KNOWLEDGE ECONOMY AT IIT

AN IP PERSPECTIVE

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Introduction of Knowledge Pillar

The Indian Institutes of Technology (IITs) are pillars of knowledge centre in modern India. Few of the IITs have acquired such brand value making them comparable with western Institutes, and they are the ones which in true sense carrying the glorified legacy of ancient India. IITs are self-governing public, technical, and research institutes located across India. They are under the dominion of Ministry of Education, Government of India. Each IIT is an autonomous institute that draft their own curricula. Each IIT is linked to other IITs though a common council called IIT council.

As per legal framework, the Minister of Education is the ex-officio chairperson of the IIT Council. IITs are administered by the Institute of Technology Act, 1961, which has declared each IIT as an "Institution of National Importance". Presently, the Institutes of Technology Act, 1961 lists twenty-three institutes as IIT. Commencing 2022, the total number of seats for undergraduate programs in all IITs is approximately 16,053.

History of Knowledge Legacy

The history of IITs date back to 1945, when the government of India, on the initiative of Sir Ardeshir Dalal and under the chairmanship of N. R. Sarkar, appointed a twenty-two-member committee of industrialists, scientists, and educators, to consider the development of higher technical institutions in India. The goal was to corroborate an adequate supply of technical workforce for India's industrial development. The committee recommended the establishment of at least four "higher technical institutions", scattered throughout India-one each in the north, south, east, and west to prevent regional imbalance. These institutions were possibly to be modelled after the Massachusetts Institute of Technology (MIT).

The first IIT, named as the Indian Institute of Technology (IIT) Kharagpur, was inaugurated at Kharagpur in West Bengal on 18 August 1951 by Maulana Abul Kalam Azad, the then minister of education. Prime Minister Jawaharlal Nehru laid the cornerstone on 3 March 1952, and formally opened the institute on 21 April 1956. On the recommendations of the Sarkar Committee, four campuses were established at Bombay (1958) in collaboration with the former Soviet Union, Madras (1959) in collaboration with West Germany, Kanpur (1959) in collaboration with top US colleges led by MIT. IIT Delhi (1961) was established by upgrading the College of Engineering and Technology with British collaboration. Thereafter in 1994, sixth IIT, IIT Guwahati was established according to the Assam accord, under the existing IIT system without any foreign support. Thereafter in 2001, through an ordinance by the President of India, the oldest technical institute of India, the University of Roorkee, was upgraded to an IIT and was renamed as the Indian Institute of Technology, Roorkee, in the state of Uttaranchal.

Over the past few years, India witnessed a rise in establishment of several IITs in different parts of the country. In 2008 to 2009, eight new IITs were set up in Gandhinagar, Jodhpur, Hyderabad, Indore, Patna, Bhubaneswar, Ropar, and Mandi. In 2012, the Institute of Technology, Banaras Hindu University was made a member of the IITs and renamed as IIT (BHU) Varanasi.

In 2015 to 2016, six new IITs in Tirupati, Palakkad, Dharwad, Bhilai, Goa and Jammu were approved through a 2016 bill amendment, along with the conversion of Indian School of Mines Dhanbad into IIT (ISM) Dhanbad.

Establishment of IITs

S. No.	Name	Year of Establishment	State/UT
1	IIT Kharagpur	1951	West Bengal
2	IIT Bombay	1958	Maharashtra
3	IIT Madras	1959	Tamil Nadu
4	IIT Kanpur	1961	Uttar Pradesh
5	IIT Delhi	1961	Delhi
6	IIT Guwahati	1994	Assam
7	IIT Roorkee	2001	Uttarakhand
8	IIT Ropar	2008	Punjab
9	IIT Bhubaneswar	2008	Odisha
10	IIT Gandhinagar	2008	Gujarat
11	IIT Hyderabad	2008	Telangana
12	IIT Jodhpur	2008	Rajasthan
13	IIT Patna	2008	Bihar
14	IIT Indore	2009	Madhya Pradesh
15	IIT Mandi	2009	Himachal Pradesh
16	IIT(BHU) Varanasi	2012	Uttar Pradesh
17	IIT Palakkad	2015	Kerala
18	IIT Tirupati	2015	Andhra Pradesh
19	IIT Dhanbad	2016	Jharkhand
20	IIT Bhilai	2016	Chhattisgarh
21	IIT Dharwad	2016	Karnataka
22	IIT Jammu	2016	Jammu
23	IIT Goa	2016	Goa

Table-1

Governance of IITs

The governance and organisational structure of each IIT is essentially comparable. The President of India is the ex-officio visitor of each IIT. Directly under the visitor is the IIT council, headed by the minister of education, of the Government of India who circumspect on policy issues common to all IITs. Each IIT has a Board of Governors, Honorary Chairman (part-time) and a Director (full-time) appointed by the IIT Council with approval of the visitor.

For various academic and administrative functions, Dean is appointed. At the grass root level, the governance structure may vary at each IIT, as determined by their respective Board of Governors and Senate. The Director of each IIT is the principal academic and executive officer, similar to the Vice-Chancellor

Ranking of IITs

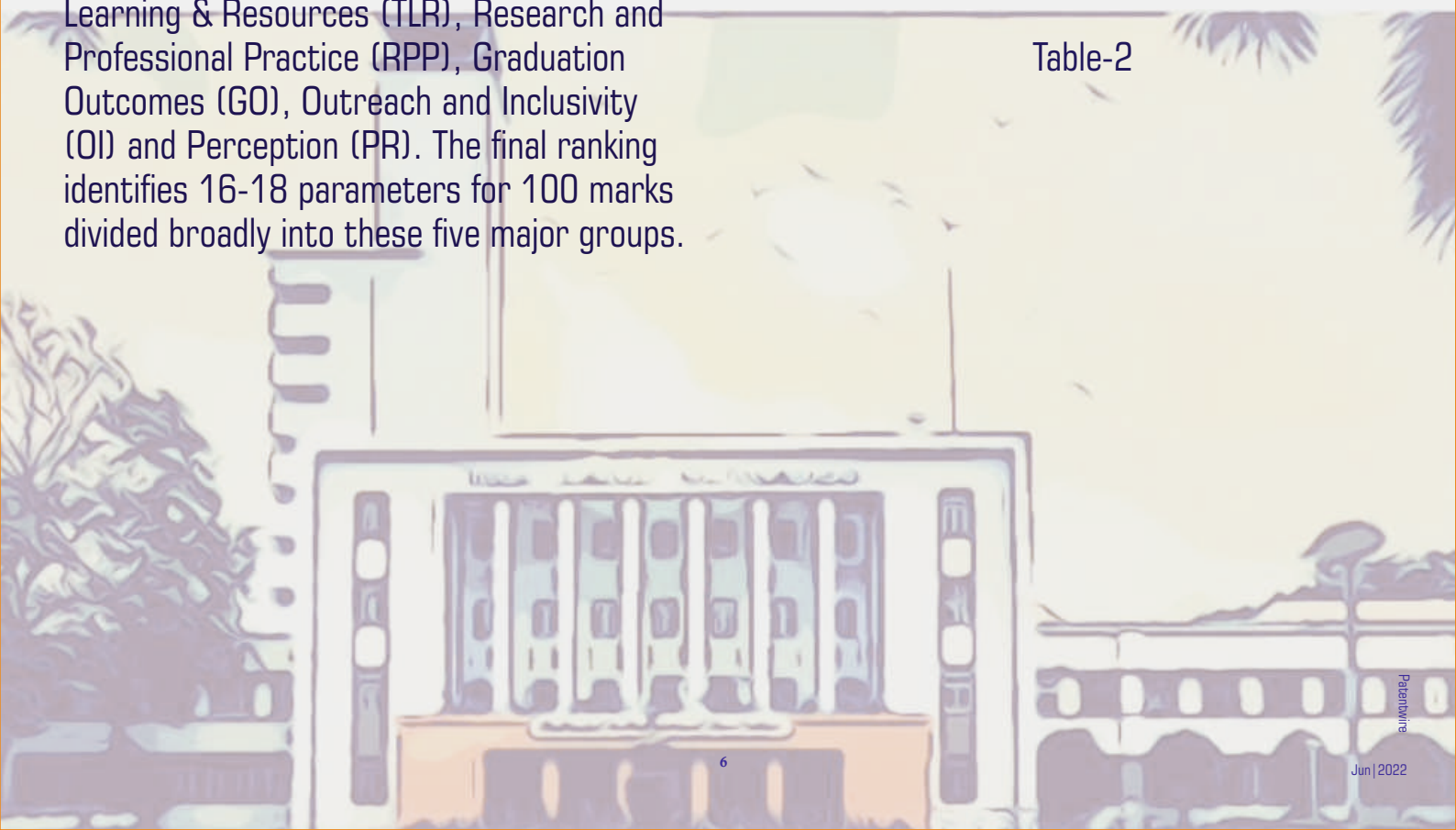
IITs are premier institutes for studying engineering and are generally ranked above other engineering colleges in India. Despite similar organizational structure, IITs differ evidently among their rankings. In the present article, we have disclosed rankings of IITs based on 2021 NIRF rankings and we have also tried to analyse the ranking and score with the Intellectual Property (IP) performance of respective institutes. Table 2 below shows the rank of IITs as per 2021 NIRF ranking as well as their score.

IIT Madras is the top engineering institute in the country as per 2021 NIRF ranking. It has continuously maintained its first rank in NIRF ranking since 2016.

The NIRF provides rankings for different categories and subject domains with five broad parameters namely Teaching, Learning & Resources (TLR), Research and Professional Practice (RPP), Graduation Outcomes (GO), Outreach and Inclusivity (OI) and Perception (PR). The final ranking identifies 16-18 parameters for 100 marks divided broadly into these five major groups.

S. No.	Name	Rank	Score
1	IIT Madras	1	90.19
2	IIT Delhi	2	88.96
3	IIT Bombay	3	85.15
4	IIT Kanpur	4	83.22
5	IIT Kharagpur	5	82.03
6	IIT Roorkee	6	78.08
7	IIT Guwahati	7	73.84
8	IIT Hyderabad	8	68.69
9	IIT Dhanbad	11	64.07
10	IIT Indore	13	62.56
11	IIT (BHU) Varanasi	14	62.10
12	IIT Ropar	19	58.09
13	IIT Patna	21	57.38
14	IIT Gandhinagar	22	56.86
15	IIT Bhubaneswar	28	55.71
16	IIT Mandi	41	52.58
17	IIT Jodhpur	43	51.56
18	IIT Tirupati	Not ranked	
19	IIT Bhilai	Not ranked	
20	IIT Goa	Not ranked	
21	IIT Jammu	Not ranked	
22	IIT Dharwad	Not ranked	
23	IIT Palakkad	Not ranked	

Table-2



Contribution of IP in NIRF Ranking of IITs

A thorough analysis of the scores of each IIT, especially the IP score was analysed which is a part of Research and Professional Practice (RPP) and carries 15 out of 100 marks in a cumulative RPP score.

Patents and publications of an institute together are calculated as Research and Professional Practice (RPP) in NIRF ranking which carries a weightage of 15 marks.

NIRF considers three-years window for publications, citations, patents, and sponsored research funding to assess the research performance of HEIs.

The RPP score comprises of four parameters as given in the following Table 3.

Parameters of RPP score	Marks	Contribution to Ranking
Combined metric for publications (CP)	35	10.5%
Combined metric for quality of publications (QP)	35	10.5%
IPR	15	4.5%
Footprints of Projects and Professional Practice (FPPP)	15	4.5%

Table-3

Table 4 highlights the total RPP score and contribution of IP and Patents score of each IIT.

S. No.	Name	Rank	RPP score	IPR score
1	IIT Madras	1	96.43	15
2	IIT Delhi	2	95.82	13
3	IIT Bombay	3	92.56	15
4	IIT Kanpur	4	83.13	15
5	IIT Kharagpur	5	88.59	12
6	IIT Roorkee	6	78.13	6
7	IIT Guwahati	7	70.32	4
8	IIT Hyderabad	8	56.90	7
9	IIT Dhanbad	11	65.53	2.50
10	IIT Indore	13	55.89	2
11	IIT (BHU) Varanasi	14	51.62	4
12	IIT Ropar	19	34.08	1.50
13	IIT Patna	21	44.92	1.50
14	IIT Gandhinagar	22	35.05	1
15	IIT Bhubaneswar	28	37.81	1
16	IIT Mandi	41	35.39	0
17	IIT Jodhpur	43	28.07	0

Table-4

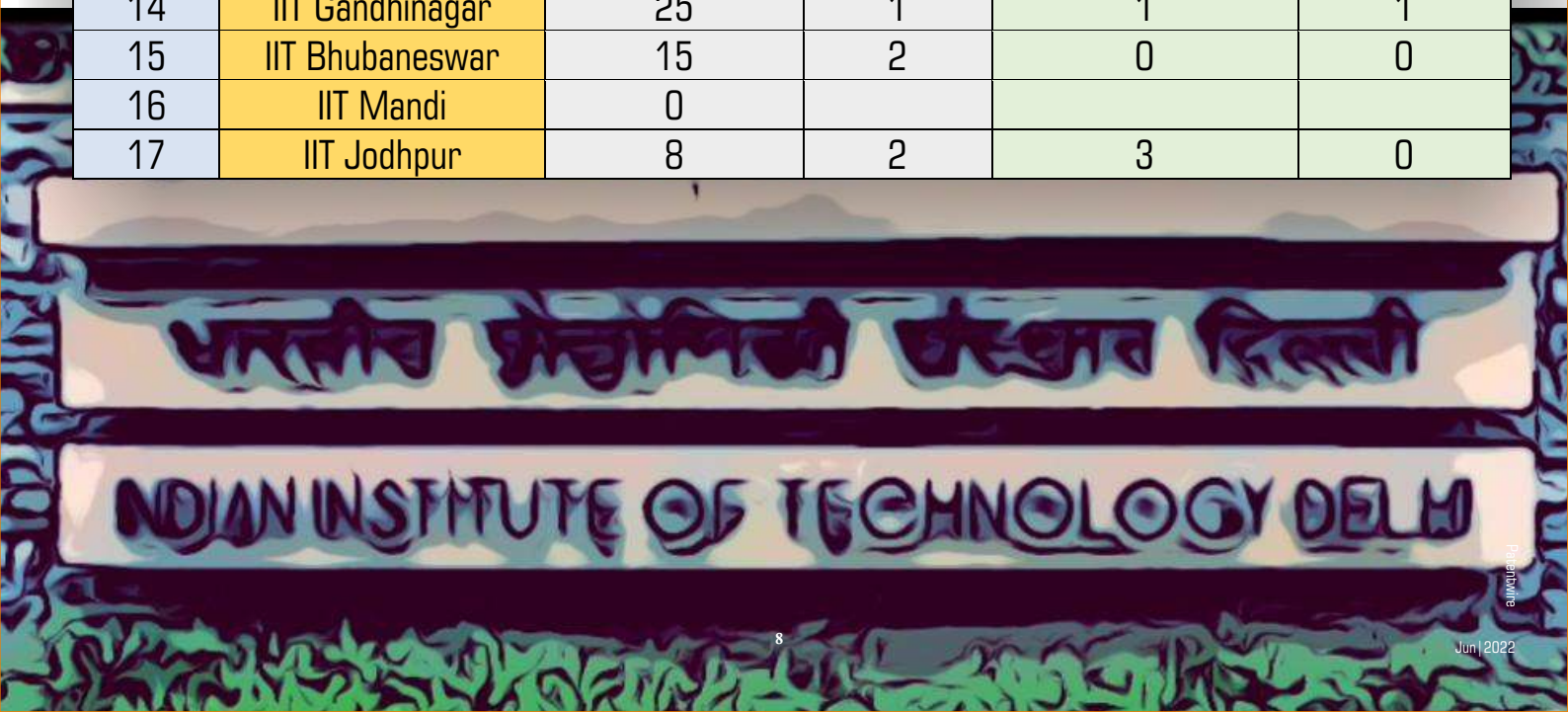
Even though the weightage of Publications (CP) and Quality of Publications (QP) combined is 21% to the final score when compared to 4.5% of Patents, still it is regarded as ambitious initiative by the Government of India to foster IP generation & promotion.

IIT Madras, IIT Bombay and IIT Kanpur are amongst the top IITs with 15/15 IPR score followed by IIT Delhi and IIT Kharagpur. The contribution of IPR score is quite relevant to calculate the RPP score. Compared to other IITs, IIT Mandi and IIT Jodhpur have zero IPR score, which clearly reflects in their overall rank.

Patents filed by IITs

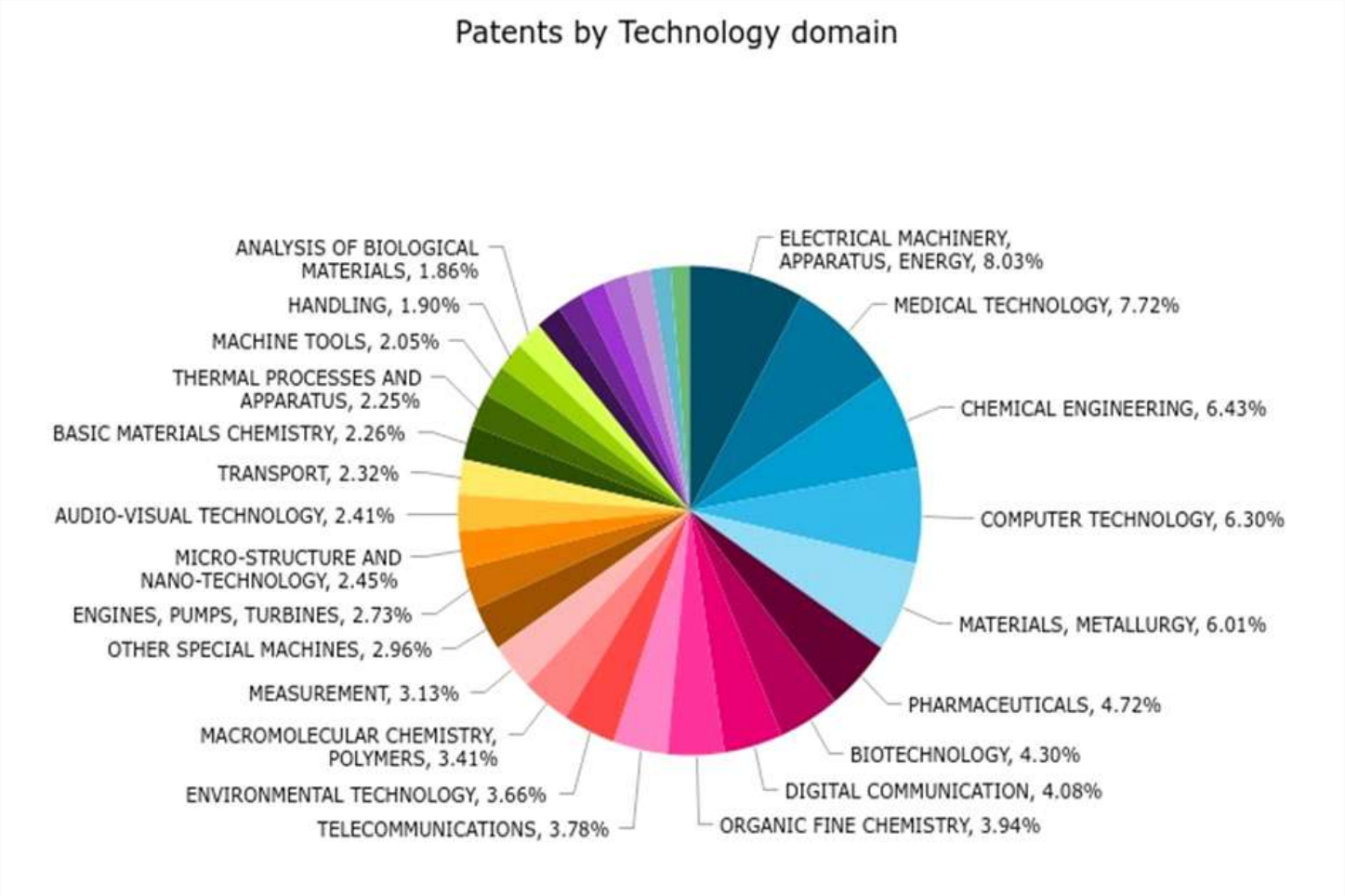
Several IITs have filed/published a swell as received a grant for the patent with different national and international (foreign countries) patents offices. Table 5 presents data on number of patents published and granted both nationally and internationally. It shows that the IIT Bombay has maximum number of patents published both nationally and internationally. However, IIT Bombay has maximum number of granted patents in both national and international patent offices from 2019-2021. On the other hand, some IITs such as IIT Dhanbad, IIT(BHU) Varanasi, and IIT Bhubaneshwar have no presence in foreign jurisdiction. 13 IITs have patents published and granted both nationally and internationally.

S. No	Name	National		International	
		Published	Granted	Published	Granted
1	IIT Madras	582	117	204	19
2	IIT Delhi	402	127	105	17
3	IIT Bombay	530	234	92	34
4	IIT Kanpur	292	121	14	6
5	IIT Kharagpur	104	49	6	4
6	IIT Roorkee	160	19	7	1
7	IIT Guwahati	100	11	35	12
8	IIT Hyderabad	59	1	35	9
9	IIT Dhanbad	19	4	0	0
10	IIT Indore	12	7	18	1
11	IIT (BHU) Varanasi	135	3	0	0
12	IIT Ropar	25	2	2	1
13	IIT Patna	28	7	1	0
14	IIT Gandhinagar	25	1	1	1
15	IIT Bhubaneswar	15	2	0	0
16	IIT Mandi	0			
17	IIT Jodhpur	8	2	3	0



Technology Domains of IITs

We performed a search to find out the technology/domain in which the number of patents were published/granted between 2019-2021. Pie chart below shows the domain of the invention covered by the patent published and granted during the last ten years by all IITs.
It is seen that maximum patents are available in mechanical field which specifically belongs to Electrical Machinery, Apparatus, Energy domain followed by patents in the field of Medical Technology. Least number of patents are filed in the fields of IT Methods for Management and Furniture, Games. It is evident from the pie chart, that maximum number of patents belong to five subject areas, namely Mechanical Engineering, Chemical, Computer technology, Biotechnology and Pharmaceuticals.



Technology Transfer and Licensing

IP management is an important point of concern for the competitiveness of technology based startups/incubators. Besides, resources needed to obtain, monitor and enforce IP rights makes IP management a difficult issue. Successful transfer of new technology from laboratory to commercial enterprises lead to creation of wealth, new jobs as well as a solution to problem.

IITs have emerged as leading solution providers in terms of transfer of new technologies. One of the approaches adopted by these institutes is setting up their own technology incubators. Technology transfer incubators amalgamate the concept of fostering new business development with the concept of commercialization and transfer of technology. We conducted a search to find out the number of patents licensed by each IIT as well as to find out the presence of technology incubators in IITs. We have summarized in Table 6 whether any data is available on the number of technologies commercialized by IITs as well as the presence of a technology incubator/park in an IIT to facilitate technology transfer or promote entrepreneurship.

S. No.	NAME	Technology transfer data	Technology incubator/Technology Park
1	IIT Madras	No	Yes
2	IIT Delhi	No	Yes
3	IIT Bombay	No	Yes
4	IIT Kanpur	No	Yes
5	IIT Kharagpur	No	Yes
6	IIT Roorkee	No	Yes
7	IIT Guwahati	No	Yes
8	IIT Hyderabad	No	Yes
9	IIT Dhanbad	No	Yes
10	IIT Indore	No	Yes
11	IIT (BHU) Varanasi	No	Yes
12	IIT Ropar	No	Yes
13	IIT Patna	No	Yes
14	IIT Gandhinagar	No	Yes
15	IIT Bhubaneswar	No	Yes
16	IIT Mandi	No	Yes
17	IIT Jodhpur	No	Yes

Unfortunately, there is no clear information available on the number of patents that have been technology transferred by any IIT, neither on the website of IITs nor in the NIRF data for the years 2019-2021.

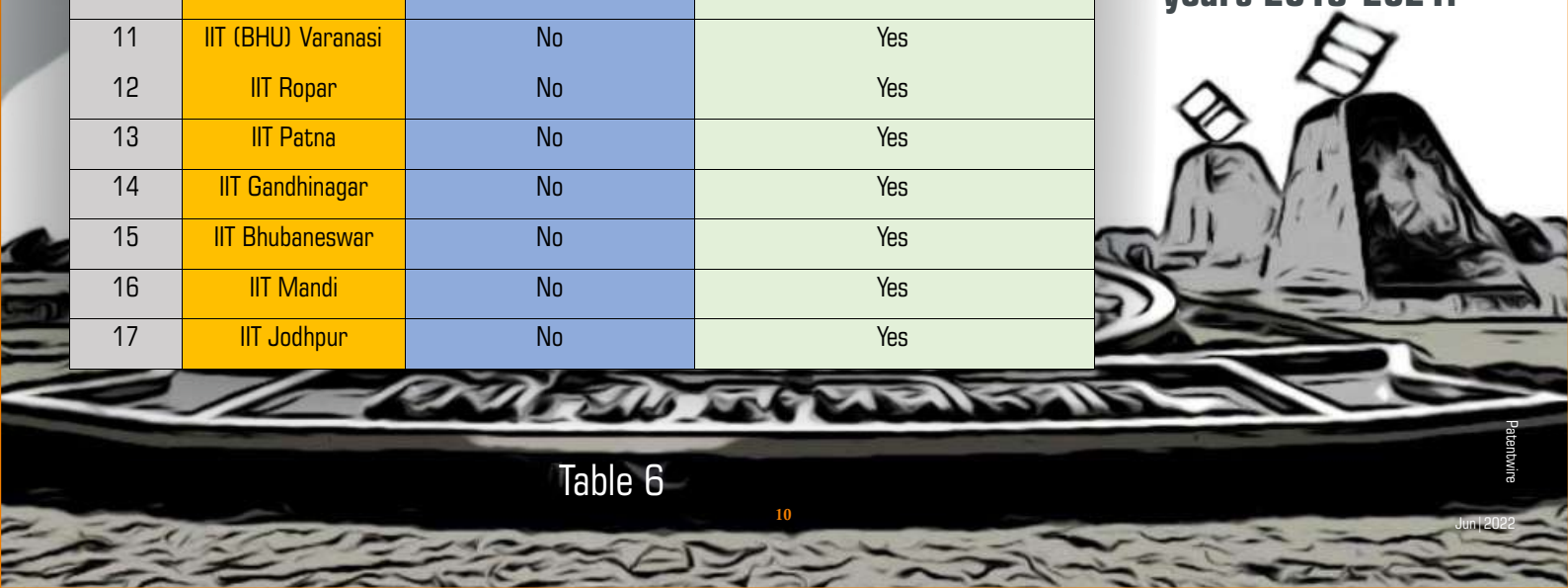


Table 6

IP Policy

IPR policy is a document to streamline the process of IP. Every organization working towards innovation, research, scientific growth, entrepreneurship and creativity must have their IPR policy. We looked for the IPR policy for each IIT with respect to whether the revenue generated from technology transfer is being shared with the creators of that invention as summarized in Table 7.

S. No.	Name	IPR Policy	Revenue sharing with the Inventor
1	IIT Madras	https://icandsr.iitm.ac.in/ipr/news/IPR%20policy.pdf	Yes
2	IIT Delhi	https://ird.iitd.ac.in/policy/IPRPolicy-IITD.pdf	Yes
3	IIT Bombay	https://rnd.iitb.ac.in/ip-policy	Yes
4	IIT Kanpur	https://siicincubator.com/wp-content/uploads/2019/10/IPR-Policy_IIT-Kanpur.pdf	Yes
5	IIT Kharagpur	http://www.iitkgp.ac.in/industry-ip-policy	Yes
6	IIT Roorkee	https://www.iitr.ac.in/ipr/downloads/Intellectual%20Property%20Rights%20Policy_IITR.pdf	Yes
7	IIT Guwahati	NA	-
8	IIT Hyderabad	https://www.iith.ac.in/research/patents/	Yes
9	IIT Dhanbad	https://www.iitism.ac.in/assets/pdfs/ciie/ciie.pdf	Yes
10	IIT Indore	NA	-
11	IIT (BHU) Varanasi	https://iitbhu.ac.in/contents/institute/2021/notification/noti_gad_ipr_24036.pdf	Yes
12	IIT Ropar	https://sites.google.com/site/roparipreell/ip-policy	Yes
13	IIT Patna	NA	-
14	IIT Gandhinagar	NA	-
15	IIT Bhubaneswar	NA	-
16	IIT Mandi	NA	-
17	IIT Jodhpur	https://rnd.iitj.ac.in/pdf/ipr/B.%20IPR-Policy%20Dec%202019_23022022.pdf	Yes
18	IIT Tirupati	https://www.iittp.ac.in/pdfs/IPR%20Policy.pdf	Yes
19	IIT Bhilai	https://www.iitbhilai.ac.in/index.php?pid=Intellecutual_Property_Policy#:~:text=with%20IIT%20Bhilai.-,2.,ever%20entered%20by%20IIT%20Bhilai	Yes
20	IIT Goa	http://iitgoa.ac.in/wp-content/uploads/IP_Policy.pdf	Yes

Table 7

Observation and Recommendation

About patent trend, we have noted that during the NIRF rankings in 2016, a detail information on the number of patents filed, granted, and licensed was delineated. In 2017 and 2018 NIRF ranking details, information on the number of patents published, granted and earnings out of patents was specified. However, this trend is not being observed for the years 2019-2021.

Now, information on the number of patents published, granted and licensed is not available. Besides technology transfer incubators being established with each IIT, there is no data available on the number of patents licensed by respective IIT. In this technology and start-ups era, where India is setting a milestone in innovations and knowledge pool, these data is required to motivate and to take learning from these knowledge pillars. Further, based on data available and trend, we have following observations and recommendations:

1. Except few, there is no Technology Transfer Office (TTO) functioning in IIT.

2. There is no Technology Transfer Data publicly available to evaluate the monetization aspect of the innovations.

3. Considering the same administration, Patent filing trend is inconsistent with most of the IITs.

4. Functioning of IP Cell is not well articulated.

5. No IP Policy has captured qualitative aspect of patent filing system.

6. Many IITs do not file PCT or foreign application.

7. Many IITs even not file any patent application.

8. Industry Institute Partnership is missing in many IITs.

9. Research at many places is not oriented towards industrial issues.

10. Entrepreneurial skills are superseded by overseas research and lucrative package.

11. Major essential courses like Intellectual Property Rights, Brand Value, Anti-counterfeit, etc are not part of curriculum.

12. Industry visits and live demo at Industry premises are missing at many IITs.

13. NIRF ranking parameters should be more defined in terms of IPR, Technology Transfer, Industrial Collaborations, Entrepreneurships, Innovative Product launches, Revenue generation, etc.

Conclusion

Patents play an essential role as an identification of research/innovation for any institution. It is also taken into consideration in different rankings and accreditation systems initiated by the Government of India such as ARIIA, NAAC, NIRF, etc. Number of patents granted/licensed is directly proportional to the revenue generated by that organization. The consequence of grant/license is eco-system installations, start-ups, revenue income and enhanced research productivity for that institution which ultimately encourages entrepreneurship potential in institutes. First seven IITs (first seven established) top the NIRF rankings, both in terms of rank as well as in terms of patents filed/published and granted when compared to IITs that were established in later years. These institutes certainly need to pay more attention and consistent boosting to ensure an increased growth rate in their research/innovation sector and more sensitization for IPR. This will eventually lead to enhancement in the IPR score and improvement in NIRF ranking and may ultimately serve the real purpose of Knowledge Economy of India.

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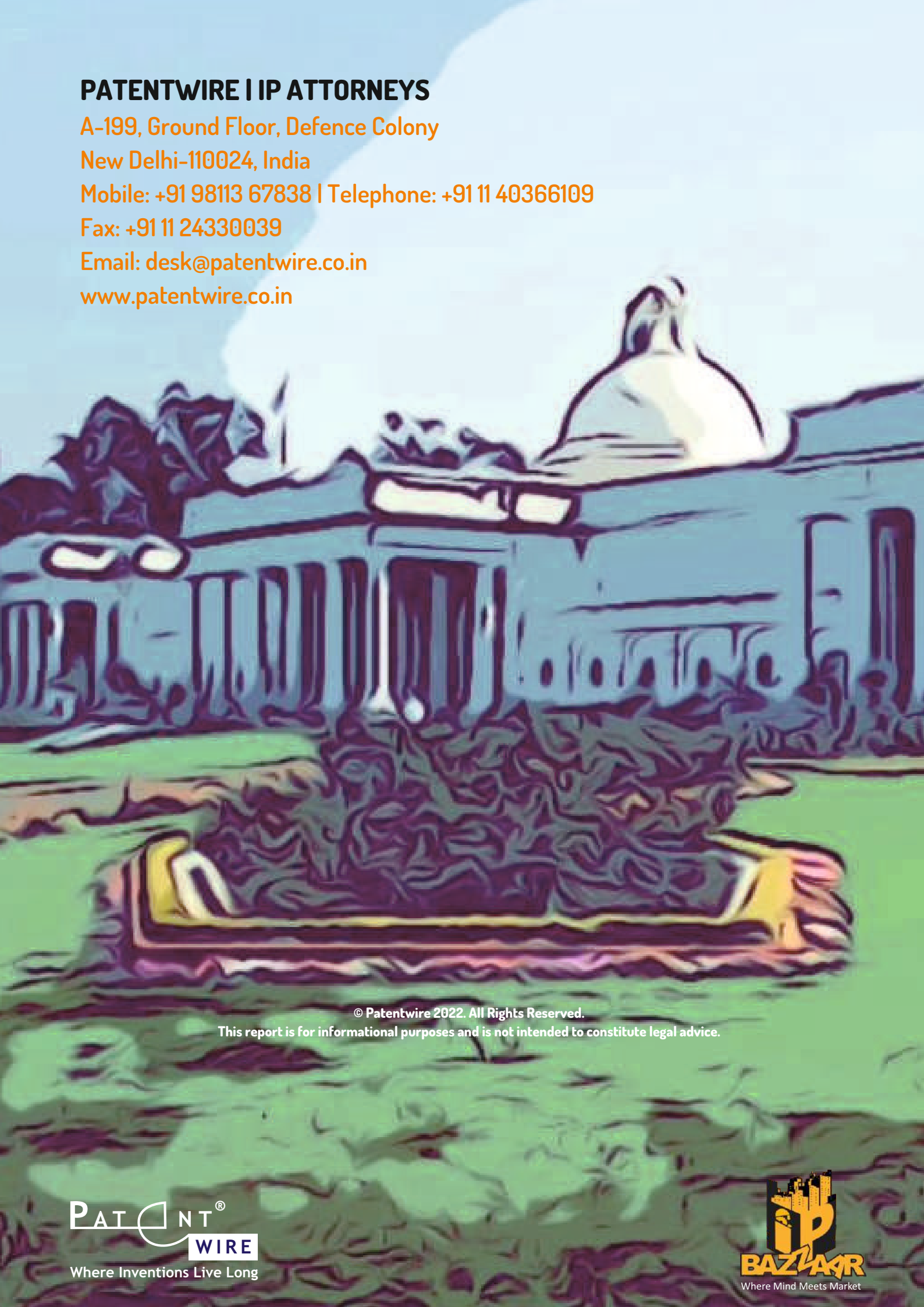

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