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IPR TREND IN INDIA: EMPIRICAL EVIDENCE FOR A SELF-RELIANT MISSION

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Abstract *Innovation is an engine for economic growth in the modern technological age and knowledge-centric economy. However, protecting the rights of innovators and rewarding them legally is a major constraint due to a lot of procedural hurdles and time consuming processes. IPR boosts the economic growth and development of the nation, which in turn may propel the AATMANIRBHAR movement of India. In this background, it was deemed necessary to present the status and trends of Indian patents and patentees in recent times. The present research work would provide a road map for future self-reliant Indian economic development. Secondary data for the last decade relating to IPR was collected from websites, research papers, journals, books, newsletters, and the WIPO website. It is recommended that the legal hassles involved in obtaining IPR and other paperwork may be excluded with a view to making patenting much easier for the beneficiaries.*

Keywords: *IPR, Self-Reliance, Filing, Grants, Patentees, Trends, Growth Rate, Garret Ranking, Factor Analysis*

INTRODUCTION

Innovation is an engine for economic growth in the present technological era and knowledge-centric economy. In the modern days, there are many forums to exhibit innovation and convert them into an economical means. Simultaneously, protecting the rights of innovators and rewarding them legally has challenges in the present digital world, especially in a developing nation like India, which has huge knowledge workers and resourceful innovators. However, the number of innovations which come to the limelight of economic development, especially grassroots innovations, are limited, compared to the actuals. Moreover, protecting the rights of original thinkers and innovators is a big challenge, as they face procedural hurdles and the process is time consuming. If these IPR challenges are taken care of, the Indian economic growth and development may propel the AATMANIRBHAR movement of India.

In this background, it was deemed necessary to present the status and trends of Indian patents and patentees in recent times. The current research work gives a road map for future self-reliant Indian economic development.

AIM OF THE PAPER

The article aims to throw light on the status and trends of Indian patents and patentees (institutes and universities, scientific, R & D organisations, and Indian and foreign) state-wise and sector-wise, along with the duration of filing and granting a patent in recent times. The article also throws light on the many bottlenecks that need to be addressed in the IPR domain to encourage more innovators to file patents for their creative works using suitable statistical techniques.

REVIEW OF LITERATURE

A huge majority of the research papers focus on issues pertaining to the plant biotechnology sector or the plant breeding sector. Despite the IPR sector contributing significantly to the political, economic, entrepreneurial, and social environment of the nation, the sector, as well as the stakeholders involved in the sector, have been neglected by the scholarly sorority. This could perhaps be the cause of narrow studies focusing on the aspects of IPR.

Numerous developing nations have not reached the patenting stage in the field of agricultural biotechnology due to many tangible and intangible reasons in their research and development systems and also due to their under-developed market infrastructure (Asebey et al., 1995). Technological distance and different degrees of technical protection indicate the differences in the relative significance of IPRs in agriculture (Correa, 1996). Extensive studies have indicated that the advancement of the developing nations maybe enhanced/destroyed by strengthening their own IPRs. Further, without IPRs, the rate of agricultural productivity in

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developing nations may not be able to catch up with those in the developed nations (Perrin, 1999).

For developing nations to benefit from modern agricultural biotechnology, key concerns like bio piracy and bioterrorism have to be identified and handled with the help of suitable R and D mechanisms (Ban, 2000).

On evaluating the 'Intellectual property rights in plant biotechnology: A contribution to crop biosecurity', the various forms and scope of IPR specific to crop biosecurity and the potential positive and negative consequences of introducing and strengthening IPRs for the transfer of technology and innovation in developing nations were realised (Malik & Zafar, 2005). A balance must be set between the interests of the inventor and the society to indicate them as a key element for facilitating innovation and not for hindering them. There is a huge significance of finding the balance between patents and PBRs, between breeders' and farmers' rights. Since there is vast interdependence among the various stakeholders in the agricultural sector, realising fairness has been considered a preliminary step for encouraging innovation in the agricultural sector (Visser & Jonge, 2016).

The intellectual property rights and the ascent of proprietary innovation in agriculture can be seen by studying the nature of the IPR and their evolutionary process, apart from their impact on innovation. Aspects pertaining to the relation between IPR, market structure, as well as the proprietary input pricing in agriculture, are extremely important (Clancy & Moschini, 2017).

HYPOTHESIS OF THE STUDY

- H_0: There are no significant reasons for scientific institutions and organisations to patent their creations.
- H_0: The Indian environment is not conducive for patenting.

RESEARCH METHODOLOGY

An empirical study was formulated with the key objectives of assessing the patent status in India over the years - to analyse their growth; to study the various sectors covered under IPR; patent applications in India and the world; patent applications per GDP; value of the patents; total patents registered across the world; states, institutes and universities, scientific, research, and development organisations that have registered patents; total patents in India and the world with its growth rate and ranking; trends in patent applications; time taken for granting and filing a patent; patents filed over the years; trends in filing grant of patent applications in various fields of technology; and Indian and foreign applicants for patents.

Secondary data related to the IPR was collected from websites, research papers, journals, books, newsletters, and the WIPO website. It is expected that the results may provide substantial evidence, reflecting how best the potential of IPR, as well as its application on farmer-led innovations, can be tapped. The secondary data was collected from 2002 to 2020 from the World Intellectual Property Organisation Annual Report (2016-2017), the Office of the Controller General of Patents, Designs, Trademarks and Geographical Indications, Government of India, Ministry of Commerce and Industry, Department of Industrial Policy and Promotion, and also from the official website of Intellectual Property India (ipindia.gov.in).

The data collected from the above mentioned databases have been analysed in a meticulous and methodical manner and presented in the form of tables, charts, and graphs; certain statistical tools like frequency tabulation and percentage analysis have been used in appropriate places.

The Garret ranking technique was applied to assess the factors influencing the scientific institutions and organisations to opt for patenting their innovations and factor analysis was used for construing the major challenges/constraints/bottlenecks faced by the scientific institutions and organisations during the patenting process.

RESULTS AND DISCUSSION

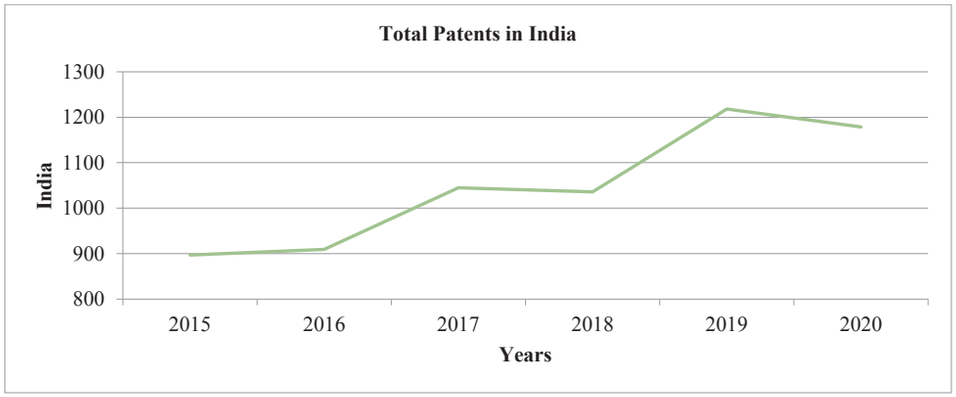
The section highlights the major findings of the study. Over the years, the patents registered have been showing an upward trend from 2015 to 2020. Around 897 patents were filed in India in 2015 and about 1,179 patents were filed in 2020. At the global level, about 3,26,971 patents were filed in 2015, while about 3,90,576 patents were filed in 2020. With respect to the growth rate in terms of filing patents, India witnessed the highest growth rate in 2019 (17.568), followed by 2017 (14.961). India witnessed a dip during the years 2018 (−0.861) and 2020 (−3.202). With respect to the growth rate in terms of filing patents, the highest growth rate in the world was seen in 2019 (15.102), followed by 2017 (5.352). India witnessed a dip during the years 2018 (−3.257) and 2020 (−0.52). India has also ranked between 30 (2017) and 47 (2020) during the same period (Table 1).

Table 1: Total Patents in India and the World with Their Corresponding Growth Rate and Rank

Years	Countries		Growth Rate		Rank
	India	World	India	World	India
2015	897	326971	-	-	-
2016	909	334674	1.338	2.356	38
2017	1045	352587	14.961	5.352	30

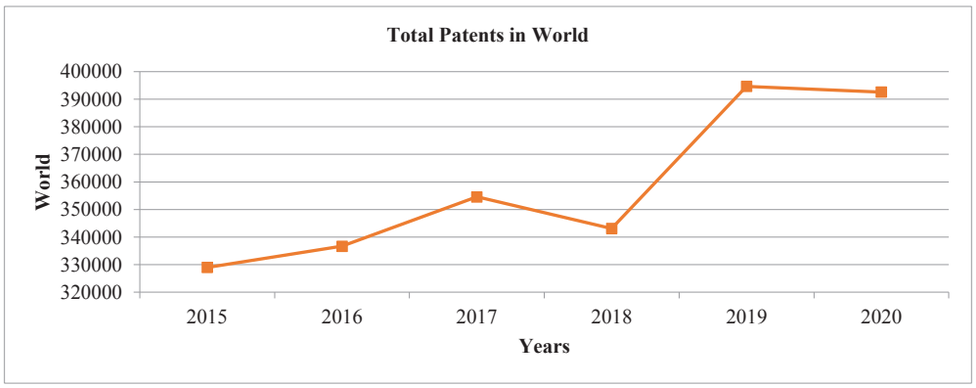
Years	Countries		Growth Rate		Rank
	India	World	India	World	India
2018	1036	341104	−0.861	−3.257	35
2019	1218	392617	17.568	15.102	36
2020	1179	390576	−3.202	−0.52	47

Source: World Intellectual Property Organisation.



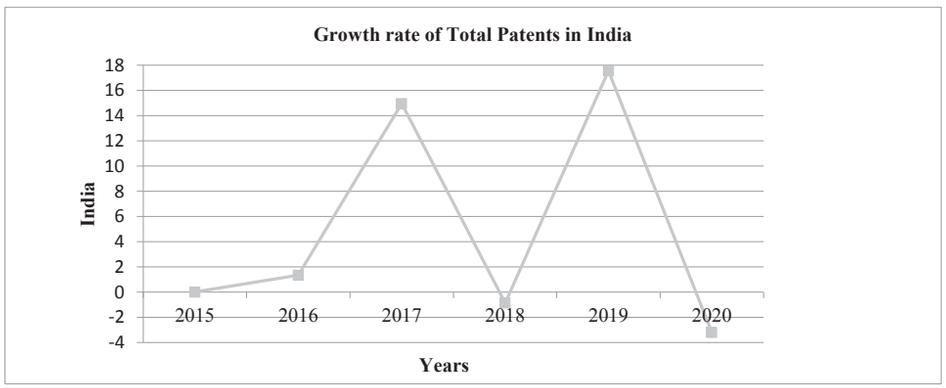
Source: World Intellectual Property Organisation.

Fig. 1: Total Patents in India



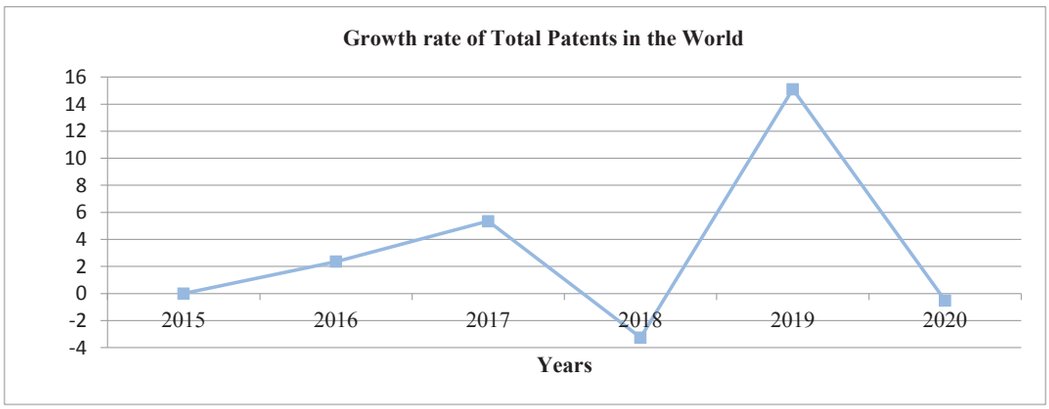
Source: World Intellectual Property Organisation.

Fig. 2: Total Patents in the World



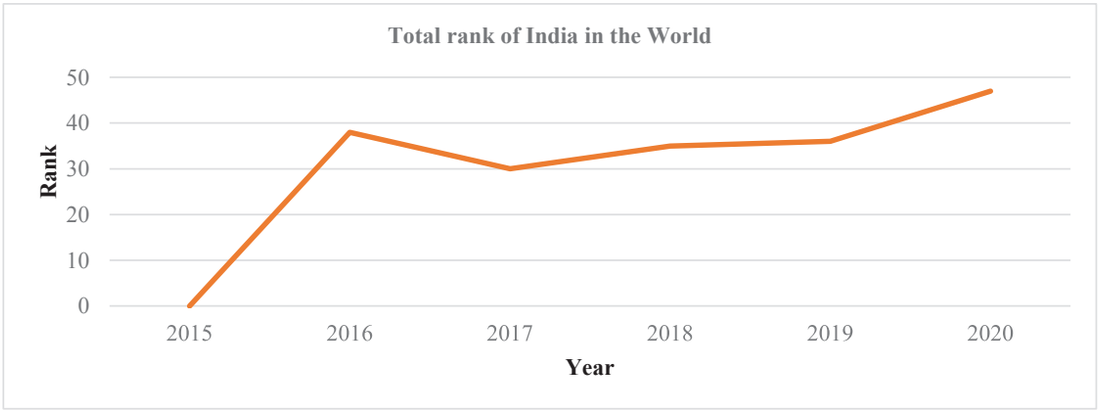
Source: World Intellectual Property Organisation.

Fig. 3: Growth Rate of Total Patents in India



Source: World Intellectual Property Organisation.

Fig. 4: Growth Rate of Total Patents in the World



Source: World Intellectual Property Organisation.

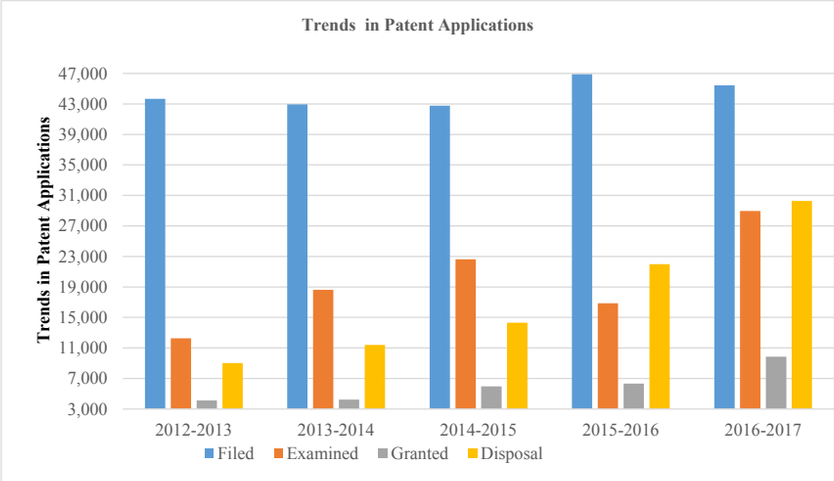
Fig. 5: Total Rank of India in the World

Moving over to the trends in patent applications, it is obvious from the table that the number of patents filed between 2012-13 and 2016-17 have shown a steady decrease (from 43,674 patent applications in 2012-13 to 45,444 applications in 2016-17), while the number of patents examined between 2012-13 and 2016-17 have shown a steady increase (from 12,268 patent applications in 2012-13 to 28,967 applications in 2016-17). Similarly, the number of patents granted between 2012-13 and 2016-17 have shown a steady increase (from 4,126 patent applications in 2012-13 to 9,847 applications in 2016-17), while the number of patents disposed between 2012-13 and 2016-17 have shown a steady increase (from 9,027 patent applications in 2012-13 to 30,271 applications in 2016-17) (Table 2).

Table 2: Trends in Patent Applications between 2012-2013 and 2016-2017

Sr. No.	Year	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
1	Filed	43,674	42,951	42,763	46,904	45,444
2	Examined	12,268	18,615	22,631	16,851	28,967
3	Granted	4,126	4,227	5,978	6,326	9,847
4	Disposed	9,027	11,411	14,316	21,987	30,271

Source: Annual Report of the Office of the Controller General of Patents.



Source: Annual Report of the Office of the Controller General of Patents.

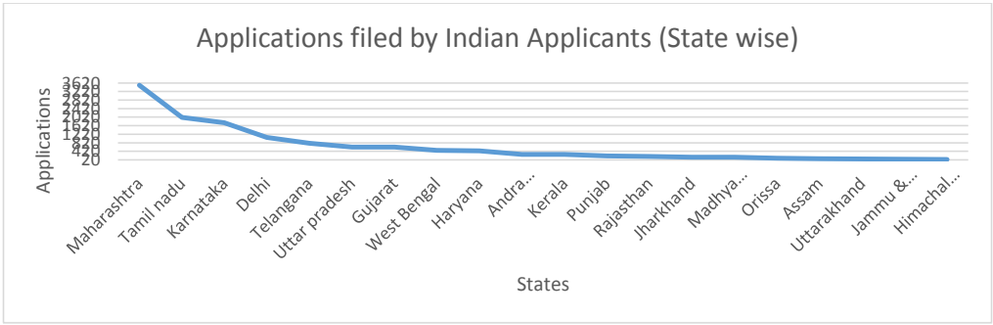
Fig. 6: Trends in Patent Applications between 2012-2013 and 2016-2017

The applications filed by Indian applicants state-wise indicate that Maharashtra has the largest number of applications filed (3,513), followed by Tamil Nadu (2,003), Karnataka (1,764), Delhi (1,066), and Telangana (798). The other states in the list include Uttar Pradesh, Gujarat, West Bengal, Haryana, Andhra Pradesh, Kerala, Punjab, Rajasthan, Jharkhand, Madhya Pradesh, Odisha, Assam, and Uttarakhand. The least number of applications were filed in Jammu and Kashmir (49) and Himachal Pradesh (40) (Table 3).

Table 3: Applications Filed by Indian Applicants (State-Wise)

Sr. No.	State	Applications
1	Maharashtra	3513
2	Tamil Nadu	2003
3	Karnataka	1764
4	Delhi	1066
5	Telangana	798
6	Uttar Pradesh	625
7	Gujarat	620
8	West Bengal	460
9	Haryana	441
10	Andhra Pradesh	271
11	Kerala	276
12	Punjab	207
13	Rajasthan	181
14	Jharkhand	144
15	Madhya Pradesh	140
16	Odisha	103
17	Assam	68
18	Uttarakhand	64
19	Jammu & Kashmir	49
20	Himachal Pradesh	40

Source: Annual Report of the Office of the Controller General of Patents.



Source: Annual Report of the Office of the Controller General of Patents.

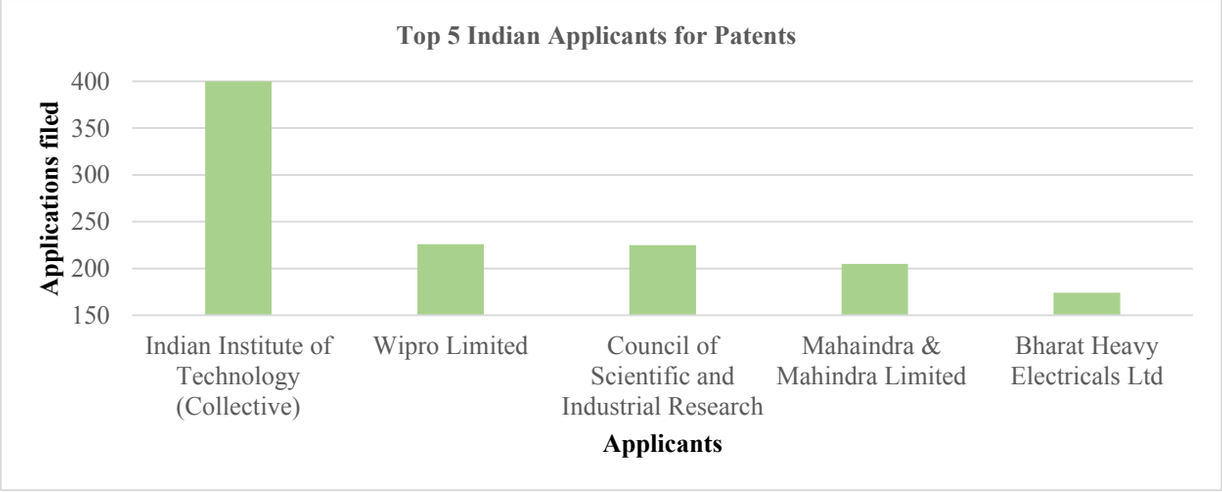
Fig. 7: Applications Filed by Indian Applicants (State-Wise)

The top five Indian applicants for patents include the Indian Institute of Technology (Collective) with 400 applications filed, followed by Wipro Limited (226), the Council of Scientific and Industrial Research (225), Mahindra and Mahindra Limited (205), and Bharat Heavy Electricals Limited (174) (Table 4).

Table 4: Top Five Indian Applicants for Patents

Sr. No.	Name of Applicants	Applications Filed
1	Indian Institute of Technology (Collective)	400
2	Wipro Limited	226
3	Council of Scientific and Industrial Research	225
4	Mahindra & Mahindra Limited	205
5	Bharat Heavy Electricals Ltd	174

Source: Annual Report of the Office of the Controller General of Patents.



Source: Annual Report of the Office of the Controller General of Patents.

Fig. 8: Top Five Indian Applicants for Patents

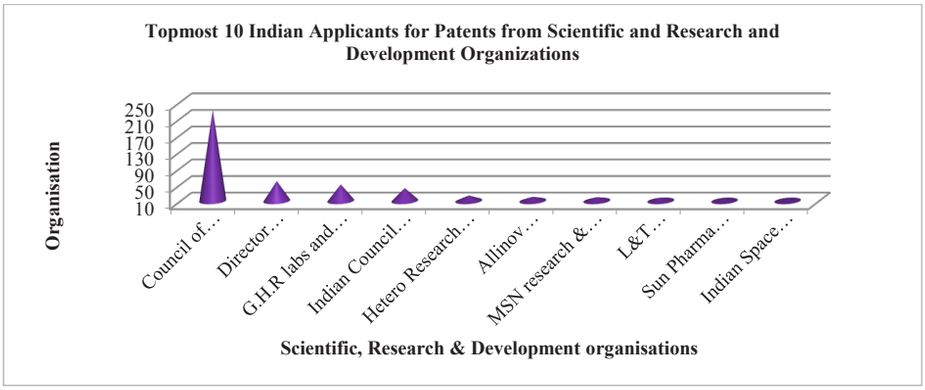
The topmost ten Indian applicants for patents were from scientific and research and development organisations, which include the Council of Scientific and Industrial Research, with 230 applications filed, followed by the Director General, Defence Research and Development Organisation (58), G.H.R Labs and Research Centre (50), Indian Council of Agricultural Research (ICAR), with 41 applications, Hetero Research Foundation (23), Allinov Research and Development Private Limited (20), MSN Research and Development Centre (19), L & T Technology Services Limited (18), Sun Pharma Advanced Research Company Limited (14), and Indian Space Research Organisation (13) (Table 5).

Table 5: Topmost Ten Indian Applicants for Patents from Scientific and Research and Development Organisations

Sr. No.	Name of Scientific and Research and Development Organisations	Applications Filed
1	Council of Scientific and Industrial Research	230
2	Director General, Defence Research and Development Organisation	58
3	G.H.R labs and Research Center	50
4	Indian Council of Agricultural Research (ICAR)	41
5	Hetero Research & Development Private Limited	23

Sr. No.	Name of Scientific and Research and Development Organisations	Applications Filed
6	Allinov Research & Development Private Limited	20
7	MSN Research & Development Center	19
8	L&T Technology Service Limited	18
9	SUN Pharma Advanced Research Company Limited	14
10	Indian Space Research Organisation	13

Source: Annual Report of the Office of the Controller General of Patents.



Source: Annual Report of the Office of the Controller General of Patents.

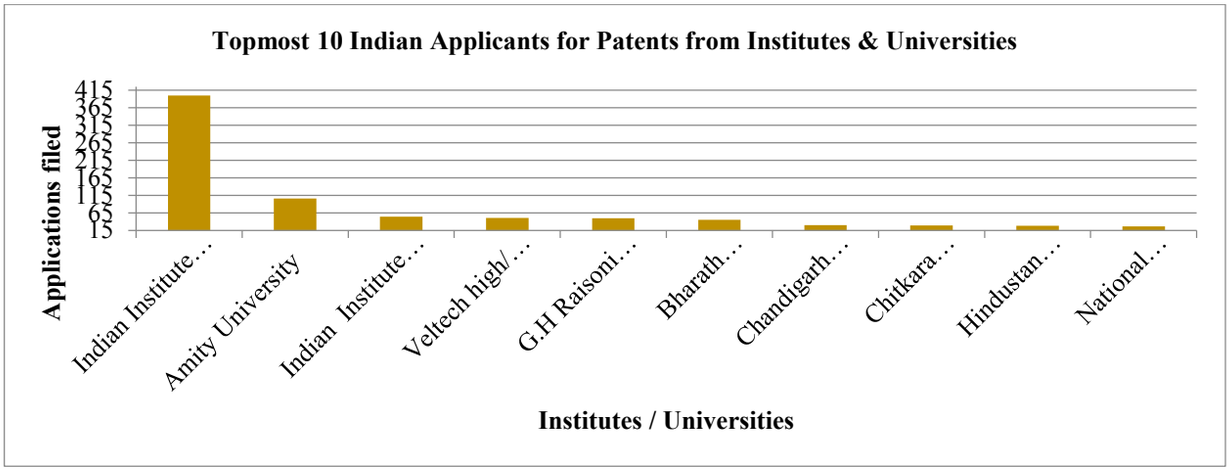
Fig. 9: Topmost Ten Indian Applicants for Patents from Scientific and Research and Development Organisations

Among the topmost 10 Indian applicants for patents from institutes and universities are the Indian Institute of Technology (Collective), which filed 400 applications, followed by Amity University with 106 applications, Indian Institute of Science (54), Veltech High/Multi Tech Dr. RR and Dr. SR (College and University), with 50 applications, G.H Raisoni College of Engineering (49), Bharath University (45), Chandigarh Group of Colleges (30), Chitkara University (29), Hindustan University of Technology and Science (28), and National Institute of Technology (Collective) (26 applications) (Table 6).

Table 6: Topmost Ten Indian Applicants for Patents from Institutes and Universities

Sr. No.	Name of Institutes/Universities	Applications Filed
1	Indian Institute of Technology (Collective)	400
2	Amity University	106
3	Indian Institute of Science	54
4	Veltech High/Multi Tech Dr. RR & Dr. SR (College and University)	50
5	G.H Raisoni College of Engineering	49
6	Bharath University	45
7	Chandigarh group of colleges	30
8	Chitkara University	29
9	Hindustan Institute of Technology & Science	28
10	National Institute of Technology (Collective)	26

Source: Annual Report of the Office of the Controller General of Patents.



Source: Annual Report of the Office of the Controller General of Patents.

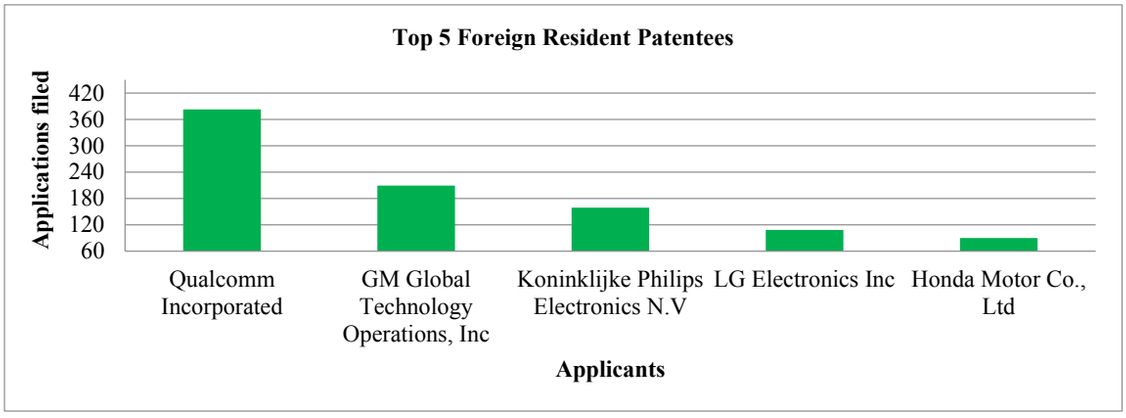
Fig. 10: Topmost Ten Indian Applicants for Patents from Institutes and Universities

Among the topmost five foreign resident patentees, Qualcomm Incorporated ranked first with 383 patents granted, followed by GM Global Technology Operations Inc. (209), Koninklijke Philips Electronics N.V. (159), LG Electronics Inc. (108), and Honda Motor Co. Ltd. (90) (Table 7).

Table 7: Top Five Foreign Resident Patentees

Sr. No.	Name of Applicant	Applications Filed
1	Qualcomm Incorporated	383
2	GM Global Technology Operations, Inc.	209
3	Koninklijke Philips Electronics N.V.	159
4	LG Electronics Inc.	108
5	Honda Motor Co., Ltd.	90

Source: Annual Report of the Office of the Controller General of Patents.



Source: Annual Report of the Office of the Controller General of Patents.

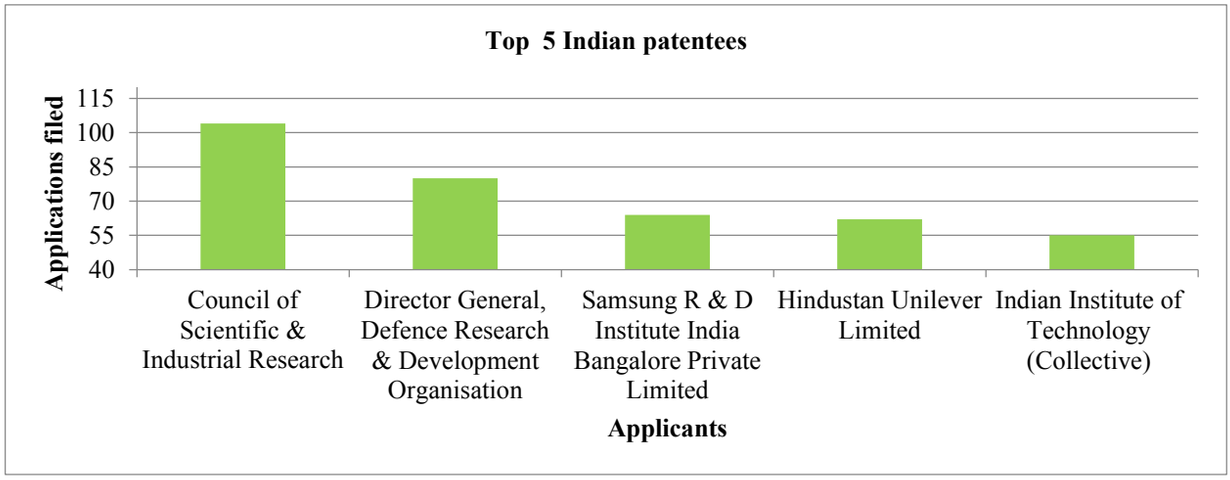
Fig. 11: Top Five Foreign Resident Patentees

Among the top 5 Indian patentees are the Council of Scientific and Industrial Research, which ranked first with 104 patents granted, followed by the Director General, Defence Research and Development Organisation (80), Samsung R & D Institute India Bangalore Private Limited (64), Hindustan Unilever Limited (62), and the Indian Institute of Technology (Collective) (55) (Table 8).

Table 8: Top Five Indian Patentees

Sr. No.	Name of Applicant	Applications Filed
1	Council of Scientific & Industrial Research	104
2	Director General, Defence Research & Development Organisation	80
3	Samsung R&D Institute India Bangalore Private Limited	64
4	Hindustan Unilever Limited	62
5	Indian Institute of Technology (Collective)	55

Source: Annual Report of the Office of the Controller General of Patents.



Source: Annual Report of the Office of the Controller General of Patents.

Fig. 12: Top Five Indian Patentees

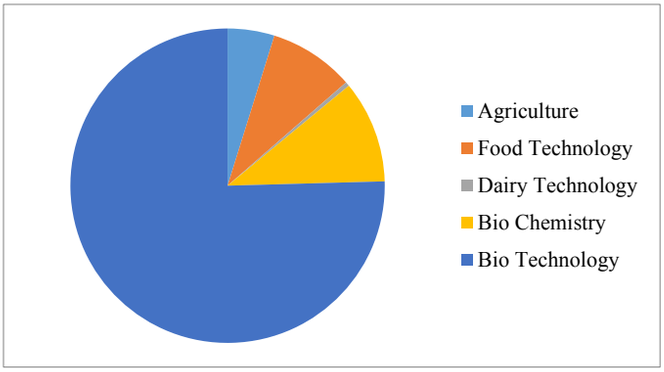
Sector-Wise Filing of Patents

Among the various sectors in which numerous patents have been registered for creative works, the biotechnology sector attributes to nearly three-fourth of the patents registered, followed by biochemistry contributing about 10.53 per cent, food technology (8.77%), and agriculture (4.82%). The dairy technology sector has a miniscule percentage of patents registered (0.44%). The key reasons for the biotechnology sector leading are: some of the most novel proprietary technologies are in the field of plant transgenics, specifically in the areas of field crops, transgenic events, yield increase, drought tolerance, and disease/stress resilience. The highest number of applications have been received in the area of field crops, followed by disease/stress resistance, yield increase, transgenic event, or drought tolerance (Table 9).

Table 9: Patents Filed Across Different Sectors

Sr. No.	Area	Patents Filed	Percentage
1	Agriculture	11	4.82
2	Food Technology	20	8.77
3	Dairy Technology	1	0.44
4	Biochemistry	24	10.53
5	Biotechnology	172	**75.44**
	Total	228	100

Source: ipindia.gov.in



Source: ipindia.gov.in

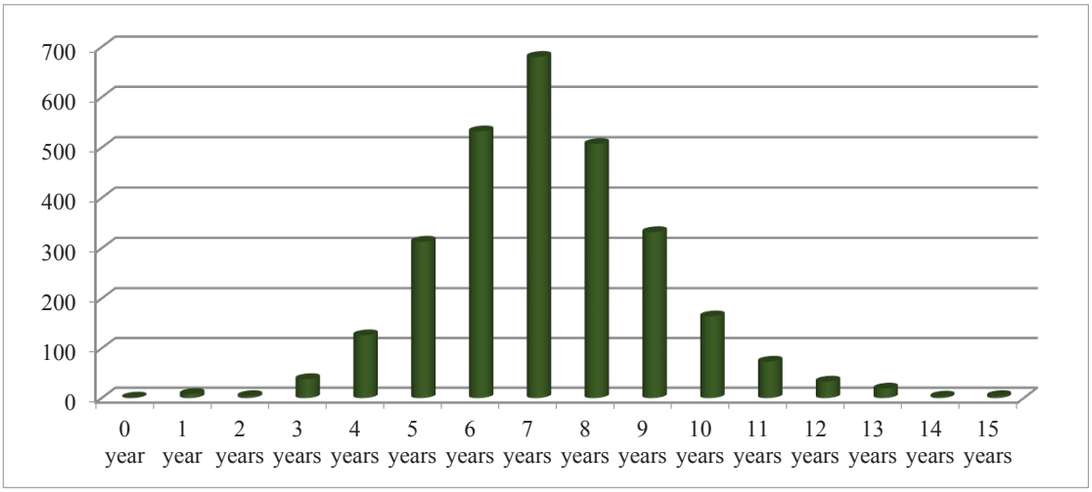
Fig. 13: Patents Filed Across Different Sectors

Chemical and Biotechnology/Drug Industry

Table 10: Time Taken for Granting a Patent Since the Time of Application

Sr. No.	Years	Frequency	Percentage
1	0	1	0.04
2	1	8	0.28
3	2	4	0.14
4	3	38	1.34
5	4	126	4.44
6	5	313	11.03
7	6	532	18.75
8	7	680	23.97
9	8	507	17.87
10	9	332	11.70
11	10	164	5.78
12	11	73	2.57
13	12	33	1.16
14	13	19	0.67
15	14	3	0.11
16	15	4	0.14
Total Number of Patents Registered		2837	100.00

Source: ipindia.gov.in



Source: ipindia.gov.in

Fig. 14: Time Taken for Granting a Patent Since the Time of Application

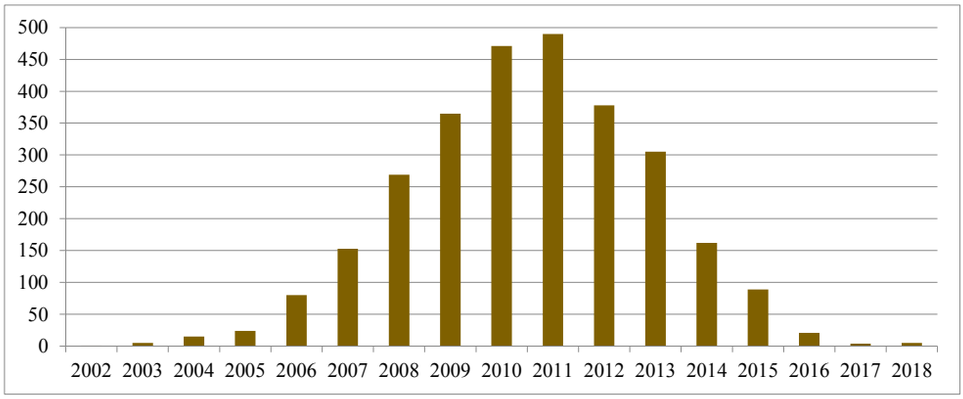
The time taken for granting a patent since the time of application in India in the chemical and biotechnology/drug industry was found to vary from zero to 15 years. Nearly one-fourth of the applications took about 7 years for the patent to be granted (23.97%), followed by 6 years (18.75%), eight years (17.87%), nine years (11.70%), and five years (11.03%). Only a miniscule portion of the applications took zero, one, two, 14, 15, and 16 years for the patent to be granted (0.04%, 0.28%, 0.14%, 0.67%, 0.11%, 0.14%, respectively) (Table 10).

Table 11: Patents Filed over the Years - 2002 to 2018

Sr. No.	Years	Patents Filed	Percentage
1	2002	1	0.04
2	2003	5	0.18
3	2004	15	0.53
4	2005	24	0.85
5	2006	80	2.82
6	2007	153	5.39
7	2008	269	9.48
8	2009	365	12.87
9	2010	471	16.60
10	2011	490	17.27
11	2012	378	13.32
12	2013	305	10.75
13	2014	162	5.71
14	2015	89	3.14

Sr. No.	Years	Patents Filed	Percentage
15	2016	21	0.74
16	2017	4	0.14
17	2018	5	0.18
Total Number of Patents Registered		2837	100.00

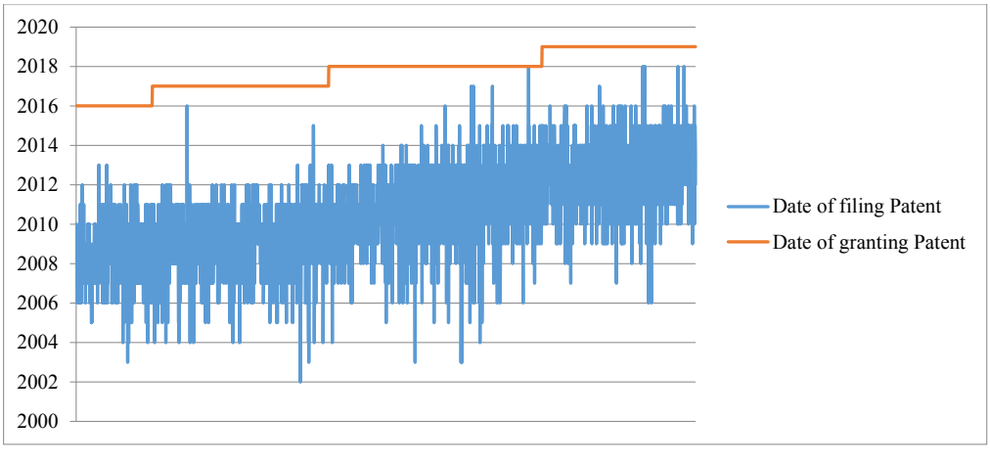
Source: ipindia.gov.in



Source: ipindia.gov.in

Fig. 15: Patents Filed over the Years - 2002 to 2018

Among the patents filed between 2002 and 2018 in the chemical and biotechnology/drug industry, about 2,837 patents were filed, wherein about 490 patents were filed in 2011 contributing to about 17.27 per cent, followed by 471 patents filed in 2010 contributing to about 16.60 per cent, 378 patents in 2012 (13.32%), 365 patents in 2009 (12.87%), and 305 patents in 2013 (10.75%). A miniscule portion of the patents were filed during the years 2002, 2003, 2004, 2005, 2016, 2017, and 2018 (0.04%, 0.18%, 0.53%, 0.85%, 0.74%, 0.14%, 0.18%, respectively).



Source: ipindia.gov.in

Fig. 16: Patents Filed and Granted over the Years - 2002 to 2018

It is apparent from Fig.16 that numerous patents were granted between 2002 and 2018, while a large number of patents have been granted after 2016; this shows an increasing trend in the chemical and biotechnology/drug industry.

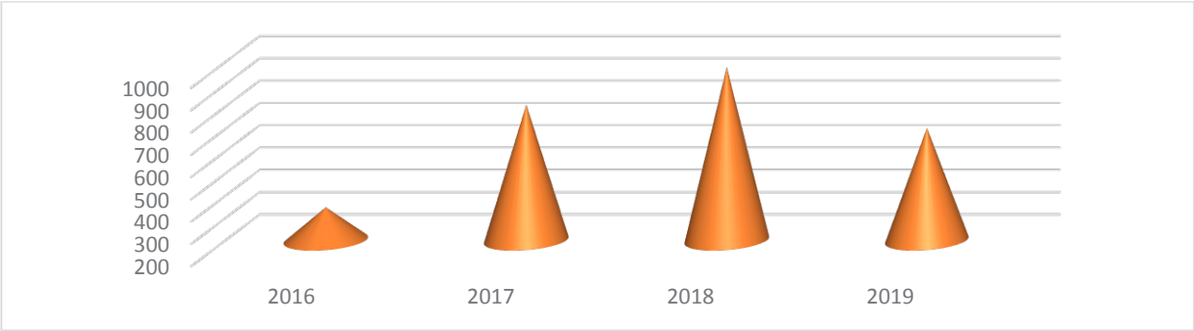
Table 12: Patent Granted over the Years - 2016 to 2019

Sr. No.	Years	Patents Granted	Percentage
1	2016	348	12.27
2	2017	808	28.48

Sr. No.	Years	Patents Granted	Percentage
3	2018	977	34.44
4	2019	704	24.81
Total		2837	100.00

Source: ipindia.gov.in

Among the patents granted during 2016-2019 in the chemical and biotechnology/drug industry, a little more than one-third (977) were granted in 2018, contributing to about 34.44 per cent, followed by 28.48 per cent of the patents being granted in 2017 and 24.81 per cent granted in 2019. The least number of patents (348) were registered in 2016, contributing to about 12.27 per cent.



Source: ipindia.gov.in

Fig. 17: Patent Granted over the Years - 2016 to 2019

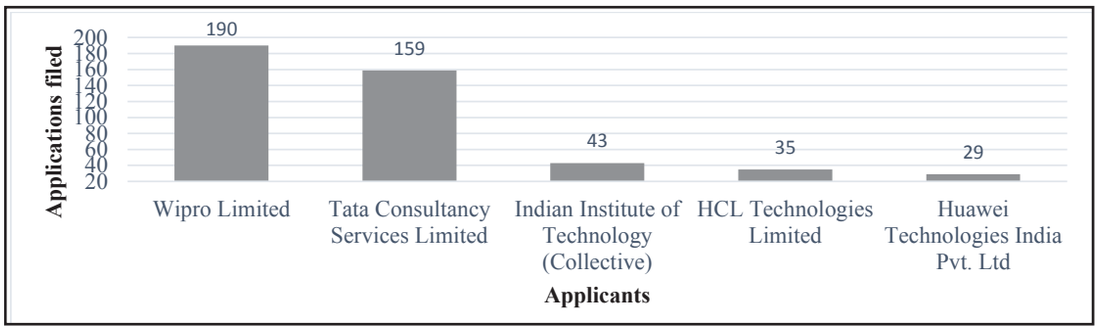
Information Technology

Among the top 5 Indian applicants for patents in the information technology sector, Wipro Limited occupied first place (190), while Tata Consultancy Services Limited was second (159). The Indian Institute of Technology (Collective) filed 43 applications, followed by HCL Technologies Limited (35 applications) and Huawei Technologies India Pvt. Ltd. (29).

Table 13: Top Five Indian Applicants for Patents in Information Technology

Sr. No.	Name of Applicants	Applications Filed
1	Wipro Limited	190
2	Tata Consultancy Services Limited	159
3	Indian Institute of Technology (Collective)	43
4	HCL Technologies Limited	35
5	Huawei Technologies India Pvt. Ltd.	29

Source: Annual Report of the Office of the Controller General of Patents.



Source: Annual Report of the Office of the Controller General of Patents.

Fig. 18: Top 5 Indian Applicants for Patents in Information Technology

The Garret ranking technique was implemented to assess the factors influencing the scientific institutions and organisations to opt for patenting their innovations. The formula used in the Garret ranking for converting ranks into per cent is:

Percent Position = 100 x (Rij − 0.50) / Nj
Rij = Rank given for the i^{th} item by the j^{th} individual
Nj = Number of items ranked by the j^{th} individual

Table 14: Factors Influencing the Scientific Institutions and Organisations to Opt for Patenting Process

Sr. No.	Factors	Score	Ranking
1	For protection against competitors	67.50	1
2	As reserve for future needs	62.32	2
3	For the improvement of products and services	58.55	3
4	For blocking competitors	53.26	4
5	For attracting investment	51.90	5
6	For the sale or license of IPR	46.75	6
7	For creating a brand image in the market	43.22	7
8	For driving away competitors	41.34	8
9	For monopolising the market	41.27	9
10	For motivating employees	39.56	10
11	Do not know	35.46	11
12	Not relevant	32.19	12

The factors influencing the scientific institutions and organisations to opt for the patenting process is presented in Table 14. The Garret ranking technique was used for computing the twelve factors. The factors are: for protection against competitors, as reserve for future needs, for the improvement of products and services, for blocking competitors, for attracting investment, for the sale or license of IPR, for creating a brand image in the market, for driving away competitors, for monopolising the market, for motivating employees, do not know, and not relevant. A total of 60 scientific institutions were requested to rate the factors based on what makes them opt for the patenting process, bearing in mind the important factors before applying for a patent. From the results, it is apparent that protection against competitors is the most important factor, which is ranked with a Garret score of 67.50. The factors patents are a reserve for future needs and that they are vital for the improvement of products and services were ranked second and third, respectively, with scores of 62.32 and 58.55. Aspects like blocking competitors and attracting investment were ranked fourth and fifth, respectively, with scores of 53.26 and 51.90. Scientific institutions and organisations also patented innovations for factors like sale or license of IPR and for creating a brand image in the market; these were ranked sixth and seventh, respectively, with scores of 46.75 and 43.22. Other factors like driving away competitors, monopolising the market, and motivating employees were ranked eighth, ninth, and tenth, respectively, with scores of 41.34, 41.27, and 39.56. The least ranked factors were scientific institutions and organisations stating that they were not aware why the patents were applied and the reasons being irrelevant; these were ranked eleventh and twelfth, respectively, with scores of 35.46 and 32.19. The table reveals that scientific institutions and organisations place major emphasis on protection against competitors from copying/imitating their creations and give least importance to lack of awareness and irrelevance. This disproves the hypothesis that there are no significant reasons for scientific institutions and organisations to patent their creations. Hence, we reject the null hypothesis.

Challenges that Need to be Addressed in the IPR Domain

To identify the major challenges/constraints/bottlenecks faced by the scientific institutions and organisations during the patenting process, 13 statements were prepared and administered to 60 scientific institutions and organisations.

Factor analysis was employed to identify the major challenges/constraints/bottlenecks faced by the scientific institutions and organisations during the patenting process.

The KMO measure was 0.710, which indicates that the factors account for a fair amount of variance. The chi-square value for Bartlett's test was significant, thus rejecting the null hypothesis. The results indicated in the table show that the internal consistency of the data was suitable (KMO = 0.710) and the Bartlett statistic was significant at 1% level.

Table 15: Kaiser-Meyer-Olkin Measure and Bartlett's Test for Adequacy of Factor Analysis and Reliability Analysis for Consistency

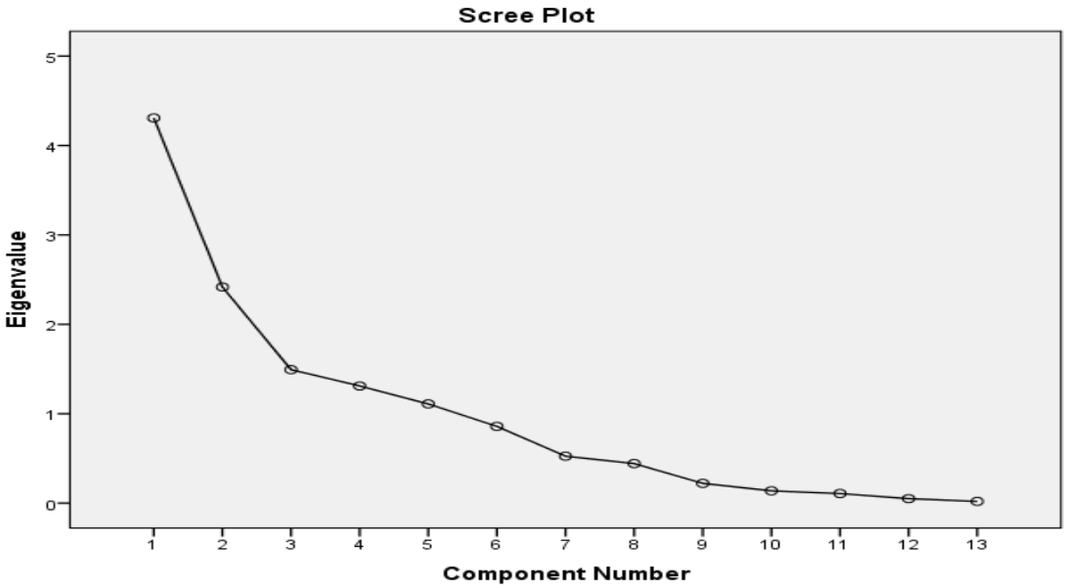
KMO and Bartlett's Test			Reliability Analysis	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.710	Cronbach's Alpha	0.886
Bartlett's Test of Sphericity	Approx. Chi-Square	154.369		
	df	78		
	Sig.	.000		

The internal consistency was tested using Cronbach's alpha in SPSS. The alpha value was found to be greater than 0.8, which specifies that the internal consistency is acceptable (Blunch, 2008).

Regarding the Kaiser criterion, five factors with more than 1 Eigen value were extracted. The rotation value of above 0.500 has been considered under each component. Hence, the first component has the value 0.725, 0.833, 0.567, 0.812, and 0.830; the second component has the value 0.533, 0.596, 0.771, and 0.610; the third component has the value 0.696; the fourth component the value 0.601; and the fifth the value 0.508 and 0.536. The highest Eigen value of the first factor is 4.307.

According to the Scree plot, results revealed that based on the Eigen value, five factors, such as *legal and economic factors, resource-based constraints, process-based constraints, monetary factors, and uncertainty-based factors* were the major challenges/constraints/bottlenecks faced by the scientific institutions and organisations during the patenting process.

These factors have indicated the measures that need to be taken by the government and other concerned authorities in encouraging more scientific institutions and organisations to patent their creations. This disproves the hypothesis that the Indian environment is conducive for patenting. Hence, we reject the null hypothesis.



Rotated Component Matrix[a]					
Particulars	**Component**				
	1	**2**	**3**	**4**	**5**
1. Higher cost involved in the certification/IPR process	.545	−.467	.093	.601	.141
2. The need for a long period for the certification/ IPR process	.503	−.533	.398	.415	.226
3. Lack of proper certifying agencies in the nearby place	**.725**	−.007	.531	−.144	.014
4. The stringent standards and rules of the certification process	**.833**	.054	.201	−.027	−.136
5. Lack of conducive legal environment	**.567**	−.179	−.540	−.151	.016
6. Low economic value of the innovations	**.812**	−.153	−.256	−.200	−.082
7. Tremendous existing restrictions and barriers that affect the entry of potential innovations in the market	**.830**	−.077	−.250	−.279	.045
8. Lack of agricultural credit	−.292	**.596**	−.146	.431	.339
9. Lack of experimental plots	.399	**.771**	.056	−.149	.293
10. Lack of resources for innovation	.582	**.610**	−.064	.082	.476
11. Hesitation in innovation	.385	.496	.261	−.034	−.508
12. Extremely lengthy and complicated process	−.315	.030	**.696**	−.400	.196
13. Lack of e-certificate and e-investment	.194	.531	.047	.489	**−.536**
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalisation.					

1	Legal and economic factors	S3	Lack of proper certifying agencies in the nearby place
		S4	The stringent standards and rules of the certification process
		S5	Lack of conducive legal environment
		S6	Low economic value of the innovations
		S7	Tremendous existing restrictions and barriers that affect the entry of potential innovations in the market

2	Resource-based constraints	S2	The need for a long period for the certification/IPR process
		S8	Lack of agricultural credit
		S9	Lack of experimental plots
		S10	Lack of resources for innovation
3	Process-based constraints	S12	Extremely lengthy and complicated process
4	Monetary factors	S1	Higher cost involved in the certification/IPR process
5	Uncertainty-based factors	S11	Hesitation in innovation
		S13	Lack of e-certificate and e-investment

There are abundant challenges that must be addressed in the IPR domain. The major challenges to be addressed to encourage more innovators to apply for patent rights are reviewed below.

- Creating a conducive legal environment which considers research and development, besides other investments, that an innovation needs to be commercialised (Gupta, 2008).
- Reducing/removing the existing restrictions and barriers that hinder the entry of potential innovations in the market, besides increasing the economic value of the innovations (Brown, 2010).
- Development of innovations in the agricultural sector can be enhanced by providing the innovators with agricultural credit (Reddy, 2012).
- Experimental plots (medium-sized farm) can be provided to budding innovators in the field of agriculture (Dutta & Bhuyan, 2019).
- Judicious use of both internal and external resources with a view to facilitate sustainable indigenous innovations (Archie & Bolduc, 2020).
- Encouraging IP in nascent and budding industries and industries that show reluctance/hesitation (Kilpatrick, 2021).
- Use of the public resources to develop certain productive IP initiatives/ventures (Cabaleiro & Salce, 2020).
- Provision of e-certificate and e-investment can also help a greater number of innovators in filing their patents (Deb & Paul, 2015).

SUMMARY AND CONCLUSION

Over the years, the patents registered have been showing an upward trend from 2015 to 2020. At the global level, patents filed were found to be increasing over the years. With respect to the growth rate in terms of filing patents, both India and the world witnessed the highest growth rate in 2019, followed by 2017. India witnessed a dip during 2018 and 2020. India has also ranked below 50 during the same period.

Moving over to the trends in patent applications in India, it is evident that the number of patents filed over the years 2012-13 to 2016-17 have shown a steady decrease, while the number of patents examined over the years 2012-13 to 2016-17 have shown a steady increase. Similarly, with respect to the number of patents granted, the years 2012-13 to 2016-17 have shown a steady increase, while the number of patents disposed over the years 2012-13 to 2016-17 have shown a steady increase.

The time taken for granting a patent since the time of application in India was found to vary from zero to 15 years. Nearly one-fourth of the applications took about 7 years for the patent to be granted, followed by 6 years for other applications. Regarding the patents filed from 2002 to 2018, nearly 3,000 patents were filed wherein around 500 patents were filed in the year 2011. Numerous patents have been filed over the years 2002 to 2018, while a large number of patents have been granted after the year 2016; this has shown an increasing trend. With respect to the patents granted over the years 2016-19, a little more than one-third of the patents were granted in the year 2018.

The applications filed by Indian applicants state-wise indicate that Maharashtra has a large number of applications filed, followed by Tamil Nadu and Karnataka. Least number of applications were filed in Jammu and Kashmir and Himachal Pradesh. Among the various sectors in which a large number of patents have been registered for creative works in India, the biotechnology sector attributes to nearly three-fourth of the patents registered, followed by biochemistry. The top five Indian applicants for patents include the Indian Institute of Technology (Collective), followed by Wipro Limited. Among the top 5 Indian applicants for patents in information technology, Wipro Limited occupied the first place, while Tata Consultancy Services Limited was second. The topmost ten Indian applicants for patents from Scientific and Research and Development Organisations include the Council of Scientific and Industrial Research, followed by Director General, Defence Research, and Development Organisation. Among the topmost ten Indian applicants for patents from institutes and universities are the Indian Institute of Technology (Collective), followed by Amity University. Among the top five foreign resident patentees, Qualcomm Incorporated stood first, followed by GM Global Technology Operations, INC. Among the topmost five Indian

patentees, the Council of Scientific and Industrial Research stood first, followed by Director General, Defence Research, and Development Organisation.

The Garret ranking technique was adopted to evaluate the factors influencing the scientific institutions and organisations to opt for patenting their innovations. The scientific institutions and organisations place major emphasis on protection against competitors from copying/ imitating their creations and give least importance to lack of awareness and irrelevance.

Factor analysis was employed for deducing the major challenges/constraints/bottlenecks faced by the scientific institutions and organisations during the patenting process; they are legal and economic factors, resource-based constraints, process-based constraints, monetary factors, and uncertainty-based factors. These factors have indicated the measures that need to be taken by the government and other concerned authorities in encouraging more scientific institutions and organisations to patent their creations. Further, all the two hypotheses developed have been disproved, i.e., there are noteworthy motives for scientific institutions and organisations to patent their creations, and the Indian environment is conducive to patenting; the null hypotheses have been rejected.

ROADMAP FOR FUTURE

The policy makers and the concerned IPR department have to undertake measures to create wide awareness about the prominence of IPR contributing to economic development. It is obvious from the data that the average time taken for awarding patents is around 7 years. A procedure has to be devised to award patents within months and not years. It can be simplified using digital technologies and reduction of steps involved in obtaining a patent. The process needs to be made more transparent and less chaotic. Moreover, other developing countries are awarding patents in a more competent timeframe, to boost their economy.

It is evident that only MNCs and government institutions are present at the top levels. Hence, to encourage and facilitate innovations in medium- and small-scale industries, and underpriviledged sectors like agriculture, a separate division for providing patents to them must be established. Agriculture, on which nearly 75 per cent of the population is dependent, particularly those in rural areas, need to be given greater emphasis (Shweta & Shachi, 2015). Presently, the offices are located in metropolitan cities. The new offices may be established near industry clusters and product-specific/crop-specific areas to facilitate the obtaining of patents.

It is suggested that with public research and development systems, like the usage of agri-incubators, business planning and developers, state agricultural universities, non governmental organisations, farmer breeders/farmer innovators, and farmer conservers, policy makers may further the prospects of obtaining IPR for people's creations. It is recommended that the legal hassles involved in obtaining IPR and other paperwork may be eliminated with a view to making patenting much easier for the beneficiaries.

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