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Legal Protection, Consolidation and Evaluation of IP in Academic Units

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Intellectual property (IP) is one such legal area that has evolved with time. IP is very precious in today's economy, and its existence becomes crucial if the creator of such IP is unaware of the commercial potential. The IP creator might not have the expertise to understand the economic intricacies which an IP possesses hold. To understand these economic intricacies and to value IP, experts have suggested various IP valuation methods. However, for any IP valuation to follow, the first step is IP evaluation. The statutes' legal protection does not have much to offer when determining IPs' economic potential. In this paper, the authors have tried to pull all the relevant data concerning IP protection and IP management (IPM) of two of the Institute of National Importance (INIs) academic units and tried to structure the same in an IPM Audit Model. Thus, the system will help IP creators to self-evaluate their IP once they are legally protected. The authors have adopted an exploratory, case study research methodology. The research's focus is limited to 8 types of IP generated by an academic institution. The study demonstrates an exploration of the IPM audit framework to reduce the complexity involved in IP evaluation, which substantiates the legal protection offered to IPs.

Keywords: Intellectual Property, IP Evaluation, IP Valuation, IPM Audit Model, IPR Score

Intellectual Property (IP) was an emerging field and was accorded legal protection after extensive deliberations at international and national forums. Every nation adopted its standards and sui generis system of protecting the IP generated by them.[1] In India, various acts were enforced for the same purpose. The protection of IP is the goal of these statutes like the Patents Act,[2] the Copyright Act[3] and the Trademarks Act,[4] etc. However, legal protection is something that happens once the IP is generated and qualifies various benchmarks set by the statutes. Once the IP attain legal recognition, it has a specific process to follow that would help the IP in commercialization and further achieve its monetization. Academic institutes are the prolific generator of copyrights and patents. The process of ideation, identification, generation, and protection of IPs like copyright and patents is inherent in academic institutions working.[5]

As academic institutions' IP generation capacity increases, the management of those IP becomes an inevitable task. This IP legislation's status is legal, and once the legal existence cajoles these IPs, they are commercialized further to extract value from them. The process of value extraction is regarded as an interdisciplinary field as it requires expertise from the legal, technical, and management background. This process is termed IP management, and IP generation is a part of IP management. IP management has various sub-processes in it. Being the first process towards IP Management, IP Audit's process becomes essential to know its pre-requisite. IP audit is an efficient and the most effective way by which any institution can develop its IP portfolio or increase the revenue generated by the IP owned.[6] The IP held a review and their performance to mitigate risks if any, and device effective technique for better IP performance, remedy the issues and manage the IP system is the most critical objective of an IP audit. Based on an effective IP audit, the institution's IP policy and IP strategy are designed to assess and revise IP owned, licensed-in, licensed-out, acquired, or rented. The IP audit review serves as an insight for an institution to see the better performing IPs and to identify and understand the weaknesses and strengths it holds.[7]

The leverage point is, an institution's IP audit can be done in various ways. The standard general classification of IP audit being the broad IP audit and a narrow IP audit. Further, it is categorized as a general-purpose IP audit, event-driven IP audit, and limited purpose-focused IP audit.[8] It involves evaluating the IPs and highlighting the strength and

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weakens of an institution and its IP, minimizing the legal issues involving third parties relating to ownership, infringement, and better planning and positioning those technologies that the IPs curate.[9] IP audit involves collecting data, preparing an audit plan, conducting an audit, reviewing the existing IP strategy, scrutinizing the IP and examining IP contracts and agreements, and reviewing information flow in an institution.

After an IP audit, it follows the process of evaluation of the information collected concerning IPs. The evaluation of the data is an essential step as its analysis gives direction to IP policy and strategy, which helps recommend the best practices and complement the legal protection. The IP evaluation process engages in IP generation, increasing efficiency, reducing the cost associated with IP, and productivity of the IP portfolio.[10] IP evaluation helps in determining the monetary value of the IP portfolios. The process of evaluation helps in decisions making where business planning is involved. Once the institution reaches the IP evaluation stage, issues like joint ventures, licensing, acquisitions, mergers, investments, loans against IP, etc., are examined in micro detail. These securitizations of IP assets have been widely practiced and have become an indispensable part of an institution's legal and financial transaction.

Indian academic institutions, like institutes of national importance (INI), being the pioneer in inventions and innovation involving technologies, are reservoirs of IP. However, the lack of IP awareness does not allow them to extract value and lack legal awareness. Evaluation of IP for academic institution becomes elementary as the investment in legal fees for the IP's whole life cycle. Its maintenance is the primary investment. The investment used for turning an invention into a functioning technology involving various innovations can be handled efficiently when an IP portfolio is thoroughly evaluated. Since the institutes have this cyclic pattern; hence the evaluation of IP becomes the next important step after the IP audit. The use of IP evaluation in any research institute is to facilitate[11] the following actions:

a) Decision Making: Decision making is very crucial during the development and exploitation stage of any IP. A correct IP evaluation concerning law and management can change the fate of the academic institute's IPs. It can strategically place them above various entities involved in the IP generation market.
b) Adding Value to IP Assets: The invention has a specific value at its R&D stage. The investment made in R&D can be recouped by a well-planned and well-structured IP evaluation, and the legal expertise can direct the whole process into a robust one.
c) Communication: The well-founded decision is the masonry of the IP owned by the academic institutes. The IP's decision should be formulated and communicated as necessary and required among its stakeholders like teachers, research staff, students, and the third party. IP evaluation facilitates and gives the necessary direction to the same.
d) Indicator/monitoring: The allocation of funds during any R&D project is critical in future output. Whether the concerned invention has been allocated an adequate amount of funds and the inventions' return can be answered through IP evaluation.

Academic institutions like the Indian Institute of Technology (IIT) have become a hub for invention and research, impacting society. These academic institutes have served us with great inventions and annually generate a considerable amount of IP. Established in 1951, the Institute of national importance (INI), considered for this study, started its functioning with 224 freshers, 42 teachers, and 10 departments. The institute has grown now with about 40 academic units, 11500 students, and 700+ faculty members. With time it has expanded its research domains from core engineering to life sciences, management, IP law, psychology, etc., with various interdisciplinary studies. The institute has made a mark and is rated as the top three research institutions in India by the Department of Science and Technology (Department of Biotechnology) and National Institutional Ranking Framework (NIRF).[12] About 2000 research papers are published each year by researchers. The institute files about 50-100 patents in a year. It has been awarded the top academic institute for patents, 2016 by the Indian intellectual property office and Confederation of Indian Industries (CII). About 300 R&D sponsored projects are undertaken every year, valued at Rs 150 – 200 crores.[13]

With such a wide ambit of IP in its hands, it is the need of the hour to address the IP not just for its legal status but also see the additional responsibilities which come with it. The demand for IP protection and its

processing has been on the rise. It is inevitable for the legal community to be oblivion to these facts. Hence, this study would shed light on the next big step to be considered by the legal fraternity and IP lawyers for better performance and the best legal accord. To address this gap and lend the auxiliary hand, the author has explained the importance of IP in an academic institution. To show the extent of the commercialized IP being generated once the legal status is granted, we have attempted this case study concerning the IP audit of two departments in the academic institute. This paper aims to understand academic institutes' contribution to IP generation and help them handle the IPs in the best possible way. This paper would sketch the picture of IPs inception to its commercialization for the readers and explain its intricacies.

Theoretical Background

Intellectual Property (IP) is a formalization of ideas into a workable manner. The creator of IP seeks formal recognition through the law, which, when accorded, is a signal for further value extraction. For example, copyright is commercialized via licensing, selling, and assignment; similarly, other IPs like patents, trademarks, etc. also are either sold or licensed or assigned or rented to extract value and put them out in the market use. The process of this commercialization is rarely discussed concerning academic institutes.

Evaluation of ideas into an applicable and professional product and process generates other technologies and devices. IP serves as the vital element for any organization which builds value on future technologies, and its IP derives its evolving value from legal statutes. It has a significant role in institute restructuring and, accordingly, IP strategies,[14] vision, goals, and managing tools are evolved and evaluated continuously. The evaluation of IP is a continuous process and cannot be fixed in a block structure as seen when it is accorded legal protection. It must be conducted on a cyclic basis. Activities involving managing, protecting, and risk analysis of IP are interwoven into the evaluation process.

The evaluation process is so essential to IP that we may not find separate mention of them, but they are practiced and employed daily. The knowledge-driven institutes embrace IP's lifecycle from its idea generation stage till technology maturation and consider the core challenges involved in the process. The evaluation process provides a solution to the challenges and alerts them accordingly. The IP management becomes very smooth and efficient with the evaluation process being integrated with the institutes' functioning system and is complemented by procedural legal structures.

IP evaluation is not just limited to the estimation of the IP portfolio.[15] It facilitates the IP issue discussion, spreading awareness, IP alignment, and related activities across the institutes. The limited approach to IP portfolio value is not a fair evaluation process. The evaluation process facilitates the strategy, policy, and IP related activities with the objectives and working of the institute's R&D unit. Evaluation is an elaborated and inclusive process. It entails legal-management and control of invention and innovation in the institute; the interaction and functioning of units like finance, accounts, management, and policy; evaluation of research methods and challenges involved; case studies and field research relationship in intellectual capital management; implementation and evaluation of new methods, theories in furthering the development of IP, etc. The evaluation process helps find the relative strength in the organization's existing IP portfolio and visualizes and aligns its functioning within an organization's functioning.

While evaluation is integrated into the IP lifecycle, another essential process in the IP lifecycle is IP due diligence.[16] Comprehensive legal planning and knowledge about the IPs in an organization furthers research strategies and technologies. This legal IP due diligence's primary purpose is to keep a check on the existing, evolving, and future IPs that can be a part of an institute's IP portfolio. IP due diligence is a process that must be religiously followed, and the results are to be integrated and considered before making any decisions relating to IPs.

This process's primary goal is to identify and check an organization's IP assets' legal status at the micro-level. It also involves checking and understanding the legal status of potential association forming entities. These associations may be merger, acquisition, joint venture, or otherwise as per the type and strength of the IP under consideration. IP due diligence assesses the validity of these entities and ascertains the scope of IP assets. It also enlists the potential infringement and its remedies. The process of IP due diligence follows a pattern, but it can be molded according to the individual Institute's strategy and policy. The pattern is altered as per the expected outcome, and a target IP and associating entities are involved.

IP due diligence gives an upper hand and prepares an institute for future action concerning IP strategies and decisions. It helps in strategizing the decisions for acquisition, expansion, and abandonment of IPs. If performed with due care, IP due diligence output can help and direct an institute's decision concerning IP and its course as a technology after commercialization.

After understanding audit, evaluation, and due diligence next step is the valuation of IP.[17] The real value of an IP is realized when it is successfully commercialized. The correct positioning and evaluation of IP accompanied by an appropriate IP valuation method make the innovation and invention undefeatable in the long run. IP valuation is essential in business success. The accuracy of IP valuation will reflect on the success of business transactions. The decision relating to investment is dependent on the valuation process of IP.

For valuation of IP, as per Indian Accounting Standards (IAS)[18] the asset must be recognizable and should have a separate identity. The IP being valued should be legally enforceable and transferable. The income streaming from the IP should separately be assessable. Certain factors influence the valuation of IP. The valuation process is governed by the context or circumstances which exist and the standard of the value globally.[19]Reason and purpose are the pivots governing IP valuation. Factors like time, date, and legal accessibility of relevant data are crucial in the process. IP valuation has various methods for assigning the value to IP. There are advantages and disadvantages of each of the known IP valuation processes.[20]

A few non-monetary methods serve as a guide for IP assets' value by observing and scoring various IP factors. These factors are also referred to as value indicators, which influence the value of IP either in an incremental way or a negative direction. Background of IP, legal factor, technological development, and market utility with management capacities are inclusive elements in these factors.

Thus, the IP life cycle entails the idea or innovation and a whole complex but intricate procedure that governs technology's legal processes to bring it into the market for commercialization. The processes like IP audit and due diligence, evaluation, and IP valuation are the IP commercialized essence. The revenue generated is dictated by the application of these procedures. It is expected that the institutes should implement these processes with the utmost care and should keep a periodic review of such processes. The institute always makes sure that the processes are updated and implemented timely to reap the IP's maximum value.

Research Methodology

The methodology adopted for this study is qualitative and exploratory. The data has been collected through the institute's websites, departmental records, and the institute's annual report. Interviews with the concerned authorities were conducted. Exploratory research design has been used, and the qualitative inquiry mode is employed. The IP evaluation process includes listing down all the IPs and segregating them, and then strategically putting data in the IP audit framework, which is further analyzed.

Case Study

In this case study, two departments of an academic institute were considered. These departments are engaged in IP generation and other activities like IP maintenance, IP enforcement, and IP commercialization, which are part of the IP lifecycle. These two case studies will demonstrate to the readers the intricate processes involved in the IP lifecycle and understand the importance of IP beyond legal contours termed as Intellectual property management. In this case study, the data has been collected for the two departments for five academic years and structured into an IP audit framework, auditing and reviewing the IPs. Further, the data is analyzed, and IPR credence is calculated for each department, which later can be used to base important decisions on the academic institutes.

IP Management System of Institute of National Importance

Intellectual property management system (IPMS) is a tool available for managers to accumulate and put the IP in the best exploitation mode. The intellectual property management system (IPMS) includes specific steps that help accumulate IP-related information, leading us to take strategic decisions relating to the IPs' commercialization. Also, every institution has specific intellectual capital (IC)[21] they were Contributing to the generation of the IPs. Such ICs are human capital, relational capital, organizational capital, etc. These include the human resources working towards IP generation, the forms of collaborations generating IPs, and the organizational infrastructure that facilitates IPs generation. It is

needless to mention that all processes are derived from the legal pivot supporting them. The various steps or subsystems[22] which help the academic institution to realize the total value of the IP generated are:

a) Generation of IP: Academic institutions being the generation of knowledge are the most efficient IP generators.
b) IP Portfolio Management: Any IP must perform to its full extent, which requires recurrent IP portfolio development and management to realize IPs' full potential.
c) IP Valuation: It is a process where the IPs are evaluated and assigned a value as per the market pull demand and the technology life cycle.
d) Competitive Assessment: The process following IP evaluation is an assessment of IP concerning the other competing technology or innovation been developed. It helps in assessing the need and demand of the IP in the market.
e) Strategic Decision Making: After all the steps mentioned above are diligently performed, a structured outcome must be devised for the IPs generated in an institution. Based on the above step's outcome, a strategic decision is made to enhance the IP portfolio and generate revenue.

A similar procedure can be seen interwoven in the academic institute's functioning, which is considered for this study. The IPMS of this institute is strong and has been developed over the years. The departments, centers, and schools are the generator of IPs. The research facilities available in the departmental laboratory are the birthplace of various inventions, which are managed by Research and Industrial Consultancy Centre (RICC).

The RICC cell is responsible for sponsored research activities in the institute and the IP management of inventions and innovations. The institute, every year, takes up various research projects. RIC looks after project management, which involves IPR protection and technology transfer. RICC initiates various new research projects vital for IP Portfolio development and its commercialization and implements various national initiatives. RICC is supported by an in-house banking facility and has well equipped and computerized offices. The cell has handled about 1221 research projects worth Rs.104 crores to date and has the capacity to handle 600 R&D projects at once. Currently, RICC is involved in 450 sponsored projects, including national and international collaborations.[13]

With all the research projects being lined up before the cell, it has an IPR cell that looks after the IP generated during the research and accumulated and protects them. Institute has its own IPR Policy, which is exhaustive and has broad coverage. Events like patent drives and technology transfer (TT) group initiatives keep spreading awareness and protecting IPs. Also, IPR Cell has an in-house patent claim examination, which helps the institute's inventors get their invention protected under the law. The most crucial advantage to the institute is the presence of a law college. Professors of this law school are actively involved in IP moderation. The double review process in two perspectives, legal and technology, provides more chances of granting the application filed. Also, the institute has another school that focuses on the commercialization of inventions. It imparts entrepreneurial values and creates an ecosystem for early start-ups. The school has a product-first approach and optimizes its functioning accordingly.

The institute has a well-evolved IPMS where not just the IP generation is structured and secured. However, the institutes also have various cells, laboratories, centers, and schools to further the step-by-step process of IPM and successfully commercialize its generated IPs. The IPMS of the institute will be studied and analyzed in the below-mentioned case studies of its-two academic units.

Case Study I: Electrical Engineering Department

The academic unit under consideration is the institute's electrical engineering department, which was established in 1951 and actively engaged in research. The department is well equipped with modern laboratories and excellent faculty members. It offers two undergraduate programs in electrical engineering and instrumentation engineering. The department has four research groups: electric drives & power electronics, control systems, power & energy systems, and sensors & signal processing. These research groups offer four postgraduate programs in their respective areas. The department offers a doctoral program in control systems, instrumentation, machine drives, mixed-signal very-large-scale integration (VLSI), power electronics, power & energy systems, signal/image processing, and machine learning. The departmental also engages in industrial consultancy, sponsored research, collaborative R&D, and technology incubation. The faculties have been active in offering consultancy services to industries concerning research and development.[13]

Physical Security and Legal Document Maintenance

Institute is a public entity, considering physical security to laboratory access and protection of confidential information, the department takes due care. Laboratory notebook maintenance practice is followed to record research work. The department consults with the institute legal and IPR cell whenever necessary. As part of the appointment procedure, the institute staff and faculty sign a non-disclosure agreement (NDA). If there is any involvement of a third party, all required agreements, protocols are duly followed by the department.

Human Capital

Professors, students, research staff, laboratory staff, etc., form the department's human capital. The faculty members are grouped under four broad specializations – machine drives and power electronics, control systems engineering, power and energy systems, instrumentation, and signal processing. At present, the department has 36 core faculty members and 12 visiting experts. The undergraduate student strength of the department is 536. The total postgraduate student strength is 220, which includes doctoral scholars and master students. The department has 20 permanent supporting staff.

Organizational Capital

13 laboratories support academic activities. The department has focused on control systems, instrumentation, machine drives, mixed-signal VLSI, power electronics, power & energy systems, signal/image processing, and machine learning. Department offers specialization in four areas as electric drives & power electronics, control systems, power & energy systems, and sensors & signal processing. Department runs 29 courses.

Relational Capital

As suggested by Sanchez[23] relational capital is the institution's external relationship, such as customers, suppliers, R&D partners, government, etc. Relational capital considered here is the department's collaboration with external partners for consultancy projects, research projects, and visitors to the department. Visitors include experts, alumni. The total number is presented against the academic year.

IP- Patent and Copyrights

IPRs considered being patents and copyright material that were undertaken in respective years against IPRs generated. In the year 2014-15, 53 research projects were completed; in each of the years 2015-16 and 2016-17, 52 research projects; in 2017-18, 53 research projects; and in 2018-19, 55 research projects were completed. The academic unit's patent for the year 2014-15 is 7, and for the year 2015- 16 is 2. Copyright was generated in the form of articles published in journals, conference papers.

Application of IP audit Framework to the Academic Unit

The academic unit's IP audit is conducted for the academic years 2014-15, 2015, 2016-17, 2017-18, and 2018-19 using the "IP audit Framework".[24] There is a limit to data due to the institute's confidential information policy. The available data is applied in the IP audit framework below (Fig. 1 to 5):

IP Score for the Academic Unit (Electrical Engineering Department)

The IPR score of any department of the institute can be suggested for a specific time frame using weightage unit calculation against the value assigned to each IPR. Table 1[24] gives the information relating to the weightage of the IPR. Institute being academic and serving as knowledge base copyright is given highest weightage. Activities like, patent filing requires comparatively higher efforts. That is why it is designated with higher credence than any other IPR. Consulting and R&D are carried out in an academic institute, but the information related to those is kept confidential. The data for the same cannot be easily obtained. Sometimes no records exist as to the number of trade secrets held by an institute. Hence, 0 credence is allotted for the trading secret.

The IPR credence (Table 1) calculates the IPR score of each year. The data was collected regarding each academic year and was accordingly segregated and put in the IPR credence. In the academic year 2018-19, the copyright output is 124, and in the academic year 2017-18, the copyright output is 74. In the academic year 2016-2017, the copyright output is 70, and in the academic year 2015-2016, the copyright output was the same as 70, the patent output was 2, and the technology transferred was 1. Similarly, in the academic year 2014- 2015, the copyright output was 55, the patent output was 7, and the technology transferred was 1. The IPR score is calculated by adding the number of copyright multiplied by IPR credence (n x 1) with the number of patents multiplied by IPR credence (n x 3). Therefore, the IPR score for academic year 2018-19 is 124 + (3 x 0) = 124; for academic year 2018-17 is 74 +

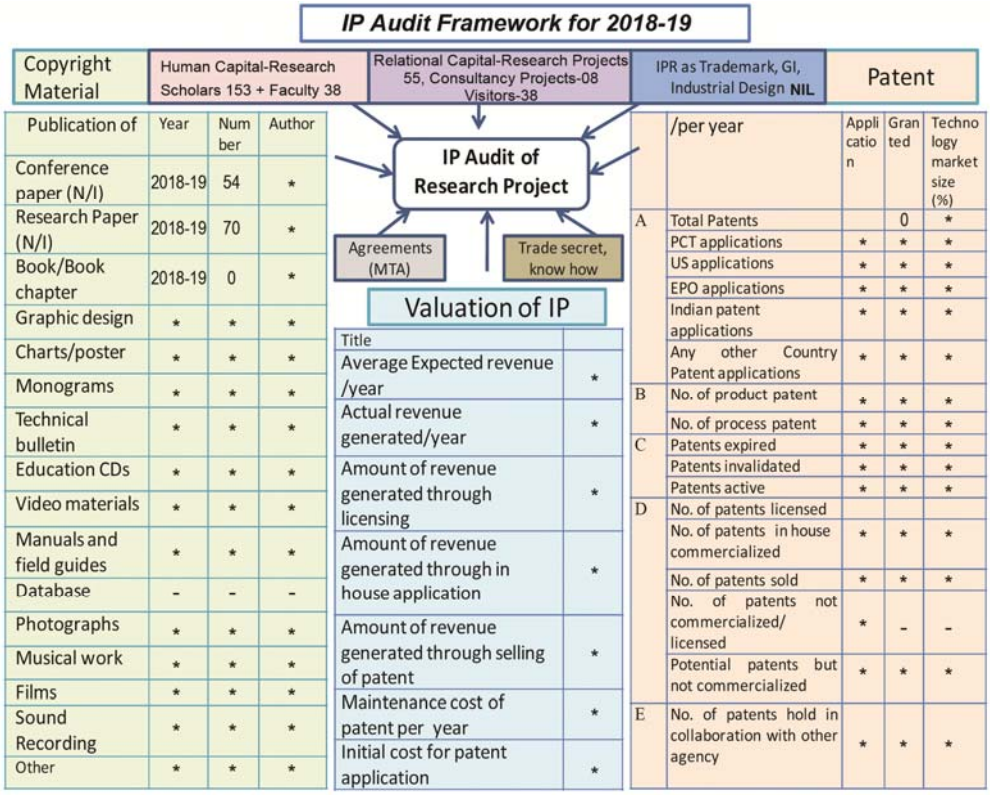


Fig. 1 — IP Audit Framework for 2018-19, Electrical Engineering Department

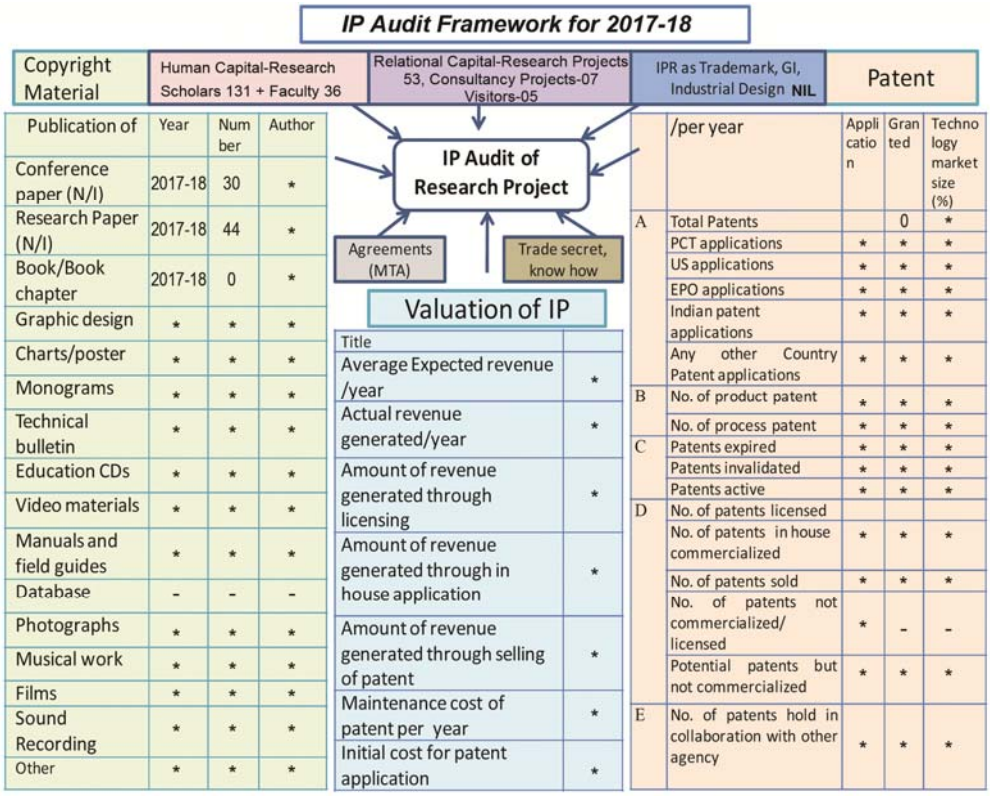


Fig. 2 — IP Audit Framework for 2017-18, Electrical Engineering Department

IP Audit Framework for 2016-17

Copyright Material	Human Capital-Research Scholars 104 + Faculty 36	Relational Capital-Research Projects 52, Consultancy Projects-10 Visitors-12	IPR as Trademark, GI, Industrial Design **NIL**	Patent

IP Audit of Research Project

Agreements (MTA) | Trade secret, know how

Publication of	Year	Number	Author
Conference paper (N/I)	2016-17	71	*
Research Paper (N/I)	2016-17	70	*
Book/Book chapter	2016-17	0	*
Graphic design	*	*	*
Charts/poster	*	*	*
Monograms	*	*	*
Technical bulletin	*	*	*
Education CDs	*	*	*
Video materials	*	*	*
Manuals and field guides	*	*	*
Database	-	-	-
Photographs	*	*	*
Musical work	*	*	*
Films	*	*	*
Sound Recording	*	*	*
Other	*	*	*

Valuation of IP

Title	
Average Expected revenue /year	*
Actual revenue generated/year	*
Amount of revenue generated through licensing	*
Amount of revenue generated through in house application	*
Amount of revenue generated through selling of patent	*
Maintenance cost of patent per year	*
Initial cost for patent application	*

	/per year	Application	Granted	Technology market size (%)
A	Total Patents		0	*
	PCT applications	*	*	*
	US applications	*	*	*
	EPO applications	*	*	*
	Indian patent applications	*	*	*
	Any other Country Patent applications	*	*	*
B	No. of product patent	*	*	*
	No. of process patent	*	*	*
C	Patents expired	*	*	*
	Patents invalidated	*	*	*
	Patents active	*	*	*
D	No. of patents licensed			
	No. of patents in house commercialized	*	*	*
	No. of patents sold	*	*	*
	No. of patents not commercialized/ licensed	*	-	-
	Potential patents but not commercialized	*	*	*
E	No. of patents hold in collaboration with other agency	*	*	*

Fig. 3 — IP Audit Framework for 2016-17, Electrical Engineering Department

IP Audit Framework for 2015-16

Copyright Material	Human Capital-Research Scholars 104 + Faculty 36	Relational Capital-Research Projects 52, Consultancy Projects-23 Visitors-0	IPR as Trademark, GI, Industrial Design **NIL**	Patent

IP Audit of Research Project

Agreements (MTA) | Trade secret, know how

Publication of	Year	Number	Author
Conference paper (N/I)	2015-16	78	*
Research Paper (N/I)	2015-16	69	*
Book/Book chapter	2015-16	1	*
Graphic design	*	*	*
Charts/poster	*	*	*
Monograms	*	*	*
Technical bulletin	*	*	*
Education CDs	*	*	*
Video materials	*	*	*
Manuals and field guides	*	*	*
Database	-	-	-
Photographs	*	*	*
Musical work	*	*	*
Films	*	*	*
Sound Recording	*	*	*
Other	*	*	*

Valuation of IP

Title	
Average Expected revenue /year	*
Actual revenue generated/year	*
Amount of revenue generated through licensing	*
Amount of revenue generated through in house application	*
Amount of revenue generated through selling of patent	*
Maintenance cost of patent per year	*
Initial cost for patent application	*

	/per year	Application	Granted	Technology market size (%)
A	Total Patents		2	*
	PCT applications	*	*	*
	US applications	*	*	*
	EPO applications	*	*	*
	Indian patent applications	*	*	*
	Any other Country Patent applications	*	*	*
B	No. of product patent	*	*	*
	No. of process patent	*	*	*
C	Patents expired	*	*	*
	Patents invalidated	*	*	*
	Patents active	*	*	*
D	No. of patents licensed			
	No. of patents in house commercialized	*	*	*
	No. of patents sold	*	*	*
	No. of patents not commercialized/ licensed	*	-	-
	Potential patents but not commercialized	*	*	*
E	No. of patents hold in collaboration with other agency	*	*	*

Fig. 4 — IP Audit Framework for 2015-16, Electrical Engineering Department

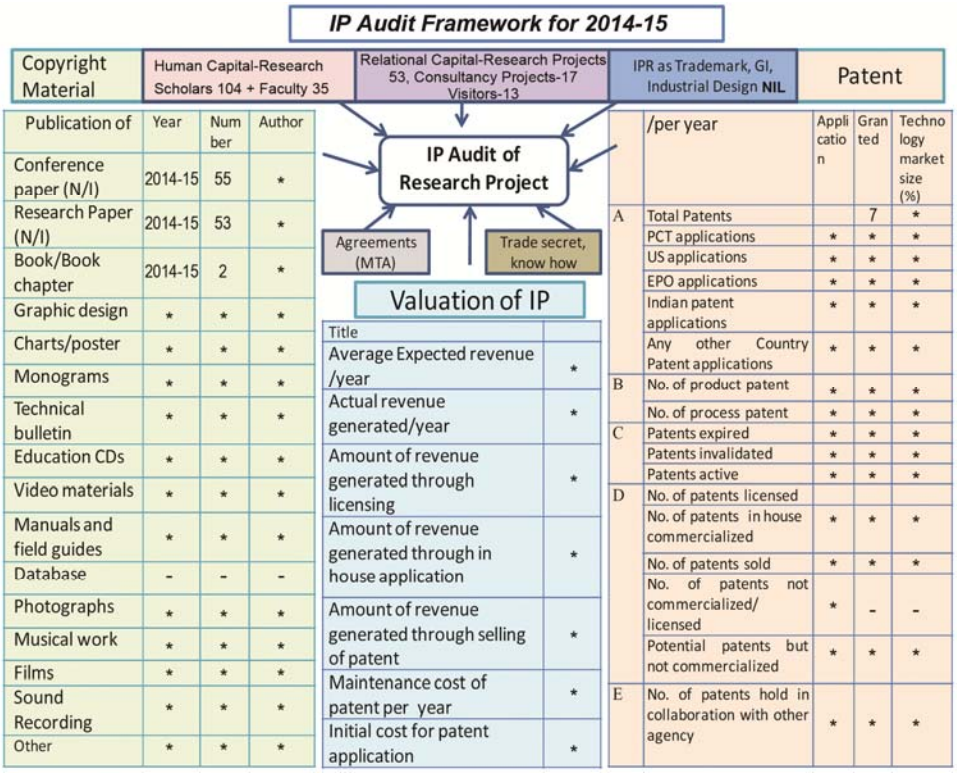


Fig. 5 — IP Audit Framework for 2014-15, Electrical Engineering Department

(3 x 0) = 74; for academic year 2016-2017 is 70 + (3 x 0) = 70; for 2015-2016 the score is 70 + (3 x 2) = 76 and for 2014 - 2015 the IPR score is 55 + (3 x 7) = 76. The annual score for every year is shown in Table 2.

Case Study II: Mechanical Engineering Department

The academic unit under consideration is the institute's Mechanical Engineering Department, which is actively engaged in research. The department is well equipped with modern laboratories and excellent faculty members. It offers courses under three broad fields of applied mechanics and engineering design, thermal sciences and energy systems, and manufacturing processes and systems. The current research areas include bond graph and computer-aided design techniques, computer-aided manufacturing, flexible manufacturing systems, and robotics, intelligent machines and systems, solid modeling and computer graphics, application of neural networks, systems dynamic simulation, precision engineering heating ventilation, and air conditioning systems, combustion modeling and jet impingement heat transfer. The sponsored projects include developing mono-dispersible aerosols, building automation, machining of advanced materials, and environmental friendly grinding of titanium alloys using cryogenic cooling, development of industrial robots, laser material processing technology, noise and vibration control, condition monitoring.[13]

Table 1 — The weightage of the IPRs in Academic Unit (Electrical Engineering Department)

IPR Credence	
IPR	Credence (Unit)
Patent	3
Copyright	1
Industrial Design	2
Trademark	1.5
Layout Design of IC	2
Geographical Indication	1.5
Plant Variety and Farmer's Right	3
Trade Secret	0

Table 2 — IPR score of the Academic Unit (Electrical Engineering Department)

IPR score	
Academic year	IPR score (unit)
2014-15	76
2015-16	76
2016-17	70
2017-18	74
2018-19	124

Human Capital

Professors, students, research staff, laboratory staff, etc., form the department's human capital. The department has 46 core faculty members, out of which 6 are Associate Professors and 9 Assistant Professors. The undergraduate student strength of the department is 396. The total postgraduate student strength is 310, which includes doctoral scholars and master students.

Organizational Capital

The academic activities are supported by 80 and above research areas aided by various laboratories. The department has focused research in more than 80 areas of additive and laser-based manufacturing, adsorption, automation and robotics, automobile engineering, biomechanics, biomedical systems, bulk, and sheet metal forming, computational fluid dynamics, computational weld mechanics and welding technology, computer control of machine tools and computer integrated manufacturing, etc. the department has many accolades attached to it through it fellows and faculty members. Achievements like, the Shanti Swarup Bhatnagar Prize, Sir J C Bose National Fellow, Fellow of the Indian National Science Academy, Alexander von Humboldt Fellow, etc. The department received various recognitions and awards.

Relational Capital

Relational capital is the institution's external relationship, such as customers, suppliers, R&D partners, government, etc. Relational capital considered here is the department's collaboration with external partners for consultancy projects, research projects, and visitors to the department. Visitors include experts, alumnus. The total number is presented against the academic year.

IP- Patent and Copyrights

IPRs considered being patents and copyright material. In the year 2014-15, 74 research projects were completed; in 2015-16, 107 research projects; in 2016-17, 88 research projects; in 2017-18, 81 research projects; and in 2018-19, 95 research projects were completed. Also, the academic unit's patent for the year 2014-15 is 1, and for the year 2015- 16 is 4. Copyright generation was in the form of articles published in journals, conference papers, etc.

Application of IP Audit Framework to the Academic Unit

The academic unit's IP audit is conducted for the academic years 2014-15, 2015-16, 2016-17, 2017-18, and 2018-19 using the "IP audit Framework".[13] There is a limit to data due to the institute's confidential information policy. The available data is applied in the audit framework (Fig. 6 to 10).

IP Audit Framework for 2018-19

Copyright Material	Human Capital-Research Scholars 111 + Faculty 46	Relational Capital-Research Projects 02, Consultancy Projects-93 Visitors-22	IPR as Trademark, GI, Industrial Design NIL	Patent

Publication of	Year	Number	Author
Conference paper (N/I)	2018-19	75	*
Research Paper (N/I)	2018-19	164	*
Book/Book chapter	2018-19	0	*
Graphic design	*	*	*
Charts/poster	*	*	*
Monograms	*	*	*
Technical bulletin	*	*	*
Education CDs	*	*	*
Video materials	*	*	*
Manuals and field guides	*	*	*
Database	-	-	-
Photographs	*	*	*
Musical work	*	*	*
Films	*	*	*
Sound Recording	*	*	*
Other	*	*	*

IP Audit of Research Project

Agreements (MTA)

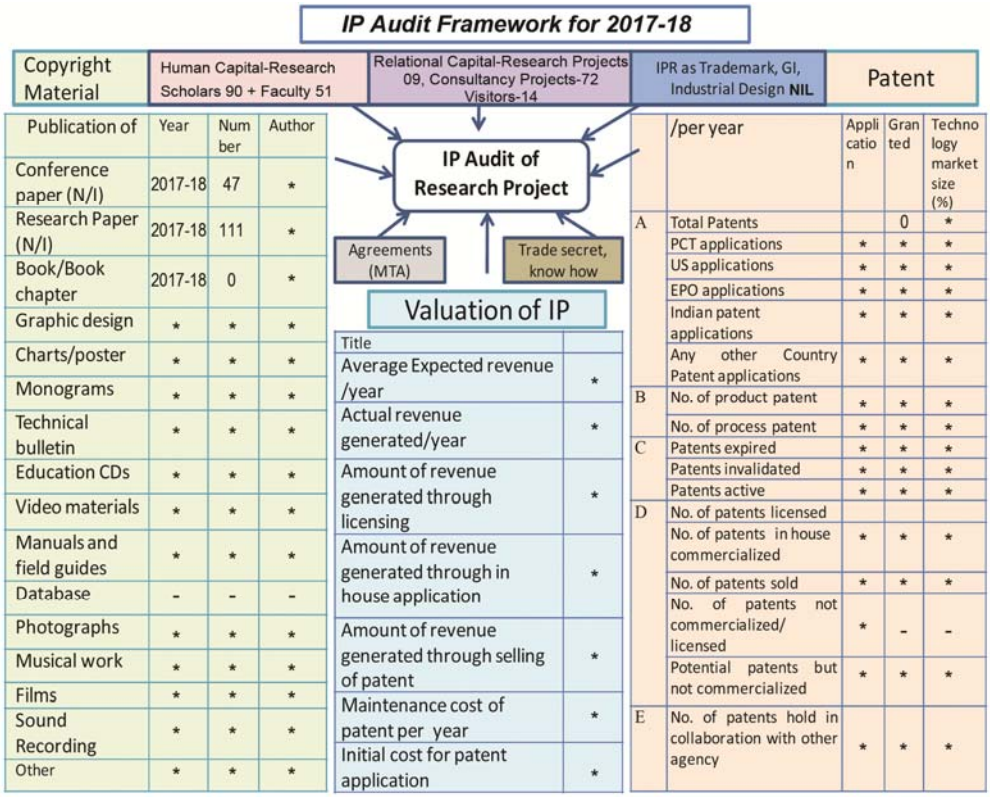
Trade secret, know how

Valuation of IP

Title	
Average Expected revenue /year	*
Actual revenue generated/year	*
Amount of revenue generated through licensing	*
Amount of revenue generated through in house application	*
Amount of revenue generated through selling of patent	*
Maintenance cost of patent per year	*
Initial cost for patent application	*

	/per year	Application	Granted	Technology market size (%)
A	Total Patents		0	*
	PCT applications	*	*	*
	US applications	*	*	*
	EPO applications	*	*	*
	Indian patent applications	*	*	*
	Any other Country Patent applications	*	*	*
B	No. of product patent	*	*	*
	No. of process patent	*	*	*
C	Patents expired	*	*	*
	Patents invalidated	*	*	*
	Patents active	*	*	*
D	No. of patents licensed			
	No. of patents in house commercialized	*	*	*
	No. of patents sold	*	*	*
	No. of patents not commercialized/ licensed	*	-	-
	Potential patents but not commercialized	*	*	*
E	No. of patents hold in collaboration with other agency	*	*	*

Fig. 6 — IP Audit Framework for 2018-19, Mechanical Engineering Department



IP Audit Framework for 2017-18

Copyright Material	Human Capital-Research Scholars 90 + Faculty 51	Relational Capital-Research Projects 09, Consultancy Projects-72 Visitors-14	IPR as Trademark, GI, Industrial Design **NIL**	Patent

Publication of	Year	Number	Author
Conference paper (N/I)	2017-18	47	*
Research Paper (N/I)	2017-18	111	*
Book/Book chapter	2017-18	0	*
Graphic design	*	*	*
Charts/poster	*	*	*
Monograms	*	*	*
Technical bulletin	*	*	*
Education CDs	*	*	*
Video materials	*	*	*
Manuals and field guides	*	*	*
Database	-	-	-
Photographs	*	*	*
Musical work	*	*	*
Films	*	*	*
Sound Recording	*	*	*
Other	*	*	*

IP Audit of Research Project

Agreements (MTA)

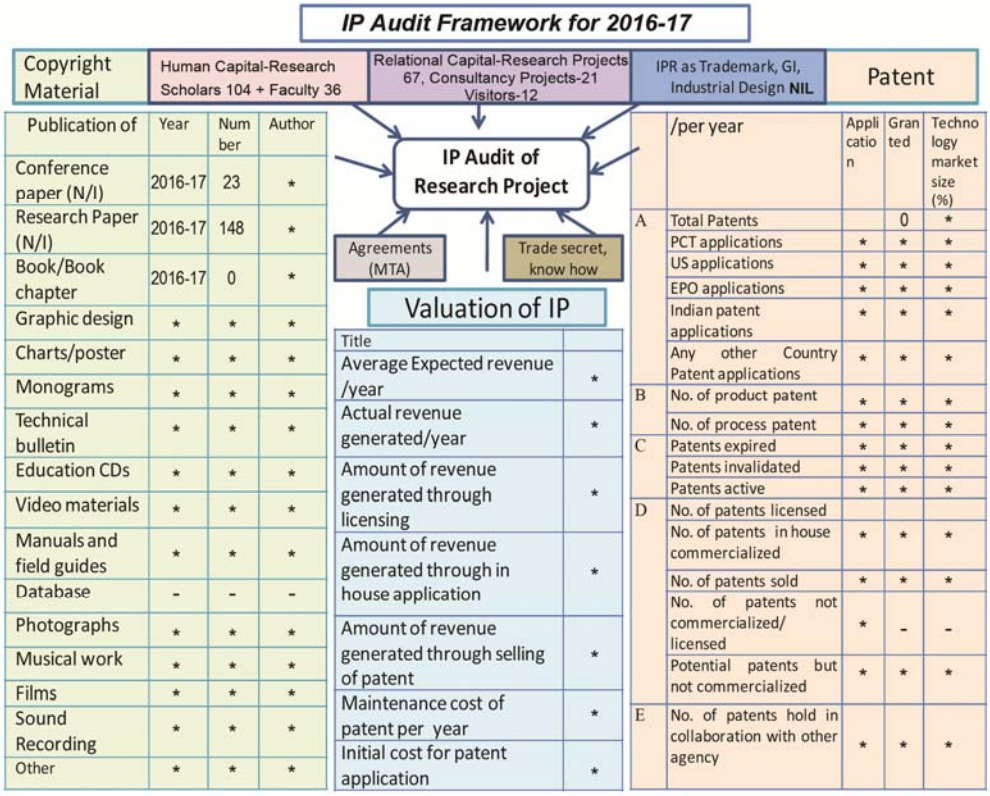
Trade secret, know how

Valuation of IP

Title	
Average Expected revenue /year	*
Actual revenue generated/year	*
Amount of revenue generated through licensing	*
Amount of revenue generated through in house application	*
Amount of revenue generated through selling of patent	*
Maintenance cost of patent per year	*
Initial cost for patent application	*

	/per year	Application	Granted	Technology market size (%)
A	Total Patents		0	*
	PCT applications	*	*	*
	US applications	*	*	*
	EPO applications	*	*	*
	Indian patent applications	*	*	*
	Any other Country Patent applications	*	*	*
B	No. of product patent	*	*	*
	No. of process patent	*	*	*
C	Patents expired	*	*	*
	Patents invalidated	*	*	*
	Patents active	*	*	*
D	No. of patents licensed			
	No. of patents in house commercialized	*	*	*
	No. of patents sold	*	*	*
	No. of patents not commercialized/ licensed	*	-	-
	Potential patents but not commercialized	*	*	*
E	No. of patents hold in collaboration with other agency	*	*	*

Fig. 7 — IP Audit Framework for 2017-18, Mechanical Engineering Department



IP Audit Framework for 2016-17

Copyright Material	Human Capital-Research Scholars 104 + Faculty 36	Relational Capital-Research Projects 67, Consultancy Projects-21 Visitors-12	IPR as Trademark, GI, Industrial Design **NIL**	Patent

Publication of	Year	Number	Author
Conference paper (N/I)	2016-17	23	*
Research Paper (N/I)	2016-17	148	*
Book/Book chapter	2016-17	0	*
Graphic design	*	*	*
Charts/poster	*	*	*
Monograms	*	*	*
Technical bulletin	*	*	*
Education CDs	*	*	*
Video materials	*	*	*
Manuals and field guides	*	*	*
Database	-	-	-
Photographs	*	*	*
Musical work	*	*	*
Films	*	*	*
Sound Recording	*	*	*
Other	*	*	*

IP Audit of Research Project

Agreements (MTA)

Trade secret, know how

Valuation of IP

Title	
Average Expected revenue /year	*
Actual revenue generated/year	*
Amount of revenue generated through licensing	*
Amount of revenue generated through in house application	*
Amount of revenue generated through selling of patent	*
Maintenance cost of patent per year	*
Initial cost for patent application	*

	/per year	Application	Granted	Technology market size (%)
A	Total Patents		0	*
	PCT applications	*	*	*
	US applications	*	*	*
	EPO applications	*	*	*
	Indian patent applications	*	*	*
	Any other Country Patent applications	*	*	*
B	No. of product patent	*	*	*
	No. of process patent	*	*	*
C	Patents expired	*	*	*
	Patents invalidated	*	*	*
	Patents active	*	*	*
D	No. of patents licensed			
	No. of patents in house commercialized	*	*	*
	No. of patents sold	*	*	*
	No. of patents not commercialized/ licensed	*	-	-
	Potential patents but not commercialized	*	*	*
E	No. of patents hold in collaboration with other agency	*	*	*

Fig. 8 — IP Audit Framework for 2016-17, Mechanical Engineering Department

IP Audit Framework for 2015-16

Copyright Material	Human Capital-Research Scholars 120 + Faculty 46	Relational Capital-Research Projects 91, Consultancy Projects-21 Visitors-0	IPR as Trademark, GI, Industrial Design **NIL**	Patent

Publication of	Year	Number	Author
Conference paper (N/I)	2015-16	21	*
Research Paper (N/I)	2015-16	133	*
Book/Book chapter	2015-16	0	*
Graphic design	*	*	*
Charts/poster	*	*	*
Monograms	*	*	*
Technical bulletin	*	*	*
Education CDs	*	*	*
Video materials	*	*	*
Manuals and field guides	*	*	*
Database	-	-	-
Photographs	*	*	*
Musical work	*	*	*
Films	*	*	*
Sound Recording	*	*	*
Other	*	*	*

IP Audit of Research Project

Agreements (MTA) | Trade secret, know how

Valuation of IP

Title	
Average Expected revenue /year	*
Actual revenue generated/year	*
Amount of revenue generated through licensing	*
Amount of revenue generated through in house application	*
Amount of revenue generated through selling of patent	*
Maintenance cost of patent per year	*
Initial cost for patent application	*

	/per year	Application	Granted	Technology market size (%)
A	Total Patents		4	*
	PCT applications	*	*	*
	US applications	*	*	*
	EPO applications	*	*	*
	Indian patent applications	*	*	*
	Any other Country Patent applications	*	*	*
B	No. of product patent	*	*	*
	No. of process patent	*	*	*
C	Patents expired	*	*	*
	Patents invalidated	*	*	*
	Patents active	*	*	*
D	No. of patents licensed			
	No. of patents in house commercialized	*	*	*
	No. of patents sold	*	*	*
	No. of patents not commercialized/ licensed	*	-	-
	Potential patents but not commercialized	*	*	*
E	No. of patents hold in collaboration with other agency	*	*	*

Fig. 9 — IP Audit Framework for 2015-16, Mechanical Engineering Department

IP Audit Framework for 2014-15

Copyright Material	Human Capital-Research Scholars 116 + Faculty 46	Relational Capital-Research Projects 60, Consultancy Projects-14 Visitors-0	IPR as Trademark, GI, Industrial Design **NIL**	Patent

Publication of	Year	Number	Author
Conference paper (N/I)	2014-15	21	*
Research Paper (N/I)	2014-15	148	*
Book/Book chapter	2014-15	1	*
Graphic design	*	*	*
Charts/poster	*	*	*
Monograms	*	*	*
Technical bulletin	*	*	*
Education CDs	*	*	*
Video materials	*	*	*
Manuals and field guides	*	*	*
Database	-	-	-
Photographs	*	*	*
Musical work	*	*	*
Films	*	*	*
Sound Recording	*	*	*
Other	*	*	*

IP Audit of Research Project

Agreements (MTA) | Trade secret, know how

Valuation of IP

Title	
Average Expected revenue /year	*
Actual revenue generated/year	*
Amount of revenue generated through licensing	*
Amount of revenue generated through in house application	*
Amount of revenue generated through selling of patent	*
Maintenance cost of patent per year	*
Initial cost for patent application	*

	/per year	Application	Granted	Technology market size (%)
A	Total Patents		1	*
	PCT applications	*	*	*
	US applications	*	*	*
	EPO applications	*	*	*
	Indian patent applications	*	*	*
	Any other Country Patent applications	*	*	*
B	No. of product patent	*	*	*
	No. of process patent	*	*	*
C	Patents expired	*	*	*
	Patents invalidated	*	*	*
	Patents active	*	*	*
D	No. of patents licensed			
	No. of patents in house commercialized	*	*	*
	No. of patents sold	*	*	*
	No. of patents not commercialized/ licensed	*	-	-
	Potential patents but not commercialized	*	*	*
E	No. of patents hold in collaboration with other agency	*	*	*

Fig. 10 — IP Audit Framework for 2014-15, Mechanical Engineering Department

Table 3 — IPR score of the Academic Unit (Mechanical Engineering Department)

IPR score Academic year	IPR score (unit)
2014-15	111
2015-16	145
2016-17	151
2017-18	158
2018-19	239

IP Score for the Academic Unit (Mechanical Engineering Department)

The IPR score[13] of any department of the institute can be suggested for a specific time frame by using weightage unit calculation against the value assigned to each IPR. The above mentioned IPR credence calculates the IPR score of each year. The data was collected regarding each academic year and was accordingly segregated and put in the IPR credence. In the academic year 2018-19, the copyright output is 239; in 2017-18, 158; in 2016-2017, 148; and in 2015-2016, the copyright output was the same as 133; while the patent output was 0 and 4 in the respective years. Similarly, in the academic year 2014-2015, the copyright output was 111, the patent output was 1.

Therefore, the IPR score for academic year 2018-19 is 239 + (3 x 0) = 239; for 2017-18 is 158 + (3 x 0) = 158; for 2016-2017 is 148 + (3 x 1) = 151; for 2015-2016 the score is 133 + (3 x 4) = 145; and for 2014 - 2015 the score is 111 + (3 x 0) = 111. The annual score for every year is shown in the Table 3.

Discussion

The case studies conducted produce IPR scores for the mapped IPs generated and commercialized by the departments. The IPR score in the case studies of both departments generates a consistent IPR score for five consecutive years (2014-2015, 2015-2016, 2016-2017, 2017-18 and 2018-19). These scores derive their nectar from the legal status accorded to the IPs generated by the institutes. These scores show that the legal determination of IPR status can reap monetary benefits if they are mapped and appropriately structured by the institutes generating IPs.

The process of value extraction of IPs is considered interdisciplinary as it requires expertise from law, management, and technology. Nevertheless, as demonstrated by the above two case studies, any institution by an in-house practice can accelerate value extraction from IPs applying this IP audit framework to its intellectual capitals. This case study explains the intricacies like IP enforcement, IP acquisition, IP policy, and other agreements that IPs hold essential for their existence and at the same time suggests how to handle those for the best result. Once institutes start applying this framework, the outsourcing of IP enforcement and commercialization would be considerably reduced, and institutes would emerge as self-sufficient in IP value extraction. The case studies demonstrate successful value extraction and IP mapping.

Conclusion

IP incorporates the technicalities as it starts progressing after deriving its validity from the law. It does not mean that it is devoid of legal subject matter afterward. The intricate relation of varied fields that IP brings in the legal field is unique and has to be addressed, just like IP's presence. To better handle IP and the enforcement of legal statutes, it is essential to address IP's progressive need with the market and society. This study focuses on that intricate relationship that IP introduces and establishes. It studies the importance of IP and its working in the market place with two case studies of an institution.

An effective IP evaluation system is the essence of a strong IP. IP derives its validity from the legal statutes. Where the evaluation system is comprehensive and inclusive, the IPs can be well structured and scrutinized. With a well-structured and established system, these IP’s values are magnified and help serve individual IP to their maximum potential. The IP evaluation system has some elements which further the evaluation process in a well-formulated fashion. Elements like, IP policy and relevant institute policy evaluation elements help the IP creator check dos and don’ts while doing business. Legal documents like contracts and other agreements should be diligently drafted and vetted, statutory provisions should be thoroughly read and understood, which can be put into practical use. Also, innovation and inventions should be critically approved to carry them forward as a product. IP assessment system from time to time, helps to keep the application of things at their best. Inventory evaluation is also a crucial part, and revenue evaluation, including maintenance cost and commercialization fees, is one of the critical elements of the IP evaluation process. Licensing decisions and evaluation of enforcement procedure evaluation help in efficient commercialization.

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