for internal-combustion engines; testing of ignition timing in compression-ignition engines
B62H	10	cycle stands; supports or holders for parking or storing cycles; appliances preventing or indicating unauthorised use or theft of cycles; locks integral with cycles; devices for learning to ride cycles
H02K	9	dynamo-electric machines
B29C	9	shaping or joining of plastics; shaping of substances in a plastic state, in general; after-treatment of the shaped products, e.g. repairing
B60T	9	vehicle brake control systems or parts thereof; brake control systems or parts thereof, in general
F16F	8	springs; shock-absorbers; means for damping vibration
B60L	7	propulsion of electrically-propelled vehicles
F16C	7	shafts; flexible shafts; mechanical means for transmitting movement in a flexible sheathing; elements of crankshaft mechanisms; pivots; pivotal connections; rotary engineering elements other than gearing, coupling, clutch or brake elements; bearings
B01J	6	chemical or physical processes, e.g. catalysis, colloid chemistry; their relevant apparatus
H01M	6	processes or means, e.g. batteries, for the direct conversion of chemical energy into electrical energy
B62L	5	brakes specially adapted for cycles
H02J	5	circuit arrangements or systems for supplying or distributing electric power; systems for storing electric energy
H02P	5	control or regulation of electric motors, electric generators or dynamo-electric converters; controlling transformers, reactors or choke coils
B60C	5	vehicle tyres
	891	

Honda has patents on a large number of niche technologies not listed specifically in IPC classes. These include aspects of engineering consumer products for vehicles, engines, environmental technology, mechanical elements like gearing, electrical machinery, special machines, etc. The technologies also span energy use in motor vehicles, and some on electrical apparatus.

Honda Global is an innovative company and has over 100 000 patents in different countries. Its US patent ownership is over 13 731 during 2001-2014 period. Honda is one of the leading patent holders in the country.

Hewlett-Packard Company or HP is an American multinational information technology company headquartered in United States. It provides hardware, software and services to consumers.

HP was the world's leading PC manufacturer from 2007 to 2013, after which Lenovo ranked ahead of HP. The company specializes in developing and manufacturing computing, data storage, and networking hardware, designing software and delivering services. Major product lines include personal computing devices, enterprise and industry standard servers, related storage devices, networking products, software and a diverse range of printers and other imaging products.

Hewlett-Packard company events have included the spin-off of its electronic and bio-analytical measurement instruments.

Hewlett-Packard		
B41J	51	typewriters; selective printing mechanisms, i.e. mechanisms printing otherwise than from a forme; correction of typographical errors
C09D	13	coating compositions, e.g. paints, varnishes or lacquers; filling pastes; chemical paint or ink removers; inks; correcting fluids; woodstains; pastes or solids for colouring or printing; use of materials therefor
G06F	11	electric digital data processing
H01L	6	semiconductor devices; electric solid state devices not otherwise provided for
G06K	5	recognition of data; presentation of data; record carriers; handling record carriers
	123	

Most of the HP patents in IPO deal with printing technologies. Associated aspects also include computer technology, digital data processing and semiconductors dealing with these processes. The company also has assorted patents on basic materials chemistry relating to chemicals in the printing ink in IPO listed below:

- *Restoration of black to color bleed performance of amphoteric pigment*
- *Dispersion based inks of low pigment loads*
- *Ink system containing polymer binders*
- *Magenta ink-jet inks*
- *Reactive ink set for ink-jet printing*
- *Cosolvents in printing fluids*

The company's USPTO assigned patents during the overlapping years - 2001-2014, exceeds 21,000.

The **Indian Institutes of Technology (IITs)** are autonomous public institutes of higher education, located in India. They are governed by the Institutes of Technology Act, 1961 which has declared them as "institutions of national importance". The Institutes of Technology Act, 1961 lists seven institutes located at Chennai, Delhi, Guwahati, Kanpur, Kharagpur, Mumbai, and Roorkee. In addition, nine others institutes were added in 2008 at Bhubaneswar, Gandhinagar, Hyderabad, Indore, Jodhpur, Mandi, Patna, Ropar and Varanasi. Each IIT is an autonomous institution, linked to the others through a common IIT Council, which oversees their administration. The IITs receive comparatively higher grants than other engineering colleges in India.

Indian Institutes of Technology		
G01N	10	Investigating or analysing materials by determining their chemical or physical properties
C07C	8	Acyclic or carbocyclic compounds
A61K	8	Preparations for medical, dental, or toilet purposes
B01D	7	Separation
C08F	6	Macromolecular compounds obtained by reactions only involving carbon-to-carbon unsaturated bonds
C01B	6	Non-metallic elements; compounds thereof (fermentation or enzyme-using processes for the preparation of elements or inorganic compounds ;

		production of non-metallic elements or inorganic compounds by electrolysis or electrophoresis
C23C	6	Coating metallic material; coating material with metallic material; surface treatment of metallic material by diffusion into the surface, by chemical conversion or substitution; coating by vacuum evaporation, by sputtering, by ion implantation or by chemical vapour deposition, in general
G06F	6	Electric digital data processing
C08L	5	Compositions of macromolecular compounds
C08G	5	Macromolecular compounds obtained otherwise than by reactions only involving carbon-to-carbon unsaturated bonds
C04B	5	Lime; magnesia; slag; cements; compositions thereof, e.g. Mortars, concrete or like building materials; artificial stone; ceramics
B24B	5	Machines, devices, or processes for grinding or polishing
	206	

Innovations from IITs are in the areas of organic fine chemistry, pharmaceuticals, chemical engineering, molecular chemistry, metallurgy, surface technology, instrumentation, information technology and machine tools.

The International Business Machines Corporation (IBM) is an American multinational technology and consulting corporation. IBM manufactures and markets computer hardware and software, and offers infrastructure, hosting and consulting services in areas ranging from mainframe computers to nanotechnology.

The company was founded in 1911 as the Computing-Tabulating-Recording Company through a merger of the Tabulating Machine Company, the International Time Recording Company, and the Computing Scale Company. CTR was changed to "International Business Machines" in 1924, using a name which had originated with CTR's Canadian subsidiary.

IBM has 12 research laboratories worldwide, bundled into IBM Research. The company held the record for most patents generated by a business for 22 consecutive years. Notable company inventions include the automated teller machine, the floppy disk, the hard disk drive, the magnetic stripe card, the relational database, the Universal Product Code, the financial swap, the Fortran programming language, SABRE airline reservation system, DRAM, copper wiring in semiconductors, the silicon-on-insulator semiconductor manufacturing process, and Watson artificial intelligence.

IBM has constantly evolved since its inception. Over the past decade, it has steadily shifted its business mix by exiting commoditizing businesses such as PCs, hard disk drives and DRAMs and focusing on higher-value, more profitable businesses such as business intelligence, data analytics, business continuity, security, cloud computing, virtualization and green solutions.

In November 2014, IBM and Twitter announced a global landmark partnership which they claim will change how institutions and businesses understand their customers, markets and trends. With Twitter's data on people and IBM's cloud-based analytics and customer-engagement platforms they plan to help enterprises make better, more informed decisions. The partnership will give enterprises and institutions a way to make sense of Twitter's mountain of data using IBM's Watson supercomputer.

IBM		
G06F	128	electric digital data processing
H01L	73	semiconductor devices; electric solid state devices not otherwise provided for
H04L	39	transmission of digital information, e.g. telegraphic communication
G11B	9	information storage based on relative movement between record carrier and transducer
G10L	9	speech analysis or synthesis; speech recognition; speech or voice processing; speech or audio coding or decoding
G11C	8	static stores
G06K	8	recognition of data; presentation of data; record carriers; handling record carriers
H04Q	5	selecting (switches, relays, selectors h01h; wireless communication networks h04w)
H04N	5	pictorial communication, e.g. television
	345	

IBM holds most number of patents world over. In USPTO alone during the post 2001 period IBM has been granted nearly 65, 000 patents. In India they have been assigned patents on computer technology, digital communications, audio visual technologies associated with computer technologies, graphics, wireless communication, relays etc. They also own patents on semiconductors like the following:

- A semiconductor memory device
- Polymer and ceramic composite electronic substrates
- A thermoelectric device
- A method for forming a diffusion region in a silicon substrate
- A method for increasing an electrical resistance of a resistor in a semiconductor device.
- A method for forming micro-scale structure

French Institute of Petroleum (in French: *Institut français du pétrole, IFP*) is a public research organisation in France founded in 1944. The Institute is responsible for a post-graduate training centre, IFP School (also known as the *École du pétrole et des moteurs*), and an extensive industrial training programme.

IFP has designed several methods to assess the oil potential of a sedimentary rock, amongst others, the Rock-Eval technique using a standardized pyrolysis apparatus. This technique is used worldwide amongst petroleum companies to compare their results in the same way.

Institut Français Du Pétrole		
C10G	33	Cracking hydrocarbon oils; production of liquid hydrocarbon mixtures, e.g. By destructive hydrogenation, oligomerisation, polymerisation
C07C	24	Acyclic or carbocyclic compounds
B01J	23	Chemical or physical processes, e.g. Catalysis, colloid chemistry; their relevant apparatus
B01D	10	Separation
C01G	7	Compounds containing metals not covered by subclasses c01d or c01f

G01N	6	Investigating or analysing materials by determining their chemical or physical properties
	127	

The patent portfolio of the Institute spans basic materials chemistry going with cracking hydrocarbons, organic fine chemistry, processes associated with chemical engineering materials, metallurgy associated with petroleum processing. The portfolio also includes an assortment of innovations on instrumentation associated with these processes. IFP's patents could only be licensed to petrochemical industries in the country, as they do not have any operations locally.

Intel Corporation (Integrated Electronics) is an American multinational technology company. Intel is one of the world's largest and highest valued semiconductor chip makers. The company is the inventor of the x86 series of microprocessors found in most personal computers.

Intel makes motherboard chipsets, network interface controllers and integrated circuits, flash memory, graphic chips, embedded processors and other devices related to communications and computing. Intel combines advanced chip design capability with a leading-edge manufacturing capability.

Intel was an early developer of SRAM and DRAM memory chips, and this represented the majority of its business until 1981. Although Intel created the world's first commercial microprocessor chip in 1971, it was not until the success of the personal computer that this became its primary business. During the 1990s, Intel invested heavily in new microprocessor designs fostering the rapid growth of the computer industry.

INTEL		
G06F	100	electric digital data processing
H01L	40	semiconductor devices; electric solid state devices not otherwise provided for
H04L	26	transmission of digital information, e.g. telegraphic communication
H04N	16	pictorial communication, e.g. television
H05K	6	printed circuits; casings or constructional details of electric apparatus; manufacture of assemblages of electrical components
	268	

Intel owns, in all, 268 patents in India, during 2001-2014 period. These include technologies related to semiconductors, solid-state devices, and computer technologies. One-fourths of the company patents are also in different associated sub-classes, but in numbers smaller than five. Intel's patents during the overlapping period in USPTO total 21,552.

Janssen Pharmaceutica is a pharmaceutical company headquartered in Belgium.

Janssen Pharmaceutica conducts research and development activities related to a wide range of human medical disorders, including mental illness, neurological disorders, anaesthesia and analgesia, gastrointestinal disorders, fungal infection, allergies and cancer.

Janssen Pharmaceutica		
C07D	70	heterocyclic compounds
A61K	28	preparations for medical, dental, or toilet purposes
C07C	9	acyclic or carbocyclic compounds
	120	

The patents of this pharma company centres around pharmaceutical processes and organic fine chemistry.

Johnson & Johnson is an American multinational medical devices, pharmaceutical and consumer packaged goods manufacturer.

The corporation includes some 250 subsidiary companies with operations in over 57 countries and products sold in over 175 countries.

Johnson & Johnson's brands include numerous household names of medications and first aid supplies. Among its well-known consumer products are the Band-Aid Brand line of bandages, Tylenol medications, Johnson's baby products, Neutrogena skin and beauty products, Clean & Clear facial wash and Acuvue contact lenses. The company's business is divided into three major segments, pharmaceuticals, medical devices and diagnostics, and consumer products.

The company's major franchises in the pharmaceutical segment include immunology, neuroscience, infectious disease, and oncology.

Johnson & Johnson		
A61F	24	filters implantable into blood vessels; prostheses; devices providing patency to, or preventing collapsing of, tubular structures of the body, e.g. stents; orthopaedic, nursing or contraceptive devices; fomentation; treatment or protection of eyes or ears; bandages, dressings or absorbent pads; first-aid kits
G02C	20	spectacles; sunglasses or goggles insofar as they have the same features as spectacles; contact lenses
A61K	19	preparations for medical, dental, or toilet purposes
B29D	17	producing particular articles from plastics or from substances in a plasticstate
A61L	13	methods or apparatus for sterilizing materials or objects in general; disinfection, sterilisation, or deodorisation of air; chemical aspects of bandages, dressings, absorbent pads, or surgical articles; materials for bandages, dressings, absorbent pads, or surgical articles
C08F	6	macromolecular compounds obtained by reactions only involving carbon-to-carbon unsaturated bonds
B65D	6	containers for storage or transport of articles or materials, e.g. bags, barrels, bottles, boxes, cans, cartons, crates, drums, jars, tanks, hoppers, forwarding containers; accessories, closures, or fittings therefor; packaging elements; packages
A61B	5	diagnosis; surgery; identification
	160	

Johnson & Johnson own 2,200 patents in the USPTO during the post-2001 period, but in India, they have obtained patent rights on only 160 innovations during the same period. These include innovations on medical technology, medical equipment mainly absorbent pads, bandages, receptacles, and pharmaceuticals.

The company also has patents on special machines/ apparatus for sterilization, chemical aspects of bandages etc. A few in the area of macromolecular chemistry and polymers basically used in bandages, etc. Patents have also been obtained on containers for storage of these materials and a few on medical technologies per se.

LG Corporation is a South Korean multinational conglomerate corporation. It is the fourth-largest chaebol in South Korea. LG makes electronics, chemicals, and telecom products and operates subsidiaries such as LG Electronics, Zenith, LG Display, LG Telecom and LG Chem in over 80 countries.

LG Corp. established as Lak-Hui Chemical Industrial Corp. in 1947. In 1952 LG became the first Korean company to enter the plastics industry. As the company expanded its plastic business, it established GoldStar Co. Ltd. (currently LG Electronics Inc.) in 1958. Both companies Lucky and GoldStar merged and formed Lucky Goldstar. Currently LG has 16 holding companies in electronics industry, chemical industry, and telecommunication and services. LG has a diverse portfolio going with the background of the company. The company has 287 patents and included in them are: mobile communication, refrigeration washing machines, TV etc. The highest cluster of patents is in telecom related technologies, audio visual technologies, thermal processes, and apparatus. It also has patents on other consumer goods such as LCDs.

LG has 135 patents in all in IPO. These patents fall in the areas such as: basic materials chemistry, chemical engineering, organic chemistry, and molecular chemistry. The company also has a few patents on optics or measurement and electrical machinery.

LG Corporation		
H01M	54	processes or means, e.g. batteries, for the direct conversion of chemical energy into electrical energy
C09K	11	materials for applications not otherwise provided for; applications of materials not otherwise provided for
B01J	8	chemical or physical processes, e.g. catalysis, colloid chemistry; their relevant apparatus
C07C	8	acyclic or carbocyclic compounds
C08F	7	macromolecular compounds obtained by reactions only involving carbon-to-carbon unsaturated bonds
C09J	7	adhesives; non-mechanical aspects of adhesive processes in general; adhesive processes not provided for elsewhere; use of materials as adhesives
G02F	5	devices or arrangements, the optical operation of which is modified by changing the optical properties of the medium of the devices or arrangements for the control of the intensity, colour, phase, polarisation or direction of light, e.g. switching, gating, modulating or demodulating; techniques or procedures for the operation thereof; frequency-changing; non-linear optics; optical logic elements; optical analogue/digital converters
C07D	5	heterocyclic compounds
	135	-

Some of the patents in subclass G02F of the company are as follows:

- *In-plane switching liquid crystal display comprising compensation film for angular field of view using +a-plate and +c-plate*
- *In-plane switching liquid crystal display*
- *In-plane switching liquid crystal display with negative biaxial retardation film and (+) c-plate*
- *Complex light-compensation c plate for liquid crystal display,*

SchliffMaschinen, a Germany company, is one of the Leading names in manufacturing and providing technical services in the field of machine tools, precision surface, profile and creep feed grinding machines, heavy machineries as well technical solutions. The company was established in 2002

Schliff Maschinen		
D01H	98	spinning or twisting
D01G	49	preliminary treatment of fibres, e.g. for spinning
H01H	11	electric switches; relays; selectors; emergency protective devices
B65H	6	handling thin or filamentary material, e.g. sheets, webs, cables
DO1H	5	spinning or twisting
H01F	5	magnets; inductances; transformers; selection of materials for their magnetic properties
	224	

In IPO the company's 224 patents are mostly in textile processes preliminary treatment of fibers, spinning & twisting. The patents also deal with electrical machinery, handling filamentary materials. Some of the representative titles of the company in the subclass D01H are as follows:

- *Spinning ring for a spinning frame*
- *A spring frame comprising a drafting unit*
- *Filtering apparatus with a collecting element*
- *A method to exchange tapes at the lower rollers of the drafting unit of a ring spinning or ring twisting frame and a device for the same.*
- *An apparatus for forming a sliver*

Mitsubishi Electric Corporation is a Japanese multinational electronics and electrical equipment manufacturing company. It is one of the core companies of Mitsubishi Electric.

Mitsubishi Electric manufactures electric and architectural equipment. It is a major worldwide producer of photovoltaic panels.

Principal divisions and business units such as Building Systems; Communication Systems; Industrial Automation; Medical Systems; Power Systems; Semiconductors & Devices; Transportation; Visual Information Systems

Mitsubishi Electric Corporation		
H04B	31	transmission
G11B	26	information storage based on relative movement between record carrier and transducer
H04L	18	transmission of digital information, e.g. telegraphic communication
H04N	16	pictorial communication, e.g. television
H04Q	13	selecting (switches, relays, selectors h01h; wireless communication networks h04w)
H04J	12	multiplex communication
H01M	11	processes or means, e.g. batteries, for the direct conversion of chemical energy into electrical energy
G06F	11	electric digital data processing
H04M	10	telephonic communication
H03M	8	coding, decoding or code conversion, in general
H01Q	8	aerials
D06F	6	laundering, drying, ironing, pressing or folding textile articles
	231	

The company has been assigned 231 patents during 2001-14 period by IPO, which mainly deal with electrical apparatus in transmission, coding-decoding, audiovisual technologies and digital communication. The company also has a few patents on consumer goods, dealing with laundering etc.

As a consumer goods innovative company it owns over 100 000 patents in different patent offices of the world. India patents are only a fraction of its total holdings.

Motorola, Inc is multinational telecommunications company based in the United States is now divided in to Motorola Mobility and Motorola Solutions.

Motorola designed and sold wireless network equipment such as cellular transmission base stations and signal amplifiers. Motorola's home and broadcast network products include set-top boxes, digital video recorders, and network equipment used to enable video broadcasting, computer telephony, and high-definition television.

Motorola's wireless telephone handset division was a pioneer in cellular telephones.

In 1991, Motorola demonstrated the world's first working-prototype digital cellular system and phones using GSM standard. In 1994, Motorola introduced the world's first commercial digital radio system that combined paging, data and cellular communications and voice dispatch in a single radio network and handset. In 1995 Motorola introduced the world's first two-way pager which allowed users to receive text messages and e-mail and reply with a standard response.

In 1998, Motorola was overtaken by Nokia. In 2010 Motorola sold its cellular-infrastructure business to Nokia Siemens.

Motorola Inc		
H04Q	76	selecting (switches, relays, selectors H01H; wireless communication networks H04W)
H04B	63	transmission
H04L	33	transmission of digital information, e.g. telegraphic communication
G06F	27	electric digital data processing
H04M	22	telephonic communication
G08B	9	signalling or calling systems; order telegraphs; alarm systems
H04J	8	multiplex communication
G10L	6	speech analysis or synthesis; speech recognition; speech or voice processing; speech or audio coding or decoding
H04N	6	pictorial communication, e.g. television
H01Q	5	aerials
G09G	5	arrangements or circuits for control of indicating devices using static means to present variable information
H01M	5	processes or means, e.g. batteries, for the direct conversion of chemical energy into electrical energy
H03M	5	coding, decoding or code conversion, in general
	338	

Motorola's 338 patents are in the technologies such as telecom, wireless communication, digital communication and associated equipment, digital data processes, code conversion, multiplex communication to facilitate data transmission etc. Also in the portfolio are patents on speech recognition and voice processing. Some of the company's patents in this category in IPO are as follows:

- *A method and apparatus for coding speech*
- *A communication unit having a voice activity detection mechanism and a method of detecting a speed signal input to the communication unit*
- *An apparatus for mitigating errors in a distributed speech recognition process*
- *Method and apparatus for performing harmonic noise weighting in digital speech coders*

Nokia Oyj is a Finnish multinational communications and information technology company. Nokia operates across 120 countries.

The company currently focuses on large-scale tele communications infrastructures, technology development and licensing and online mapping services. Nokia is also a significant contributor to the mobile telephony industry, having assisted in development of the GSM and LTE standards, and was, for a period, the largest vendor of mobile phones in the world. In September 2013, Microsoft announced that it would acquire Nokia's mobile phone business.

In the 1970s, Nokia became more involved in the telecommunications industry by developing the Nokia DX 200, a digital switch for telephone exchanges. The DX 200 became the workhorse of the network equipment division. Its architecture enabled it to develop into various switching products.

Nokia Oyj		
H04L	99	transmission of digital information, e.g. telegraphic communication
H04Q	92	selecting (switches, relays, selectors H01H; wireless communication networks H04W)
G06F	34	electric digital data processing
H04M	20	telephonic communication
H04B	16	transmission
G10L	12	speech analysis or synthesis; speech recognition; speech or voice processing; speech or audio coding or decoding
H04N	12	pictorial communication, e.g. television
H04J	11	multiplex communication
H03M	6	coding, decoding or code conversion, in general
	324	

Nokia patents are in their core activities of mobile telephony. Patents are in the areas of transmission, wireless communication, electrical digital data processing, code conversion and the like. Nokia owns over 87 000 patents world over in different patent offices.

The following are some of Nokia's patents in sub-class G10L:

- *Method and devices for source controlled variable bit-rate wideband speech coding* [220573]
- *Method and device for gain quantization in variable bit rate wideband speech coding* [223991]
- *An lpc-type speech synthesiser and a post-processing method for enhancing lpc-synthesised speech* [241026]
- *Method and apparatus for encoding an audio signal* [253989]
- *Audio coding system* [256191]
- *Apparatus configured to communicate with a packet network* [260582]
- *Selection of coding model excitation for an audio signal* [260899]

Novartis International AG is a Swiss multinational pharmaceutical company based in Switzerland. It ranked number one in sales among the world-wide industry in 2013. In 1996, Ciba-Geigy merged with Sandoz, and the pharmaceutical and agrochemical divisions of both companies formed Novartis as an independent entity.

Novartis manufactures such drugs as clozapine (Clozaril), diclofenac (Voltaren), carbamazepine (Tegretol), valsartan (Diovan) and imatinib mesylate (Gleevec/Glivec). Additional agents include cyclosporin (Neoral/Sandimmun), letrozole (Femara), methylphenidate (Ritalin), terbinafine (Lamisil), and others.

The company's global research operation is called Novartis Institutes for BioMedical Research. Two research institutes reside within NIBR that focus on diseases in the developing world. Novartis Institute for Tropical

Diseases, which works on tuberculosis, dengue, and malaria. Novartis Vaccines Institute for Global Health, which works on salmonella typhi(typhoid fever) and shigella.

Novartis International AG		
A61K	104	preparations for medical, dental, or toilet purposes
C07D	69	heterocyclic compounds
C07C	22	acyclic or carbocyclic compounds
C07K	18	peptides
A01N	7	preservation of bodies of humans or animals or plants or parts thereof
C07D	6	heterocyclic compounds
	255	-

Novartis patents obtained in India are basically in chemistry associated with pharmaceuticals, biotechnology, and organic and basic materials chemistry. Novartis Indian patent holdings are fewer compared to its global possession of over 47 000. The company lost a controversial 'ever greening' case relating to patent on drug *Gleevec* in India

Outokumpu is a group of companies headquartered in Finland, producing stainless steel and high performance alloys in more than 30 countries. Outokumpu has a long history as a mining company, and it still mines chromium ore in Kemnmaa for use as ferrochrome in stainless steel.

Outokumpu Tech.		
C22B	22	production or refining of metals
B01D	12	separation
F27D	7	details or accessories of furnaces, kilns, ovens, or retorts, in so far as they are of kinds occurring in more than one kind of furnace
B01J	6	chemical or physical processes, e.g. catalysis, colloid chemistry; their relevant apparatus
F27B	6	furnaces, kilns, ovens, or retorts in general; open sintering or like apparatus
C25C	6	processes for the electrolytic production, recovery or refining of metals
C21B	6	manufacture of iron or steel
	102	

Outokumpu's patents related to its core competence and are in IPC classes relating to chemical processes and those relations to iron and steel manufacturing.

Panasonic Corporation formerly known as Matsushita Electric Industrial Co., is a Japanese multinational electronics corporation headquartered in Japan. From 1935 to October 1, 2008, the company name was Matsushita Electric Industrial Co., Ltd.

The company was founded in 1918, and has grown to become one of the largest Japanese electronics producers. Canon Inc. Panasonic is the world's fourth-largest television manufacturer by 2012 market share. The company used the brand National outside of North America from the 1950s to the 1970s. It sold televisions, VHS VCRs, high fidelity stereo receivers, multi-band shortwave radios, and marine radio direction finders.

Panasonic's operations are organised into three broad business fields - Consumer, Solutions and Components & Devices - and nine domain companies - AVC Networks, Eco Solutions, Appliances, Industrial Devices, Systems and Communications, Automotive Systems, Energy, Healthcare, and Manufacturing Solutions.

Panasonic Automotive Systems is an original equipment manufacturer of factory installed mobile audio equipment such as head units, speakers and navigation modules. Panasonic Avionics Corporation, a subsidiary of Panasonic Corporation of North America, is a supplier of in-flight entertainment and communication systems. Panasonic Mobile Communications manufactures mobile phone handsets and related equipment.

Panasonic has over 580 subsidiary companies.

Panasonic Corporation		
H04N	23	pictorial communication, e.g. television
G11B	21	information storage based on relative movement between record carrier and transducer
H04L	10	transmission of digital information, e.g. telegraphic communication
H04Q	7	selecting (switches, relays, selectors H01H; wireless communication networks H04W)
G06F	6	electric digital data processing
H01M	5	processes or means, e.g. batteries, for the direct conversion of chemical energy into electrical energy
	106	

Panasonic's patents are in the technologies relating to audiovisuals digital communication and those relating to electrical energy used in these devices. Compared to global holdings, which is over 100 000 patents, Panasonic's patents are far fewer in IPO and cover select of technologies only.

Procter & Gamble Co. is an American multinational consumer goods company. Its products include pet foods, cleaning agents, and personal care items. Prior to the sale of Pringles to Kellogg Company, its product line included foods and beverages.

In January 2005 P&G announced an acquisition of Gillette, forming the largest consumer goods company and placing Unilever into second place.

From 2014, the company structure is categorized into four sectors - Beauty Care; Baby, Feminine, and Family Care; Fabric and Home Care; Health and Grooming.

Procter & Gamble Co		
C11D	133	detergent compositions; use of single substances as detergents; soap or soap-making; resin soaps; recovery of glycerol
A61F	63	filters implantable into blood vessels; prostheses; devices providing patency to, or preventing collapsing of, tubular structures of the body, e.g. stents; orthopaedic, nursing or contraceptive devices; fomentation; treatment or protection of eyes or ears; bandages, dressings or absorbent pads; first-aid kits
A61K	36	preparations for medical, dental, or toilet purposes
C07D	13	heterocyclic compounds
A61L	11	methods or apparatus for sterilizing materials or objects in general; disinfection, sterilisation, or deodorisation of air; chemical aspects of bandages, dressings, absorbent pads, or surgical articles; materials for bandages, dressings, absorbent pads, or surgical articles
C07C	11	acyclic or carbocyclic compounds
A23L	8	foods, foodstuffs, or non-alcoholic beverages; their preparation or treatment, e.g. cooking, modification of nutritive qualities, physical treatment
C02F	7	treatment of water, waste water, sewage, or sludge
B32B	6	layered products, i.e. products built-up of strata of flat or non-flat, e.g. cellular or honeycomb, form
C08L	6	compositions of macromolecular compounds
B65D	6	containers for storage or transport of articles or materials, e.g. bags, barrels, bottles, boxes, cans, cartons, crates, drums, jars, tanks, hoppers, forwarding containers; accessories, closures, or fittings there for; packaging elements; packages
	383	

As consumer goods company, a third of P&G patents are in basic materials chemistry. Nearly a hundred patents are in medical technology, pharmaceuticals. P&G also has innovations in food chemistry, macro molecular chemistry and products that fall under the heading - handling of materials. Some of the patents in handling category are as follows:

- *A cap having a button for the actuation of a valve of a container*
- *A reusable hand-held container*
- *Easy opening re-closeable bag*
- *A mineral fortification system*
- *A container system*
- *Child resistant sachet*
- *A cap having a button for the actuation of a valve of a container*

P&G patents under the IPC class C11D(70), A61F (46) is around the same as the number patented in IPO. The company's global patents are to the tune of 1574.

Koninklijke Philips N.V. is a Dutch diversified technology company. It is one of the largest electronics companies in the world. Philips is organized into three main divisions: Philips Consumer Lifestyle, Philips Healthcare, and Philips Lighting.

Philips introduced the audio Compact Audio Cassette tape in 1963. Philips introduced the first combination portable radio and cassette recorder. Later, the cassette was used in telephone answering machines, including a special form of cassette where the tape was wound on an endless loop.

In 1972 Philips launched the world's first home video cassette recorder. Later one-hour tapes were also offered. As competition increased Philips introduced the N1700 system which allowed double-length recording. The concept was quickly copied by the Japanese makers, whose tapes were significantly cheaper.

Koninklijke Philips Electronics		
G11B	187	information storage based on relative movement between record carrier and transducer
H04N	103	pictorial communication, e.g. television
G06F	65	electric digital data processing
H04L	45	transmission of digital information, e.g. telegraphic communication
G10L	23	speech analysis or synthesis; speechrecognition; speech or voice processing;speech or audio coding or decoding
G06T	21	image data processing or generation, in general
H04B	19	transmission
H03M	18	coding, decoding or code conversion, in general
H04Q	16	selecting
B26B	12	hand-held cutting tools not otherwise provided for
A61B	11	diagnosis; surgery; identification
G02B	11	optical elements, systems, or apparatus
H01J	7	electric discharge tubes or discharge lamps
G01R	7	measuring electric variables; measuring magnetic variables
G01S	7	radio direction-finding; radio navigation; determining distance or velocity by use of radio waves; locating or presence-detecting by use of the reflection orre-radiation of radio waves; analogous arrangements using other waves
G06K	6	recognition of data; presentation of data;record carriers; handling record carriers
G09G	5	arrangements or circuits for control of indicating devices using static means to present variable information
H04H	5	broadcast communication
A47J	5	kitchen equipment; coffee mills; spice mills; apparatus for making beverages
D06F	5	laundering, drying, ironing, pressing or folding textile articles
H04S	5	stereophonic systems
G02F	4	devices or arrangements, the optical operation of which is modified by changing the optical properties of the medium of the devices or arrangements for the control of the intensity, colour, phase, polarisation or direction of light, e.g. switching, gating, modulating or demodulating; techniques or procedures for the operation thereof; frequency-changing; non-linear optics; optical logic elements; optical analogue/digital converters
	662	

Philips has the second largest patent portfolio among the foreign entities in the country. Philips deals with a variety of consumer products locally. Audiovisuals take the important place in the company's patents. These patents fall in digital communication, computer technologies, stereophonic systems and telecommunication. Philips' patents are also noticeable in medical instrumentation (A61B) electrical machinery, instrumentation (measurement) and other consumer goods like washing machines. Some of the patents in the D06F are as follows:

- *Electric iron arrangement*
- *Steam ironing device*
- *Method for controlling an ironing temperature during a steam ironing process*
- *Steam iron and a method for operating the steam iron*

Praxair Inc., is the largest industrial gases company in North and South America. The company was originally founded as Union Carbide in 1907. Praxair was the first company in North America to commercialize cryogenically separated oxygen. The company introduced the first distribution system for liquid gas in 1917 and developed on-site gas supply in the 1940s. In the 1960s, Praxair introduced non-cryogenic means of air separation. Praxair operates in more than 50 countries.

Praxair, Inc.		
B01D	23	separation
F25J	14	liquefaction, solidification, or separation of gases or gaseous mixtures by pressure and cold treatment
C01B	9	non-metallic elements; compounds thereof
B01J	7	chemical or physical processes, e.g. catalysis, colloid chemistry; their relevant apparatus
B01F	5	mixing, e.g. dissolving, emulsifying, dispersing
	115	

The company has a total of 115 patents assigned during 2001-2014 period in India. These are mostly associated with environmental engineering and associated chemical engineering. Over half of its patents are in the diverse sub-classes and holdings are in smaller numbers. The following are some of the company's patents:

- *Cryogenic indirect oxygen compression system [189050]*
- *A method for heating or melting a charge of material in a direct-fired furnace [195262]*
- *Method for providing refrigeration [195713]*
- *A method for producing cryogenic liquefied industrial gas [197099]*
- *A method for producing lower purity oxygen [197362]*
- *Coherent jet injector lance [199533]*
- *Methods for removing contaminants from polymers [199658]*
- *A method for producing high and low purity oxygen and an apparatus for producing the same [199809]*

Qualcomm Incorporated is an American global semiconductor company started in 1985 that designs and markets wireless telecommunications products and services. The company has 157 worldwide locations. Qualcomm's wholly owned subsidiary, Qualcomm Technologies, Inc., operates substantially all of Qualcomm's R&D activities, as well as its product and services businesses, including its semiconductor business, Qualcomm CDMA Technologies.

Qualcomm pioneered the commercialization of the CDMA One (IS-95) standard for wireless cellular communications, following up with CDMA2000, an early standard for third-generation (3G) mobile.

Currently, the company is the leading patent holder in advanced 3G mobile technologies, including CDMA2000 1xEV-DO and its evolutions; WCDMA and its higher-speed variant known as HSPA and its evolutions; and TD-SCDMA;

as well as patents on 4G. The license streams from the patents on these inventions, and related products, are a major component of Qualcomm's business. Qualcomm has several products which include the following:

1. Tracking devices
2. Semiconductors
3. Satellite phones -
4. MediaFLO - which transmits 12-15 television channels within 6 MHz of spectrum. Qualcomm has standardized the lower layers of this design in TIA, and manufactures chips and software to add this television capability to cellphones.
5. QChat - QChat is a cellular/data 2-way push-to-talk voice communications program.
6. Qualcomm Gobi - a mobile broadband chipset used mainly for cellular data networking and it is also now used in a few enterprise smart phones.
7. Mirasol displays - Mirasol displays are the world's first and only reflective, bistable display based on IMOD technology.
8. Operating system - BREW (Binary Runtime Environment for Wireless) is a proprietary cell phone application platform.
9. Speech codec - Qualcomm has developed an audio codec for speech called PureVoice, which, besides use on mobile phones, was also licensed for use in the very popular Chinese instant messaging software Tencent QQ.
10. Eudora client -
11. Eudora servers -
12. Management & Diagnostic tool[edit]
13. QPST (Qualcomm Product Support Tool),
14. QXDM (Qualcomm eXtensible Diagnostic Monitor)
15. QPST and diagnostic (QXDM) Qualcomm based devices.
16. QChat is a Push-to-Talk (PTT) technology.

Qualcomm has development centres in 37 countries spanning most of the continents, including in India.

In IPO Qualcomm has the second highest number of patents - 1,554 during the 2001-2014 period. In the USPTO the total for the same period is - 10,588. Internationally, spanning other patent offices, Qualcomm's patent holdings exceed 100,000. Qualcomm patents are discussed separately under the section on telecom.

BlackBerry Limited, formerly known as Research In Motion Limited (RIM), is a Canadian telecommunication and wireless equipment company best known to the general public as the developer of the BlackBerry brand of smartphones and tablets, but also well known worldwide as a provider of secure & high reliability software for industrial applications and mobile device management. BlackBerry's software and hardware products are used worldwide by various government agencies and by car makers and industrial plants throughout the world, much of this activity being unseen by the public.

In 1996, RIM introduced the Interactive Pager, the first two-way messaging pager, and the RIM 900 OEM radio modem. The company worked with RAM Mobile Data and Ericsson to turn the Ericsson-developed Mobitex wireless data network into a two-way paging and wireless e-mail network.

The primary competitors of the BlackBerry are smart phones running Android and the Apple iPhone, with Microsoft's Windows Phone platform emerging as a more recent competitor.

BlackBerry Limited		
G06F	43	electric digital data processing
H04L	35	transmission of digital information, e.g. telegraphic communication
H04Q	27	selecting (switches, relays, selectors h01h; wireless communication networks h04w)
H04M	12	telephonic communication
H04B	11	transmission
H04N	5	pictorial communication, e.g. television
	167	

This Canadian company's inventions registered in India deal with audiovisual, digital and wireless communications. The arrival of the Apple iPhone and later Google's Android platform caused a slowdown in BlackBerry growth and a decline in sales.

Samsung is a South Korean multinational conglomerate. It comprises numerous subsidiaries and affiliated businesses, most of them united under the *Samsung* brand. It is highly diversified, with activities in areas including construction, consumer electronics, financial services, shipbuilding, and medical services.

Samsung entered the electronics industry in the late 1960s and the construction and shipbuilding industries in the mid-1970s; these areas would drive its subsequent growth. Samsung has increasingly globalized its activities, and electronics, particularly mobile phones and semiconductors have become its most important source of income. Notable Samsung industrial subsidiaries include Samsung Electronics, Samsung Heavy Industries, and Samsung Engineering and Samsung C&T. Other notable subsidiaries include Samsung Life Insurance, Samsung Everland, and Cheil Worldwide.

Samsung became the largest producer of memory chips in the world in 1992, and is the world's second-largest chipmaker after Intel. The company is a pioneer in liquid-crystal display screen.

In first quarter of 2012, Samsung Electronics became the world's largest mobile phone maker overtaking Nokia.

SAMSUNG		
G11B	129	information storage based on relative movement between record carrier and transducer
H04B	128	transmission
H04L	73	transmission of digital information, e.g. telegraphic communication
G06F	48	electric digital data processing
H04N	38	pictorial communication, e.g. television
H03M	33	coding, decoding or code conversion, in general
H04J	25	multiplex communication
H04Q	20	selecting (switches, relays, selectors h01h; wireless communication networks h04w)
G02B	13	optical elements, systems, or apparatus

F25D	9	refrigerators; cold rooms; ice-boxes; cooling or freezing apparatus not covered by any other subclass
G06T	8	image data processing or generation, in general
C03B	6	manufacture or shaping of glass, or of mineral or slag wool; supplementary processes in the manufacture or shaping of glass, or of mineral or slag wool
	605	

Samsung is one of the top patent holders in the country with over 600 patents. The patents fall in their core area of operation such as digital and telecommunications. One-third of the patents are in IPC sub-classes G11B and H04B which relates to mobile telephony related technologies in general. Samsung also has a fully owned Indian subsidiary which has also been assigned separately as Indian patents under its own name. Its global patent ownership exceeds 100 000. Samsung has obtained 60 906 patents in USPTO during 2001-2014 period.

Samsung R&D Institute India is a Private Limited R&D Company headquartered in Bangalore. SRI-B contributes to the different technologies in Wireless, Networking, Convergence, Digital and Semi-conductor in India. The R&D activities focus on technologies such as, B2B, Digital Printing Division, System LSI Division, Memory Solutions Division, Telecom and Network Division, Wireless Terminals Division, Health Care and Smart School solutions, and the like.

Samsung R&D India		
H04L	52	Transmission of digital information, e.g. Telegraphic communication
G06F	48	Electric digital data processing
H04Q	30	Selecting
H04N	21	Pictorial communication, e.g. Television
H04M	18	Telephonic communication
H04B	13	Transmission
B41J	7	Typewriters; selective printing mechanisms, i.e. Mechanisms printing otherwise than from a forme; correction of typographical errors
H04J	5	Multiplex communication

Samsung R&D India focuses on semiconductors and telecommunications.

Sanofi S.A. is a French multinational pharmaceutical company headquartered in France. As of 2013 the company had world's fifth-largest by prescription sales. The company was formed as Sanofi-Aventis in 2004 by the merger of Aventis and Sanofi-Synthelabo, which were each the product of several previous mergers. It changed its name to Sanofi in May 2011.

Sanofi engages in the research and development, manufacturing and marketing of pharmaceutical drugs principally in the prescription market, but the firm also develops over-the-counter medication. The company covers seven major therapeutic areas: cardiovascular, central nervous system, diabetes, internal medicine, oncology, thrombosis and vaccines.

Sanofi S.A.		
C07D	96	heterocyclic compounds
A61K	59	preparations for medical, dental, or toilet purposes
C07C	25	acyclic or carbocyclic compounds
C07K	18	peptides
C12N	10	micro-organisms or enzymes; compositions thereof
C07H	8	sugars; derivatives thereof; nucleosides; nucleotides; nucleic acids
C12Q	7	measuring or testing processes involving enzymes or micro-organisms
	257	

The company's 257 patents deal with pharmaceuticals, biotechnology and organic fine chemistry products and processes. Sanofi owns over 37 000 patents worldwide.

Schneider Electric SE is a European multinational corporation that specializes in electricity distribution, automation management and produces installation components for energy management. The roots of this company are in the iron, steel, and armaments factories of Schneider-Creusot and other industrial concerns.

Schneider Electric SE		
H01H	57	electric switches; relays; selectors; emergency protective devices
H02H	12	emergency protective circuit arrangements
H02B	11	boards, substations, or switching arrangements for the supply or distribution of electric power
H01R	6	electrically-conductive connections; structural associations of a plurality of mutually-insulated electrical connecting elements; coupling devices; current collectors
	99	

In India all the patents of the company are on electrical machinery dealing with either circuit arrangement, switches, protective devices etc.

Shell Oil Company is the United States-based subsidiary of Royal Dutch Shell which is among the largest oil companies in the world. Shell Oil Company is one of America's largest oil and natural gas producers, natural gas marketers, gasoline marketers, and petrochemical manufacturers.

Shell products include oils, fuels, and card services as well as exploration, production, and refining of petroleum products.

Shell gasoline previously included the RU2000 and SU2000 lines but they have been superseded by the V-Powerline.

Shell Oil Company		
E21B	57	earth or rock drilling
C10G	45	cracking hydrocarbon oils; production of liquid hydrocarbon mixtures, e.g. by destructive hydrogenation, oligomerisation, polymerisation
B01J	20	chemical or physical processes, e.g. catalysis, colloid chemistry; their relevant apparatus

C10M	19	lubricating compositions (well drilling compositions c09k 8/02); use of chemical substances either alone or as lubricating ingredients in a lubricating composition
B01D	17	separation
C07C	17	acyclic or carbocyclic compounds
C07D	14	heterocyclic compounds
C10L	9	fuels not otherwise provided for; natural gas; synthetic natural gas obtained by processes not covered by subclasses c10g or c10k; liquefied petroleum gas; use of additives to fuels or fires; fire-lighters
C01B	8	non-metallic elements; compounds thereof
F25J	7	liquefaction, solidification, or separation of gases or gaseous mixtures by pressure and cold treatment
C08L	6	compositions of macromolecular compounds
C08G	6	macromolecular compounds obtained otherwise than by reactions only involving carbon-to-carbon unsaturated bonds
	280	

Shell has 280 patents in IPO during the post-2001 period and they deal, among other things, with civil engineering operation such as drilling. The chemistry related patents are in the areas of cracking hydrocarbon oils, lubricating compositions (basic materials chemistry) processes relating to environmental engineering, macro molecular chemistry etc. The innovations exclusively deal with the technologies directly associated with the Shell's operations of petrochemicals. Shell owns over 100 000 patents world over and its US PTO possession is over 7,500 patents.

Siemens AG is a German multinational conglomerate. It is the largest engineering company in Europe. The principal divisions of the company are Industry, Energy, Healthcare, and Infrastructure & Cities, which represent their main activities. The company is a prominent maker of medical diagnostics. Siemens operates in around 190 countries and approximately 285 production and manufacturing facilities.

Siemens offers a wide range of electrical engineering- and electronics-related products and services. Its products fall into the following categories: buildings-related; drives, automation and industrial plant-related; energy-related; lighting; medical; and transportation and logistics-related.

Siemens invests equivalent of around 5% of revenues on R&D. Siemens hold approximately 53,300 patents worldwide.

Siemens AG		
H01H	50	electric switches; relays; selectors; emergency protective devices
H04L	45	transmission of digital information, e.g. telegraphic communication
G05B	27	control or regulating systems in general; functional elements of such systems; monitoring or testing arrangements for such systems or elements
H04Q	23	selecting (switches, relays, selectors h01h; wireless communication networks h04w)
H02B	17	boards, substations, or switching arrangements for the supply or distribution of electric power
H04B	15	transmission

G06F	15	electric digital data processing
H02H	13	emergency protective circuit arrangements
F22B	12	methods of steam generation; steam boilers
B21B	12	rolling of metal
F01K	11	steam engine plants; steam accumulators; engine plants not otherwise provided for; engines using special working fluids or cycles
G08B	10	signalling or calling systems; order telegraphs; alarm systems
H04M	8	telephonic communication
B61L	7	guiding railway traffic; ensuring the safety of railway traffic
F01D	7	non-positive-displacement machines or engines, e.g. steam turbines
F02C	7	gas-turbine plants; air intakes for jet-propulsion plants; controlling fuel supply in air-breathing jet-propulsion plants
H01F	7	magnets; inductances; transformers; selection of materials for their magnetic properties
H04N	7	pictorial communication, e.g. television
H04R	6	loudspeakers, microphones, gramophone pick-ups or like acoustic electro mechanical transducers; deaf-aid sets; public address systems
B22D	6	casting of metals; casting of other substances by the same processes or devices
F02M	6	supplying combustion engines in general with combustible mixtures or constituents thereof
H01R	6	electrically-conductive connections; structural associations of a plurality of mutually-insulated electrical connecting elements; coupling devices; current collectors
B01D	5	separation
G06K	5	recognition of data; presentation of data; record carriers; handling record carriers
G01F	5	measuring volume, volume flow, mass flow, or liquid level; metering by volume
H05K	5	printed circuits; casings or constructional details of electric apparatus; manufacture of assemblages of electrical components
H02K	5	dynamo-electric machines
	493	-

With 493 patents in IPO the company is among the top five foreign patent holders in the country during the last decade and a half. The patents are in a host of sub-classes. The main concentration of patents are in digital and telecommunication, transmission control, instrumentation, machine tools, mechanical engineering - in the shape of engines, electrical machinery etc. The patents are dissipated in several sub-classes in small numbers. This reflects selective patenting. Globally Siemens' patents exceed 100 000.

Silverbrook Research Pty Ltd. Kia Silverbrook is an Australian inventor, scientist, and serial entrepreneur. He is the most prolific inventor in the world, and has been granted more than 4,665 US utility patents. Internationally, he has nearly 10,000 patents or patent applications registered at the international patent document database (INPADOC). Silverbrook has founded companies and developed products in a wide range of disciplines, including computer graphics, video and audio production, scientific computing, factory automation, digital printing, liquid crystal displays, molecular electronics, internet software, content management, genetic analysis, MEMS devices, security inks, photovoltaic solar cells, and interactive paper.

Silverbrook has made numerous inventions in the fields of digital music synthesis, digital video, digital printing, digital paper, internet commerce, computer graphics, liquid crystal displays, robotics, 3D printing, organic chemistry, DNA analysis, lab-on-a-chip, solar photovoltaics, software, image processing, microelectromechanical systems, mechanical engineering, cryptography, sensors, nanotechnology, microfluidics, polymers, fault tolerance, parallel processing, semiconductor fabrication, and integrated circuit (chip) architecture.

Silverbrook Research Pty Ltd		
B41J	111	Cycle saddles or seats; accessories peculiar to cycles and not otherwise provided for, e.g. Article carriers or cycle protectors
G06F	26	Electric digital data processing
G06K	19	Recognition of data; presentation of data; record carriers; handling record carriers This subclass covers: marking, sensing, and conveying of record carriers; recognising characters or other data; presenting visually or otherwise the data recognised or the result of a computation.
G03B	6	Apparatus or arrangements for taking photographs or for projecting or viewing them; apparatus or arrangements employing analogous techniques using waves other than optical waves; accessories therefor
	205	

Sony Corporation is the electronics business unit and the parent company of the Sony Group, which is engaged in business through its four operating segments - electronics (including video games, network services and medical business), motion pictures, music and financial services. These make Sony one of the most comprehensive entertainment companies in the world. Sony is among the worldwide top 20 semiconductor sales leaders, the fourth-largest television manufacturer in the world, after Samsung Electronics, LG Electronics and TCL.

Sony produced the world's first portable music player, the Walkman in 1979. This line fostered a fundamental change in music listening habits by allowing people to carry music with them and listen to music through lightweight headphones.

Sony Corporation		
G11B	80	information storage based on relative movement between record carrier and transducer
H04N	41	pictorial communication, e.g. television
G06F	40	electric digital data processing
H04L	25	transmission of digital information, e.g. telegraphic communication
H04M	13	telephonic communication
H04B	8	transmission
H04R	7	loudspeakers, microphones, gramophone pick-ups or like acoustic electro mechanical transducers; deaf-aid sets; public address systems
G06T	6	image data processing or generation, in general
	318	

Sony deals with a host of businesses and their total patent holding world over is more than 100 000. Their Indian holdings are limited to information storage, telecommunications, including digital communication. One-third of their patents are in measurement, instrumentation, and medical equipment. Their India holdings also focus on audiovisual technologies.

Steel Authority of India Limited (SAIL) is one of the largest state-owned steel making company of India and one of the top steel makers in world. SAIL operates and owns five integrated steel plants. According to a recent survey, SAIL is one of India's fastest growing Public Sector Units. Among other facilities, the company has a full-fledged R&D centre for Iron & Steel, Centre for Engineering and Technology.

Steel Authority of India Ltd.		
C21D	17	Modifying the physical structure of ferrous metals; general devices for heat treatment of ferrous or non-ferrous metals or alloys; making metal malleable by decarburisation, tempering, or other treatments
C22C	14	Alloys
B21B	12	Rolling of metal
C04B	10	Lime; magnesia; slag; cements; compositions thereof, e.g. Mortars, concrete or like building materials; artificial stone; ceramics
C21C	7	Processing of pig-iron, e.g. Refining, manufacture of wrought-iron or steel; treatment in molten state of ferrous alloys
B22D	7	Casting of metals; casting of other substances by the same processes or devices
C10B	6	Destructive distillation of carbonaceous materials for production of gas, coke, tar, or similar materials
C21B	5	Manufacture of iron or steel
C01B	5	Non-metallic elements; compounds thereof (fermentation or enzyme-using processes for the preparation of elements or inorganic compounds
	179	

SAIL patents are in the area of metallurgy and materials.

Sumitomo Chemical Co., Ltd., is a major Japanese chemical company. It's a member of the Sumitomo group and was founded in 1913 as a fertilizer manufacturing plant. The company has as many as 10 different labs catering exclusively to Petrochemicals, Energy & Functional Materials, IT-related Chemicals, Health & Crop Sciences, Industrial Technology, Environmental Health Science, Tsukuba Material Development, Advanced Materials Research, Genomic Science, and Production & Safety.

Sumitomo Chemical Co.		
C07C	50	acyclic or carbocyclic compounds
C07D	39	heterocyclic compounds
A01N	21	preservation of bodies of humans or animals or plants or parts thereof
B01J	6	chemical or physical processes, e.g. catalysis, colloid chemistry; their relevant apparatus
	131	

In India most of the company's patents deal with processes relating to organic fine chemistry and a few in basic materials chemistry. Globally Sumito Chemicals own nearly 85 000 patents.

Syngenta AG is a global Swiss agribusiness that markets seeds and agrochemicals. Syngenta is involved in biotechnology and genomic research. It was formed in 2000 by the merger of Novartis Agribusiness and Zeneca Agrochemicals. The company was ranked third in total seeds and biotechnology sales in 2009 in the commercial market. Syngenta operations are in over 90 countries.

Like many agriculture companies, Syngenta also works in the biofuel space. In 2011, it announced the corn trait ENOGEN to reduce substantially the consumption of water and energy versus conventional corn. Several ethanol producers plan to process such improved corn. For example, Syngenta has signed a commercial agreement with Three Rivers Energy, LLC, Ohio, USA to use grain featuring Enogen trait technology following the 2014 corn harvest.

Syngenta		
A01N	75	preservation of bodies of humans or animals or plants or parts thereof
C07D	42	heterocyclic compounds
C07C	23	acyclic or carbocyclic compounds
C12N	13	micro-organisms or enzymes; compositions thereof
	187	

Most of the company's technology ownership in India deals with innovations in basic and organic chemistry. They also have taken patents in biochemistry in the country.

Tata Steel Limited is an Indian multinational steel-making company and a subsidiary of the Tata Group. Tata Steel has manufacturing operations in 26 countries, including Australia, China, India, the Netherlands, and the United Kingdom. The company was ranked 486 in the 2014 Fortune Global 500 ranking of the world's biggest corporations.

Tata Steel		
C21C	15	Processing of pig-iron, e.g. Refining, manufacture of wrought-iron or steel; treatment in molten state of ferrous alloys
G01N	13	Investigating or analysing materials by determining their chemical or physical properties
C21D	9	Modifying the physical structure of ferrous metals; general devices for heat treatment of ferrous or non-ferrous metals or alloys; making metal malleable by decarburisation, tempering, or other treatments
B21B	8	Rolling of metal
C22C	8	Alloys
C22B	7	Production or refining of metals
C21B	7	Manufacture of iron or steel
B22D	6	Casting of metals; casting of other substances by the same processes or devices
	184	

Tata Steel innovations are in materials and metallurgy

TVS Motor Company is the third largest two-wheeler manufacturer in India and one among the top ten in the world. TVS Group spans across industries like Automobile, Aviation, Education, Electronics, Energy, Finance, Housing, Insurance, Investment, Logistics, Service, textiles. TVS Motor's strength lies in design and development of new products.

TVS		
B62K	13	Cycles; cycle frames; cycle steering devices; rider-operated terminal controls specially adapted for cycles; cycle axle suspensions; cycle sidecars, forecars, or the like
B62J	8	Cycle saddles or seats; accessories peculiar to cycles and not otherwise provided for, e.g. Article carriers or cycle protectors
F16H	7	Gearing
B60R	7	Vehicles, vehicle fittings, or vehicle parts, not otherwise provided for
B60Q	6	Arrangement of signalling or lighting devices, the mounting or supporting thereof or circuits therefor, for vehicles in general
B60K	5	Arrangement or mounting of propulsion units or of transmissions in vehicles; arrangement or mounting of plural diverse prime-movers in vehicles; auxiliary drives for vehicles; instrumentation or dashboards for vehicles
	104	

TVS innovations are in transport, mechanical elements relating to automotive industry.

UOP LLC, formerly known as Universal Oil Products, is a multi-national company developing and delivering technology to the petroleum refining, gas processing, petrochemical production, and major manufacturing industries.

UOP products fall into two groupings, physical products that can be seen, and technology products that provide knowledge and design. Physical products tend to be items used within a refinery or petrochemical plant to help convert chemicals into a desired product. Technology products tend to be based upon the ability to convert one chemical into another, refine crude oil, and separate chemicals from each other. These also include adsorption separation technology and renewable fuels technology.

In 2008, UOP revealed its ecofining process which takes vegetable oils, or lipids, and converts them into replacements for diesel and jet fuels. The resultant fuels from this refining process are indistinguishable from existing fossil-based petro-diesels and jet fuels.

UOP LLC		
C07C	43	acyclic or carbocyclic compounds
C10G	25	cracking hydrocarbon oils; production of liquid hydrocarbon mixtures, e.g. by destructive hydrogenation, oligomerisation, polymerisation
B01J	19	chemical or physical processes, e.g. catalysis, colloid chemistry; their relevant apparatus
C01B	6	non-metallic elements; compounds thereof
B01D	5	separation
	115	

UOP's patents obtained in IPO are in the areas of chemical engineering, basic materials and organic chemistry. UOP has obtained nearly 6 800 patents. The company's US patent holdings are around 1900.

The above 65 assignees are Indian and foreign entities which hold over 100 or more patents each during time period covered by this analysis. As could be seen most of them own several times more patents in other patent offices and their Indian portfolio is invariably small and selective. However, their new technology ownership could be a reflection of the state of the Indian economy, growth potential, possible consumer base for new technologies and innovation capability as perceived by them. IPO has attracted a large assignee base with the opening of PCT route. However, their patent possession is very small. As most of these top patent holders are MNCs, their indirect patent ownership in India could be slightly more due to mergers and new acquisitions have turned out to be a continuous process.

6 Medical Device Patents

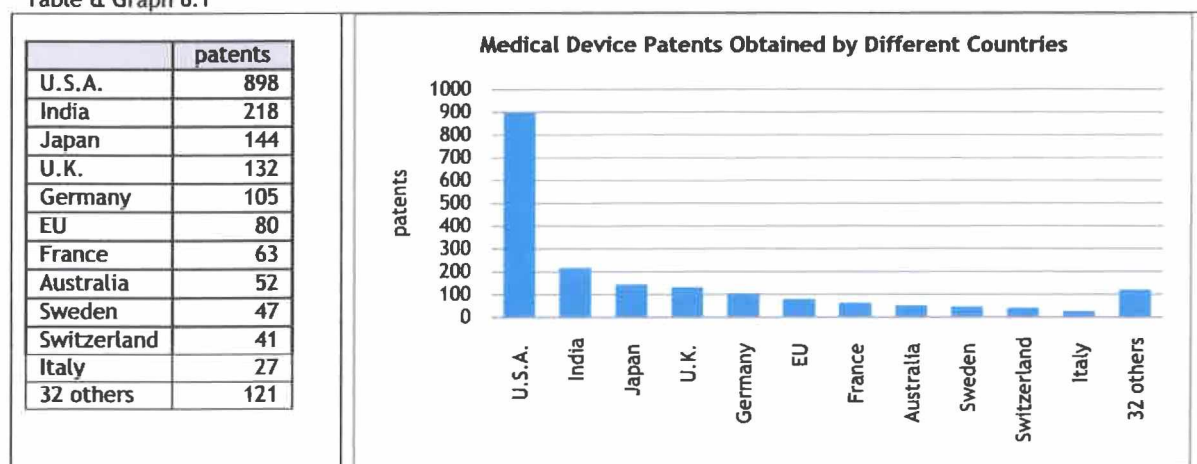
Medical devices are essential technologies in the current health conscious society. Medical device is estimated to be US \$ 400 billion market world over (). India, with 18% of the world population also figure prominently in that market space. These devices have to be either locally manufactured or to be imported for use in hospitals or at home, depending on the nature of the device. IPO database was explored to find out the nature and extent of medical device patenting in the above context. The analysis also goes into the entities which have shown interest in patenting their innovations, and the country affiliation of the same.

Medical device patents were identified for the study using the IPC class and sub-class numbers suggested by Schmoch (2008) as an improvement on ISI-OST-INPI technology classification. The IPC codes for Medical Technology include -

- A61B** *diagnosis; surgery; identification*
- A61C** *dentistry; apparatus or methods for oral or dental hygiene*
- A61D** *veterinary instruments, implements, tools, or methods*
- A61F** *filters implantable into blood vessels; prostheses; devices providing patency to, or preventing collapsing of, tubular structures of the body*
- A61G** *transport, personal conveyances, or accommodation specially adapted for patients or disabled persons*
- A61H** *physical therapy apparatus*
- A61J** *containers specially adapted for medical or pharmaceutical purposes*
- A61L** *methods or apparatus for sterilising materials or objects in general*
- A61M** *devices for introducing media into, or onto, the body), A61N(electrotherapy; magnetotherapy; radiation therapy; ultrasound therapy*
- H05G** *x-ray technique*

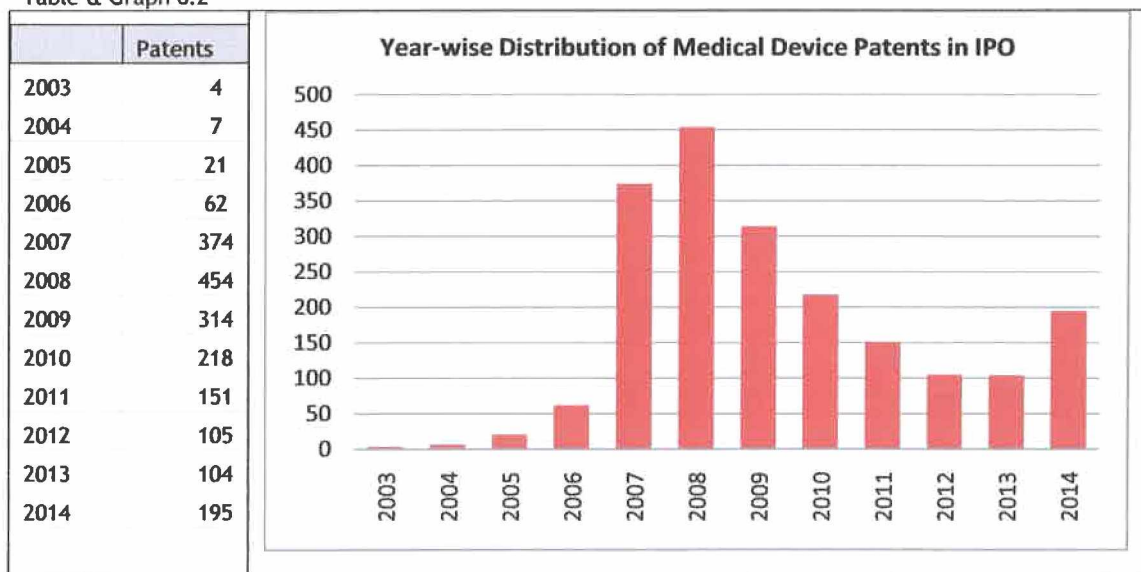
Indian innovation interest in pharmaceuticals is now well documented. India has also shown interest in the medical device market space. IPO has 2009 patents granted under this head during the 2001-2014 period. There are as many as 43 countries that have been granted patents in IPO for these technologies. As it has been noticed with other technologies, five countries viz., Germany, India, Japan, UK, and the US, have more than 100 patents each on these categories. These five countries make up almost three-fourths, and top 10 countries make up 90% of the total patents granted under the technology. Applications filed through convention mode through EU, France, and Australia make up over 50 patents each, followed by Sweden and Switzerland with over 40 each. Thirty-two other countries own the remaining 121 patents.

Table & Graph 6.1



The analysis also examined year-wise trend in granting patents. The overall trend of patent grants in IPO peaking in the immediate post-2005 period (when we amended our patents Act to comply with TRIPS norms) holds good for this technology as well. There has been a gradual decline from 2008, only to revive in 2014.

Table & Graph 6.2



Nearly 1,118 entities have obtained patents on medical devices. On an average it works out to less than two an assignee. P&G and Johnson & Johnson are the companies in the lead with 79 and 48 patents respectively.

In all, only 57 entities have more than five patents on medical devices. These entities make up 34.2% in 2009 patents on the technology. Other 1,045 entities make up the rest, averaging 1.3 patents each. USPTO has as many as 148,135 medical device patents during the same period.

Assignees with five or more patents in medical devices are listed below.

Table 6.3 Assignees with medical device patents in IPO

	Patents
Procter & Gamble Company	76
Synthes GMBH	44
Ethicon Endo-Surgery Inc	42
Uni-Charm Corporation	34
Mcneil PPC Inc	23
Koninklijke Philips Electronics N. V	21
3M Innovative Properties Company	19
Becton, Dickinson and Company	33
Johnson & Johnson Vision Care Inc	15
Kimberly - Clark Worldwide, Inc	14
Ethicon Inc	13
Novo Nordisk AS	13
Alza Corporation	12
Baxter International Inc	12
Johnson & Johnson Inc	12

Reckitt Benckiser(UK) Limited	12
GE Medical Systems Global Technology Company Llc	11
General Electric Company	10
Glaxo Group Limited	10
SreeChitraTirunal Institute For Medical Sciences &Technology	10
Steris Inc.	10
Valois S. A.	10
American Sterilizer Company	9
DCA Design International Limited	9
Alcoa Inc	8
Insulet Corporation	8
Lifescan ,Inc	8
Obtech Medical AG	8
Uni-Charm Co. Ltd.	8
Becton Dickinson France	7
CilagGmbh International	7
GE Yokogawa Medical System Ltd.	7
Medela Holding AG	7
Synthes AG Chur	7
Aga Medical Corporation	6
Astra Aktiebolag	6
Clinical Designs Limited	6
Colgate Palmolive Company	6
Council Of Scientific & Industrial Research	6
Gambro LundiaAb	6
Toray Industries Inc	6
BespakPlc	5
Crossject	5
Dr. Satyanarayan Mishra	5
ErbeElektromedizin GMBH	5
Given Imaging Ltd	5
Indian Institute Of Technology	5
Japan Absorbent Technology Institute	5
Johnson &Johnson Industria E ComercioLtda	5
Prof. Mayil VahananNatarajan // Maria Celestine Jayasingh	5
Sunshine Heart Company Pty Ltd	5
Terumo Penpol Limited	5
Tredegar Film Products Corporation	5

Only five of these entities, totaling 31 patents, are of Indian origin. The remaining 48 are foreign assignees.

The following is a list of specific subjects which have attracted at least five patents in the country during the years covered under this analysis.

IPC codes		Patents
A61B	Diagnosis; Surgery; Identification	28
A61B 1/00	Instruments for performing medical examinations of the interior of cavities or tubes of the body by visual or photographic inspection, e.g. endoscopes	34
A61B 10/00	Other methods or instruments for diagnosis, e.g. for vaccination diagnosis; Sex determination; Ovulation-period determination; Throat striking implements	11
A61B 17/00	Surgical instruments, devices or methods, e.g. tourniquets	194
A61B 18/00	Surgical instruments, devices or methods for transferring non-mechanical forms of energy to or from the body	17
A61B 19/00	Instruments, implements or accessories for surgery or diagnosis	23
A61B 3/00	Apparatus for testing the eyes; Instruments for examining the eyes	20

A61B 5/00	Measuring for diagnostic purposes	143
A61B 6/00	Apparatus for radiation diagnosis, e.g. combined with radiation therapy equipment	20
A61B 7/00	Instruments for auscultation	5
A61B 8/00	Diagnosis using ultrasonic, sonic or infrasonic waves	22
A61C 13/00	Dental prostheses; Making same	6
A61C 17/00	Devices for cleaning, polishing, rinsing or drying teeth, teeth cavities or prostheses	13
A61C 5/00	Filling or capping teeth	8
A61C 7/00	Orthodontics, i.e. obtaining or maintaining the desired position of teeth, e.g. by straightening, evening, regulating, separating, or by correcting malocclusions	5
A61C 8/00	Means to be fixed to the jaw-bone for consolidating natural teeth or for fixing dental prostheses thereon; Dental implants; Implanting tools	18
A61C3	Dental tools or instruments	6
A61F	Filters implantable into blood vessels; prostheses; devices providing patency to, or preventing collapsing of, tubular structures of the body	9
A61F 11/00	Methods or devices for treatment of the ears, e.g. surgical; Protective devices for the ears, carried on the body or in the hand	5
A61F 13/00	Bandages or dressings	225
A61F 15/00	Auxiliary appliances for wound dressings; Dispensing containers for dressings or bandages	6
A61F 2/00	Filters implantable into blood vessels; Prostheses, i.e. artificial substitutes or replacements for parts of the body; Appliances for connecting them with the body; Devices providing patency to, or preventing collapsing of, tubular structures of the body, e.g. stents	111
A61F 5/00	Orthopaedic methods or devices for non-surgical treatment of bones or joints	27
A61F 6/00	Contraceptive devices; Pessaries; Applicators therefor	10
A61F 7/00	Heating or cooling appliances for medical or therapeutic treatment of the human body	12
A61F 9/00	Methods or devices for treatment of the eyes; Devices for putting in contact-lenses; Devices to correct squinting; Apparatus to guide the blind; Protective devices for the eyes, carried on the body or in the	18
A61H 1/00	Apparatus for passive exercising; Vibrating apparatus; Chiropractic devices	7
A61H 3/00	Appliances for aiding patients or disabled persons to walk about	5
A61J	Containers specially adapted for medical or pharmaceutical purposes; devices or methods specially adapted for bringing pharmaceutical products into particular physical or administering forms; devices for administering food or medicines orally; baby comforters; devices for receiving spittle	5
A61J 1/00	Containers specially adapted for medical or pharmaceutical purposes	31
A61J 3/00	Devices or methods specially adapted for bringing pharmaceutical products into particular physical or administering forms	19
A61J 7/00	Devices for administering medicines orally, e.g. spoons; Pill counting devices; Arrangements for time indication or reminder for taking medicine	5
A61J 9/00	Feeding-bottles in general	5
A61L	Methods or apparatus for sterilising materials or objects in general; disinfection, sterilisation, or deodorisation of air; chemical aspects of bandages, dressings, absorbent pads, or surgical articles; materials for bandages, dressings, absorbent pads, or surgical articles	15

A61L 12/00	Methods or apparatus for disinfecting or sterilising contact lenses; Accessories therefor	6
A61L 2/00	Methods or apparatus for disinfecting or sterilising materials or objects other than foodstuffs or contact lenses; Accessories therefor	66
A61L 27/00	Materials for prostheses or for coating prostheses	38
A61L 29/00	Materials for catheters or for coating catheters	8
A61L 31/00	Materials for other surgical articles	20
A61L 9/00	Disinfection, sterilisation or deodorisation of air	36
A61L15	Chemical aspects of, or use of materials for, bandages, dressings or absorbent pads	41
A61M	Devices for introducing media into, or onto, the body	18
A61M 1/00	Suction or pumping devices for medical purposes; Devices for carrying-off, for treatment of, or for carrying-over, body-liquids; Drainage systems	50
A61M 11/00	Sprayers or atomisers specially adapted for therapeutic purposes	8
A61M 15/00	Inhalators	75
A61M 16/00	Devices for influencing the respiratory system of patients by gas treatment, e.g. mouth-to-mouth respiration; Tracheal tubes	38
A61M 25/00	Catheters; Hollow probes	33
A61M 29/00	Dilators with or without means for introducing media	8
A61M 3/00	Medical syringes, e.g. enemata	13
A61M 31/00	Devices for introducing or retaining media, e.g. remedies, in cavities of the body	5
A61M 35/00	Devices for applying media, e.g. remedies, on the human body	5
A61M 37/00	Other apparatus for introducing media into the body	20
A61M 39/00	Tubes, tube connectors, tube couplings, valves, access sites or the like, specially adapted for medical use	14
A61M 5/00	Devices for bringing media into the body in a subcutaneous, intra-vascular or intramuscular way; Accessories therefor	183
A61N 1/00	Electrotherapy; Circuits therefor	50
A61N 2/00	Magneto-therapy	5
A61N 5/00	Radiation therapy	8
A61N 7/00	Ultrasound therapy	6
H05G 1/00	X-ray apparatus involving X-ray tubes; Circuits therefor each	13
	100 others with 4 or less patents	

Classification of Medical Devices

Not all medical devices are of the same technical sophistication. Neither have they to go through the same level of regulatory scrutiny before they are accepted for public use. Global Harmonization Task Force (GHTF) conceived in 1992 is an international effort to achieve greater uniformity between national medical device regulatory systems. This is being done with two aims viz., enhancing patient safety and increasing access to safe, effective and clinically beneficial medical technologies around the world. GHTF has adopted *Principles of Medical Devices Classification* in 2006. <http://www.gh tf.org/documents/sq1/SG1-N15-2006-Classification-FINAL.pdf>

GHTF has adopted the following harmonized definition of the term medical device: 'Medical device' means any instrument, apparatus, implement, machine, appliance, implant, *in vitro* reagent or calibrator, software, material or other similar or related article -

a) Intended by the manufacturer to be used, alone or in combination, for human beings for one or more of the specific purpose(s) of:

- diagnosis, prevention, monitoring, treatment or alleviation of disease,
- diagnosis, monitoring, treatment, alleviation of or compensation for an injury,
- investigation, replacement, modification, or support of the anatomy or of a physiological process,
- supporting or sustaining life,
- control of conception,
- disinfection of medical devices,
- providing information for medical or diagnostic purposes by means of *in vitro* examination of specimens derived from the human body; and

b) Which does not achieve its primary intended action in or on the human body by pharmacological, immunological or metabolic means, but which may be assisted in its intended function by such means.

The Principles of Medical Devices Classification, as adopted by GHTF (2006), (<http://www.ghetf.org/documents/sg1/SG1-N15-2006-Classification-FINAL.pdf>) takes into consideration the level of technology and sophistication. Various levels of technologies call for different level of regulatory clearances. The levels recognized by GHTF are the following: Low Risk, Low-Moderate Risk, and Moderate-High Risk and High Risk devices, named as Class A; B; C; and D respectively.

Class A Low Risk	Surgical retractors / tongue depressors
Class B Low-moderate Risk	Hypodermic Needles / suction equipment / imaging solutions
Class C Moderate-high Risk	Lung ventilator / orthopedic implants
Class D High Risk	Heart valve / Implantable defibrillator

Distribution of IPO Patents on Risk Levels

The patents identified as medical devices, based on the IPC codes, were classified after careful scrutiny into these four categories corresponding to four risk levels indicated by international classification of medical devices. It is interesting to note that on the whole medical device patents granted in India are almost two-thirds (63.36%) in either Low Risk or Low Moderate Risk categories. This is followed by Moderate High Risk (28.62%) and High Risk (8.01%). This pattern of distribution of patents holds good for almost all major countries, which have filed patents in this category in India. Absorbents, which fall in Low Risk category total 174 (highest with in a subgroup IPC code) and 59 patents on Syringes which fall in Low Moderate Risk.

Table & Graph 6.4 Distribution of medical device patents on risk categories

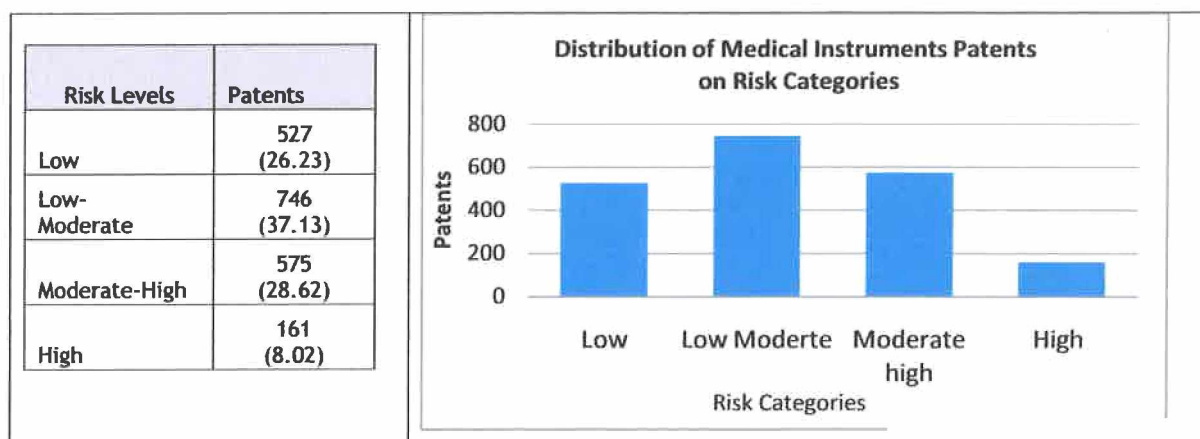


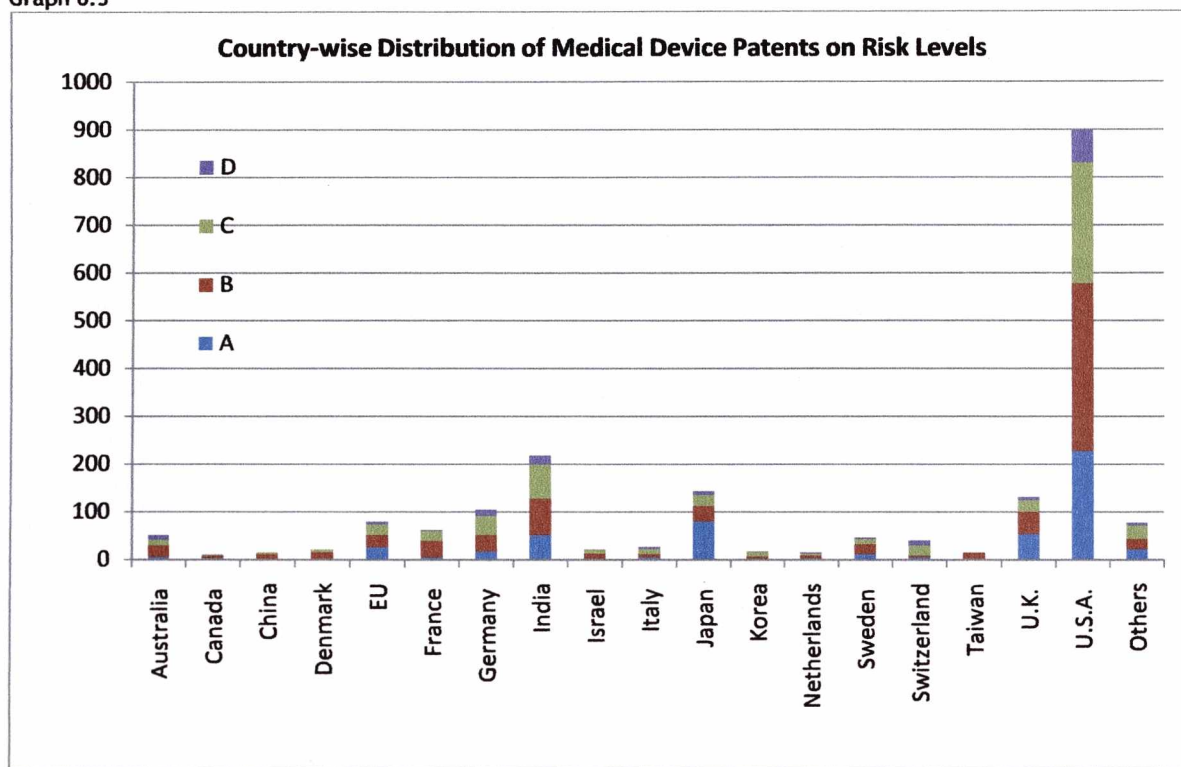
Table 6.5 Country-wise distribution of patents on risk categories

	Low	Low-Moderate	Moderate High	High	Total
U.S.A.	227	351	253	67	898
India	52	76	72	18	218
Japan	80	33	23	8	144
U.K.	54	46	25	7	132
Germany	17	35	40	13	105
EU	26	26	22	6	80
France	5	34	22	2	63
Australia	6	24	12	10	52
Sweden	12	21	11	3	47
Switzerland	5	4	21	11	41
Italy	5	7	11	4	27
Denmark	1	15	6		22
Israel	2	11	8	1	22
Korea	1	6	10	1	18
China	2	10	4		16
Netherlands	3	6	4	3	16
Taiwan	1	14	1		16
Canada	3	5	2	1	11
25 Other countries	22	22	28	6	78

The country-wise distribution of patents indicate that proportionately fewer patents are obtained in IPO on high or moderate-high risk categories by all the countries. Absence of competition from local enterprises in higher end of this technology could be a reason for this trend. Because of this incremental innovation that happens in technology

would not figure in our patents, as it does in some of the other leading patent databases. As it could be noticed the US has the most number of patents in all risk categories in this technology.

Graph 6.5



Some of the High Risk category patents obtained in India are as follows:

Patent No.	Title	Country	Assignee	Year
253571	<i>Injectable sustained release implant having a bioerodible matrix core and a bioerodible skin</i>	U.S.A.	Psivida Inc.	2012
211875	<i>A heartburn and reflux disease treatment apparatus</i>	U.S.A.	Obtech Medical Ag	2007
216126	<i>An expandable bifurcated stent and method for production thereof</i>	Canada	Evysio Medical Devices Utc,	2008
225219	<i>A biocompatible drug release device and a method of preparing a biocompatible implantable medical device to inhibit the proliferation of smooth muscle cells after a stent implantation</i>	U.S.A.	Endovascular Devices, Inc.	2008
193185	<i>An endoluminal prosthesis</i>	Australia	William A. Cook Australia Pty. Ltd	2005
228130	<i>An absorbent polymer composition and a method of making the same</i>	U.S.A.	3m Innovative Properties Company	2009
214308	<i>A blood processing system</i>	U.S.A.	Baxter International Inc	2008
227289	<i>Calcium phosphate coated stent, processes for making same</i>	U.S.A.	University Of British Columbia	2009

Some of the low risk medical devices are the following

Patent No.	Title	Country	Assignee	Year
235463	<i>An absorbent article</i>	U.S.A.	Procter & Gamble	2009
234248	<i>Simple disposable absorbent article having breathable side barriers</i>	U.S.A.	Procter & Gamble	2009
233832	<i>Disposable pull-on garment</i>	U.S.A.	Procter & Gamble	2009
238032	<i>Sanitary napkin for clean body benefit</i>	U.S.A.	Procter & Gamble	2010
231336	<i>Thin sanitary napkin having protrusions</i>	U.S.A.	Johnson & Johnson Inc	2009
231222	<i>Simple disposable absorbent article</i>	U.S.A.	Procter & Gamble	2009
233673	<i>A two layer structure for use in an absorbent article</i>	U.S.A.	McneilPpcInc	2009
224967	<i>An interlabial pad</i>	Japan	Uni-Charm Corporation	2008
236923	<i>A feminine hygiene pad</i>	U.S.A.	McneilPpcInc	2009
250096	<i>Discrete absorbent articles</i>	U.S.A.	McneilPpcInc	2011
242202	<i>Compression-resistant sanitary napkin</i>	U.S.A.	Johnson & Johnson Inc	2010
255818	<i>Skin antiseptic composition dispenser</i>	U.S.A.	3m Innovative Properties Company	2013
255650	<i>A wiper</i>	China	Longood Medicine (Jiangsu) Co., Ltd	2013
206368	<i>Sanitary napkin with deformable absorbent core</i>	Japan	Uni-Charm Corporation	2007
202648	<i>A device for cleaning teeth and messaging gums</i>	India	PoddarRatan	2007
244475	<i>Toothbrush with gripping area</i>	U.S.A.	Colgate Palmolive	2010

Some of the Low Moderate Device patents are the following:

Patent No.	Title	Country	Assignee	Year
263599	<i>Injection device</i>	U.K.	CilagGmbh International	2014
248143	<i>A drug delivery device</i>	U.K.	Caretek Medical Limited	2011
256478	<i>Insulin pump</i>	Korea	Greenwill Co., Ltd. // Lee, Kyung-Ho // Enter Tech Co., Ltd.	2013
263755	<i>A compact injection device for automatic extension and retraction of its syringe after content discharge</i>	U.K.	CilagGmbh International	2014
199053	<i>A syringe</i>	Denmark	Novo Nordisk .A/S	2006
232848	<i>A safety apparatus for sheathing a medical needle and the method for the same</i>	U.S.A.	Tyco Healthcare Group Lp	2009
246963	<i>A needle apparatus</i>	Australia	Maxwell Edmund Whisson // Dean Brian Prestige	2011
238054	<i>A device for delivering fluid to a patient</i>	U.S.A.	Insulet Corporation	2010
211427	<i>Device for regulating flow rate of intravenous medical solution during injection</i>	Korea	Meintech Co. Ltd.	2007
255722	<i>Method and device for controlling several infusion pumps</i>	Germany	B. Braun Melsungen Ag	2013
209127	<i>A needleless syringe</i>	France	Crossject	2007

Examples of High Moderate Risk Patents in IPO

Patent No.	Title	Country	Assignee	Year
252281	A devise band electrode	India	Larsen &Toubro Limited	2012
206361	An improved appartus for ultrasonography using a continuous wave doppler system.'	India	Indian Institute Of Technology	2007
233665	Device for monitoring the condition of a human being	South Africa	Pietersen, Johannes, De Klerk	2009
241021	An imaging system	Greece	Foundation For Research And Technology-Hellas,	2010
234591	Sensor in vivo measurement of osmotic changes.	Norway	Lifecare As // Lifecare As	2009
235593	A system for acquisition and monitoring of medical data and use thereof	U.S.A.	Cardiosafe International Ag. // Cardiosafe International Ag.	2009
230207	An apparatus for measuring tissue analyte such as glucose, in vivo	U.S.A.	Sensys Medical Inc.	2009
229244	An image enhancing medium for use in a medical imaging procedure	U.S.A.	UltrasLLc,	2009
226539	Apparatus for determination of a measure of a glycation end-product or disease state using tissue fluorescence	U.S.A.	Veralight Inc.	2008
223861	Apparatus for determining likelihood of occurrence of a cause of one or more effects	U.K.	Uws Ventures Limited	2008
253769	A drug delivery apparatus	U.S.A.	Ethicon Endo-Surgery Inc	2012
228937	An implantable prosthesis for the repair of muscle wall defects	U.K.	Evexar Medical Limited	2009

There are as many as 59 different syringes and 225 bandages or dressings from different entities which have been granted the patents in IPO.

This shows that Indian portfolio of patents on medical devices is relatively weak. The companies which have patented these devices in India have only focused on lower risk level technologies. And, within this only Procter & Gamble and Johnson & Johnson have the critical mass of patents that give them a dominant share in the market. The others have far fewer patents. To examine this aspect at a greater depth patents obtained by companies on specific sub-groups were analysed.

Table 6.6 Distribution patents of select companies on risk categories

	Low	Low-Moderate	Moderate-High	High
Procter & Gamble	72	2	2	1
Johnson & Johnson	24	8	16	
Indian Cos.	52	76	72	18

More than 90% of the P&G patents are in 'low risk' category and so also 50% of that of Johnson & Johnson patents in IPO. In fact, the Indian entities as a whole have a greater share of patents in 'Moderate High Risk' and 'High Risk' devices.

Medical Device Imports

Indian medical device production, in Rupee terms, has increased almost five-fold from 2001-02 onwards -from Rs. 13,058 million to Rs. 62,204 million in 2012-13 (Table 6.7).

The country imported medical devices worth US\$ 3381 million (Rs. 202,900 million) in 2014-15 alone. Our import costs in medical devices are three times the current manufacturing in Rupee terms. Most of these devices came from Europe and Asian countries. However, country-wise figures show that our import from the USA stands on the top of the list with US \$ 750 million (Rs. 45,000 million). This works out to more than one-fifth of the total import value on this technology. This is followed by Germany, China and Japan. These three make up 35% of the imports. Other countries with over US \$100 million (Rs. 6,000 million) imports of medical device to India are Ireland, South Korea, Switzerland and Singapore and the UK.

Thus, as indicated by the import figures, we need medical devices, but perhaps not in the scale that would make the manufacturing companies to establish their units here. It may also be that these companies do not feel the threat from local entities. In medical devices, it is only in the low risk or mass market technologies, the assignees feel, there is a possibility of market capture by the local companies (or product innovation possibility), and hence patenting in those products.

Table 6.7 Manufacturing of Medical Instruments in India

	(Rs. Million)				
2000-01	9,482.60	2005-06	14,086.30	2011-12	37,429.40
2001-02	13,058.00	2006-07	13,788.50	2012-13	62,204.90
2002-03	10,689.30	2007-08	21,435.00	Source: Annual Survey of Industries	
2003-04	15,117.00	2008-09	22,688.40		
2004-05	18,859.60	2009-10	23,786.40		
		2010-11	36,872.60		

Graph 6.7

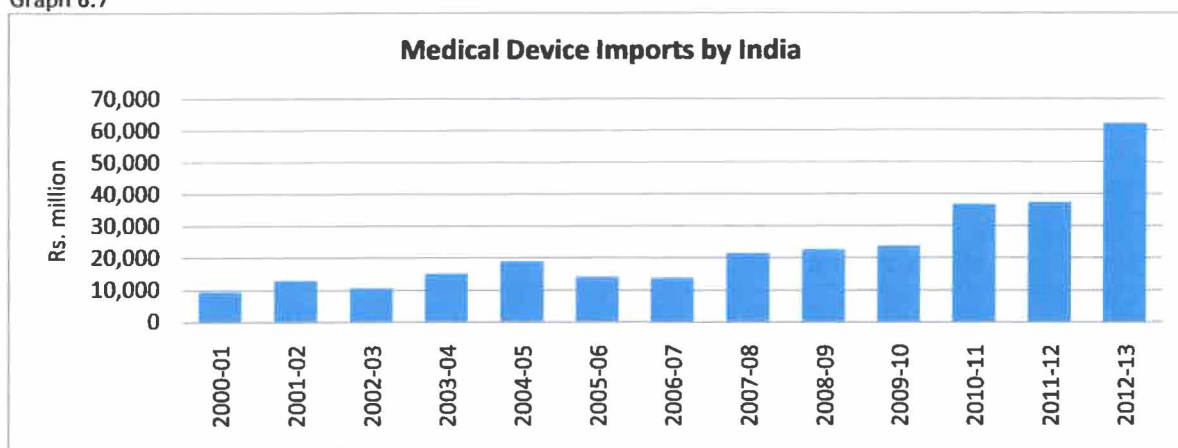


Table 6.8 India's Imports from Regions and Countries: Medical and scientific instruments

(US \$ Million)								
	2013-14 (%)	2014-15 (%)						
USA	751.2 (22.84)	727.7 (21.52)	UK	125.4 (3.81)	147.9 (4.37)	Austria	41.6 (1.26)	41.5 (1.23)
Germany	581 (17.67)	550.3 (16.27)	South Korea	135.9 (4.13)	143.7 (4.25)	Malaysia	52.1 (1.59)	39.9 (1.18)
China	300.9 (9.15)	333.2 (9.85)	Switzerland	144.1 (4.38)	138.7 (4.1)	Sweden	41.1 (1.25)	36.6 (1.08)
Japan	307.1 (9.34)	319.3 (9.44)	Singapore	122.3 (3.72)	137 (4.05)	Netherlands	34.2 (1.04)	35 (1.03)
Ireland	146.9 (4.47)	161.7 (4.78)	France	92.9 (2.83)	96.6 (2.86)	Belgium	16.6 (0.5)	25.7 (0.76)
			Italy	70.3 (2.14)	74.5 (2.2)	Australia	12.8 (0.39)	25.4 (0.75)
			Israel	42.2 (1.28)	45.5 (1.35)	Canada	36.3 (1.1)	24.9 (0.74)

Taiwan (Taipei)	19.8 (0.6)	22.8 (0.67)
Hong Kong	20.9 (0.64)	21.9 (0.65)
Thailand	23 (0.7)	21.6 (0.64)
Mexico	15.7 (0.48)	21.3 (0.63)

Bulgaria	13.7 (0.42)	20.7 (0.61)
Denmark	18.6 (0.57)	19.9 (0.59)
UAE	7.5 (0.23)	16.6 (0.49)
Viet Nam	9.1 (0.28)	13.6 (0.4)

Spain	13.1 (0.4)	12.7 (0.37)
Brazil	8.1 (0.25)	7.9 (0.23)
Czech Republic	6.9 (0.21)	7.1 (0.21)

The figures indicate that apart from patenting selectively to capture the market in the medical devices, they also exploit the export opportunities provided by the county.

To examine whether the companies are patenting selectively in India, patents obtained by Johnson & Johnson and K Phillips in medical technologies during the overlapping period was analysed. Johnson & Johnson has obtained 813 patents and K. Phillips 1,253 patents on medical devices during the 2001-2014 period. The following is the risk category-wise distribution of these patents:

Table 6.9 Distribution of Medical Devices Patents on Risk Categories by Select Companies in IPO and the USPTO during 2001-2014

	Low		Low-Moderate		Moderate-High		High	
	USPTO	IPO	USPTO	IPO	USPTO	IPO	USPTO	IPO
Johnson& Johnson	216	24	97	8	277	16	3	-
K. Phillips	64	5	768	10	348	6	73	1

It could be noted that Johnson & Johnson and Phillips have far fewer patents over all and also in the overlapping risk categories in IPO. Phillips particularly has very few patents (22 during the period covering the analysis) in medical device categories in IPO. It is true that both the MNCs have several incremental patents on these technologies in the USPTO. Philips is a leader in imaging technologies that figure in Low-Moderate and Moderate-High risk categories.

In IPO their patents are more in the nature of products. Philips has not taken any patent on their imaging technologies, though they are major competitors in this technology and a major source of import in the country.

Thus, market potential, perceived competitiveness of the local R&D base seems to be guiding the medical device patents in IPO. The trend indicates that both on low risk, but high volume trade medical devices, and on high value products we tend to be dependent on these external entities. Need for local R&D in medical devices considering the country's population base is imperative.

Notes and References:

1. The Global Harmonization Task Force is "a voluntary group of representatives from national regulatory authorities (such as the U.S. Food and Drug Administration (FDA)) and the members of the medical device industry" whose goal is the standardization of medical device regulation across the world. <http://www.ghmf.org/index.html>

Principles of medical device classification.

http://www.mdb.gov.my/mdb/documents/principles_md_classification.pdf

Schmoch, Ulrich (2008) Concept of a Technology Classification for Country Comparisons. Fraunhofer Institute for Systems and Innovation Research, Karlsruhe, Germany.

http://www.wipo.int/export/sites/www/ipstats/en/statistics/patents/pdf/wipo_ipc_technology.pdf

7 Telecom

Telecom is one of the high growth sectors in the modern economies world over. This technology provides the prime support services needed for rapid growth and modernisation of various sectors of the economy.

Thanks to mobile telephony and the Internet communications coming along with it. During the post-2001 period the US PTO has granted over 234, 000 patents on telecommunication related technologies. In fact, during this phase telephony and the associated technologies have revolutionalised.

Telecom services have been acknowledged globally as an essential tool for the socio-economic development of a nation. India is currently the world's second-largest telecommunications market and has registered exceptional growth in the past few years.

Indian telecom industry has grown from a tele-density of 3.58% in March 2001 to 74% in June 2013. This great leap in consumer base as well as revenues from telecom services has not only provided sufficient contribution in Indian GDP growth but also provided much needed employment opportunity (Nazmuddin, 2013)

(<http://www.itu.int/en/ITU-D/Statistics/Documents/events/wtis2013/009INF-E.pdf>)

The Indian mobile telephone economy is growing rapidly and is expected to contribute approximately US\$ 400 billion to India's GDP, according to report prepared by Groupe Speciale Mobile Association (GSMA) in collaboration with Boston Consulting Group. (http://www.gsmamobileeconomyindia.com/GSMA_Mobile_Economy_India_Report_2013.pdf)

Rapid strides in the telecom sector have been facilitated by liberal policies of the Indian Government that provide easy market access for telecom equipment and a fair regulatory framework for offering telecom services at affordable prices. The deregulation of foreign direct investment norms has made the sector one of the fastest growing and a top five employment opportunity generators in the country.

Market Size

Driven by strong adoption of data consumption on handheld devices, the total mobile services market revenue in India is estimated US\$ 29.8 billion in 2014 and is expected to touch US\$ 37 billion in 2017, registering a compound annual growth rate of 5.2 per cent, according to research firm IDC. (Groupe Speciale Mobile Association , 2013)

As per the study by GSMA, is expected that smart phones will account for two out of every three mobile connections globally by 2020 and India is all set to become the fourth largest smart phone market.

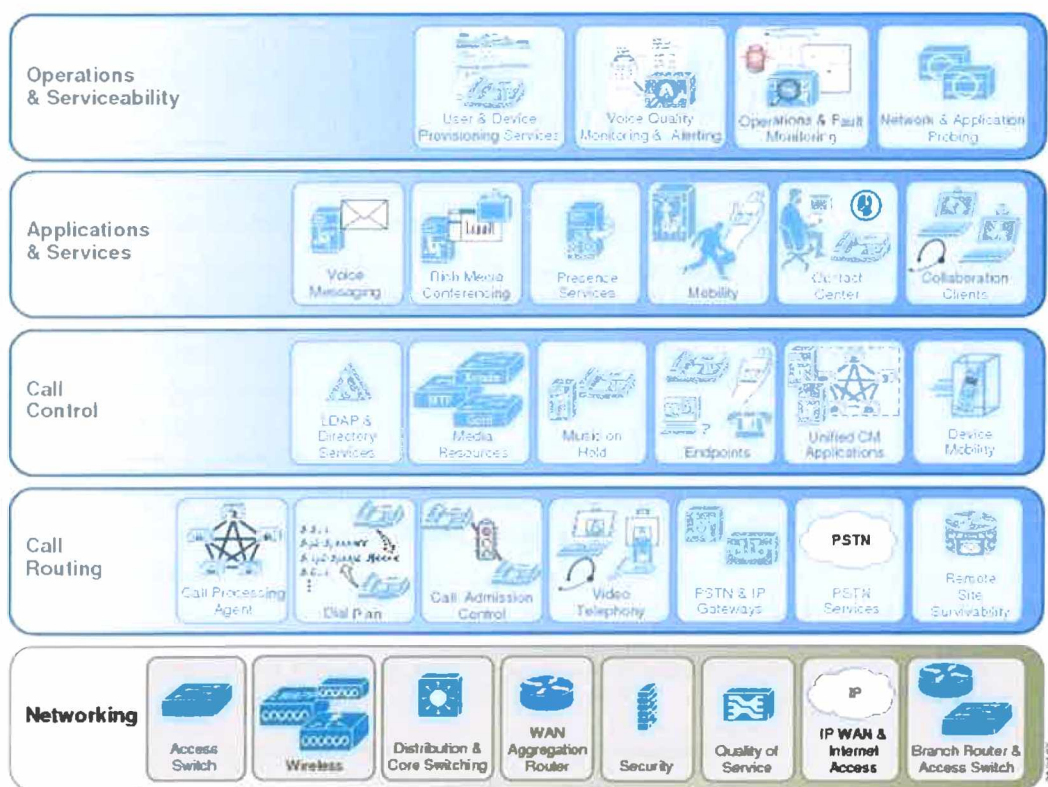
India is projected to have 213 million mobile internet users by June 2015, a 23 per cent rise over a six month period, according to Mobile Internet in India 2014 report. The broadband services user-base in India is expected to grow to 250 million connections by 2017.

India saw the fastest growth in new mobile-phone connections with 18 million net additions in the third quarter of 2014, followed by China with 12 million new additions, according to a report by Swedish mobile network equipment maker Ericsson. (India Brand Equity Foundation (2015)

India is expected emerge as a leading player in the virtual world by having 700 million internet users of the 4.7 billion global users by 2025, as per the Microsoft report. (Ministry of External Affairs, India, 2015)

With the government's favourable regulation policies and 4G services hitting the market, rapid growth is expected in the Indian telecommunication sector in the next few years. Also, with developments in this sector, services such as security and surveillance, remote monitoring of ATM machines, home automation, traffic management, retail, logistics and grid energy could eventually facilitate optimisation of resources.

All the above goes on to state that telecom is one of the fastest-growing industries in India. Today India stands as the second-largest telecommunications market in the world.



Source: http://www.cisco.com/c/en/us/td/docs/solutions/Enterprise/Data_Center/VMDC/3-0/UC/UCS.html

Telecom usage patterns have continued to evolve, which can be traced to three primary drivers of mobile device technology evolution:

- mobile operating systems,
- user interface technologies, and
- mobile microprocessors/semiconductors.

Other factors include new features, crisper displays, new applications, device miniaturization, and resulting form-factors, which have also played an important role.

Mobile telephony has brought in a whole host of technology requirements. Successful operation of mobile services would call for both hardware and software innovations. Every successful mobile operation would involve technology assistance by some or all the below stated devices:

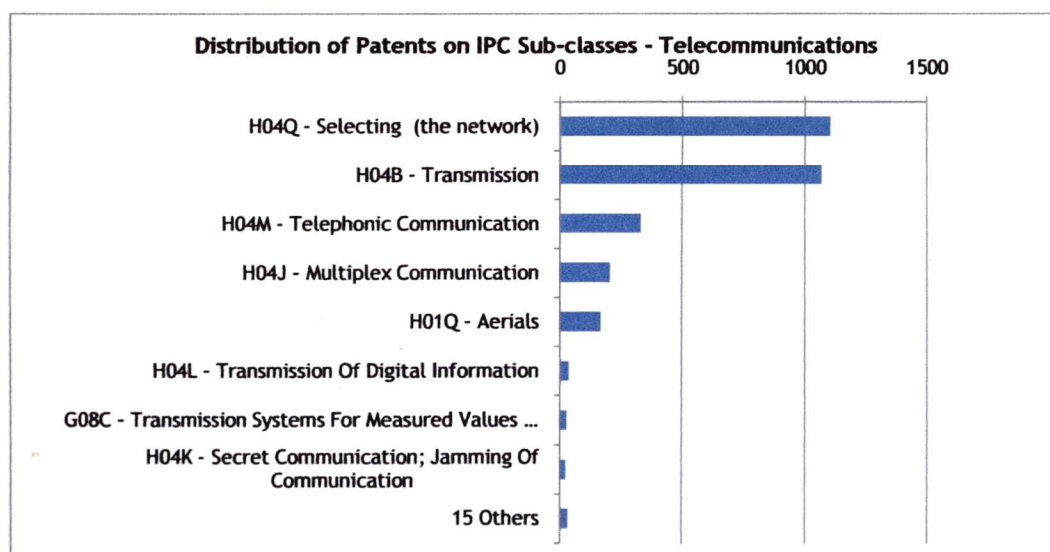
- Operations would call for user end devices in conjunction with service provider
- Applications and service would need compatible equipment, software, and service provider end compatibility
- Call control, Call routing, networking would require equipment/ technology at the service provider end in the background.

These rapid changes have generated in USPTO alone 169,238 patents on this technology during 2001-14.

The following are the technologies on which the telecommunications related patents have been obtained by various entities in IPO in the 2001 -2014 period.

IPC Subclass	Patents	Description of IPC Subclass
H04Q	1105	Selecting (the network) methods, circuits, or apparatus for establishing selectively a connection between a desired number of stations (normally two), or between a main station and a desired number of <u>substations</u> (normally one) for the purpose of transferring information <u>via</u> this connection after it has been established; Selective calling arrangements over connections already established.
H04B	1069	Transmission of information-carrying signals, the transmission being independent of the nature of the information, and includes monitoring and testing arrangements and the suppression and limitation of noise and interference.
H04M	331	Telephonic communication
H04J	205	Multiplex communication
H01Q	167	Aerials
H04L	36	Transmission of digital information
G08C	28	Transmission systems for measured values, control or similar signals
H04K	25	Secret communication; jamming of communication

Graph 7.1



It could be noticed that two sub-classes, namely H04Q (Methods for selecting the network in the context, circuits, or apparatus for establishing selectively) and H04B (Transmission of information-carrying signals) are the technologies which are most patented on and also important in the current telecommunication scene.

Patents in these technologies were probed further to identify specific narrower fields where the innovation rights are being claimed. Listed below are the sub-groups which have attracted patents.

H04Q7/38	372	Communication networks for selectively establishing one or a plurality of wireless communication links between a desired number of users or between users and network equipment, for the purpose of transferring information via these wireless communication links
H04B7/26	189	For communication between two or more posts at least one of which is mobile.
H04Q7/20	134	Hierarchically pre-organised networks, e.g. paging networks, cellular networks, WLAN [Wireless Local Area Network] or WLL [changed IPC Code H04W 84/02]
H04B7/005	125	Control of transmission; Equalising
H04Q7/00	118	Wireless network protocols or protocol adaptations to wireless operation, e.g. WAP [H04W 80/00]
H04Q7/32	88	Terminal devices; Devices specially adapted for wireless communication networks, H04W 88/02
H04Q7/22	86	Network topologies [H04W 84/00]
H04B1/707	79	Using direct sequence modulation
H04B7/00	66	Radio transmission systems, i.e. using radiation field
H04J11/00	51	Orthogonal multiplex systems
H04B1/38	49	Transceivers, i.e. devices in which transmitter and receiver form a structural unit and in which at least one part is used for functions of transmitting and receiving
H04Q7/36	45	Network planning, e.g. coverage or traffic planning tools; Network deployment, e.g. resource partitioning or cell structure
H04B	42	Transmission
H04B7/06	40	At transmitting station
H04Q7/24	36	Network topologies [H04W 84/00]
H04B1/00	32	Details of transmission systems; details of transmission systems not characterised by the medium used for transmission
H04Q	31	Wireless communication networks
H01Q1/24	29	With receiving set
H04B17/00	28	Monitoring; Testing
H04J13/00	28	Code division multiplex systems
H04M1/00	28	Substation equipment, e.g. for use by subscribers
H04B7/216	27	Code-division or spread-spectrum multiple access
H04Q7/30	25	Network topologies, Trunked mobile radio systems [H04W 84/08]
H04B1/40	24	Circuits
H04M11/00	24	Telephonic communication systems specially adapted for combination with other electrical systems

H04Q7/34	24	Supervisory, monitoring or testing arrangements [of wireless communication networks] [H04W 24/00]
H04B7/185	23	Space-based or airborne stations
H04B1/69	22	Spread spectrum techniques
H04B7/02	22	Diversity systems
H04Q7/28	21	Trunked mobile radio systems, or Network topologies [H04W 84/08]
H04B7/08	20	at receiving station [2006.01]
H04M	20	Telephonic Communication
H04M3/42	19	Systems providing special services or facilities to subscribers
H04B1/16	18	Circuits
H04J3/16	18	in which the time allocation to individual channels within a transmission cycle is variable, e.g. to accommodate varying complexity of signals, to vary number of channels transmitted
H04M15/00	18	Arrangements for metering, time-control or time-indication
H04B15/00	17	Suppression or limitation of noise or interference
H04B7/212	17	Time-division multiple access
H04J3/06	17	Synchronising arrangements
H04M1/725	16	Cordless telephones
H04Q3/00	16	Selecting arrangements [H04Q 5/00-H04Q 11/00 take precedence]
H04M1/02	15	Constructional features of telephone sets
H04B1/10	13	Means associated with receiver for limiting or suppressing noise or interference
H04L12/56	13	Packet switching systems []
H04M3/00	13	Automatic or semi-automatic exchanges
H04B3/54	12	Systems for transmission via power distribution lines
H04J3/00	12	Time-division multiplex systems
H04K1/00	12	Secret communication
H04M17/00	11	Prepayment telephone systems (using a coded card to authorise calls from a telephone set H04M 1/675)
H04B10/00	10	Transmission systems employing electromagnetic waves other than radio-waves, e.g. infrared, visible or ultraviolet light, or employing corpuscular radiation, e.g. quantum communication
H04M1/64	10	Automatic arrangements for answering calls; Automatic arrangements for recording messages for absent subscribers; Arrangements for recording conversations
H04M11/06	10	·Simultaneous speech and data transmission, Telephonic communication systems specially adapted for combination with other electrical systems
H04M7/00	10	Arrangements for interconnection between switching centres
369 others subgroups	752	

IPO granted 2997 patents on telecom related technologies, a relatively large number compared to the grants for other technologies. These patents fall under 23 IPC sub-classes, with top two of them, namely H04Q and H04B making up 73% of the total. Fifteen of these 23 have less than 10 patents in the respective sub-classes. As could be seen Innovations in this sector focus on a few technologies.

A closer look at the subject scope of the patents indicate that these patents fall under 424 IPC sub-groups. In fact, IPC revised the classes comprising these subjects during the period to provide for new innovations unique to this sector.

Among the sub-groups, 369 of them at the lower end have contributed 752 patents in all, averaging less than two per sub-group. In fact, the highest number of patents granted in any of these sub-groups is 10. At the top of the list 53 specific subjects made up 75% of all the patents in this technology. Distribution of innovations, even among these sub-groups at the top of the ladder is skewed, where top 10 groups make up 58% of the total. Telecommunications patents are mostly obtained by the assignees from the USA, as they make up 54.2% of the total. Other countries in the picture are South Korea, Japan, UK, China, Sweden and others. India with 141 patents in this technology occupies fourth position, unlike most of the other technologies where it stands second in IPO.

Graph 7.2

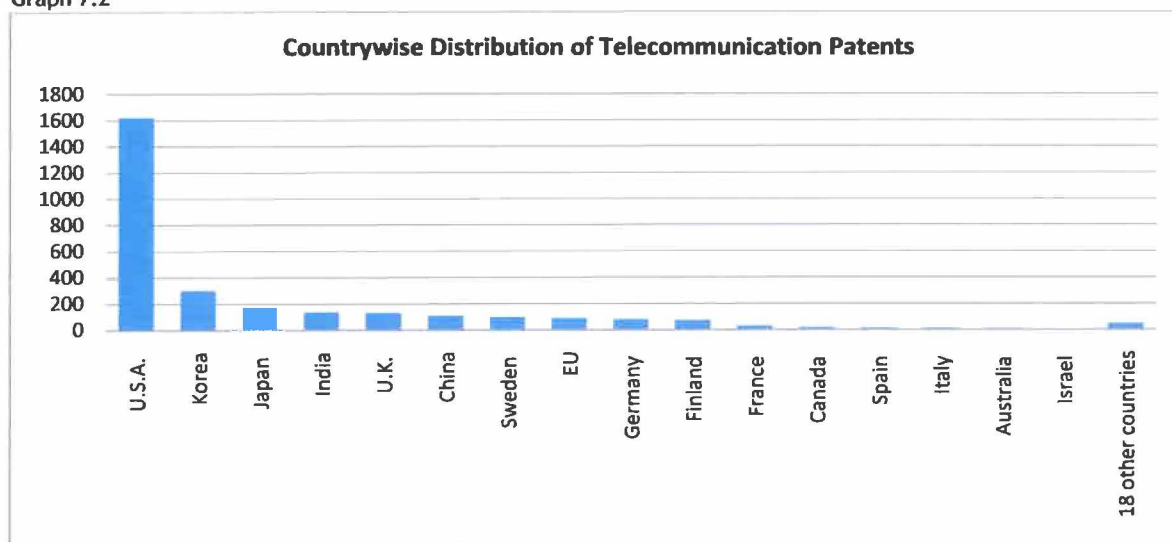


Table 7.1 Distribution of Telecom Patents

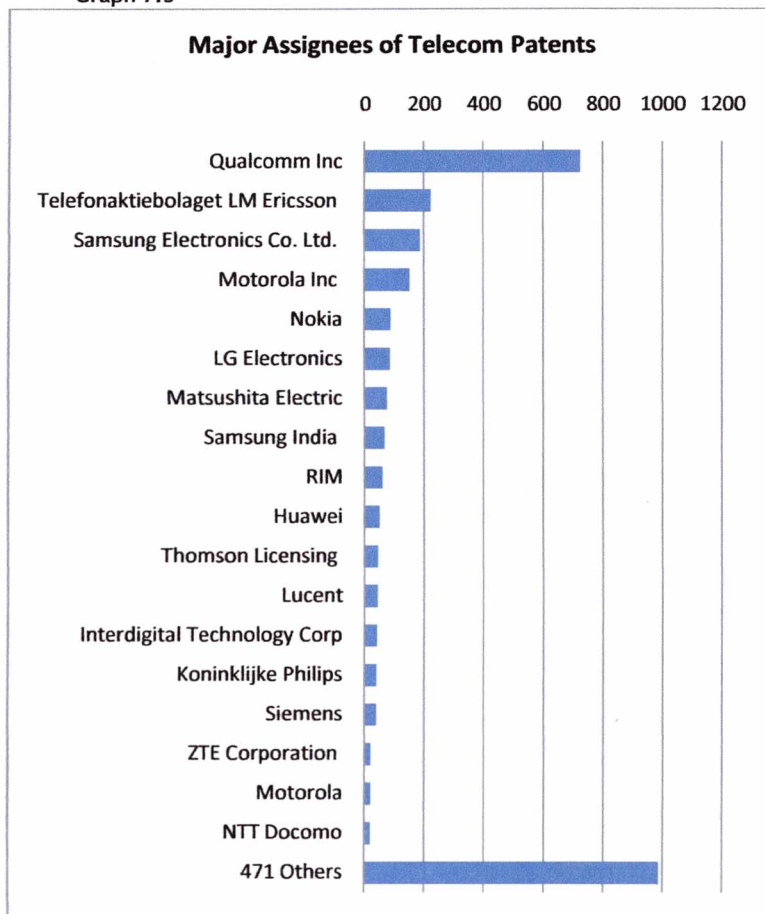
Assignees	Patents
Qualcomm Inc	724
Telefonaktiebolaget LM Ericsson	224
Samsung Electronics Co. Ltd.	188
Motorola Inc	153
Nokia	89
LG Electronics	87

Matsushita Electric	77
Samsung India	68
RIM	62
Huawei	52
Thomson Licensing	47
Lucent	46
Interdigital Technology Corp	44

Koninklijke Philips	42
Siemens	42
ZTE Corporation	22
Motorola	22

NTT Docomo	21
471 Others	987
	2997

Graph 7.3



In most of the top seven IPC sub-groups in which most of the patents are assigned, the US entities collectively have more patents than all the others from different countries put together. The US seems to have a definite technology edge on this technology.

The distinctive features of patenting in this technology are as follows:

- There are patents obtained on over 50 IPC subgroups
- Network topologies, WLL, Terminal devices, wireless services, resource partitioning, dominate the patented subjects
- Most of these are held by a few companies making a patent wall
- There is not much of Indian R&D on these technologies
- Most of the Indian patents are also obtained by Samsung R&D Institute India, fully owned subsidiary in the country
- Most of these patents are 'method' related patents

Considering the distribution of patents in IPC sub-classes in this technology, it is important to study two top sub-classes - H04Q and H04B which have attracted most of the R&D and patents.

H04Q Communication networks for selectively establishing wireless communication

This subclass covers **methods, circuits, or apparatus for establishing selectively a connection** between a desired number of stations, or between a main station and a desired number of substations for the purpose of transferring information via this connection after it has been established.

Selective **calling arrangements** over connections already established.

There are as many as 1105 patents in this technology during 2001-14 period. Despite representation of 23 countries in the group it is the USA entities which have obtained most of these patents. The patents in this sub-class fall under 57 sub-groups indicating specific narrower focus. IPC Code H04Q7/38 has a large cluster of Patents followed by H 04Q7/20 and H04Q7/00. These three are followed by terminal devices and network topologies.

H04Q7/38	Communication <u>networks</u> for selectively establishing one or a plurality of wireless <u>communication links</u> between a desired number of <u>users</u> or between <u>users</u> and <u>network</u> equipment, for the purpose of transferring information via these wireless <u>communication links</u> ; Services or facilities specially adapted for wireless communication <u>networks</u> this no is changed to H04W 4/00]	379
H04Q7/20	·Hierarchically pre-organised networks, e.g. paging networks, cellular networks, WLAN [Wireless Local Area Network] or WLL <u>H04W 84/02</u>	142
H04Q7/00	Services or facilities specially adapted for wireless communication <u>networks</u> <u>H04W 4/00</u>	123
H04Q7/32	·Terminal devices <u>H04W 88/02</u>	91
H04Q7/22	<u>H04W 84/00</u> Network topologies	86
H04Q7/36	<u>H04W 16/00</u> Network planning, e.g. coverage or traffic planning tools; <u>Network</u> deployment, e.g. resource <u>partitioning</u> or cell structures	48
H04Q7/24	Network topologies <u>H04W 84/00</u>	37
H04Q7/30	· · ·Trunked mobile radio systems <u>H04W 84/08</u>	25
H04Q7/34	Supervisory, monitoring or testing arrangements <u>H04W 24/00</u>	23
H04Q7/28	· · ·Trunked mobile radio systems <u>H04W 84/08</u>	23
H04Q	communication <u>networks</u> for selectively establishing one or a plurality of wireless <u>communication links</u> between a desired number of <u>users</u> or between <u>users</u> and <u>network</u> equipment, for the purpose of transferring information via these wireless <u>communication links</u> ;	21
H04Q3/00	Selecting arrangements [<u>H04Q 5/00</u> - <u>H04Q 11/00</u> take precedence)	17
Others	45 other sub-groups under the class	90

Graph 7.4

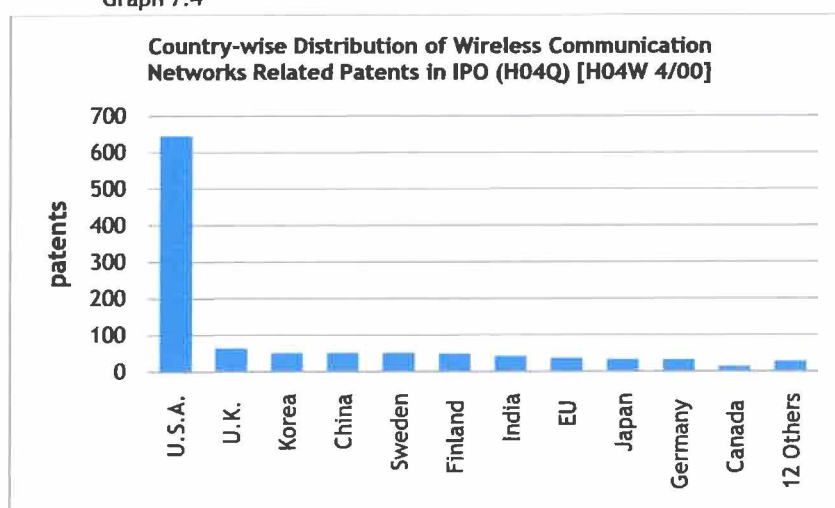


Table 7.2 Top Ranking Assignees of Patents in H04Q (H04W 4/00)

Qualcomm Inc	299
Telefonaktiebolaget LM Ericsson	106
Motorola Inc	65
Nokia Corporation	57
Research In Motion Limited	32
Samsung India Software Operations Private Limited	29
Huawei Technologies Co. Ltd.	28
LG Electronics Inc	24
Interdigital Technology Corporation	22
Samsung Electronics Co. Ltd.	20
Siemens Aktiengesellschaft	19
Lucent Technologies Inc	18
Ericsson Inc	16
Koninklijke Philips Electronics N. V	16
Nokia Mobile Phones Limited	15
Matsushita Electric Industrial Co Ltd	13
NTT Docomo Inc	11
Orange Personal Communications Services Limited	11
ZTE Corporation	11
Soma Networks Inc.	10

The entities from the USA have a dominant presence in this technology, followed by the UK, Korea and 20 other countries. Our patent presence in this technology is even behind that of China in IPO. In all, 179 entities have obtained patents under this sub-class during the period analysis. Qualcomm, with 299, is in the lead, far ahead of others. This is followed by Ericsson, Motorola, Nokia, RIM (Blackberry) and others. Top four assignees have ownership of 47.7% of the total in this sub-class indicating a firm grip and possible strong influence on the use of these technologies in mobile services industry within the country.

The following is a list of representative patents indicating the nature of innovations under this subject:

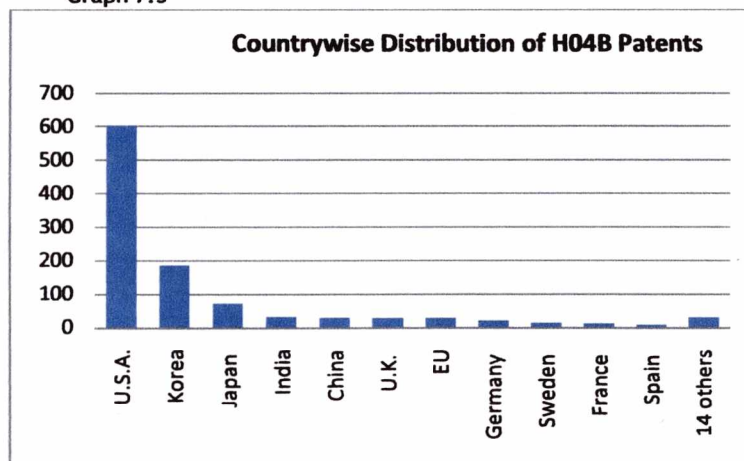
- *An apparatus for receiving broadcast messages from a transmitter in a communication network [193025]*
- *A wireless system for calculating uplink signals transmitted from a plurality of remote terminals using a common uplink channel [193616]*
- *A method and apparatus for generating a dial tone within a wireless local loop signal transmission system [193867]*
- *An apparatus for minimizing external interference signals in a code division multiple access[CDMA] mobile phone [194971]*
- *Method of controlling call for identical incoming office number in exchange system [195760]*
- *Forward link power control device and method for a mobile communication system supporting transmission diversity [195789]*
- *Communication transceiver for use in a communication system [196140]*
- *A method and a telecommunications network for transmitting signals comprising digitally coded data [196447]*

H04B - Transmission of information-carrying signals

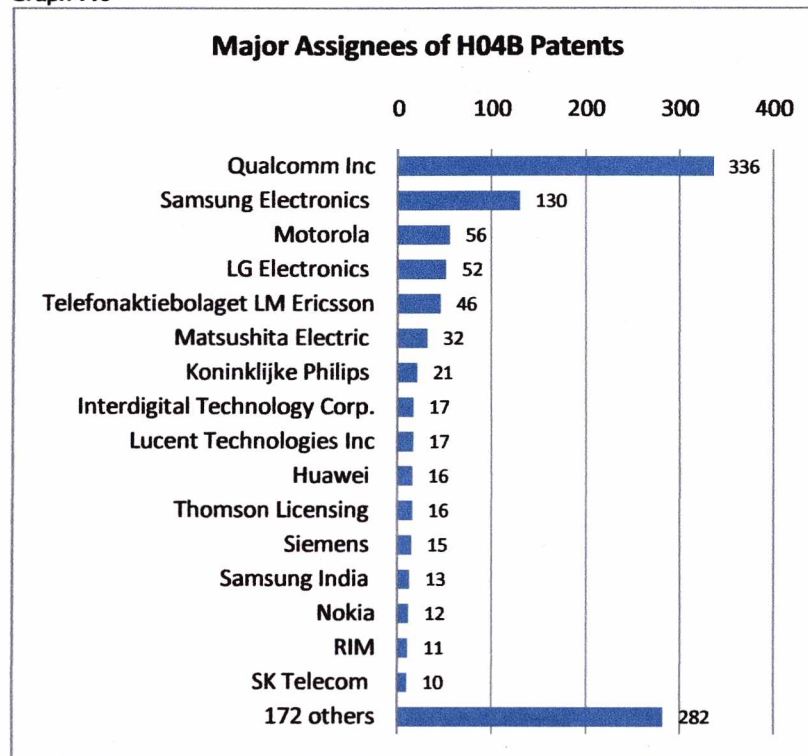
This subclass covers the technologies relating to transmission of information-carrying signals, the transmission, being independent of the nature of the information, includes monitoring and testing arrangements and the suppression and limitation of noise and interference.

There are 25 countries which have been granted patents under this sub-class. The US entities are in the lead with 599 patents even under this sub-class, followed by Korea, Japan, India, China and others.

Graph 7.5



Graph 7.6



There are, in all, 188 assignees which have been granted patents. This bunch of assignees is also led by Qualcomm, with Samsung following it at a distance. Motorola, Ericsson, and LG together fall in the third cluster. Again, a list of 172 entities make a long tail of assignees, which have only one or two patents each. Patents under this sub-class fall under nearly 250 specific subjects. Top five of these have attracted over 50 patents each.

IPC No.	patents	Subject Details
H04B7/26	179	for communication between two or more posts at least one of which is mobile
H04B7/005	120	Radio transmission systems, i.e. using radiation field Control of transmission; Equalising
H04B1/707	77	Spread spectrum techniques in general using direct sequence modulation
H04B7/00	64	Radio transmission systems, i.e. using radiation field
H04B1/38	50	Transceivers
H04B	37	transmission of information-carrying signals
H04B7/06	35	at transmitting station
H04B1/00	30	Details of transmission systems, not covered by a single one of groups
H04B17/00	27	Monitoring; Testing
H04B7/216	25	Code-division or spread-spectrum multiple access
H04B7/185	23	Space-based or airborne stations
H04B1/40	22	Circuits
H04B1/69	22	Spread spectrum techniques
H04B7/02	21	Diversity systems
H04B15/00	17	Suppression or limitation of noise or interference
H04B7/08	17	at receiving station
H04B7/212	17	Time-division multiple access
H04B1/16	16	Circuits
H04B1/10	13	Means associated with receiver for limiting or suppressing noise or interference
H04B3/54	12	Systems for transmission via power distribution lines [in alarm signalling systems]

H04B10/00	10	Transmission systems employing electromagnetic waves other than radio-waves,
	248	138 Sub-groups

The following is a list of patents indicative of the nature of innovation in this sector:

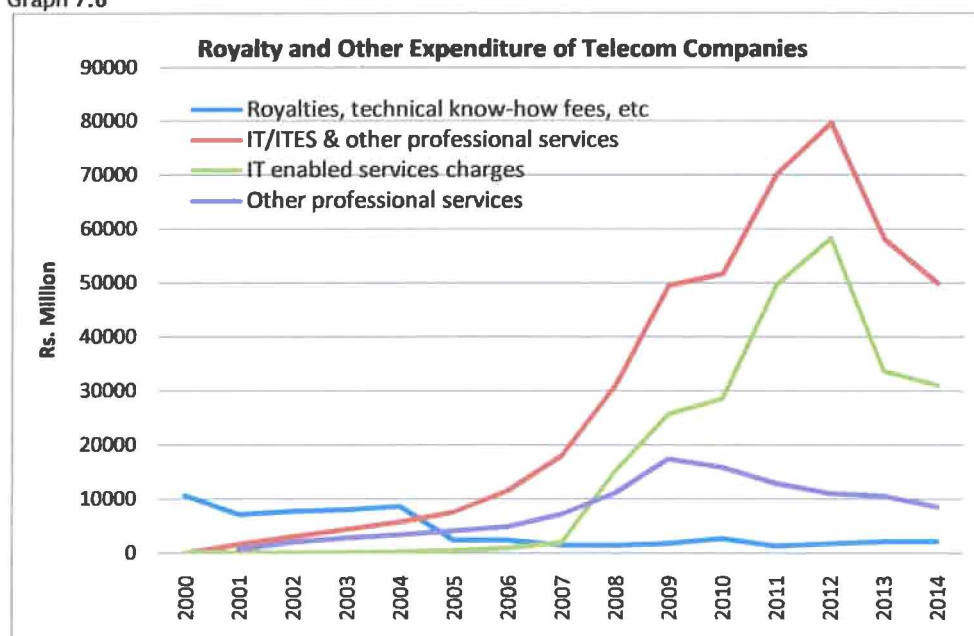
- **Method for handoff from packet switching domain to circuit switching domain and equipment thereof**
- **Method for assigning and searching a mobile subscriber roaming number**
- **Method for handoff from packet switching domain to circuit switching domain and equipment thereof**
- **Method for assigning and searching a mobile subscriber roaming number**
- **Method for allocating communication resources**
- **Method for call control**
- **A method and a system for updating a routing area in a packet radio network**
- **A method for emitting a user-data stream when changing between a first and a second transmission path, and a communication terminal**
- **A method of enhancing voice communication between a group of users in a network within a voice group call service**
- **Method and apparatus for preventing leaks of information**
- **Method and device for transmitting a signal**
- **Method and system for voice SMS messaging**
- **Universal short code administrator**
- **A mobile communication system and a method for processing telephonic communications**
- **A method for priority access channel assignment, a base station and a mobile station**
- **Arrangement for data exchange in a wireless communication system**
- **A method and an apparatus for originating a wireless telephone call**
- **A method and apparatus for performing network discovery**

Unlike other technologies examined, foreign presence almost completely dominates innovations in telecom sector. Though the country has several mobile service operating companies, to a large extent, they have to depend exclusively on these technologies at the backend for running their services. The leading patent holders like Qualcomm have also established their R&D set up in India. Even Samsung has a fully owned subsidiary in the country, which is active in R&D space in this technology. But for this the local Indian presence is marginal. As could be seen this trend makes us technology followers for a long time, despite a large market in the sector. The following section enquires into this aspect.

Royalty / License Fee

A Close look at the technology dependence by our telecom companies was analysed taking into consideration the royalty and other payments. 130 companies which make up the total telecom space in the country, on the whole in 2014 incurred Rs. 140 574 996.5 million on royalty, IT/ ITES, and other payments towards backend support. Telecom companies exhibit their technology dependence in several ways.

Graph 7.6



Source: CMIE Prowess Database

Some of the larger enterprises like Airtel have completely outsourced the backend operations. This would mean the associated hardware and services are catered to and maintained by external technology owners. These charges are substantial recurring amount that cuts into the profit margins of the respective telecom operators, without any technology transfer or hands on learning. This, along with sparse R&D expenditure by those enterprises, does not hold out well in technology and innovation front. This view is also reinforced recently by C-DOT Executive Director "There is very little manufacturing happening at this point in time in India. Consequently, we are losing ground in terms of competency, market share and production of cost-effective products to meet rural and urban demands," (<http://telecom.economictimes.indiatimes.com/news/policy/make-in-india-state-run-telecom-tech-giant-c-dot-seeks-government-support/49010326>) Graph 7.6 reflect the trend of technology dependence in this sector.

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Notes and References

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8 Transportation

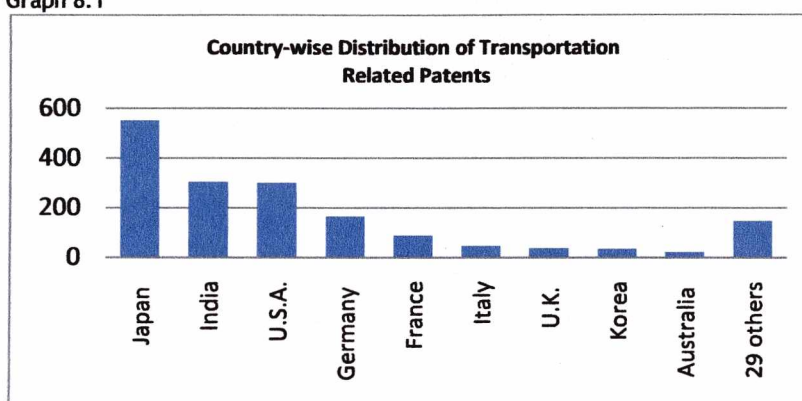
Transportation is one of the prominent sectors in a modern economy. The sector provides much needed mobility to people and goods. Modern transportation involves manufacturing and associated support services to fulfill its functions. Automobile sector alone contributes to 7% of the GDP. Transportation covers land, water and airways with multitudinal means in each of this category. (India Brand Equity Foundation, 2015)

Modern transportation has evolved over several decades. Transport vehicles, technologies associated with that have developed over a period, both by local and foreign entities. Consequently there is invariably some local manufacturing base catering to local and export needs. Automobiles, an important component of this sector, is an employment intensive sector, and receive due attention from the business, government and also society at large. Patents on transport sector for the period 2001-14 was retrieved by using the IPC codes B60#, B61# , B62#, B63B, B63C, B63G, B63H, B63J, B64#. Schmoch (2008) These codes cover subjects such as land, sea and air vehicles. There are as many as 1,705 patents on transportation assigned by the IPO during the period 2001-14. Thirty-seven countries have obtained patents in this sector and 24 of them, however, own less than 10 patents (Table 8.1). Countries with most patents in this sector are Germany, India, Japan, the USA, all of them with over a hundred each, followed by France, Italy, South Korea, UK, and others. Japanese entities have almost one-third of these patents assigned in IPO during the 2001-14 period.

Table 8.1 country-wise distribution of transportation related patents

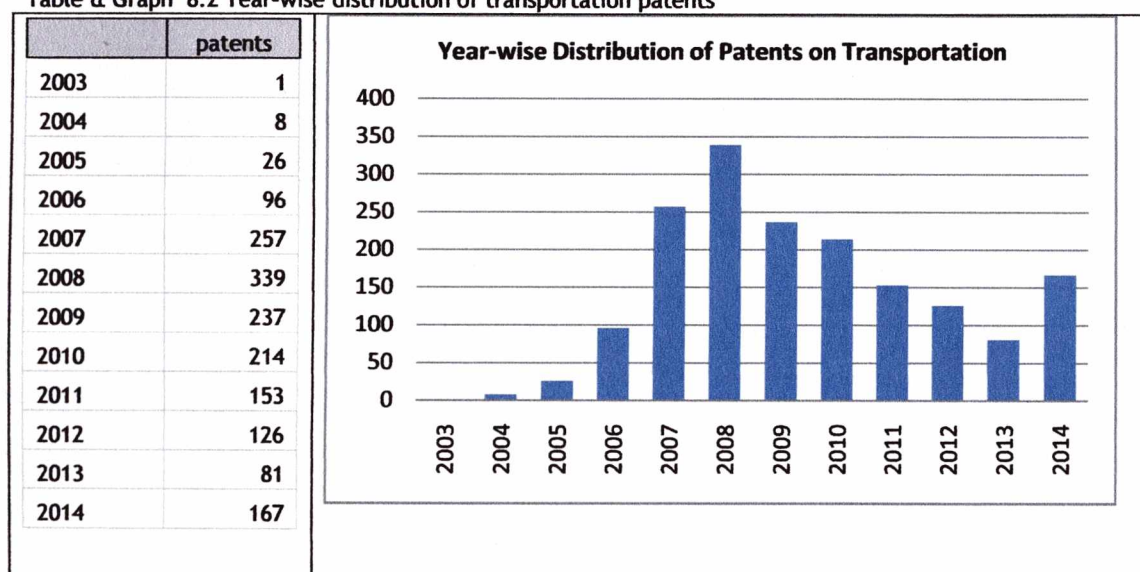
Country	Patents		
Japan	552	Canada	4
India	305	Russia	4
U.S.A.	302	Argentina	4
Germany	166	Slovenia	3
France	89	Denmark	2
Italy	47	Finland	2
U.K.	39	Belgium	1
Korea	35	Bahamas	1
Australia	23	Egypt	1
EU	17	Israel	1
Sweden	15	Ireland	1
Netherlands	15	Liechtenstein	1
Austria	15	Malaysia	1
Norway	10	New Zealand	1
China	9	Singapore	1
Taiwan	8	Hungary	1
Spain	8		1705
South Africa	7		
Switzerland	7		
Brazil	5		

Graph 8.1



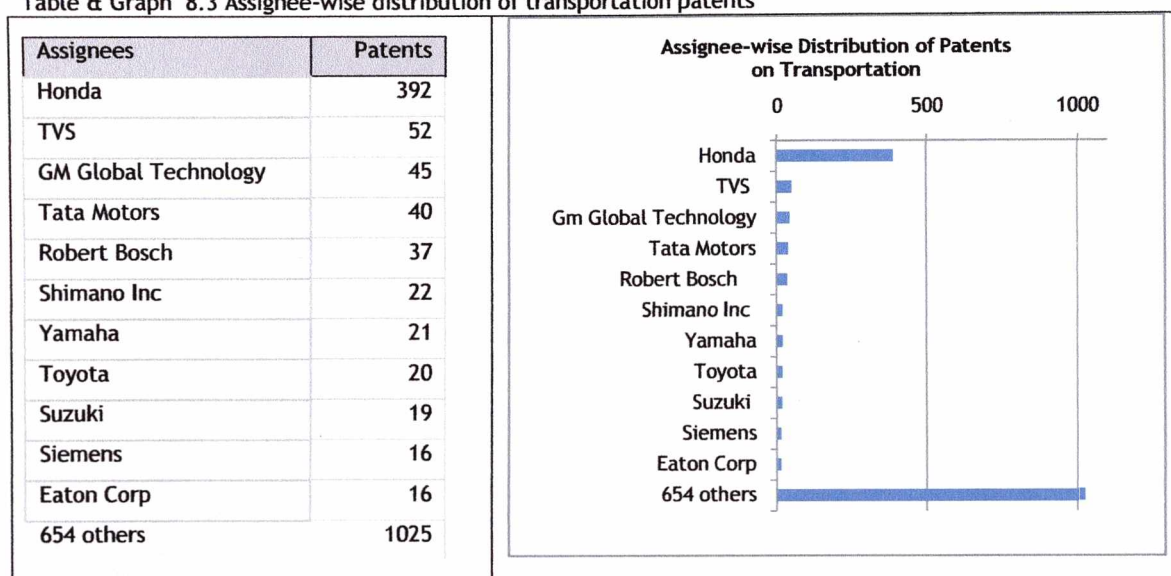
As is the case with other technologies most patents are granted during the years 2007-2008, with the year 2014 showing a surge after a period of decline.

Table & Graph 8.2 Year-wise distribution of transportation patents



There are as many as 665 assignees who have been granted patents on transportation related subjects. However, most of them, totaling 649 (97.6%) have less than 10 patents on the technology under one or the other IPC sub-groups. Those with 1 or 2 patents make up 579 (87.1%) of them during the time span of the data covered. Excepting TVS Motor Co., and Tata Motors, which have 52 and 40 patents respectively during 2001-14, others in the top list (of those with at least 10 patents) are foreign assignees. Honda tops the list with 392 patents making up almost 40% of the total under this broad category of technology. A large number of assignees with limited number of patent holdings could at best enjoy exclusive rights on the innovation. Yet, such ownership would be difficult to exploit strategically in business.

Table & Graph 8.3 Assignee-wise distribution of transportation patents



Transport related patents granted during the period 2001-14 fall in 60 IPC sub-classes. At the top of these subjects are five sub-classes with over 100 patents, four, between 50 and 100. There are 13 other sub-classes with patents between 20 and 50.

Table 8.3 Distribution of Transport Related Patents in IPO

IPC sub-class	Patents	B60#, B61# , B62#, B63B, B63C, B63G, B63H, B63J, B64#
B60B	26	Vehicle wheels; castors; axles for wheels or castors; increasing wheel adhesion
B60C	79	Vehicle tyres; tyre inflation; tyre changing; connecting valves to inflatable elastic bodies in general; devices or arrangements related to tyres
B60G	53	Vehicle suspension arrangements
B60H	32	Arrangements or adaptations of heating, cooling, ventilating, or other air-treating devices specially for passenger or goods spaces of vehicles
B60J	26	Windows, windscreens, non-fixed roofs, doors, or similar devices for vehicles; removable external protective coverings specially adapted for vehicles
B60K	189	Arrangement or mounting of propulsion units or of transmissions in vehicles; arrangement or mounting of plural diverse prime-movers in vehicles; auxiliary drives for vehicles; instrumentation or dashboards for vehicles; arrangements in connection with cooling, air intake, gas exhaust or fuel supply of propulsion units in vehicles
B60L	38	Propulsion of electrically-propelled vehicles
B60N	44	Vehicle passenger accommodation not otherwise provided for
B60P	16	Vehicles adapted for load transportation or to transport, to carry, or to comprise special loads or objects
B60Q	38	Arrangement of signaling or lighting devices, the mounting or supporting thereof or circuits there for, for vehicles in general
B60R	153	Vehicles, vehicle fittings, or vehicle parts, not otherwise provided for
B60S	40	Servicing, cleaning, repairing, supporting, lifting, or maneuvering of vehicles, not otherwise provided for
B60T	84	Vehicle brake control systems or parts thereof; brake control systems or parts thereof, in general arrangement of braking elements on vehicles in general; portable devices for preventing unwanted movement of vehicles; vehicle modifications to facilitate cooling of brakes

B60W	21	Conjoint control of vehicle sub-units of different type or different function; control systems specially adapted for hybrid vehicles; road vehicle drive control systems for purposes not related to the control of a particular sub-unit
B61B	18	Railway systems; equipment there for not otherwise provided for
B61F	26	Rail vehicle suspensions, e.g. Under frames, bogies or arrangements of wheel axles; rail vehicles for use on tracks of different width; preventing derailling of rail vehicles; wheel guards, obstruction removers or the like for rail vehicles.
B61G	18	Couplings specially adapted for railway vehicles; draught or buffing appliances specially adapted for railway vehicles
B61H	13	Brakes or other retarding apparatus peculiar to rail vehicles; arrangements or dispositions of brakes or other retarding apparatus in rail vehicles
B61L	34	Guiding railway traffic; ensuring the safety of railway traffic
B62D	152	Motor vehicles; trailers
B62H	19	Cycle stands; supports or holders for parking or storing cycles; appliances preventing or indicating unauthorised use or theft of cycles; locks integral with cycles; devices for learning to ride cycles
B62J	165	Cycle saddles or seats; accessories peculiar to cycles and not otherwise provided for
B62K	117	Cycles; cycle frames; cycle steering devices; rider-operated terminal controls specially adapted for cycles; cycle axle suspensions; cycle sidecars, fore cars, or the like
B62L	12	Brakes specially adapted for cycles
B62M	68	Rider propulsion of wheeled vehicles or sledges; powered propulsion of sledges or cycles; transmissions specially adapted for such vehicles
B63B	43	Ships or other waterborne vessels; equipment for shipping
B63C	12	Launching, hauling-out, or dry-docking of vessels; life-saving in water; equipment for dwelling or working under water; means for salvaging or searching for underwater objects
B63H	15	Marine propulsion or steering
B64C	30	Airplanes; helicopters
B64D	20	Equipment for fitting in or to aircraft; flying suits; parachutes; arrangements or mounting of power plants or propulsion transmissions in aircraft
B64G	12	Cosmonautics; vehicles or equipment there for

As could be seen, excepting three sub-classes B63B, which pertains to ships and B64C and B64D relating to aeroplanes, others in the top group of patented subjects focus on land vehicles or those dealing with general features of vehicle functioning.

IPC class B62 – Land vehicles for traveling otherwise than on rails - has 550 patents granted for the years covered in the study. A closer analysis was made of this IPC class and its components, with a special focus on two-wheeler sector for understanding the technology priorities for assignees and local enterprises relative interest in the same.

Land Vehicles

It is known that automobile sector occupies key place in manufacturing in a modern economy. In India automobile sector, including passenger vehicles, commercial vehicles, three-wheelers and, two-wheelers contribute 7% to the GDP. Twenty-two percent of our manufacturing GDP is accounted for by this sector. Within the land vehicles, it is the two-wheeler sector which is more active due to large proportion of younger population in the country, affordability of the vehicles, growth of the middle class with dispensable income, rapid urbanization, as also increasing disposable incomes in the rural agri-sector. Two-wheeler sector make up 78% of the total in land vehicles. (India Brand Equity Foundation, 2015)

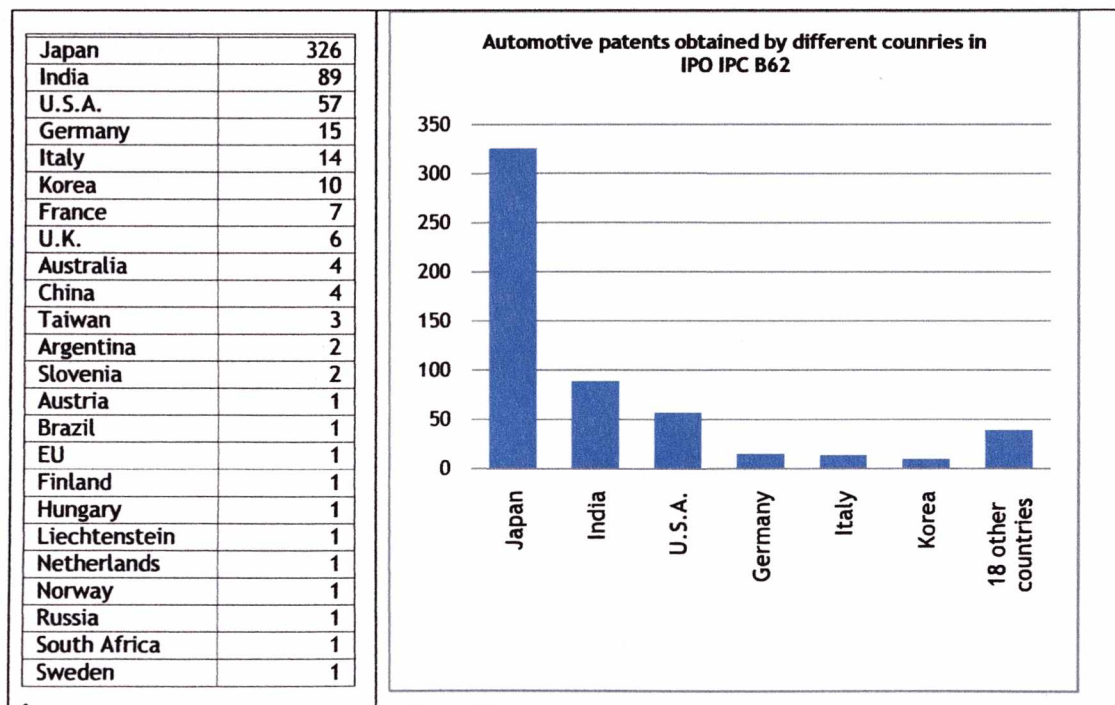
India is currently the seventh-largest automobile producer in the world with an average annual production of 17.5 Million vehicles, of which 2.3 million are exported. The Indian automobile market is estimated to become the third largest in the world by 2016 and will account for more than 5% of global vehicle sales. India is the second-largest two-wheeler manufacturer, the largest motorcycle manufacturer, and the fifth largest commercial vehicle manufacturer in the world. The total turnover by 2016 is slated to be USD 145 billion. (Investor Facilitation Cell, GoI 2015)

Two-wheelers and three-wheelers are projected to expand at a CAGR of 9% between 2013-20. This calls for technology innovation in passenger vehicle sector to suit the local conditions. In addition to these, India is also emerging as a global R&D base with many of the global players recognizing the local capabilities.

Distribution of patents within B62 shows that there are as many as 550 patents granted during 2001-14 period. There are four IPC sub-classes and 254 sub-groups on which patents have been granted. Given that basic technologies for petrol / diesel land vehicles have already evolved in several stages and stabilized, this industry has not seen high levels of patenting in the recent past. It could be observed in the context that USPTO under the same class has granted 1610 patents during 2001-2014 period.

Countries that have obtained patents in IPC class B62 in IPO are led by Japan, India, and the USA. Germany, Italy and South Korea have between 10 and 15 patents. We can see a large presence of Japan in this sector, unlike others, where we see the USA dominates (Table 8.4).

Table & Graph 8.4 Automotive patents obtained by different countries in IPO IPC B62



Among the Japanese companies, Honda is in the lead and is far ahead of others (Table 8.5).

Table 8.5 Automotive patents taken by Japanese cos.

Honda Gieken Kogyo Kabushiki Kaisha	268
Yamaha Hatsudoki Kabushiki Kaisha	15
Kubota Corporation	6
Suzuki Motor Corporation	6
Nissin Kogyo Co. Ltd	5
19 others	31

Subject-wise distribution of patents under IPC code B62 is presented in Table 8.6

Table 8.6 subject-wise distribution of patents under IPC code B62

IPC IPCsub- class	Patents obtained by Japanese assignees		Honda Patents
B62	1	Land vehicle	
B62B	2	Hand-propelled vehicles	2
B62C	1	Vehicles drawn by animals	1
B62H	10	Cycle stands; supports or holders for parking or storing cycles; appliances preventing or indicating unauthorised use or theft of cycles; locks integral with cycles; devices for learning to ride cycles	10
B62L	11	Brakes specially adapted for cycles	6
B62M	40	Rider propulsion of wheeled vehicles or sledges; powered propulsion of sledges or cycles; transmissions specially adapted for such vehicles	34
B62D	50	Motor vehicles; trailers	18
B62K	71	Cycles; cycle frames; cycle steering devices; rider-operated terminal controls specially adapted for cycles; cycle axle suspensions; cycle sidecars, forecars, or the like	64
B62J	137	Cycle saddles or seats; accessories peculiar to cycles and not otherwise provided for	117

It could be noticed that only a few sub-classes have attracted patents in Indian Patent Office in this technology. The clustering is the most under B62J - *cycle saddles or seats; accessories peculiar to cycles and not otherwise provided for, e.g. article carriers or cycle protectors* - which has attracted 165 patents.

Japan is in the lead in obtaining patents in this IPC class. Though several Japanese entities have been assigned exclusive rights for their innovation, it is Honda which owns more than 80% of those patents. The following distribution (Table 8.6) of Japanese patents in B62 shows that Honda has obtained most of the patents in IPO in almost all the sub-classes.

Under B62 the Honda's innovation seems to be purposive and studied for the Indian market. The company, it could be distinctly noticed, has also obtained the most of the patents in the sub-class B62J - 117 of 137. A closer look was taken at the patents obtained under this class to know Honda's innovation priorities for Indian conditions. B62J represent the consumer end of the land vehicles. It mostly deals with 'look and feel' of the finished product, and also deals with the minor difference in the design and finish associated with the secondary functioning of the vehicles.

In fact, IPC Sub-class B62 J related patents have been obtained by 16 entities from Australia, Germany, India, Italy, Japan, and the UK. Six Japanese firms have patented their innovations in this technology (Table 8.7). Despite several countries and entities in the fray, we can notice that most of the patents are taken by Honda, accounting for almost 85% of the total in this sub-class.

Table 8.7 Assignees of the IPC sub-class B62J related patents

IPC Sub-class B62J		
Andre Perret // Dr. Claus-Michael Mayr	Germany	1
Diagaraj. R	India	1
Did Italia S R L	Italy	1
Laureate Education, Inc.	U.S.A.	1
Manta Design Ltd	U.K.	1
Minda Industries Ltd.	India	1
Paul Damian Nelson	Australia	1
Toyo Denso Co Ltd	Japan	1
Toyota Jidosha Kabushiki Kaisha	Japan	1
Tsuge Kenji	Japan	1
M.D'a Francesco Riondato	Italy	2
Piaggio&C. S.P.A	Italy	3
Shimano Inc	Japan	13
Yamaha Hatsudoki Kabushiki Kaisha	Japan	7
TVS Motor Company Limited	India	8
Honda Motor Co Ltd	Japan	117

Considering Honda is leading the patent holders among the Japanese companies and the sub-class B62J is the most patented topic it is interesting to take a closer look at the sub-groups that make up this sub-class. The following are the details of the same.

The IPC details of the class B62 J and its components are presented in Table 8.8.

Table 8.8 Patents under IPC Sub-class B62J

Patents	IPC Code	Sub-groups under which Honda has obtained patents in IPO
21	B62J39/00	Acoustic signal or alarm devices
17	B62J23/00	Foot-rests; Rigidly-mounted knee grips, e.g. on petrol tank
15	B62J9/00	Adaptations or arrangements of mirrors for use on cycles
13	B62J35/00	Fuel tanks specially adapted for motorcycles or engine-assisted cycles
12	B62J25/00	Foot-rests; Rigidly-mounted knee grips,
10	B62J11/00	Supporting devices for attaching articles of definite shape to cycles; for pumps
8	B62J1/12	•Box-shaped seats; Bench-type seats, e.g. dual or twin seat
7	B62J1/00	Saddles or other seats for cycles; Arrangement thereof; Component parts

7	B62J17/00	Weather guards for riders;
7	B62J6/00	Arrangement of optical signalling or lighting devices on cycles, the mounting or supporting thereof or circuits therefor
5	B62J17/04	• Windscreens; Weather guards for riders;
5	B62J6/04	• the devices being rear lights; Arrangement of optical signalling or lighting devices
4	B62J27/00	Safety equipment, e.g. crash bars
3	B62J1/28	• Other additional equipment, e.g. back rests for children
3	B62J6/02	• the devices being headlight; Arrangement of optical signalling or lighting devices
28		21 other sub-groups under B62J
165		

Table 8.9 Select Patents on the sub-class B62J taken by Honda in IPO

B62J	Storage structure for motorcycle
B62J	Seat structure
B62J1/12	Seating detecting device for motorcycles
B62J1/12	Seat lock device in two-wheeled motor vehicle
B62J11/00	A supporting structure for an article containing chamber of a motorcycle
B62J15/00	Mudguard structure for scooter type vehicle
B62J23/00	Front lighting structure for motor scooter type vehicle
B62J23/00	Scooter type vehicle fuel device
B62J25/00	Footrest structure for a motorcycle
B62J25/00	A sari guard mounting structure for a motorcycle
B62J25/00	Assist step for passenger of motorcycle
B62J39/00	Electrical unit layout structure in motorcycle
B62J39/00	Vehicle wheel speed sensor protection structure
B62J6/02	Ventilation-hole structure of lamp device
B62J6/16	A vehicular handlebar switch structure
B62J9/00	Electrically driven vehicle
B62J23/00	Scooter type vehicle body cover structure
B62J23/00	Leg shield structure of motorcycle
B62J27/00	Impact detection sensor attachment structure for motorcycle
B62J27/00	Occupant restraining device for two-wheel vehicle
B62J39/00	Hybrid vehicle
B62J39/00	Saddle riding type fuel cell vehicle
B62J9/00	Article storing structure for vehicle

Table 8.10 Select List of Honda Patents in IPO in other Sub-classes

Side stand device for motorcycles [206919]
Method of calculating the work piece loading times for product assembly line [212505]
A fork cover mounting structure [221446]
Remote control apparatus for a light vehicle [217892]
Steering device for vehicle [238774]
Vehicle-use electronic key system [240745]
Attaching apparatus for antitheft device and article accommodating box of motorcycle [243854]
Main stand attaching/detaching structure for motorcycle [240074]
Ventilation-hole structure of lamp device [204342]
Air guide structure in front body portion of scooter type vehicle [204584]
Electrically driven vehicle [213835]
Hybrid vehicle [243734]
Occupant restraining device for two-wheel vehicle [248467]
Seat arrangement of a motorcycle [214701]
Foldable two-wheel vehicle [215216]

An audible pilot winker apparatus [216528]
A motorcycle with foreign object entry prevention means in the insertion hole in the front fender [230316]
Saddle-ride type fuel cell three-wheeled vehicle [258653]
Vehicle with solar cell [222957]
A motorcycle having increased storage capacity of the storage box [250221]
A vehicle signal light [238646]

From this select list of patent titles of Honda in India, one could notice that the R&D is specific to the local conditions, patenting is granular and aims at facilitating the brand image of the vehicle in as much as excluding other vehicles in this class from using similar structures / designs etc. Some of these patents also look at the possible future class of vehicles in its inclusion of electrically driven vehicle, fuel cell vehicles or hybrid ones. The contrast could be noticed in the absence of many such patents from local manufacturers of the same class of land vehicles. It is interesting to note in the context the growth of the company operations in the country.

Honda in India

Honda Motorcycle & Scooter India Pvt. Ltd. (HMSI) is the fully owned subsidiary of Honda Motor Company, Japan - the World's No.1 two-wheeler company. Honda started Indian 2-Wheeler operations in May 2001. Earlier on in 1984 the company had a joint venture with Hero Cycles and the venture was titled Hero Honda. In 2010, Honda decided to move out of the joint venture. Honda with Hero had established a substantial market share by 2010 in Indian two-wheeler market.

Honda had, in fact, started production in 2001 from its first plant at Manesar (Haryana) in select 2-wheeler class of vehicles. In the 14 years since then, Honda has grown to become the second largest two-wheeler company in India with three manufacturing plants in different regions of the country. (<http://yes.honda.co.in/honda-motorcycle-scooter.aspx>)

India is a focus market for Honda and it is significant that Honda's two-wheeler operation in India is the second largest contributor to Honda's global sales.

In the beginning of the financial year 2015-16, Honda had the highest market share and volume gainer in two-wheeler industry with 26% market share. In automatic scooter segment, Honda's market share is 59%. Growing at a pace nearly four times that of industry, Honda is today leading the Scooterization of Indian two-wheeler industry. Honda's future growth in India, the company feels, will be co-driven by its scooter portfolio.

<http://www.autocarpro.in/news-national/india-honda-wheeler-market-2018-8698#sthash.jccz3wpu.dpuf>

Honda's pro-active innovations to suit the 2-wheelers, especially to local conditions, along with relative absence of such a culture among Indian competitors seem to have facilitated its market domination. It is also true that the company has an international reputation to go with, and product innovation has only helped further in distinguishing the brand.

The case illustrates how focused product improvement and patenting to protect the innovation can further the market share. It is interesting to compare the Indian patents on the technology in the context. Indian entities

have obtained 89 patents in the land vehicles category during the overlapping period. TVS Motor Co has most of them with 30 patents. This is followed by Tata Motors with 12 patents. In fact, the patents assigned to individual inventors stand second only to TVS. The trend in the domestic patent office reflects poorly on the innovation culture of the industry. It is, however, reassuring that the nature of patents obtained by TVS and others focus on specific narrower innovations such as *Storage facility for a motorcycle*, *Audible warning system for a side stand assembly on two wheelers*, and the like. Local companies are learning to move in the right direction.

Table 8.11 Total Indian Patents on Land Vehicles

B62H	8	Cycle stands; supports or holders for parking or storing cycles; appliances preventing or indicating unauthorised use or theft of cycles; locks integral with cycles; devices for learning to ride cycles
B62J	10	Cycle saddles or seats; accessories peculiar to cycles and not otherwise provided for
B62M	10	Rider propulsion of wheeled vehicles or sledges; powered propulsion of sledges or cycles; transmissions specially adapted for such vehicles
B62K	25	Cycles; cycle frames; cycle steering devices; rider-operated terminal controls specially adapted for cycles; cycle axle suspensions; cycle sidecars, forecars, or the like
B62D	36	Motor vehicles; trailers

Table 8.12 Indian assignees holding patents in IPC 62

Bajaj Auto Ltd.	1
Bharat Heavy Electricals Ltd.	1
Indian Council of Medical Research	1
Kinetic Engineering Ltd.	1
MindaHuf Ltd.	1
National Institute of Research on Jute & Allied Fibre Technology	1
Pronto Steerings Ltd.	1
Department of Science & Technology	1
Solmec Earthmovers Equipments	1
Tractors And Farm Equipment Ltd.	1
UCAL Fuel Systems Ltd.	1
Indian Institute of Science	2
Minda Industries Ltd.	2
R & D, TVS Motor Company Ltd.	2
Sona Koyo Steering Systems Ltd.	2
Rane(Madras) Ltd.	3
Sona Koyo Steering Systems Ltd.	3
Tata Motors Limited	12
TVS Motor Company Ltd.	30
Assigned to Inventors	24

Table 8.13 Tata Motors Ltd IPO Patents on Motor Vehicles; Trailers

Breakaway steering system [227304]
A motor vehicle structure with unique impact energy absorbing capability [234972]
Spare wheel cover assembly [236999]
A device for measuring the steering parameters of a vehicle [240299]
An improved air vent assembly for vehicles [245869]
An improved bracket assembly for vehicles [254836]
A control system integrated with steering wheel of vehicle [258371]
A device for steering returnability and centering of a vehicle [258459]
Spare wheel mounting system for automobile [259074]

Improved steering column support structure [261432]
A joining mechanism for space frame and chassis frame of vehicle body and method of joining [263458]
Gear shifting mechanism [254641]

Table 8.14 TVS Motor Co Ltd IPO Patents on Motor Vehicles; Trailers

A gear shift interlock mechanism for a multispeed synchromesh transmission system [205193]
A gear shift device for a synchromesh transmission system [205199]
Audible warning system for a side stand assembly on two wheelers [243985]
A side stand for a motor cycle [221684]
Centre stand for two wheelers [243983]
Automatic side stand retractor for a motorcycle [244258]
Cover frame locking arrangement for a motorcycle [249489]
An oil pump and cam chain mounting arrangement for four stroke engine of a scooter type motor vehicle [216643]
A motorcycle incorporating a device for mounting an end portion of a fender thereof [223254]
Storage facility for a motorcycle [238939]
A method of manufacture of fuel tanks of motorcycle [240794]
A fuel tank inlet cap assembly for a motorcycle [243562]
Footrest sleeve for a motorcycle [249423]
A hands free footrest system for a motorcycle [253946]
Gear shifting arrangement for a motor vehicle [257247]
A toggle link device for mounting the engine of a scooter type vehicle on the frame assembly [201633]
A front panel mounting member for a scooter type of motor vehicle [201642]
A motorcycle with protected fuel tank [216679]
A handle bar control lever assembly for a motor vehicle [221361]
Speedometer assembly [242788]
Stand device for a motorcycle [243394]
Motorcycle frame structure [248689]
Foot rest for a motorcycle [249305]
A cover frame for a motor cycle provided on either side of the vehicle for covering the exposed areas thereof [249770]
A communication device for a two wheeler motor vehicle [250084]
Telescopic front fork of a motor cycle [255274]
Front fork outer tube of motor cycle and a method of manufacture thereof [196308]
A sub frame assembly for the main frame of a scooter type motor vehicle [201852]
A scooter having a centrally mounted engine with an all gear transmission means [198397]

This case illustrates that innovation and patenting is important even in established sectors like automobiles by manufacturers who plan to dominate the market - even if the entities are of foreign origin and the market is local. R&D and patenting along with product improvement makes a difference in the market capture. Successful innovations cater to current needs, as also keeps an eye on the possible technology shift to alternative options. Three cases which takes closer look into the patenting on specific sectors, reinforces the need for Indian innovation. The technology dependence, despite robust local market needs, make them persistent followers or dependents, rather than the trend setters. Our dependence on foreign technology in telecom sector is almost total. For medical devices the country is dependent on imports and a foreign patents foothold seems to occupy the low risk technology area, for which the local demand in volume is high. In automobiles the foreign innovation seems to address the local needs, as these companies get greater foothold in the local market.

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9 Do We Need Patented Technologies?

India has exercised its self interest in closely supervising patents granted locally. The Patents Act of 1970 had excluded patents in certain technologies. Provisions of compulsory licensing and restrictions on royalty payments were intended to facilitate local technology growth. The Amended Patents Act has also adopted 'non-obvious plus' standard in defining innovation. It brings in technical advance and economic significance criteria on to the non-obvious requirement. The Amended Act also seems to affirmatively prohibit the consideration of foreign uses (as opposed to foreign publications) of inventions as prior art. Generally, the trend across the economies is also to dominate patent database with local patents (Table 9.1) though there are exceptions in countries such as Australia, Brazil, as is the case with India. It is true that foreign companies / enterprises do not wish to own patents elsewhere when such ownership may not help in anyway.

Table 9.1 Patents Granted by Domestic Patent Offices in Select Countries

	2012		2013	
	Domestic Assignees	Foreign Assignees	Domestic Assignees	Foreign Assignees
Australia	1,311	16,413	1,110	16,002
Brazil	4,798	25,637	4,959	25,925
China	143,808	73,297	143,535	64,153
France	16,220	1,496	15,145	1,170
Germany	21,485	3,168	23,209	4,066
India	722	3,606	594	2,783
Japan	224,917	49,874	225,571	51,508
Korea	84,061	29,406	95,607	31,663
UK	4,996	3,890	4,528	2,771
USA	121,026	132,129	133,593	144,242
Source: http://www.wipo.int/ipstats/en/statistics/country_profile				

When enterprises do not develop the required technology in-house, they will have to obtain the same from those who own the patents on the technologies. There are several options for doing so. The most direct one is to pay royalty, an agreed sum settled on business terms. This may be for duration of use of technology, units produced, a fixed amount annually, or other agreements between those who own the technology and the enterprises which need them. Royalty payments are expenses that increase the production cost and in a highly competitive market erode the profit margin. Generally royalty rates are generated by '25% rule', which means 25% of the expected profits (Kemmerer, Jonathan E. and Lu, Jiaqing (2012). Licensed patented innovation earns 25% of the profit without any associated efforts.

Indian regulations prior to December 2009 restricted the royalty payment to 8% of the export of the enterprise and 5% of the domestic sales under technology collaboration. This restriction has since then been removed. The outflows on account of royalty and fees for technical services taken together accounted for 16 - 33% of the FDI inflows between 2009-10 and 2012-13. FDI inflows would normally accompany latest technologies and royalty on those technologies are taken away.

Foreign technologies come at a cost. It affects the local consumers and profitability of the enterprises. Cost imposed on technologies when made available is used as a restraining option by the competing organizations which own the patented technologies. Technology dependence is prevalent across the economies. Patenting provision is, in fact, to provide for such a requirement. However, it is in the country's interest to innovate the locally required technologies to a large extent as the enterprises could benefit from prior understanding of the local needs.

Indian royalty payment data was accessed from two sources: World Bank's World Development Indicators Balance Payment Data (<http://data.worldbank.org/indicator/BX.GSR.ROYL.CD/countries>) and industry-wise payment from CMIE's Prowess database.

Table 9.2 indicate our overall dependence on foreign technologies represented in terms of US \$ inflows and outflows. The gap in the balance of payment figures between inflows and outflows of charges for the use of intellectual property is widening over the years in the recent past. It stands at 1:7 ratio in 2014 - for every unit of royalty earned we are giving away seven in US \$ terms. Our earnings over the past decade has increased three-fold, and our dependence has increased 7.5 times.

Table 9.2 Inflows and outflows of Royalty Payments (US \$ million)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Royalty payments	671.83	845.95	1159.82	1528.83	1860.07	2438.30	2819.29	3990.06	3903.91	4848.71
Royalty Receipts	205.97	60.91	163.13	147.82	191.94	127.38	302.62	321.45	445.57	658.72

Source: World Bank <http://data.worldbank.org/indicator/BM.GSR.ROYL.CD/>
<http://data.worldbank.org/indicator/BM.GSR.ROYL.CD>

Graph 9.1

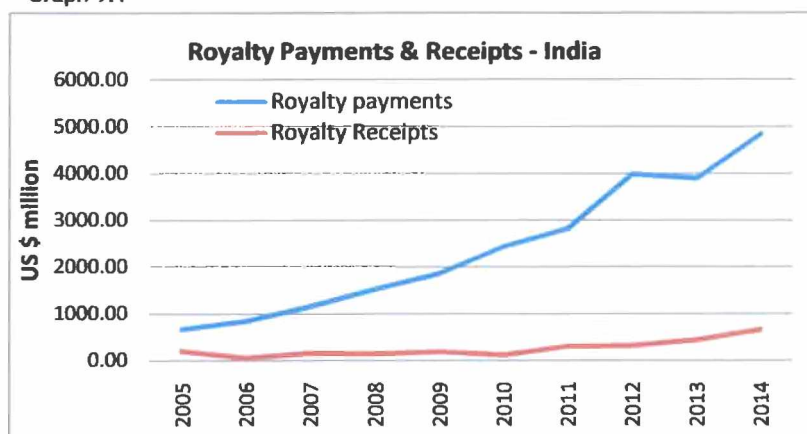


Table 9.3 presents the royalty payment made by Indian enterprises over 2000-2014 period as obtained by CMIE's Prowess database. As could be seen the amount has increase six-fold. These figures are independent of the MNC operations in India under the FDI.

Indian manufacturing and service sectors have been depending on external technologies which affect their profitability and the product costs.

Net royalty, technology knowhow fees, and license fees are on the rise as could be seen in Table 9.3. Royalty makes the most of these, which the yield for owning the technology rights. Indian businesses give out over Rs. 410,000 million as royalty on the whole. Royalty paid varies across sectors is on the rise.

Table 9.3 Royalties, Technical Know-how Fees Paid by Indian Cos.

	(Rs. millions)			
	Royalty	Technical know-how fees	Licence fees	Royalties, technical know-how fees, etc
2000	56,478	2,331	11,629	72,068
2001	67,501	2,406	3,762	73,702
2002	73,477	3,124	3,251	79,852
2003	90,120	5,718	10,284	106,122
2004	97,420	8,647	14,490	120,557
2005	123,681	7,007	8,136	138,823
2006	150,490	6,557	5,411	162,457
2007	175,599	4,706	9,237	189,542
2008	208,783	8,297	11,814	228,894
2009	175,124	9,662	12,574	197,360
2010	221,298	13,501	10,650	245,449
2011	271,342	20,106	13,679	305,126
2012	316,711	18,785	24,101	359,598
2013	367,634	12,137	25,486	405,257
2014	379,386	14,648	24,711	418,745

Graph 9.2

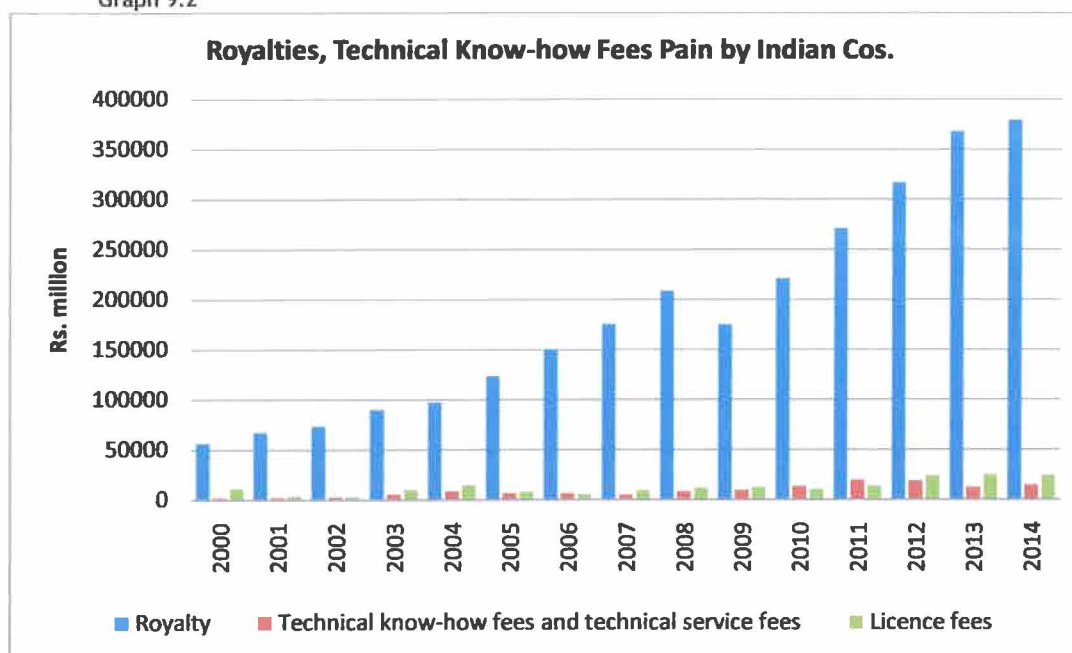


Table 9.4 presents sectors which have paid over Rs. 1000 million in 2014, and how the expenditure under this head has increased over the decade.

Oil sector pays the most royalty. But this is mostly for exploitation of natural resources. Passenger vehicles, agricultural products, cosmetics, and others have given away more than Rs. 5000 million of royalty each in 2014 alone.

None of the sectors have registered a downward trend in royalty payment, which indicates technology dependence on a continual basis

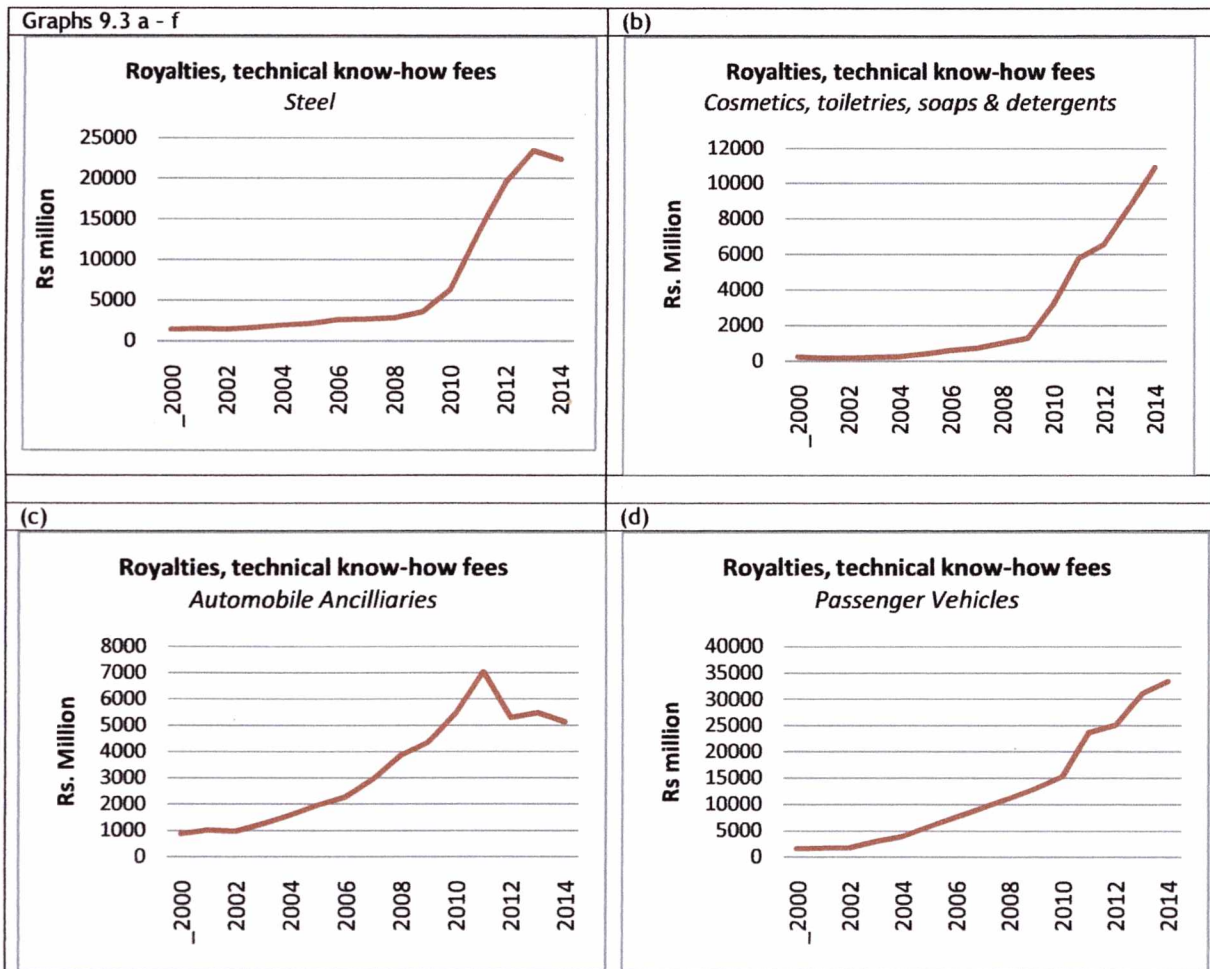
Of particular interest could be passenger vehicles / two wheeler sector where the royalty payment kept the enterprise (Hero Honda in the context (Graph 9.2 a - f) going and withdrawal of the technology, as per the prior agreement with the foreign company, has affected the product positioning and market share. This illustrates the need for local R&D and technology ownership.

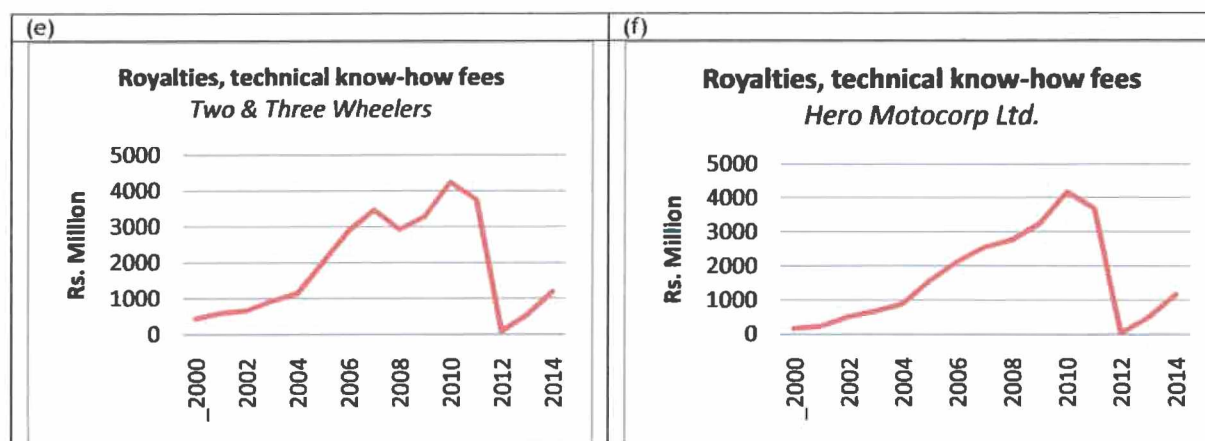
Indian patent possession on telecom is negligible. Telecom services are exclusively dependent on foreign technology for the entire range of backend operations. In fact, most of the telecom companies are not paying royalty, but the services are charged as IT/ ITES expenses, which subsumes royalty charges in the context. The entire sector has been paying nearly 3% of its sales for the purpose.

Table 9.4 Royalties, technical know-how fees, paid by Companies in Different Sectors*								
Industry group	2000-2001	2002-2003	2004-2005	2006-2007	2008-2009	2010-2011	2012-2013	2014
Road transport infrastructure services				39142	79381	80841	82303	43713
Crude oil & natural gas	48985.5	61687.2	76844.1	120175.2	136572.6	155864.9	243443.5	134463.4
Coal & lignite	36330	42799.7	57747.7	65879.3	84290.8	111774.4	152179.9	89391.4
Passenger vehicles	3426.1	4870.7	9808.8	16994	24287.7	39102.9	56152.7	33442.3
Steel	3014.1	3154.1	4159.5	5405.2	6463.4	19623.4	42930.5	22336.5
Minerals	1051.7	1704.6	2987.1	3918.9	5701.6	21579.4	28142.6	13347.1
Cement	2589.2	4819.4	5867.9	8441.5	8838.4	14476.7	20214.6	12401
Cosmetics, toiletries, soaps & detergents	410.3	408.5	662	1331.5	2314.1	8965.2	15252.9	10931.5
Other non-ferrous metals	1451.8	1601.5	2801.4	9776.9	8807.5	14161.2	17824.6	10376.1
Diversified	427.7	4419.4	10222.9	5736.2	8499.4	9251.7	13218.8	6074
Other agricultural products	1202.3	1391	2558.2	2209.9	4575.7	7139.5	8899.1	5202.9
Other automobile ancillaries	1917.6	2246.1	3571.1	5237.6	8233.5	12519.7	10785.8	5139.1
Industrial construction	1796.5	4540.3	7956.6	3518.1	3787.2	10631.4	13384.1	4957.2
Electricity generation	151.9	2184.1	3082.2	6017.8	4690.1	5880	6613.5	3236.6
Other chemicals	283.4	351.2	412.9	1556.6	2249.8	2992.3	4534.7	2783.7
Diversified machinery	133.5	197.8	329.7	851.3	2136.6	2890.3	4819.6	2669

Mining & construction equipment	73.5	160.6	278.3	1780.8	2502.5	3928.6	5161.6	2240.7
Lubricants, etc.	905.4	689.6	1112.8	1258.9	1929.9	3190.4	3875.7	2195.7
Telecommunication services	17808	15722.1	11048.2	3855	3251	3971.9	3863.9	2177.5
Boilers & turbines	409.1	385.4	294.9	1180.5	690.2	2311.3	2309.1	1628.3
Dairy products	550.4	666.5	743.3	852.1	1114.7	1533.1	1994	1572.6
General purpose machinery	522.2	472	666.5	856.1	977.9	1159.5	1947.8	1219.1
Two & three wheelers	1057.5	1612.8	3188.5	6381.6	6228.8	8008.2	642.4	1201.7
Infrastructural construction	103	215	314.2	829.9	1156.8	9296.2	2216.7	1200.3
Storage & distribution	20.3	108.6	244.5	546.4	1068.9	1513.1	1918.5	1102.6
Shipping transport infrastructure services		89.6	140.6	298.1	795.1	698.5	1376.5	1077.6

- Totals are cumulated for two financial years in a column, excepting for 2014
- Source: Data extracted from prowess database of CMIE





Source: Data extracted from CMIE Prowess database

In the context, the prevalent trend of patent ownership in IPO across a wide array of technologies needs immediate attention of the policy makers. We need to give a big push towards domestic inventorship, technology development, and patent ownership in IPO. The data conclusively establishes dependence on foreign technologies in several sectors, including FMCGs. This affects enterprise profitability and brings in technology dependence. It is heartening that the recent draft National IPR Policy recognizes these needs of IP creation. (http://dipp.nic.in/English/Schemes/Intellectual_Property_Rights/IPR_Policy_24December2014.pdf). The policy intends to address this with statutory incentives, grant of utility model patents, and more importantly IP rights protection.

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10 Summary and Conclusions

Technology and innovation are the two key factors in economic growth. Patents are the key motivators for innovators. With the coming of liberalized economies, World Trade Organization and Trade Related Intellectual Property Rights, patents have taken a more important place. Inculcating the habit of innovation and ownership of intellectual property is a challenge some of the newly industrialized countries, including India, are facing. In this background, the study attempted a holistic analysis of patented technologies in Indian Patent Office (IPO). The existing analyses mostly address specific sectors such as pharmaceuticals and chemistry related patents. The current study is more inclusive and provides a panoramic view of the patents in IPO.

Specific objectives of the study were to analyse the following:

1. Patenting trends of Indian and foreign entities as a whole in Indian Patent Office (IPO).
2. Country-wise / assignee-wise trends, based on the patents they have obtained in India.
3. Technology-wise comparisons and analysis of patents granted to Indian and foreign entities locally.
4. Patenting strategies of the major patenting countries based on technology schema adopted from the existing literature.
5. In depth view of a few specific technology areas to infer possible implications of foreign patents on local market.

The study adopted the following methodology:

- Patents granted by the IPO during 2001-2014 period was obtained from the IPO database available in the public domain (<http://ipindiaonline.gov.in/patentsearch/search/index.aspx>)
- The records were recreated in a local database constructed for the purpose of analysis.
- The patents were grouped on IPC classes, sub-classes to understand the subject wise distribution of patents granted.
- The patents were grouped on the assignees to know who owns the patents, both on a country basis and on the firms.
- Patents were also grouped on the subject schema which facilitated comparison of the Indian and foreign patents in a set of technologies.
- Patent application data were obtained from Annual Reports of the Controller General of Patents, Designs, Trademarks, and Geographical Indications (CGOP).
- After discerning the patenting trends of different patenting countries, three case studies were done to understand the nature of patents under the technology, their impact on local market and the assignees who own the patents.
- Experts in the field were interviewed to obtain their reactions and possible policy lessons in our context.

The study presents three case studies namely, patents on transportation, telecommunication, and medical devices. The report also analyses the trend of technology dependence of Indian enterprises, by considering royalty, licence fee payments in different sectors.

With the Amendment of Indian Patents Act to comply with TRIPS agreement coming into force in 2005, the applications received for award of patents have taken a giant leap. During the period covering the analysis (2000-01 - 2013-14) applications were received from 137 countries. Applications from the US topped the list with 105, 215 of them. Other countries in the top bracket include India, Japan, Germany, France, Switzerland, Netherlands, and Sweden. Applications through PCT route (National Phase Applications) dominate the trend and have marginalized those thorough normal and convention mode. Preliminary analysis by the IPO shows that applications relating to innovations in mechanical engineering top the list, followed by chemicals, computer / electronics, drug, electrical engineering technologies, biotechnology in that order. The US stands apart as a group of its own, with the host country, India, standing second. The trend indicates Indian market potential sensed by leading countries. The year 2005 is the year which marks a steep upward trend.

Of 137 countries from which we have received applications, twenty-five have filed more than 100 applications during 2000-01 to 2013-14. Of these, eight have filed more than 1,000 applications including all the three categories. These countries are France, Germany, India, Japan, Korea, Sweden, the U.K., and the U.S.A. Twelve other countries make up the second cluster of applicants. These include Austria, Australia, Belgium, China, Canada, Denmark, Finland, Israel, Italy, South Korea, Spain, and Taiwan. The general trend, among most of these countries, is the rapid growth of PCT applications in the National Phase.

The figures indicate a rapid pace of examination and for the period as a whole the success rate has been 51.7% of the total. It was also noticed that a large number of applications are abandoned prior to examination. The success rate will be higher when we consider this factor.

IPO has granted patents to assignees from 110 countries during the 2001- 2014 period. Top 10 countries - France, Germany, India, Japan, Korea, Sweden, Switzerland, UK and the US make up 90% of the patents granted. Only 25 countries have more than a total of 100 patents during 2001-2014 period. Most of the other countries are minor players in Indian innovation space. There is a considerable foreign domination among the patents granted. Mechanical and chemical engineering patents figure on the top followed by electronics, drugs, electrical engineering, biotechnology and others.

A Closer look at the subject-wise trend reveals that IPO granted patents fall in all the eight main divisions of International Patent Classification, 122 out of 130 IPC classes, and 625 out of 654 sub-classes. However, in most of these subjects the patent presence is very small. At the IPC class level, three classes make up top 25% of the patents - A61 (Medical or veterinary science; hygiene ...), C07 (Organic chemistry), H04 (Electric communication technique ...). Second quartile includes patents on G06 (Computing; calculating ...), C08 (Organic macromolecular compounds; their preparation or chemical working-up; compositions based thereon, H01 (Basic electric elements ...), B01 (Physical or chemical processes or apparatus in general), C12 (Biochemistry; microbiology; enzymology; mutation or genetic engineering). Third quartile consists of 15 broad subjects. The patent distribution is highly skewed at the level of broad subject categories.

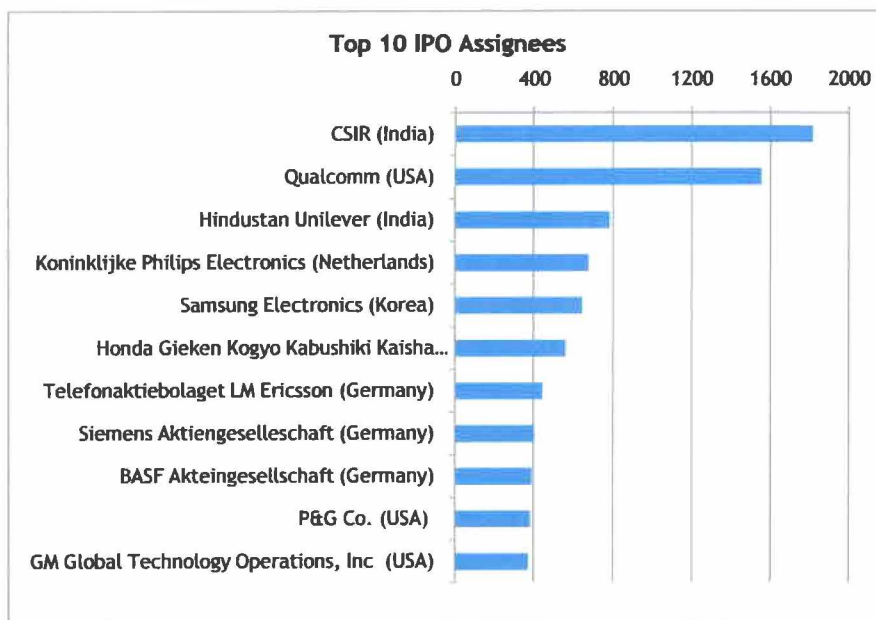
At the IPC sub-class level six relatively narrower subjects make up the first quartile - A61K (Preparations for medical, dental, or toilet purposes), C07D (Heterocyclic compounds), C07C (Acyclic or carbocyclic compounds (macromolecular compounds) C08; production of organic compounds by electrolysis or electrophoresis), G06F

(Electric digital data processing), H04L (Transmission of digital information), C12N (Micro-organisms or enzymes; compositions thereof) - followed by 22 in the second quartile, and 69 in the third. Even at the sub-class level the patent availability is much skewed. A few subjects dominate the innovation scene in the country.

More elaborate analysis of the data, taking into account 201 sub-classes with 50 or more patents in them, show that the US dominate 60% of these technologies, followed by India in 14.5% of the sub-classes. Germany, Japan and Korea are the most patent holders in the rest of the sub-classes. Indian technology space in its various components is dominated by the US entities. Yet, we get only a select set of patents filed / granted by IPO, on overlapping subjects.

India's comparative technology strength in IPO viewed from ISI-OST- INPI classification indicate that we are relatively better in chemicals related technologies with 19% of the total patent ownership, followed by mechanical engineering (16.1%) and instrumentation (15.5%). We own only 7.7% of the patents that come under the broad head - electrical engineering, which includes telecom, IT methods, semiconductors, etc. On the whole nearly 84% of the patents, making up major technologies, are owned by foreigners. The analysis shows that we have not carved any niche technology strength in domestic front. We tend to compete where other countries dominated the technology scene.

There is a skewed distribution of patents among the assignees, through 12,830 industrial enterprises, 365 universities, and 429 research institutes, along with nearly 3000 inventor assigned patents figure in our database.



Only 65 entities own more than 100 patents for the 2001-2014 period. The top assignees are Council of Scientific and Industrial Research, Qualcomm, Hindustan Unilever Ltd, Phillips, Samsung, Honda, Ericsson, Siemens, BASF, P&G and GM Global. Nearly 70% of the patent owners in IPO own only one patent, and nearly 90% of assignees own three or less patents. Patent ownership is diffused and most of them may not make much impact on the technology scene of the country.

Eight per cent of the assignees own 50% of the patents, 14% of the assignees own 50% of the patents at sub-class level. 75% of the patents fall under 8 IPC classes.

List of Assignees who own 100 or more Patents during 2001-2014				
CSIR	IBM	Astrazeneca		Aloys Wobben
Qualcomm	BHEL	IITs	CIBA	Praxair
Hindustan Unilever	Motorola	Silverbrook	Akzo Nobel	DRDO
Philips	LG	Maschinenfabrik	Sanofi Aventis	Panasonic
Samsung	Shell		Syngenta	Aventis
Honda	F Hoffmann Roche	Dow Global	Sumitomo	Canon
Ericsson	Sony	Du Pont	LG Chem Ltd	Mitsubishi
Siemens	Matsushita	Blackberry	Exxonmobil	Schneider Electric
BASF	Intel	Tata Steel	Institut Francais Du Petrole	
P&G	Samsung India	Bosch	Eli Lilly	TVS
GM	Nokia	Bayer	Janssen Pharmaceutica	Colgate
	Novartis	3M	Hewett-Packard	Outokumpu
	General Electric	SAIL	UOP	Johnson & Johnson

The study also attempted three case studies. It could be noticed that medical device sector is dominated by the entities from the USA, with India following. Most of the patents taken are in the low or low moderate risk levels.

There has been a spurt in medical device manufacturing in India. From 2001-01 to 2012-13 it has grown more than six-fold. Yet, the imports have also grown more or less in the same measure. Most of the patents in low risk level are the consumer goods like pads, absorbents etc. We see a trend where the patents occupy the technologies with high volume trade. Imports still seem to dominate the high risk device end.

Patents in telecom reflect a more sordid story. Despite telecom industry being a high growth sector with teledensity growing from 3.58% in 2001 to 78.16% in 2015 and mobile economy itself contributing US \$ 400 billion to Indian GDP, our technology strength as reflected in patent ownership seems to be low. Internet and mobile telephony have brought a whole host of technology requirements both at hardware and software ends. Two sub-classes - H04Q (Selecting (the network)methods, circuits, or **apparatus** for establishing selectively a connection between a desired number of stations) and **H04B** (Transmission of information-carrying signals) dominate the patented technologies in IPO among the 3000 patents on telecom. Qualcomm, Ericsson, Samsung Electronics, Motorola, Nokia, LG, Matsushita, Huawei are the dominant players in this innovation space, with Qualcomm being the ahead in the bunch. There are nearly 500 patent owners holding only one or two patents each. Qualcomm dominates the scene both on network selection and transmission technologies. Indian presence in the telecom patent scene is negligible. There has been a steep rise in the payment towards royalty, IT enabled service charges pertaining to backend operations of the mobile telephone economy in the country.

In transportation sector, land vehicles have attracted most of the patents during the post 2001 period in IPO. Japanese enterprises stand first in the list of countries owning them, followed by India, the USA, Germany and

others. Analysis of this data indicates a diffused patent ownership in the technology with Honda figuring prominently. More detailed look at the patents show that Honda ownership is in IPC sub-classes B62J which are more in the nature of accessories to the land vehicles. Yet, with patents which distinguish the vehicles of this class and innovation to suit the local needs, the company has been able to dominate the market. This has also come at a time when the demand for such vehicles has risen dramatically. These patents in IPO have added to the company strategy of moving away from joint venture with Hero Motors. Indian competition in this innovation space has come from TVS and to a small extent from Bajaj, Tata Motors and others.

The analysis also goes into the royalty and licence fees payment by Indian enterprises in different sectors. The data reinforces our dependence on the foreign technologies, particularly in consumer goods and high growth sectors like cosmetics, automobile, telecom, among others.

The analysis shows that there is an urgent need to spread awareness of innovation in technology and ownership of this intellectual property. This is required more to get a firm grip on the local market to start with. Our socio-cultural space is different and our technology inventions should exploit our understanding of this difference. We can focus our innovation in envisaged high growth sectors such as education, IT applications, agricultural technologies, consumer products like clothing, leisure activities, energy sector products, etc. In most of the countries' domestic patent holdings are dominated by the host country. It is essential to aim for that in IPO as well. New IPR Policy of 2015 seems to take this need earnestly and sets out to make a new beginning.

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Appendix A - IPC Code and Corresponding Details Used in the Report

IPC Class No.	Details
A01	Agriculture; forestry; animal husbandry; hunting; trapping; fishing
A01G	Horticulture; cultivation of vegetables, flowers, rice, fruit, vines, hops, or seaweed; forestry; watering
A01H	New plants or processes for obtaining them; plant reproduction by tissue culture techniques
A01K	Animal husbandry; care of birds, fishes, insects; fishing; rearing or breeding animals, not otherwise provided for; new breeds of animals
A01M	Catching, trapping or scaring of animals (appliances for catching swarms or drone-catching)
A01N	Preservation of bodies of humans or animals or plants or parts thereof
A23	Foods or foodstuffs; their <u>treatment</u> , not covered by other classes
A23C	Dairy products, e.g. Milk, butter, cheese; milk or cheese substitutes; making thereof
A23F	Coffee; tea; their substitutes; manufacture, preparation, or infusion thereof
A23G	Cocoa; cocoa products, e.g. Chocolate; substitutes for cocoa or cocoa products; confectionery; chewing gum; ice-cream; preparation thereof
A23K	Feeding-stuffs specially adapted for animals; methods specially adapted for production thereof
A23L	Foods, foodstuffs, or non-alcoholic beverages
A44B	Buttons, pins, buckles, slide fasteners, or the like
A46B	<u>Brushes</u>
A47C	Chairs; sofas; beds
A47J	Kitchen equipment; coffee mills; spice mills; <u>apparatus</u> for making beverages
A61	Medical or veterinary science; hygiene
A61B	Diagnosis; surgery; identification (analysing biological material G01N, e.g. G01N 33/48)
A61C	Dentistry; apparatus or methods for oral or dental hygiene
A61F	Filters implantable into blood vessels; prostheses; devices providing patency to, or preventing collapsing of, tubular structures of the body, e.g. stents; orthopaedic, nursing or contraceptive devices; fomentation; treatment or protection of eyes or ears; bandages, dressings or absorbent pads; first-aid kits
A61J	<u>Containers specially adapted for medical or pharmaceutical purposes; devices or methods specially adapted for bringing pharmaceutical products into particular physical or administering forms; devices for administering food or medicines orally; baby comforters; devices for receiving spittle</u>
A61K	Preparations for medical, dental, or toilet purposes
A61L	Methods or apparatus for sterilising materials or objects in general; disinfection, sterilisation, or deodorisation of air; chemical aspects of bandages, dressings, absorbent pads, or surgical articles; materials for bandages, dressings, absorbent pads, or surgical articles
A61M	Devices for introducing media into, or onto, the body
A61N	Electrotherapy; magnetotherapy; radiation therapy; ultrasound therapy
A61P	Specific therapeutic activity of <u>chemical compounds</u> or medicinal <u>preparations</u> This subclass covers therapeutic activity of chemical compounds or medicinal preparations in this subclass, the term "drugs" includes chemical compounds or compositions with therapeutic activity. In this subclass, therapeutic activity is classified in all appropriate places.
B01	Physical or chemical processes or <u>apparatus</u> in general
B01D	Separation
B01F	Mixing, e.g. Dissolving, emulsifying, dispersing. In this subclass, the following term or expression is used with the meaning indicated: "mixing" covers stirring of a single material .

B01J	Chemical or physical processes, e.g. Catalysis, colloid chemistry; their relevant apparatus
B02C	Crushing, pulverising, or disintegrating in general; milling grain (obtaining metallic powder by crushing, grinding or milling)
B05B	Spraying apparatus; atomising apparatus; nozzles
B05D	Processes for applying liquids or other fluent materials to surfaces, in general Processes for applying liquids or other fluent materials to a surface or part of a surface, in general, by any mechanical or physical method and particularly processes producing a uniform distribution of liquids or other fluent materials on a surface;
B21B	Rolling of metal
B21C	Manufacture of metal sheets, wire, rods, tubes, profiles or like semi-manufactured products otherwise than by rolling; auxiliary operations used in connection with metal-working without essentially removing material
B21D	Working or processing of sheet metal or metal tubes, rods or profiles without essentially removing material; punching metal. This subclass covers cutting or perforating of sheet metal or other stock material.
B22D	Casting of metals; casting of other substances by the same processes or devices
B22F	Working metallic powder; manufacture of articles from metallic powder; making metallic powder; apparatus or devices specially adapted for metallic powder
B23B	Turning; boring
B23C	Milling
B23K	Soldering or unsoldering; welding; cladding or plating by soldering or welding; cutting by applying heat locally,
B23Q	Details, components, or accessories for machine tools, e.g. Arrangements for copying or controlling
B24B	Machines, devices, or processes for grinding or polishing
B24D	TOOLS FOR GRINDING, BUFFING OR SHARPENING (abrading-bodies specially designed for tumbling apparatus,
B26B	Hand-held cutting tools not otherwise provided for
B29B	Preparation or pretreatment of the material to be shaped; making granules or preforms; recovery of plastics or other constituents of waste material containing plastics
B29C	Shaping or joining of plastics; shaping of substances in a plastic state, in general; after-treatment of the shaped products
B29D	Producing particular articles from plastics or from substances in a plastic state
B32B	Layered products, i.e. PRODUCTS BUILT-UP OF STRATA OF FLAT OR NON-FLAT, e.g. CELLULAR OR HONEYCOMB, FORM
B41F	Printing machines or presses
B41J	Typewriters; selective printing mechanisms, i.e. Mechanisms printing otherwise than from a forme; correction of typographical errors
B41M	Printing, duplicating, marking, or copying processes; colour printing
B42D	Books; book covers; loose leaves; printed matter characterised by identification or security features; printed matter of special format or style not otherwise provided for; devices for use therewith and not otherwise provided for; movable-strip writing or reading apparatus
B60C	Vehicle tyres; tyre inflation; tyre changing; connecting valves to inflatable elastic bodies in general; devices or arrangements related to tyres
B60G	Vehicle suspension arrangements
B60K	Arrangement or mounting of propulsion units or of transmissions in vehicles; arrangement or mounting of plural diverse prime-movers in vehicles; auxiliary drives for vehicles; instrumentation or dashboards for vehicles; arrangements in connection with cooling, air intake, gas exhaust or fuel supply of propulsion units in vehicles

B60R	<u>Vehicles</u> , <u>vehicle fittings</u> , or <u>vehicle parts</u> , not otherwise provided for
B60T	<u>Vehicle brake control</u> systems or parts thereof; brake <u>control</u> systems or parts thereof, in general
B62	Land vehicles for travelling otherwise than on rails
B62D	<u>Motor vehicles</u> ; trailers (steering, or guiding on a desired track, of agricultural machines or implements
B62J	Cycle saddles or seats; accessories peculiar to cycles and not otherwise provided for, e.g. Article carriers or cycle protectors
B62K	Cycles; cycle frames; cycle steering devices; rider-operated terminal <u>controls</u> specially adapted for cycles; cycle axle suspensions; cycle sidecars, fore cars, or the like
B62M	Rider propulsion of wheeled vehicles or sledges; powered propulsion of sledges or cycles; transmissions specially adapted for such vehicles
B65	Conveying; packing; storing; <u>handling</u> thin or filamentary <u>material</u>
B65B	Machines, <u>apparatus</u> or devices for, or methods of, packaging articles or <u>materials</u> ; unpacking
B65D	Containers for storage or transport of articles or materials, e.g. Bags, barrels, bottles, boxes, cans, cartons, crates, drums, jars, tanks, hoppers, forwarding containers; accessories, closures, or fittings therefor; packaging elements; packages
B65G	Transport or storage devices, e.g. Conveyors for loading or tipping, shop conveyor systems or pneumatic tube conveyors
B65H	<u>Handling</u> thin or filamentary <u>material</u> , e.g. Sheets, webs, cables
B66B	Elevators; escalators or moving walkways
B67D	Dispensing, delivering, or transferring liquids, not otherwise provided for
C01B	Non-metallic elements; compounds thereof
C01F	Compounds of the <u>metals</u> beryllium, magnesium, aluminium, calcium, strontium, barium, radium, thorium, or of the rare-earth <u>metals</u>
C01G	Compounds containing <u>metals</u>
C02F	Treatment of water, waste water, sewage, or sludge
C03B	Manufacture or shaping of glass, or of mineral or <u>slag wool</u> ; supplementary processes in the manufacture or shaping of glass, or of mineral or <u>slag wool</u>
C03C	<u>Chemical composition</u> of glasses, <u>glazes</u> , or vitreous <u>enamels</u> ; surface <u>treatment</u> of glass; surface <u>treatment</u> of fibres or filaments from <u>glass</u> , minerals or <u>slags</u> ; joining <u>glass</u> to <u>glass</u> or other <u>materials</u>
C04B	Lime; magnesia; slag; cements; compositions thereof, e.g. Mortars, concrete or like building materials; artificial stone; ceramics
C07	Organic chemistry
C07B	General methods of organic chemistry; apparatus therefor
C07C	Acyclic or carbocyclic compounds
C07D	Heterocyclic compounds
C07F	Acyclic, carbocyclic, or heterocyclic compounds containing elements other than carbon, hydrogen, halogen, oxygen, nitrogen, sulfur, selenium or tellurium
C07H	Sugars; derivatives thereof; nucleosides; nucleotides
C07J	Steroids
C07K	Peptides
C08	Organic macromolecular compounds; their <u>preparation</u> or chemical <u>working-up</u> ; compositions based thereon
C08B	Polysaccharides; derivatives thereof
C08F	Macromolecular compounds obtained by reactions only involving carbon-to-carbon unsaturated bonds
C08G	Macromolecular compounds obtained otherwise than by reactions only involving carbon-to-carbon

	unsaturated bonds
C08J	<u>Working-up</u> ; general processes of compounding
C08K	Use of inorganic or non-macromolecular organic substances as compounding ingredients
C08L	Compositions of macromolecular compounds
C09B	Organic <u>dyes</u> or closely-related compounds for producing <u>dyes</u> ; <u>mordants</u> ; <u>lakes</u>
C09C	Treatment of inorganic materials, other than fibrous fillers, to enhance their pigmenting or filling properties
C09D	Coating compositions, e.g. Paints, varnishes or lacquers; <u>filling pastes</u> ; chemical paint or ink removers; inks; correcting <u>fluids</u> ; woodstains; pastes or solids for colouring or printing; <u>use of materials</u> therefor
C09J	Adhesives; non-mechanical <u>aspects</u> of adhesive processes in general; adhesive processes not provided for elsewhere; <u>use of materials</u> as adhesives
C09K	<u>Materials</u> for applications not otherwise provided for; applications of <u>materials</u> not otherwise provided for. This subclass covers also the <u>use</u> of specified <u>materials</u> in general or their <u>use</u> for the applications not specifically provided for elsewhere.
C10	Petroleum, gas or coke industries; technical gases containing carbon Monoxide; fuels; lubricants; peat
C10B	Destructive distillation of carbonaceous materials for production of gas, coke, tar, or similar materials
C10G	Cracking hydrocarbon oils; production of liquid hydrocarbon mixtures, e.g. By destructive hydrogenation, oligomerisation, polymerisation
C10L	Fuels not otherwise provided for; natural gas;
C10M	LUBRICATING COMPOSITIONS In this subclass, the following terms or expressions are used with the meanings indicated: "lubricant" or "lubricating composition" includes cutting oils, hydraulic fluids, metal drawing compositions, flushing oils, slushing oils, or the like; "aliphatic" includes "cycloaliphatic".
C11B	Producing, e.g. By pressing raw materials or by extraction from waste materials, refining or preserving fats, fatty substances, e.g. Lanolin, fatty oils or waxes; essential oils; perfumes
C11D	Detergent compositions; use of single substances as detergents; soap or soap-making; resin soaps; recovery of glycerol
C12M	Apparatus for enzymology or microbiology
C12N	Micro-organisms or enzymes; compositions thereof
C12P	Fermentation or enzyme-using processes to synthesise a desired <u>chemical compound</u> or composition or to separate optical isomers from a racemic mixture
C12Q	Measuring or testing processes <u>involving enzymes</u> or <u>micro-organisms</u>
C21B	Manufacture of iron or steel This subclass covers : the production of iron or steel from source <u>materials</u> , e.g. The production of pig-iron; <u>apparatus</u> specially adapted therefor, e.g. Blast furnaces, air heaters
C21C	Processing of pig-iron, e.g. Refining, manufacture of wrought-iron or steel; treatment in molten state of ferrous alloys
C21D	Modifying the physical structure of ferrous metals; general devices for heat <u>treatment</u> of ferrous or non-ferrous metals or alloys; making metal malleable
C22B	Production or <u>refining</u> of metals
C22C	<u>Alloys</u>
C23C	Coating metallic material; coating material with metallic material; surface treatment of metallic material by diffusion into the surface, by chemical conversion or substitution; coating by vacuum evaporation, by sputtering, by ion implantation or by chemical vapour deposition, in general
C25B	Electrolytic or electro phoretic processes for the production of compounds or non- metals; apparatus there for
C25D	Processes for the electrolytic or electrophoretic production of coatings; electroforming

C07D	
D01	Natural or man-made threads or fibres; spinning
D01D	Mechanical methods or <u>apparatus</u> in the manufacture of man-made filaments, threads, fibres, bristles or ribbons
D01F	Chemical features in the manufacture of man-made filaments, threads, fibres, bristles or ribbons; apparatus specially adapted for the manufacture of carbon
D01G	Preliminary <u>treatment</u> of fibres, e.g. For spinning
D01H	Spinning or twisting
D02G	Crimping or curling fibres, filaments, yarns, or threads; yarns or threads
D03D	Woven fabrics; methods of weaving; looms
D04B	Knitting
D04H	Making textile fabrics, e.g. From fibres or filamentary material
D06F	Laundering, drying, ironing, pressing or folding textile articles
D06M	Treatment, not provided for elsewhere in class d06, of fibres, threads, yarns, fabrics, feathers or fibrous goods made from such materials
D21F	Paper-making machines; methods of producing paper thereon
D21H	Pulp compositions
E01B	Permanent way; permanent-way tools; machines for making railways of all kinds
E04B	GENERAL BUILDING CONSTRUCTIONS; WALLS, e.g. PARTITIONS; ROOFS; FLOORS; CEILINGS; INSULATION OR OTHER PROTECTION OF BUILDINGS. This subclass covers working methods used in constructing new buildings and analogous working methods on existing buildings.
E04C	Structural elements; building materials
E05B	Locks; accessories therefor; handcuffs
E21B	Earth or rock drilling
F01D	NON-POSITIVE-DISPLACEMENT MACHINES OR ENGINES, e.g. STEAM TURBINES. This subclass covers: Non-positive-displacement engines for elastic fluids, e.g. Steam turbines; non-positive-displacement engines for liquids and elastic fluids; non-positive-displacement machines for elastic fluids; non-positive-displacement machines for liquids and elastic fluids.
F01L	Cyclically operating valves for machines or engines
F01N	Gas-flow silencers or exhaust <u>apparatus</u> for machines or <u>engines</u> in general; gas-flow silencers or exhaust <u>apparatus</u> for internal-combustion <u>engines</u>
F02	Combustion <u>engines</u> ; hot-gas or combustion-product <u>engine plants</u>
F02B	Internal-combustion piston <u>engines</u> ; combustion <u>engines</u> in general
F02C	Gas-turbine plants; air intakes for jet-propulsion plants; controlling fuel supply in air-breathing jet-propulsion plants
F02D	Controlling combustion <u>engines</u>
F02M	Supplying combustion engines in general with combustible mixtures or constituents thereof
F03B	Machines or engines for liquids
F03D	WIND MOTORS This subclass covers wind <u>motors</u> , i.e. Mechanisms for converting the energy of wind into useful mechanical power, and the transmission of such power to its point of <u>use</u> .
F04B	Positive-displacement machines for liquids; pumps
F04C	Rotary-piston, or oscillating-piston, positive-displacement <u>machines</u> for liquids
F04D	Non-positive-displacement pumps . This subclass covers non-positive-displacement pumps for liquids, for elastic fluids, or for liquids and elastic fluids whether rotary or not having pure rotation.

F16	Engineering elements or units; general measures for producing and maintaining effective functioning of machines or installations; thermal insulation in general
F16B	Devices for fastening or securing constructional elements or machine parts together, e.g. Nails, bolts, circlips, clamps, clips or wedges; joints or jointing
F16C	<u>Shafts</u> ; <u>flexible shafts</u> ; mechanical means for transmitting movement in a flexible sheathing; elements of <u>crankshaft mechanisms</u> ; pivots; pivotal connections; <u>rotary engineering elements</u> other than <u>gearing</u> , coupling, clutch or brake elements; <u>bearings</u> In this subclass, the following expression is used with the meaning indicated: "rotary engineering elements other than gearing, coupling, clutch or brake elements" covers any engineering element other than gearing, coupling, clutch or brake elements which rotates in so far as its features are affected only by the fact that it rotates.
F16D	Couplings for transmitting rotation
F16F	Springs; shock-absorbers; means for damping vibration
F16H	Gearing
F16J	Pistons; cylinders; pressure vessels in general; sealings
F16K	Valves; taps; cocks; actuating-floats; devices for venting or aerating
F16L	Pipes; joints or fittings for pipes; supports for pipes, cables or protective tubing; means for thermal insulation in general
F17C	Vessels for containing or storing compressed, liquefied, or solidified gases; fixed-capacity gas-holders; filling vessels with, or discharging from vessels, compressed, liquefied, or solidified gases
F22B	Methods of steam generation; steam boilers
F23D	<u>Burners</u>
F24F	Air-conditioning; air-humidification; ventilation; use of air currents for screening
F25B	Refrigeration machines, <u>plants</u> , or systems; combined heating and refrigeration systems; heat pump systems
F25D	Refrigerators; cold rooms; ice-boxes; cooling or freezing <u>apparatus</u>
F25J	Liquefaction, solidification, or separation of gases or gaseous mixtures by pressure and cold treatment
F27B	Furnaces, kilns, ovens, or retorts in general; open sintering or like apparatus
F28D	Heat-exchange apparatus, not provided for in another subclass, in which the heat-exchange media do not come into direct contact
F28F	Details of heat-exchange or heat-transfer apparatus, of general application
G01	Measuring; testing. This class covers, in addition to "true" measuring instruments, other indicating or recording devices of analogous construction, and also signalling or control devices insofar as they are concerned with measurement (as defined in note 2 below) and are not specially adapted to the particular purpose of signalling or control.
G01B	Measuring length, thickness or similar linear dimensions; measuring angles; measuring areas; measuring irregularities of surfaces or contours This subclass covers measuring of position or displacement in terms of linear or angular dimensions. In this subclass, the groups are distinguished by the means of measurement which is of major importance. Thus the mere application of other means for giving a final indication does not affect the classification.
G01F	Measuring volume, volume flow, mass flow, or liquid level; metering by volume
G01L	Measuring force, stress, torque, work, mechanical power, mechanical efficiency, or <u>fluid</u> pressure
G01M	Testing static or dynamic balance of machines or structures; testing of structures or apparatus, not otherwise provided for
G01N	Investigating or analysing materials by determining their chemical or physical properties
G01R	Measuring electric <u>variables</u> ; measuring magnetic <u>variables</u>
G01S	Radio direction-finding; radio <u>navigation</u> ; determining distance or velocity by <u>use of radio waves</u> ; locating or presence-detecting by <u>use of the reflection or reradiation of radio waves</u> ; analogous arrangements

	using other <u>waves</u> In this subclass, the following term is used with the meaning indicated: "transponder" means an arrangement which reacts to an incoming interrogating or detecting wave by emitting a specific answering or identifying wave.
G01V	Geophysics; gravitational measurements; detecting masses or objects; tags
G02B	Optical elements, systems, or <u>apparatus</u>
G02C	<u>Spectacles; sunglasses or goggles insofar as they have the same features as spectacles; contact lenses</u>
G02F	Devices or arrangements, the optical operation of which is modified by changing the optical properties of the medium of the devices or arrangements for the control of the intensity, colour, phase, polarisation or direction of light, e.g. Switching, gating, modulating or demodulating; techniques or procedures for the operation thereof; frequency-changing; non-linear optics; optical logic elements; optical analogue/digital converters
G05B	<u>Control</u> or regulating systems in general; functional elements of such systems; monitoring or testing <u>arrangements for</u> such systems or elements. This subclass covers <u>features of control</u> systems or elements for regulating specific <u>variables</u> , which are clearly more generally applicable.
G06	Computing; calculating; counting This class covers : simulators which are concerned with the mathematics of computing the existing or anticipated conditions within the real device or system; simulators which demonstrate, by means involving computing, the function of <u>apparatus</u> or of a system, if no provision exists elsewhere; image data processing or generation.
G06F	Electric digital data processing
G06K	Recognition of <u>data</u> ; presentation of <u>data</u> ; <u>record carriers</u> ; <u>handling record carriers</u> This subclass covers: marking, sensing, and conveying of <u>record carriers</u> ; recognising characters or other <u>data</u> ; presenting visually or otherwise the <u>data</u> recognised or the result of a computation.
G06T	Image data processing or generation, in general
G07F	Coin-freed or like apparatus
G08B	Signalling or calling <u>systems</u> ; order telegraphs; alarm <u>systems</u> This subclass covers also means for identifying or incapacitating burglars or the like.
G09F	<u>Displaying; advertising; signs; labels or name-plates; seals</u>
G09G	Arrangements or circuits for control of indicating devices using static means to present variable information
G10L	<u>Speech</u> analysis or synthesis; <u>speech</u> recognition; <u>speech</u> or <u>voice</u> processing; <u>speech</u> or audio coding or decoding
G11B	Information storage based on relative movement between record carrier and transducer
H01	Basic electric elements
H01B	Cables; conductors; insulators; selection of <u>materials</u> for their conductive, insulating or dielectric properties
H01F	Magnets; inductances; transformers; selection of <u>materials</u> for their magnetic properties
H01H	Electric switches; relays; selectors; emergency protective devices
H01J	Electric discharge tubes or discharge <u>lamps</u> This subclass covers only devices for producing, influencing, or using a flow of electrons or ions, e.g. For controlling, indicating, or switching of electric current, counting electric pulses, producing light or other electromagnetic oscillations, such as x-rays, or for separating or analysing radiation or particles, and having a closed or substantially closed casing containing a chosen gas, vapour, or vacuum, upon the pressure and nature of which the <u>characteristics</u> of the device depend.
H01L	Semiconductor devices; electric solid state devices not otherwise provided for
H01M	Processes or means, e.g. Batteries, for the direct conversion of chemical energy into electrical energy
H01Q	Aerials
H01R	Electrically-conductive connections; structural associations of a plurality of mutually-insulated electrical

	connecting elements; coupling devices; current collectors
H02	Generation, conversion, or distribution of electric power
H02B	Boards, substations, or switching <u>arrangements</u> for the supply or distribution of electric power This subclass covers boards, switchyards, switchgear or their installation, or the association of switching devices with each other or with other devices, e.g. Transformers, fuses, meters or distribution boards; such associations constitute substations or distribution points.
H02G	Installation of electric cables or lines, or of combined optical and electric cables or lines
H02H	Emergency protective circuit arrangements This subclass covers only circuit arrangements for the automatic protection of electric lines or electric machines or apparatus in the event of an undesired change from normal working conditions.
H02J	Circuit arrangements or systems for supplying or distributing electric power; systems for storing electric energy
H02K	Dynamo-electric machines
H02M	<u>Apparatus</u> for <u>conversion</u> between ac and ac, between ac and dc, or between dc and dc, and for <u>use</u> with mains or similar power supply systems; conversion of dc or ac input power into surge output power; <u>control</u> or regulation thereof. This subclass covers only circuits or apparatus for the conversion of electric power, or arrangements for control or regulation of such circuits or apparatus .
H02P	<u>Control</u> or regulation of electric <u>motors</u> , electric generators or dynamo-electric converters; controlling transformers, reactors or choke coils. <i>This subclass covers arrangements for starting, regulating, electronically commutating, braking, or otherwise controlling motors, generators, dynamo-electric converters, clutches, brakes, gears, transformers, reactors or choke coils, of the types classified in the relevant subclasses,</i>
H03K	Pulse technique This subclass covers : methods, circuits, devices, or apparatus using active elements operating in a discontinuous or switching manner for generating, counting, amplifying, shaping, modulating, demodulating, or otherwise manipulating signals; electronic switching not involving contact-making and breaking; logic circuits handling electric pulses.
H03M	Coding, decoding or code conversion, in general
H04	Electric communication technique
H04B	Transmission
H04J	Multiplex communication. This subclass covers: circuits or apparatus for combining or dividing signals for the purpose of transmitting them simultaneously or sequentially over the same transmission path;
H04L	Transmission of digital information, e.g. Telegraphic communication
H04M	Telephonic communication
H04N	Pictorial communication, e.g. Television
H04Q	Selecting
H04R	Loudspeakers, microphones, gramophone pick-ups or like acoustic electro mechanical transducers; deaf-aid sets; public address systems
H05B	Electric heating; electric lighting not otherwise provided for
H05K	Printed circuits; casings or constructional details of electric <u>apparatus</u> ; manufacture of assemblages of electrical components