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Intellectual property management system: Develop and self-assess using IPM model

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ABSTRACT

The major concern in organizations, especially from developing countries, is that there is a huge gap in Intellectual Property (IP) generation and its commercialization. The key issue is that how this gap between IP generation and its commercialization can be reduced. Hence, there is a need to develop an IPM model, which can assist technology and IP managers to develop their own IPMS as well as help in self-assessment of the existing IPMS. This paper introduces an IPM model, which is easy to implement and follow and can be applied to any sector with some modifications. The model suggests 5 stages and 15 major IPM processes. The validation of the model confirmed effortless establishment of IPMS including the identification of potential IP. The IPM model also helped to reveal the gaps, if any, in the current IPMS, and facilitated strategic commercialization of organizational IP. The study followed the case study methodology.

1. Introduction

With the development of science and technology, world has seen shifts in economy from farming to industry to knowledge. But how this knowledge can be converted into wealth is the challenge. It is through protection of knowledge. To protect this knowledge, intellectual property (IP) regimes are evolved which help in generation of IP assets. It is not just IP generation that helps in growth and development but its efficient management determines its role for wealth creation and well-being of the society. Organizations are concentrating on effective utilization of IP through robust IPM but still the organizations are struggling to manage IP efficiently. The two major functions of IPM are creation and extraction of 1) Portfolio as protective view; and 2) Portfolio as business assets view.

According to Bontis (1998), managers do not know the value of their own intellectual capital (IC). They do not know if they have people, resources, or business processes in place to make a success of a new strategy [1]. Managers do not know management potential, creativity importance of IP, stock of IP owned by organization, and utilization of IP to build a new strategy. This is because they are devoid of such information. Organizations are operating in vacuum as they do not have appropriate methods or tools to use that would enable them to analyze their IC stocks (Bontis, 2001) [2]. IC includes human assets, relational assets, codified assets and organizational assets. IP are the codified assets (Litschka, 2006) [3]. Scholars have suggested several IPM models but they have not given directions about how IPM system can be developed and self-assessed [4]. Further, the models suggested are either applicable to particular sector or are complex to follow. Managers have not been trained and informed about what IPM might mean.

With reference to developing countries like India, IPM scenario is still improving; and is in its nascent stage. There is a dire need of IPM models which will help managers to develop and self-assess their own IPMS. It should also be noted that in India there is a lack of IP experts, and even if they are available, they are not affordable to many organizations especially Micro, Small, Medium Enterprises (MSMEs) and academic institutions, which constitute major part of IC.

Government of India's decision about liberalization of economy in the year 1991, and GATT signatory status of India pushed Indian

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organizations to realign functional departments in the wake of the new business environment. This change also provided pragmatic environment for many large multinational companies (MNCs) in India to set up global R&D centers. This positive change made Indian industry to accept and face the global competition.

India is now recognized as a hub for R&D activities for the industrial sectors, particularly relating to information technology, drugs and pharmaceutical, space research, biotechnology, entertainment and several other emerging fields. TRIPs compliant IP Laws in India coupled with strong enforcement mechanism and vibrant judicial system created best investment opportunities and conducive environment for protecting the IP rights in order to enable the industrial community to diversify its commercial activities [5].

In India, the legislative system created various laws or amended existing laws to align with international IP laws. The changes in the recent times have come through enforcement of various Acts such as, the Trademark Act, 1999; Copyrights Act, 1957; Designs Act, 2000; Protection of Plant Varieties and Farmer's Right Act, 2001; Geographical Indication of Goods (Registration and Protection) Act, 1999; Patents Act, 1970; Biological Diversity Act, 2002; Semiconductor integrated circuits layout- Design Act, 2000; and Information technology Act, 2000.

This change in scenario provided Indian organizations the opportunities to expand their market reach and compete globally. Still there is a huge difference (almost 1:4) between the patent applications filed by Indian organizations in the year 2000–01 and 2016–17 at Indian patents, designs and trademarks office.

Though Council for Scientific and Industrial Research (CSIR) and Indian Institute of Technology (IIT) are top IP filing organizations in India (Indian patents, designs and trademarks office annual report, 2011), the revenue generation through IP is not increasing at the same pace as generated IP. Similarly private organizations in India are not showing IP exploitation at that the same pace as they are generating it. So the question arises as to how much IP organizations are protecting and how much IP organizations are leveraging. The observation is that there is a huge gap in IP generation and IP commercialization. How this gap can be reduced is the key query that needs to be addressed. Hence, there is a need to check IPM process efficiency.

This article based on research focused on the electrical engineering sector as per the World Intellectual Property Organization (WIPO) classification of technology, attempts to fill this gap by answering some basic questions: (1) How can organizations develop their own IPM system (IPMS)? (2) How can organization assess own IPMS? (3) How to manage IPMS efficiently for wealth creation?

To address these issues authors proposed “IPM model”, which has 5 stages and 15 IPM processes. Any organization which aspires to establish or which have a desire to strengthen the current IPMS can apply the proposed ‘IPM model’. Such organizations can map the current IPMS with expected IPMS as suggested in the proposed ‘IPM model’. The mapping exercise will provide the assessment of the current IPMS of an organization. Organizations can prioritize the IPM processes out of 15 IPM processes. The organization can initiate develop the action plan, timeline for the implementation of selected IPM processes, and decide on the expected output. This procedure will help the organization in building up their IPMS and help them to manage IPMS efficiently to create wealth by commercialization of IP assets.

2. Review of literature on intellectual property management system and intellectual property management audit

Knowledge and innovation which may lead to IP generation have been seen as major drivers for economic growth. IP is not only important to ‘High-Tech’ firms and big corporates but for all organizations including academic and research institutions; MSMEs. Granstrand (1999) suggested the business component and the relative type of IP which organization owns [6]. This will help to appreciate that there are two extremities: i) There are organizations which own IP but they are unaware about what they own and how they can commercialize it to create wealth and ii) There are a few organizations which not only know what IP they own but use it very effectively to create wealth.

Dow Chemicals is the best example of efficient utilization of IP. Dow identified, valued, and assigned its IP to 15 major Business Units. Thereafter Dow assumed financial responsibility for its use and achieved immediate savings of USD 50 million in taxes and maintenance fees on idle patents; earnings in licensing revenues skyrocketed from USD 25 million to more than USD 125 million [7]. If we examine corporate giants like Genentech and Google, we can appreciate the role of academic institutions in building-up world giants, where a single patent triggered inception of a start-up and these start-ups eventually took shape as a giant corporate. If we compare these above cited scenarios with top academic institutions in India, it reflects that there is a huge gap between IP generation and commercialization. Table 1 gives the illustration about this scenario.

The first step for efficient IPM is ‘IPM audit’. Literature on IPM audit practices followed by organizations is illustrated in Table 2.

The review clearly highlights that the subject of IPM audit is perceived differently by researchers and practitioners. It is observed that researchers have used mostly three approaches which are inventory, case study and IP analytics approach: i) IP inventory approach is taking the stock of IP owned. It may be concentrated on a single type of IP or all types of IP depending on the objective. ii) IP analytics approach is another IPM audit approach which is mainly concentrated on patents and is more of an IP analytics technique. It is more or less a technology SWOT analysis. IP analytics may also include analysis of other IP such as trademark, copyright, industrial design. iii) The most widely used approach by researchers is the case study approach.

These studies provided proprietary IPM audit checklist, technology heat map, ICU framework for the management of Intellectual Capital (IC) of university, IPM excellence audit system,

Table 1
IP Generation and commercialization by top academic and research institution in India.

	2006-07 to 2010-11	
	Indian Institute of Technology (IITB)	Council of Scientific & Industrial Research (CSIR)
Number of IP (patent/design/trademark) applications filed in India and abroad	38	553
Number of IP commercialized	14	106
License money generated (in Rs Lakhs)	28	12–15

(Source: Arumugam & Jain, 2012) [8].

Table 2
IPM audit practices.

Sr. No.	Research paper/White paper/Law firm report title	Authors	Output/Result	Type of IP/IC considered	Approach	Major Focus	Year
1	Performing an IPM audit of copyrights	Hayes David [9]	Proprietary copyright checklist	Copyright	Inventory approach	Copyright related issues are highlighted	1997
2	IPM audit	Nouvelles L [10].	Proprietary IPM audit checklist	Focus on nine areas- patents, contracts with independent contractors, employment contracts, trademarks, licenses, trade secrets, copyrights including organization handbooks, training, and inventions	Inventory approach	Focus on IPM	2003
3	Intellectual property auditing: a road to riches	Ch'ang Sharyn and Yastreboff Marina [11]	Proprietary IPM audit checklist	IP -not explicitly mentioned any IP	Inventory approach	Suggested three stages method	2003
4	IPM audit	Meyer Stuart and Patel Rajiv [12]	General audit process	All IP-not explicitly mentioned any IP	Inventory approach	Suggested key issues to be addressed during IPM audit as ownership, infringement	2005
5	IPM audit checklist	Singleton Alanmiyake R [13].	Proprietary IPM audit checklist	IP-Patent, Trademark, Copyright	Inventory approach	Stock check through questionnaire	2007
6	Strategic IP portfolio management: technology appraisal using technology heat map.	Miyake M., Mune Y. and Himeno K [14]	Technology heat map	Patent	IP analytics approach	Suggested interlinkage between IPM, business strategy and R & D strategy	2004
7	Patent portfolio audit	Cullen Susan E [15]	Suggested phases of portfolio audit, IPM workflow, Benchmarking workflow, opportunity identification workflow, external and self reference mapping	Patent	IP analytics approach	IPM audit and IP lifecycle	2010
8	The University of the XXI century: intellectual capital as a new answer for management	Sanchez P., R. Castrillo and S. Elena [16]	ICU framework for the management, measurement and disclosure of IC within universities and research centers.	IC- Human capital, organizational capital, relational capital	Case study approach	IC management	2006
9	Managing IP in the financial services industry sector:Learning from Swiss Re	Bader M.A [17].	Success factors for managing intellectual property in the financial services industry sector	All types of IP	Case study approach	IPM practice	2008
10	Development of audit system for IPM excellence	Tak-Wing Liu, Kwai-Sang Chin [18]	IPM excellence audit system	IPM audit, considered enabling criteria and performance indicator criteria	Case study approach	IPM practice	2010
11	Balanced score card implementation for IP	Smandek Bernhard, Barthel Andreas, Winkler Jens and Ulbig Peter [19]	Balanced score card (BSC) system for IPM	IP asset- not specified any IP	Case study approach	Optimization of licensing income & cut costs	2010
12	Way to a healthy organization	Rastogi T [20]	IPM audit general process	All types of IP	Literature analysis	All types of IP	2010
13	IPM audit	Punnose S., Shobhana V [21]	IPM audit of university, production house and public sector undertaking	All types of IP	Case study approach	All types of IP	2012
14	A holistic audit of managing IP	Steffens Paul and Waterhouse Michael [22]	IPM	Framework to conduct a holistic audit of an organization's IP management practices and capabilities-The four overlapping domains of the framework: IP generation; IP rights; IP uptake and corporate support	Case study approach	Focus on IPM	2000

(Developed by author)

balanced score card (BSC) system for IPM.

Literature review helped to identify research gaps. Inventory approach for IPM audit provides stock taking scheme and guides to develop in-depth checklist. It mainly focuses on law aspect of the IP. This approach is more followed by law experts and it gives attention to legal status of the IP. Technology and IPM aspect are negligible or lacking in this approach.

IP analytics approach for IP audit mainly focuses only on one type of IP that is patent. This is more helpful for technology SWOT analysis. IP analysis of other types of IP may or may not be practiced. Legal and IPM aspects are negligible or lacking in this approach.

Case study approach for IPM audit concentrate on various cases to understand the IPM audit practices followed at various industries and technology sectors. It is observed that the experiences and insights developed through case study vary according to

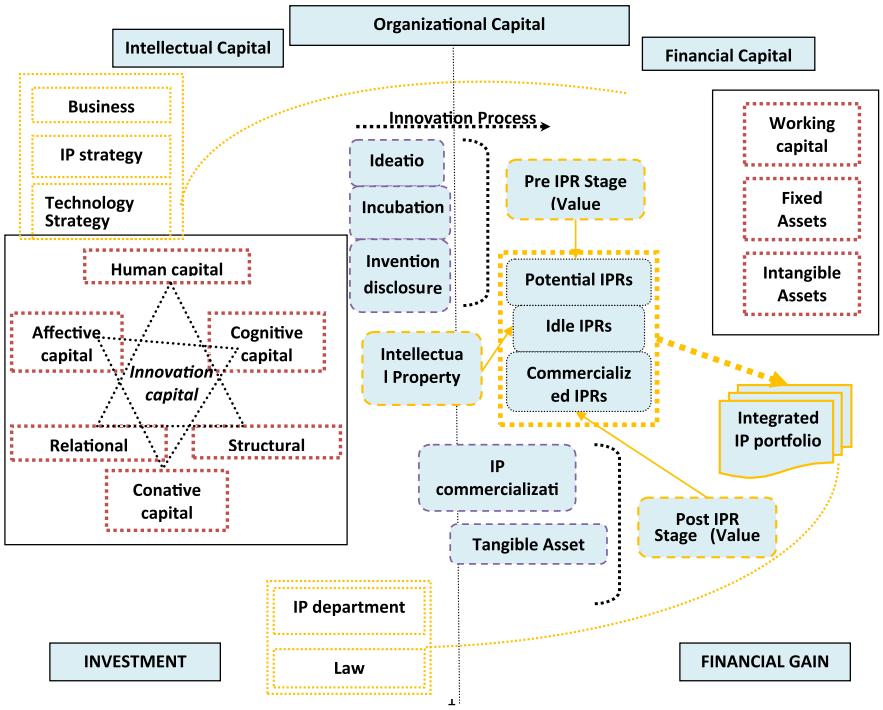

Fig. 1. The conceptual model (Developed by author).

industry, geographical area, technology sector and no general IPM audit system is developed. Thus the review of literature reveals that there is a need for holistic IPM audit approach which will not be organization, sector and geography specific and also have all three perspectives as technology, legal and IPM.

Literature review suggests that there is no availability of any general efficient readymade IPM audit model which can assist technology managers to develop and self-assess IPMS.

Based on literature analysis we have tried to develop the conceptual model. IPM and innovation management are overlapping in nature [23]. Literature on IPM, IPM audit and detailed study on overlapping nature of IP and innovation management helped to conceptualize the IPM model. One must caution here that though innovation, technology, IP, and strategy management are overlapping and exhibit integrative nature, all these four areas of management are very vast and their scope is different. IPMS deal with all these four areas. This complicates the IPMS. The balanced interaction and judicious application of principles of these varied areas will address the issues of IPMS. The conceptual model for IPM is presented in Fig. 1.

As shared in the Figure, innovation process and IPM process are overlapping in nature which start from ideation and end with a generation of integrated IP portfolio. This process is controlled by business, IP and technology strategy as shown in the Figure. IP and law department of organization decides the parameters for application of these strategies. The whole process of IPM starts with intangible "innovation capital" and expected to end with intangible assets which further can be commercialized for wealth creation.

3. Research methodology

The study adopted qualitative, exploratory, case study methodology to meet the research objectives [24,25]. The reason to select the electrical engineering sector is that, the IP filing trend at the Indian patent office shows that electrical engineering sector is one of the emerging sectors with reference to IPM. The IPMS definition focused for this study is a system which involves a systematic process to check IPM related practices, identify IP, and check the legal status of both IP and IP related legal documents. IPM performance involves checking the efficiency of each and every process of IPM. Here it is important to emphasize that, through this article; we will be dealing with only IP component of IA, i.e. 8 types of IP (Fig. 2).

The study was focused on understanding the IPM practices followed by organizations in India, and organizations from developed nations. Hence, three organizations from India, and three organizations from developed nations were considered for the study. The major criteria applied to select these organizations were the IP filing trend followed by these organizations. The Indian patents, designs, and trademarks office annual report (2011), patent landscaping and ranking of organizations by Evaluserve (2010–11) and Thomson Innovation top 100 innovator report (2011), were studied and followed to select the organizations for the case study. Thus, the scope of the study was restricted to IP savvy organizations in the electrical engineering sector. The details of macro level comparison of six case studies and in-depth interview details are presented in Table 3.

We followed Type 3: multiple case (holistic) design suggested by Yin (2009) [26]. The quality of exploratory research design is judged by three tests which include external validity, construct validity and reliability [26].

External validity refers to define the domain to which a study's findings can be generalized. The present study scope is limited to 'electrical engineering' sector. Multiple case studies within this sector achieve the generalizability of the findings. For this study, six cases were selected and studied in detail which follows external validity testing. Construct validity refers to identifying correct operational measures for the concepts being studied. Three tactics can be used to attain this validity, as use of multiple sources of evidence in a manner encouraging convergent lines of enquiry,

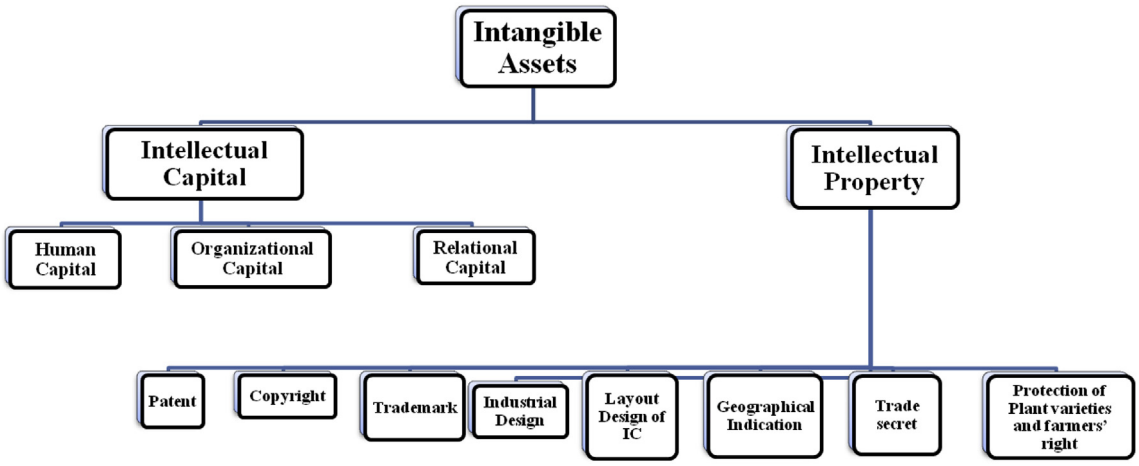

Fig. 2. Classification of IA (Developed by author).

Table 3
Macro level comparison of case studies and in-depth interview details.

Company	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Organization type	Private	Private	Public	Private	Private	Private
Date of establishment	1937	1938	1964	1847	1891	1930
Interview Location	Mumbai	Mumbai	Hyderabad	Bangalore	Bangalore	Bangalore
Respondent type	R & D, IP unit, top management	R & D, IP unit, top management	R & D, IP unit, top management	R & D, IP unit, top management	R & D, IP unit, top management	R & D, IP unit, top management
Respondent levels	Top & Executive	Top & Executive	Top & Executive	Top & Executive	Top & Executive	Top & Executive
No of respondents (formal)	7	7	12	10	5	5
Response documentation	Notes	Notes	Notes & Electronic transcription	Notes	Notes & Electronic transcription	Notes
Strength (Human resource) IP department –India	5	13	7	10	27	3
No. of patents	709	900	1030	57,000	59,000	41,200

(Developed by author)

establish a chain of evidence, and the third to have the draft case study report reviewed by key informants. For this study, primary and secondary data is collected from multiple case studies and data triangulation is carried out to achieve construct validity. The last test is reliability. An effective guideline for testing this is to conduct the research in such a way that if any other investigator follows the same procedure, he/she must arrive at the same result. The research design including construct validity, external validity, and reliability is presented in Figs. 3 and 4.

Data collection and analysis process involved concurrent phases of activity: case selection, data recording, systematic organization of the data, analysis of the data, critical observation of the data to

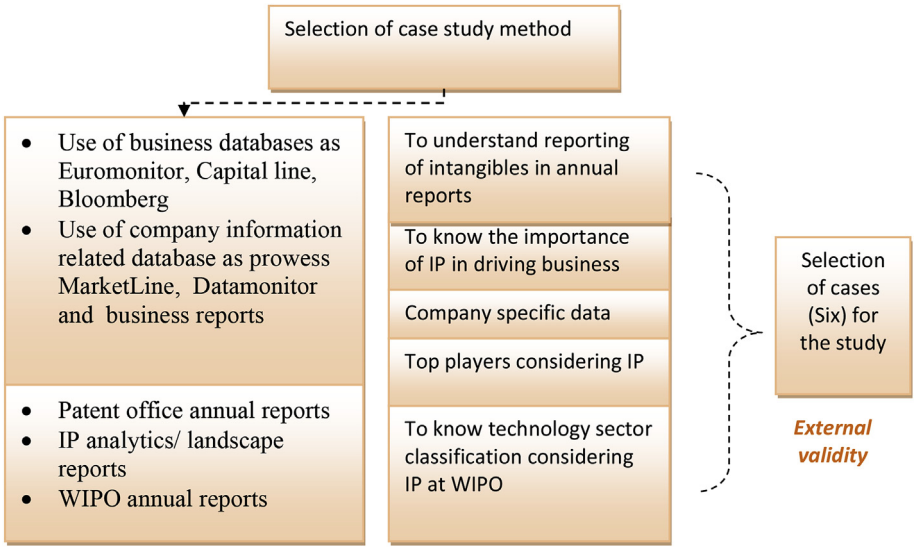

Fig. 3. Research design.

study the patterns if any, and drawing conclusions. The present study followed free-wheeling, in-depth interviews with relevant personnel, observations, and archival records. A discussion guide helped to focus on data retrieval and covered all the data required for the study. Other than the sample set of the six organizations under study, IP personnel, top management personnel and inventors of few other organizations' were interviewed and notes were recorded.

Six in-depth case studies were examined in 4 major perspectives: the inventor's perspective, CTO/Vice President's perspective that is top management perspective, marketing and finance perspective, and IP personnel perspective. Secondary data was collected from the annual reports of the organizations, information on the website of the organizations, industry and media reports, patent and trademark office reports, and business databases such as Euromonitor, Capital Line, Bloomberg, Prowess, Market-Line. The various patent databases used were Thomson Innovation, CIPIS, Questel Orbit, United State Patent and Trademark Office (USPTO), European Patent Office (EPO), and Indian Patent Office (IPO) database. The annual reports were studied to understand the strategy adopted by the organizations in relation to IPM and in response to the market competitiveness. Case details involved information about the current IPMS of the organization.

4. Data collection and analysis

Data analysis involved individual case analysis and cross-case analysis that resulted in the development of the various insights and patterns. A detailed list of current IPM processes followed by the organization was obtained from the WCA. Cross-case analysis provided patterns or like, if any. An in-depth analysis of the data was used to propose the 'IPM model'. Individual and cross-case

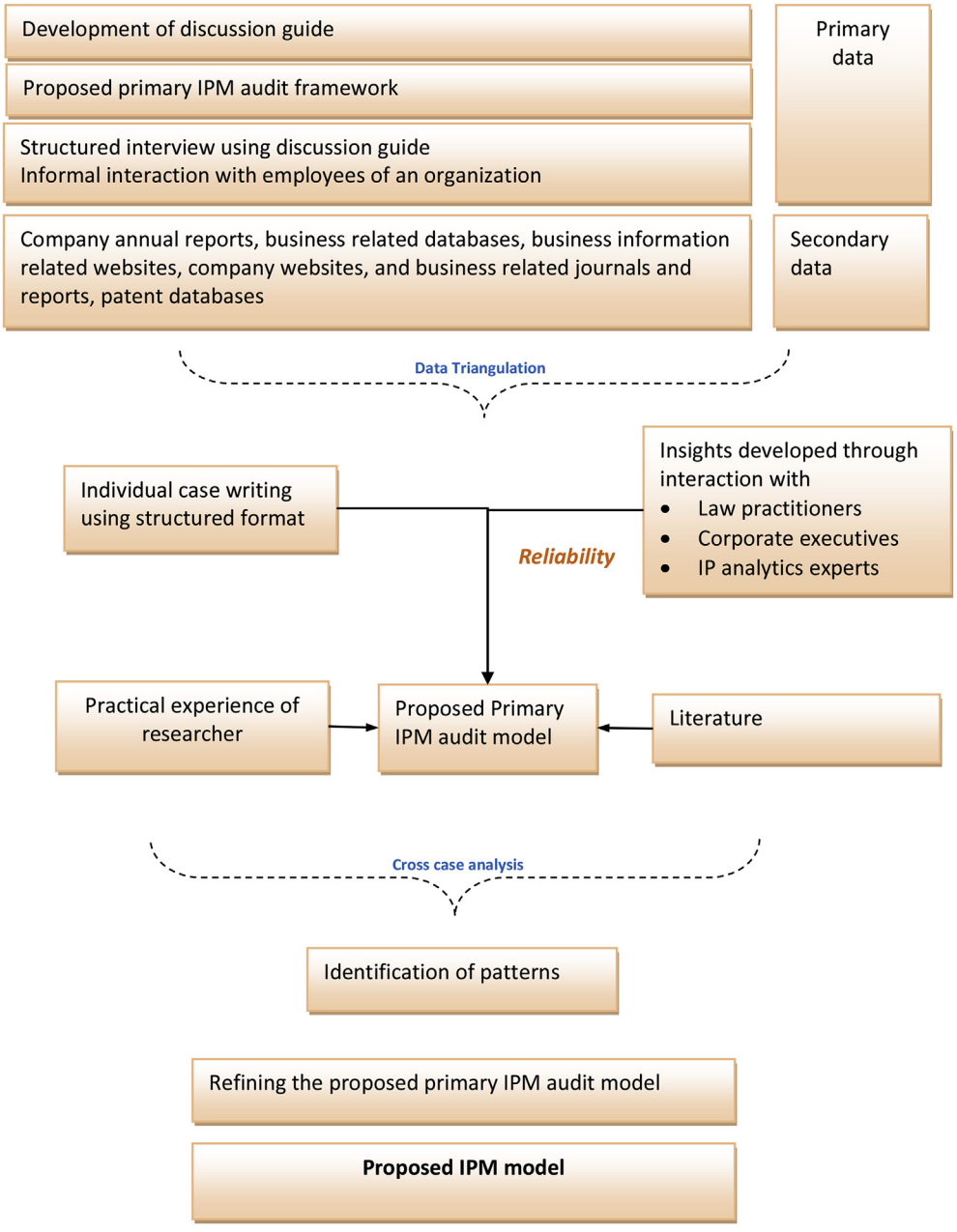

Fig. 4. Research design.

Table 4
IPM processes and/or insights identified during case study.

Sr. No.	IPM processes and/or insights	Process Code
1–14	14 processes identified in the previous case related to IPM	LT1-LT14
15	Patent analytics tool, TRIZ, literature survey and analysis, conferences are few more resources for idea generation. Periodically (six monthly) competitive intelligence reports, on demand technology mapping reports and technical bulletins covering R & D activities of the organization also help in idea generation.	LT 15
16	Almost all inventors are aware about the IP. Each unit has IP coordinator who more or less acts as liaison and this helps in IP identification. Timeline setting for each development stage of the project and mapping probable IP generation helps to identify potential IP.	LT 16
17	Decision related to IP protection is taken with various forecasting and business related inputs. Inputs received from marketing department are one of the important inputs for decision related to IP protection in particular country.	LT 17
18	The various types of inventories are maintained by the IP department such as business unit wise, application and granted status wise, product line wise, inventor wise, year wise, validity status wise etc.	LT 18
19	Considering the IP right enforcement, IP department with the help of external resources conduct infringement analysis.	LT 19
20	Projects like new market identification, demographic mapping may be used for IPM.	LT 20
21	Before undertaking any project for new developments, in depth study about potential market is carried out in the organization.	LT 21

(Developed by author)

analyses are discussed below.

4.1. Individual case analysis

Here we are presenting a single individual case, in brief, to enquire: (1) What are the IPM practices followed by an organization? (2) How have we performed individual case analysis and WCA? (3) What are the outcomes of the individual case analysis? (4) How have we codified the information extracted by rigorous follow-up and methods used for the data collection and the analysis?

This representative case is of one of the Indian organizations in the electrical engineering sector. This case illustrates the vibrancy of the organization to transform with the changes in the IP regimes very swiftly. The organization has grown rapidly in the past few years, by concentrating on established national market. The top management is actively engaged in this process of renaissance. The organization is able to establish IP culture and is now slowly becoming IP quality conscious. It is operating in a very competitive environment and is maintaining a top position in the Indian market. The organization has a perspective that IP is like armaments to survive in this technology war. It has various divisions which operate at different levels as departments, units, and sub-units.

IP department of the organization looks after IPM and is well connected with all other departments, units, and subunits. The major objectives of the IP department are to (i) assist R&D departments and others in identifying the potential IP (ii) help in IP analytics (iii) support IP protection (iv) disseminate latest technical developments, technology trends in all the technology areas related to organization's objectives (v) build valuation based IP portfolio and (vi) develop IP awareness.

The IP related reporting system of the organization is very efficient. IP department of the organization do not work in silo and proactively communicates with division head, unit head, sub-unit head, and inventors to understand their needs with reference to IPM. Inventor consults with 'IP co-ordinator'. 'IP co-ordinator' is one of the members of the team who takes a role as an 'IP co-ordinator' after basic training in IPR from IP department of the organization and other resources. 'IP co-ordinator' judges the probable IP development and reports the IP generation probability to sub-unit head. The sub-unit head takes the decision for further development and consults with unit head. At any point of time during this process, an inventor can contact IP department for any clarifications. As far as Indian patent applications are concerned the IP unit takes the decision. When a PCT (Patent Cooperation Treaty) application or any conventional patent application decision is to be taken, then top management is involved along with other division heads.

Top management appreciates IP importance and participates in critical decision making processes of IPM. IP budget is not constrained considering the Indian patent filing. Practices like monthly IP related newsletter, updated technology landscape reports are helping inventors to save their time in new developments. At this stage the organization is moving from quantitative approach to a more qualitative approach, with reference to IP portfolio development. The organization is not following open innovation and all levels of project development that is from conceptualization of an idea to commercial production are operated within the organization. This is helping organization to keep much of the information in trade secret form and is also helping to reduce legal processes involved during collaborative development. At present, the organization is accessing this policy and is thinking about 'open innovation'.

This case study is performed by the researcher after carrying out one pilot and one case study from the six case studies selected. In the previous case study, the researchers had identified 14 IPM related processes which are reconfirmed by study of this organization. In addition to these 14 IPM processes identified in the previous case study out of the selected six case studies the researchers identified 7 additional IPM related processes. These 7 identified IPM related processes are shared in Table 4 as a representation of the total 32 IPM processes identified through in depth six case studies. Thus total 14 plus 7 i.e. 21 IPM related processes and/or insights were identified. All formal and informal interactions, basic knowledge of IPM practices, practical experience of the researcher in IP domain, expert opinion, and literature analysis were employed for categorization of these IPM processes into four categories as IP generation, IP protection, IP commercialization, and IP acquisition related IPM processes, as shown in Table 5.

4.2. Cross case analysis

Cross case data analysis aimed at developing insights into the IPM processes and IPMS. During the organizational study, the focus was to understand the overall IPM practices followed in the organization over the years. This helped us to understand gradual development in IPM practices over the years, in all organizations, which is reflected in the patent application trends also. This change is the effect of trial and error methodology used by the organizations to improve IPMS.

The notes and other records received from all the organizations were used to write in detail the individual case study with a defined

Table 5
IPM processes categorization.

IP generation related IPM processes	IP protection related IPM processes	IP commercialization related IPM processes	IP acquisition related IPM processes
LT 3	LT 1	LT 13	LT 14
LT 4	LT 2		
LT 5	LT 8		
LT 6	LT 9		
LT 7	LT 12		
LT 10	LT 17		
LT 11	LT 18		
LT 15	LT 19		
LT 16			
LT 20			
LT 21			

(Developed by author)

format. These case studies were then analyzed and compared. This resulted in the development of various insights and patterns from the data. The complete process of this qualitative data analysis is presented in Fig. 5.

IPM processes and/or insights identified during case studies were recorded. Total 32 IPM processes and/or insights were identified. These processes and/or insights were coded and were organized as per the codes into 11 groups, as shared in Table 6. Further, the code 'idea generation' and 'IP inventory' were split into two and four respectively. 'Idea generation' code was divided into two codes as 'idea generation drivers' and 'idea generation processes'. 'IP inventory' was divided into four codes as 'idea inventory', 'IP inventory-non-commercialized IP' 'IP inventory-commercialized IP' and 'IP inventory-acquired IP'. Thus, total 15 codes were generated as shared in Table 6. These 15 codes were further clubbed together into 5 super codes as shown in Table 7.

5. Development of IPM model

The qualitative analysis and thorough examination of the data helped to understand the details of IPM processes. It was also observed from the case studies that IPM is not an independent activity and is reliant on 4 major factors such as technology strategy, innovation strategy, IP law related human resource availability, and IPM tools accessibility. The factors such as organizational culture and top management involvement may also influence the IPM of an organization. The IPM practices and/or insights developed during case studies that are 15 process codes were organized further into five super codes as pre-IP stage: IP generation, IP stage: IP protection, post IP stage: IP commercialization, IP acquisition, and IP enforcement as shown in Fig. 7. These five categories and 15 process codes were reorganized. This resulted into evolvement of 'IPM model' and is presented in Fig. 6. Thus proposed 'IPM model' has 5 stages and 15 major IPM processes including 4 inventories.

5.1. Pre-IP stage

Pre-IP stage is the first stage and is focused on 'IP generation'. This is a 'value creation stage' where 'potential IP' identification is a challenge. This challenging task can be handled if the five major processes suggested in the model are followed. Also at this stage, it is necessary to build the culture of data confidentiality in the organization. The reason for this is that though IP valuation techniques are available, the real value of the 'potential IP' is revealed only when it is commercialized, so all data is to be evaluated diligently. Thus, the 'pre-IP stage' with 5 major IPM processes is expected to create 'idea inventory'.

5.1.1. IP policy and contracts

IP policy of an organization is one of the important policies. It is expected that every organization should develop own IP policy. It is to be noted that the IP policy needs continuous updating to handle dynamics of competitive market. IP policy will give better result only if it is fully ingrained with organizational business strategy. It is expected that every employee of an organization must be aware about the IP policy. IP policy makes the crucial difference in the IP generation and its management [27].

Similarly, it is expected that the organization should document all agreements and contracts, and periodical checks and improvement of agreement and contract clauses are suggested. Agreement and contract implementation system is expected to be followed vigilantly.

5.1.2. IP security system

IP and related data is very sensitive and needs an adequate security system. This can be maintained by limited access areas, sign-in-out logs, use of badges for entry in specific areas, restricting or limiting access to visitors in specific areas etc. Wherever necessary, the access to critical areas is controlled by restricting employees' right of entry.

5.1.3. Idea generation drivers

Organizations must make IP education and training mandatory to all R & D personnel and impart basic IP training to all employees of the organization.

Organizations can explore one of the three major motivational aspects for IP generation as 'appraisal', 'appreciation' and 'incentive'. These motivational factors generally trigger idea generations which further results into IP generation.

There are various sources for idea generation such as informal and formal meetings for knowledge sharing, adequate research and development facilities, inputs received from external resources such as vendors, suppliers, customers and marketing units, periodic meetings with IP personnel and staff of R & D department to identify potential IP, patent analytics tool, mind mapping software, conferences [28].

Periodic (generally six monthly) generation of competitive intelligence reports, technical bulletins covering R & D activities of the organization, and on demand technology mapping reports are few other important idea generation resources. Skilled human resource for IP analytics, sufficient databases, and other related resources such as patent databases, research papers, law reports, and business news reports are of added value for idea generation.

5.1.4. Idea generation process

Before undertaking any project for new development, in-depth

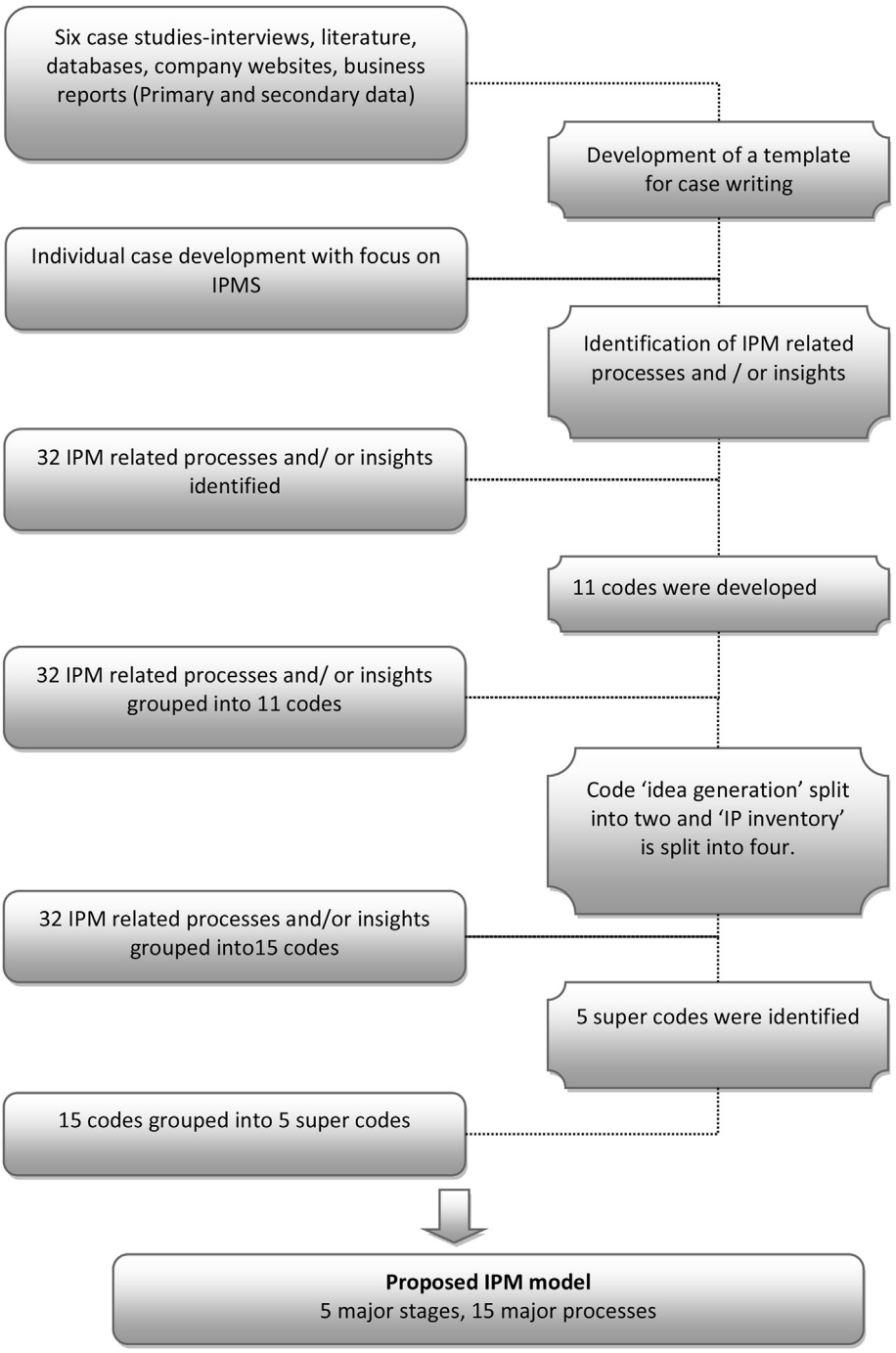

Fig. 5. Process of qualitative data analysis (Developed by author).

analysis of the potential market is an essential phenomenon. Dedicated business analytics unit accomplishes this function. Setting up dedicated R & D back up units for information retrieval and analysis helps in generating various insightful reports.

It is observed that simple Invention Disclosure (ID) process helps in increasing IP generation.

5.1.5. Idea inventory

This is the potential IP inventory of an organization and must be handled carefully. Idea inventory can be categorized as product wise, business unit wise etc. This will help classification of the ideas as ideas of greater importance and relevance to business against the other.

5.2. IP stage

IP stage is the second stage and is focused on 'IP protection'. This is the stage where IP is protected and made ready for commercial or strategic exploitation. This is a 'non-commercialized IP' of an organization. In this stage, the challenging task is the selection of the ideas which are important. This challenging task can be handled smoothly if some pointers/parameters are decided. This non-commercialized IP can be maintained in various formats.

These idea screening and protection related processes result into development of the second stage of IPM that is the 'IP stage' with 4 major IPM processes which are expected to produce IP inventory (non-commercialized IP).

Table 6
Reorganization of IPM process codes.

	Total IPM process codes	Code
1	IP policy and contracts	IPG-PC
2	IP security system	IPG-SS
3	Idea generation	IPG-IDG
4	Idea selection	IPP-IS
5	IP administrative protocols	IPP-ADM
6	IP assessment	IPP-AS
7	IP inventory	IPP-NIP
8	IP maintenance	IPC-MAI
9	IP Commercialization	IPC-COM
10	IP Acquisition	IPA-AN
11	IP enforcement	IPE-IPE
	Total IPM process codes	Code
1	IP policy and contracts	IPG-PC
2	IP security system	IPG-SS
3	Idea generation	IPG-IDG
4	Idea generation drivers	IPG-IDD
5	Idea selection	IPP-IS
6	IP administrative protocols	IPP-ADM
7	IP assessment	IPP-AS
8	IP maintenance	IPC-MAI
9	IP Commercialization	IPC-COM
10	IP Acquisition	IPA-AN
11	IP enforcement	IPE-IPE
12	Idea Inventory (Potential IP)	IPG-PIP
13	IP inventory (Non-commercialized IP)	IPP-NIP
14	IP Inventory (Commercialized IP)	IPM-CIP
15	IP Inventory (Acquired IP)	IPA-AIP

5.2.1. Idea selection

Idea selection process for project development passes through various filters such as development feasibility, current market scenario, business relevance, position of technology in technology lifecycle (leader/equal/follower), internal and external resources available for idea development, business requirement/need. Depending on these parameters the idea can be selected for further development.

5.2.2. IP administrative protocols

Dedicated IP department justifies the IP catering needs of the organization. Special budget is necessary for IP related activities. It is to be noted that IP lifecycle always starts with defensive level to cost to profit center level. Hence initial investment is always necessary.

5.2.3. IP assessment system

Novelty check and Freedom-to-Operate (FTO) analyses are the most prime activities and are generally carried out by IP department with the help of dedicated IP analytics staff or the external resources available. Decision related to IP protection is taken with the help of various forecasting and business related inputs. Inputs received from the marketing department are one of the most important inputs for decisions related to IP protection in the particular country.

5.2.4. IP inventory

This is the most important asset of an organization. This asset can be maintained by categorizing it as IP type wise, core IP and related IP, IP as licensed/in-house explored/sold out etc. along with basic types of IP inventories such as business unit wise, application and granted status wise, product line wise, inventor wise, year wise, validity status wise. for strategic purposes.

5.3. Post IP stage

Post IP stage is the third stage and is focused on 'IP commercialization'. This is the stage where IP is commercialized. This is the IP which is used to gain its value, so this is the 'commercialized IP' of an organization. This stage is a 'value extraction stage'. Here the challenging task is the selection of the IP for further maintenance. This identification of IP is very important strategically and commercially.

This results in the development of the third stage of IPM that is the 'post IP stage' stage with 3 major IPM processes, which are expected to produce 'IP inventory (commercialized IP)'.

5.3.1. IP maintenance

An interesting observation about the IP portfolio is that only 2–5% of the IP assets are really creating fortune. Some 30–40% of the IP assets are useful during negotiation activities such as cross licensing and for strategic benefits. IP maintenance requires very

Table 7
IPM processes codes and super codes.

A. Pre IP stage: IP Generation:: 5 major processes
1.1 IP policy and contracts (IPG-PC)
1.2 IP security system (IPG-SS)
1.3 Idea generation drivers (IPG-IDD)
1.4. Idea generation process(IPG-IDG)
1.5. Idea Inventory (Potential IP) (IPG-PIP)
B. IP stage: IP Protection: 4 major processes
2.1 Idea selection (IPP-IS)
2.2 IP administrative protocols(IPP-ADM)
2.3 IP assessment system (IPP-AS)
2.4 IP inventory (Non-commercialized IP) (IPP-NIP)
C. Post IP stage: IP Commercialization: 3 major processes
3.1 IP maintenance (IPC-MAI)
3.2 IP commercialization (IPC-COM)
3.3. IP Inventory (Commercialized IP) (IPC-CIP)
D. IP acquisition: 2 major processes
4.1. Acquisition Need (IPA-AN)
4.2. IP Inventory (Acquired IP) (IPA-AIP)
E. IP enforcement: 1 major process
IP enforcement (IPE-IPE)

	Categorization of 15 IPM process codes into 5 super codes
1	Pre IP stage: IP Generation (IPG)
2	IP stage: IP Protection (IPP)
3	Post IP stage: IP Commercialization (IPC)
4	IP Acquisition (IPA)
5	IP Enforcement (IPE)

A. Pre IP stage: IP Generation: 5 major processes	**B. IP stage: IP Protection: 4 major processes**	**C. Post IP stage: IP Commercialization: 3 major processes**	**D. IP acquisition: 2 major processes**	**E. IP enforcement: 1 major process**
1. IP policy and contracts	1. Idea selection process	1. IP maintenance	1. Acquisition Need	1. IP enforcement
2. IP security system	2. IP administrative protocols	2. IP commercialization	2. IP Inventory (Acquired IP)	
3. Idea generation drivers	3. IP assessment system	3. IP Inventory (Commercialized IP)		
4. Idea generation process	4. IP inventory (Non-commercialized IP)			
5. Idea Inventory (Potential IP)				

Fig. 6. IPM model (Developed by author).

A. Pre-IP stage:	B. IP stage:	C. Post-IP stage	D. IP acquisition	E. IP enforcement
Yes	No	Yes	No	Initiated
Yes	Yes	Yes	No	
Initiated	Yes	Yes		
Initiated	No			
No				

Organization'A'

A. Pre-IP stage:	B. IP stage:	C. Post-IP stage	D. IP acquisition	E. IP enforcement
No	No	Initiated	No	No
No	Initiated	Initiated	No	
Initiated	No	No		
Initiated	No			
No				

Organization 'B'

Yes : if the IPM process is followed and is almost established and is a part of organization culture
No : if the IPM process is not followed
Initiated : if it is just implemented and is in a process of refinement and is not still established.

Fig. 7. Mapping of IPM of organizations using 'IPM model' (Developed by author).

crucial decision making process and usually involves top management personnel. Generally, IP and business policy guidelines help in this decision making process.

5.3.2. IP commercialization

It is expected that the organization must take care about IP related regulatory processes and other protocols and procedures for product market entry. Integrative IPM practice is the proactive IP commercialization activity where approach is to bundle the IP rights. The major focus of some organizations is technology licensing. In such cases, the focus of IPM is strategically generating IP for revenue generation through licensing. Organizations are required to support this approach by premeditated planning for IP generation, protection, and maintenance of IP.

5.3.3. IP inventory (commercialized IP)

Detailed inventory of commercialized IP will give a fair idea about revenue generation from the IP assets. This inventory will also help to explore more possible commercialization opportunities and learnings for future technology transfer activities of an organization.

5.4. IP acquisition

IP acquisition is the fourth stage and it is more of a strategic intervention. This is the stage where IP is acquired either for financial or strategic gain. Here the challenge is the valuation of the IP to be acquired and forecasting the post-acquisition consequences. This results into development of the fourth stage of IPM

that is the 'IP acquisition' stage with two major processes which are expected to produce 'IP inventory (acquired IP)'.

5.4.1. Acquisition need

IP acquisition is imperative for ownership of high potential IP, creation of opportunity in future, for acquisition of potential IP/ technology savvy SME to avoid future competition. It is observed that careful strategic decision-making related to IP acquisition helps an organization achieve leadership position in the industry.

5.4.2. IP inventory (acquired IP)

It is a good practice to maintain separate IP portfolio of acquired IP. Statistical analysis of this IP portfolio can help organization in future acquisition activities as well as other strategic planning.

5.5. IP enforcement

IP enforcement is the fifth stage. This is the stage where IP enforcement related activities are monitored and implemented. Careful implementation of IP enforcement related activities will refrain unlawful use of IP by competitors. This resulted into development of the fifth stage of IPM that is 'IP enforcement' with 1 major IPM process.

5.5.1. IP enforcement

IP enforcement is a challenge and requires a special effort. IP department with the help of external resources conducts infringement analysis. It is the general observation that small players imitate technology more than the big players in the industry. It is also observed that enforcement becomes very challenging, if the land laws are not implemented strictly.

6. IPM model validation

We applied the IPM model to two organizations to check the validity and efficiency of the 'IPM model'. The details of this process of application will help to understand how to apply the 'IPM model' to develop your own IPMS. To check the universal application of the 'IPM model', we applied the model to two organizations from two different sectors, one mechanical and second electrical engineering sector (WIPO classification of Technology). This exercise was conducted by taking the assistance of professional IPM firm in India without their intervention; access to IPM departments of these organizations was not possible. Organization 'A' is a fortune 500 organization with head quarter in the USA having more than 80,000 employees and 6 centers in India; organization 'B' is the Indian organization with more than 3000 employees. The name and other details of the organizations are kept confidential.

We collected the IPMS data of both the organizations by using tools, discussion guide and 'data collection checklist'. One general common observation is that both organizations are following routine IPM processes which were completely dependent on external resources like IP experts, IP analysts, and IP attorneys. These external resources do involve huge cost. These organizations were practicing these IPM processes since more than three years till the expected output and sustainable IPMS development was not achieved by both of the organizations.

We mapped the data collected using 'IPM model' and evaluated IPMS of both the organizations. Organization 'A' showed a better establishment of IPMS, having 7 IPM processes and 3 IPM processes being initiated. Thus, 10 out of 15 IPM processes were followed by the organization 'A'. Organization 'B' showed that 5 IPM processes were initiated while remaining 10 IPM processes were not followed by the organization. Thus, only 5 IPM processes out of 15 IPM processes were followed by this organization.

We shared the 'IPM model' with inventors, CTOs/VPs, marketing and finance authorities and IP personnel of these organizations to get their perspective. We requested them to map the IPMS of their organization with the proposed 'IPM model'. This triggered the 'self-assessment' process. The observation on this exercise is that the use of 'IPM model', to understand the IPM performance of an organization, was a comparatively easy task for them and mapping the output by us and them showed the near match. We noted output as 'Yes', 'No' and 'Initiated' based on criteria as shown in Fig. 7.

7. Result and conclusion

We analyzed the literature, current industrial and law practices followed, and understood the state of the art. In the process, we appreciated the importance of IP for wealth creation. The literature analysis revealed the complexity of IPM, the interdependence of IPM on innovation, strategy and technology management. We also noticed the limitations such as unavailability of skilled human resource, IPM tools, and dependency on external resources. We observed that very expensive and hefty IP consultancy, complexity of IPM, lengthy time taking IP protection processes may be few factors which pull back many corporates, academicians, MSMEs, inventors from IP protection of their inventions, which result into huge losses of fortune. This was realized by them later after huge losses.

The paper introduced the five stage IPM model and confirmed five IPM related stages as IP generation, IP protection, IP commercialization, IP acquisition, and IP enforcement with total 15 major IPM processes including four IP inventories as an idea inventory, an IP inventory for non-commercialized IP, an IP inventory for commercialized IP and an acquired IP inventory. The study confirmed that the 15 IPM processes which were suggested are not followed by all organizations. It is also observed that the performance level of each individual IPM process too varies with the organization. It is further observed that even the most IP savvy organizations are not following with expected vigor all the fifteen IPM processes identified. The study developed a methodology to establish, improve and strengthen IPMS of an organization. Managers, scholars, entrepreneurs, academicians can appreciate the simplicity and scope of IPM processes suggested.

The use of the 'IPM model' has the potential to help organizations in a number of ways. The 15 IPM processes are organized systematically into 5 stages in such a way that, each stage from 1 to 4 generates four different inventories. A prominent advantage of 'IPM model' is it provides guidelines to maintain IP inventories from different perspectives. Periodically revisiting these inventories will help an organization to manage its IP portfolio and take the necessary strategic decisions.

Another important advantage of 'IPM model' is that it will help to develop various matrices to check the performance efficiency of IPMS. Established IPMS may push organization to embrace challenges in turbulent fast moving technology. The most important contribution is that the 'IPM model' is a self-assessment tool which will help technology and IP managers to evaluate IPMS of their own organization without taking help of an IP expert. Any person with basic knowledge of IP and technology can perform IPMS assessment.

The exclusive focus of this study on the electrical engineering sector limits its findings for this sector. In the context of the IPM practices in India, it is an emerging industry with maximum IP filing next to pharma and chemical industry as per Indian patent office annual report (2011). So we believe that almost all other industry sectors can benefit from the findings of this study. This can be confirmed by application of proposed 'IPM model' to the

organizations from other sectors.

The study does have some limitations with reference to which the IP data is very critical in terms of organizational competitions. Although the researcher conducted in-depth case studies, there were limitations in terms of data sharing. We believe that in such a scenario, the gathered data can be made more accurate through a thorough literature review, informal data collection, interaction with legal experts and IP professionals, and the researcher's own practical experience.

The research can certainly be expanded to other industry sectors in the future. The special research focus on government research institutions, educational organizations, and public R&D centers can be explored to address specific IP-related issues.

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