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ABSTRACT Business intelligence enables enterprises to make effective and good quality business decisions. In the knowledge economy, patents are seen as strategic assets for companies as they provide a competitive advantage and at the same time ensure the freedom to operate and form the basis for new alliances. Publication or disclosure of intellectual property (IP) strategy based on patent filings is rarely available in the public domain. Because of this, the only way to understand IP strategy is to look at patent filings, analyze them and, based on the trends, deduce strategy. This paper tries to uncover IP strategies of five US and Indian IT companies by analyzing their patent filings. Gathering business intelligence via means of patent analytics can be used to understand the strategies used by companies in advocating their patent portfolio and aligning their business needs with patenting activities. This study reveals that the Indian companies are far behind in protecting their IPs, although they are now on course correction and have started aggressively protecting their inventions. It is also observed that the rival companies in the study are not directly competing with each other in the same technological domain. Different patent filing strategies are used by firms to gain a competitive advantage. Companies make use of disclosure as strategy or try to cover many aspects of a technology in a single patent, thereby signaling their dominance in a technological area and at the same time as they add information.

KEYWORDS Business intelligence, competitive intelligence, intellectual property, IPR, IP strategy, patent analytics, software patents

1. INTRODUCTION

Business intelligence helps enterprise users make effective and high quality business decisions. It includes multiple applications, tools and technologies for information gathering, accessing, and analyzing involving all factors that affects a business (Rajan, 2009). Howard Dressner, an analyst at the Gartner Group, first coined the term business intelligence in the early 1990s. Business intelligence has become the art of sifting through large amounts of data, extracting pertinent information, and turning that information into knowledge upon which timely actions can be taken. All successful enterprises have made use of business intelligence for their business (Chaudhuri, 2011).

As per Ranjan (2009), business intelligence reveals:

- The position of the firm relative to its competitors

- Changes in customer behavior and spending patterns
- The capabilities of the firm
- Market conditions, future trends, demographic and economic information
- The social, regulatory, and political environment
- What the other firms in the market are doing

Business intelligence as a strategic framework is becoming increasingly important in strategic management and in supporting business strategies (Alnoukari and Hananao 2017). Alignment between business and business intelligence strategies can be a powerful enabler of business strategy, including new business models that bring about organizational transformation (Watson & Wixom, 2007). Business intelligence using tacit knowledge can lead to intellectual capital including patents (Sveiby, 1997 ; Herschel & Jones, 2005).

The IT industry has grown rapidly since the 1960s, starting in the USA and has slowly become global (Cameron et al., 2006). Information and communication technology (ICT) innovations are usually incremental, fast changing and having a short lifecycle (Shaikh & Londhe, 2016). Firms investing in this continuously evolving technology expect quick returns for their investments by means of some protection. Intellectual property rights (IPR) are the rights given to persons over the creations of their intellect. The framework of IPR offers a wide range of protections such as patents, trademarks, copyright, design registrations, trade secrets, anti-competitive practices in contractual licenses, protection of new plant varieties and data protection.

A patent offers the strongest protection within the framework of IPR. It is a form of intellectual property granted by the government in order to secure legal protection for inventions by means of exclusive rights for a limited period in exchange for the public disclosure of an invention. Patents are also important for trade and industry worldwide as they attract foreign investment and rapid technology transfer (OECD, 2004). Patents also promote innovation by disclosing an invention in the public domain (Moser, 2005; Walaski, 2004). Patenting decisions are seen as important strategic considerations since gaining maximum value from a patent depends on the individual firm's ability to enforce the patent (Arrow, 1962 ; Dornelles, 2016).

Patents are a major source of information and when properly processed and analyzed, can yield a wealth of information on competitors' activities, R&D trends, emerging fields, and collaborations. Taking into account the filing practices (for example, broad or specific applications, filing routes, and territorial protection sought) associated with specific companies or domains, the analysis of patent portfolios can give a reasonably accurate idea of the volume of the activity in specific research areas, reveal underlying trends, detect emerging or hidden information or deviations from expected patterns, and more. Patent analysis can also yield a wealth of information related to research activity, collaborations, location of research work, key inventors and licensing (Grandjean et.al., 2005).

Strategic IP management can be offensive or defensive resulting in the formulation and execution of strategies related to technological IP, including issues such as how to acquire, create, govern, exploit and extract value from patents. Patents can also be used to understand technology and competitor intelligence (Holgersson 2012; Krig & Sandra, 2017).

Patenting usually has strong business co-relations (Pargaonkar, 2016). In the present study, patent filing data of selected ICT companies are used as a source of information for competitive/business intelligence to highlight the intellectual property (IP) management strategies of ICT companies. Patent landscape and the accompanying IP competitive intelligence involves understanding and anticipating the competitive environment within which a company operates. More specifically, IP competitive intelligence highlights emerging IP risks, provides patent portfolio benchmarking, monitors competitor technology development efforts, and predicts commercialization of technology (Pargaonkar, 2016). The main objective of IP competitive intelligence is to create value for competitive advantage. IP competitive intelligence improves decision quality and enables IP strategies by defining the relative competitive position. IP strategy becomes important when firms differentiate themselves using technology. In such cases, IP competitive intelligence analysis plays an important role for defining, creating and sustaining a winning IP strategy. IP competitive intelligence enables value creation and strengthens multiple

aspects of an effective IP strategy (Pargaonkar, 2016).

Considering the above, there is a need to understand the various motives of firms to patent.

2. LITERATURE REVIEW

Various studies have been carried out in the field of competitive intelligence, business intelligence, their advantages to business in taking timely decisions, as well as the use of patent data for carrying out business intelligence for competitive advantage. Hughes (2017) reports that due to the high volume and speed of scientific research, it is impossible to collect, update and analyze the variables that impact the evolution of technologies as disruptive innovations need knowledge from adjacent technologies as well. Hughes (2017) proposes a model featuring expanded search depth, breadth and speed along with inputs from internal and external experts for identifying emerging technologies by coupling big data analytics machine learning with technology sequence analysis. On the other hand, Gauzelin and Bentz (2017) report on how small and medium-sized enterprises (SMEs) perceive and make use of business intelligence in decision making and highlight that business intelligence systems are perceived as a solution to various unforeseen disruptive events that hit the businesses unexpectedly. They report that assessing the success of business intelligence is not easy as they cover the entire organizations and their benefits are long term. SMEs lack business intelligence implementation due to a lack of financial and expertise capacity to implement it. However, small businesses deal with increasing volumes of data, hence making the appropriate choice of the best business intelligence in line with their strategy will allow them to have a competitive advantage. Collecting and analyzing data on business intelligence from SMEs, Gauzelin and Bentz (2017) report that business intelligence and its use have a far-reaching impact on the operation of SMEs. Søilen (2017), highlights the importance of competitive intelligence and market intelligence through a case study of two Swedish MNCs and reports that companies would succeed only if the competitive intelligence model, along with the specialist's role, are properly defined in bringing out and reporting facts instead of pleasing their seniors. Søilen (2017) also highlights that the expectations from the analysts is predicting the future, which at times is difficult. The analysts often also end up performing different tasks aside from analysis. With the increase in data and its low cost, competitive intelligence is largely defined by how well companies can draw conclusions from it, as the outcome is mainly dependent on the quality of data available and, at times of crisis, the demand for intelligence is the greatest.

Business intelligence can be viewed as a broader tool that includes knowledge management, enterprise resource planning, decision support systems and data mining (Gangadharan and Swamy, 2004). Business intelligence is also referred to as competitive intelligence, market Intelligence, customer intelligence, competitor intelligence, strategic intelligence or technical intelligence (Lönnqvist and Pirttimäki, 2006; Deshpande et.al, 2016). Scholars have define business intelligence as the process of collecting large amounts of heterogeneous data from multiple sources, analyzing that data using advanced analytical tools and methods, and quickly presenting a high-level set of reports to multiple users that condense the essence of that data into the basis of business actions, enabling management to make efficient and effective strategic business decisions that can help organizations to survive and thrive in the global economy (Stackowiak et al., 2007; Zeng et al., 2006; Ranjan, 2009).

The main challenge in any business intelligence solution is in its intelligence ability (Alnoukari and Hananao, 2017).

Business intelligence or competitive intelligence is considered to be an interdisciplinary field (Walker, 1994). Studies have suggested that competitive intelligence is associated with strategic management as well as knowledge management (Gabriel and Adiele, 2012; Calof and Viviers 2001) and intelligence has evolved as a discipline over time (Hoppe, 2015). Knowledge management can be perceived as an integral component of business intelligence (Herschel & Jones, 2005). It is usually defined in reference to collaboration, content management, organizational behavioral science, and technologies. Knowledge management is a systematic process of finding, selecting, organizing, distilling and presenting information in a way that improves an employee's comprehension in a specific area of interest (Herschel & Jones, 2005). It can be seen as consistent with resource-based theories of the firm, such as building and competing in a capability that could be quite difficult for

others to imitate practically. Knowledge management was seen to be central to product and process innovation and improvement, to executive decision-making, and to organizational adaptation and renewal (Earl, 2001). Specific knowledge management activities help focus the organization on acquiring, storing and utilizing knowledge for such things as problem solving, dynamic learning, strategic planning and decision making. Alnoukari and Hananao (2017) report that the integration of business intelligence and corporate strategic management has a direct impact on modern and flexible organizations, which leads to a gain of competitive advantages as well as easier adatation to changing scenarios and corporate strategies.

The core advantage of any competitive intelligence system is to extract the knowledge needed about competitors' opportunities and threats (Alnoukari and Hananao, 2017). Competitive intelligence ensures a firm's competitiveness in the marketplace through a greater understanding of competitors and the overall competitive environment (Solomon, 2004). Competitive intelligence and market intelligence can also be built on competitors and influencers from exhibits and tradeshows (Solberg-Søilen, 2010).

Intellectual property assets are becoming increasingly important drivers of competitive advantage. This has forced organizations to effectively and efficiently mine their IP for business intelligence. Studies suggest that patent data is also a valuable source of competitive intelligence from which to derive a strategic advantage (Rouach and Santi, 2001; Dou et al., 2005; Grandjean et al., 2005; Shih et al., 2010; Deshpande et.al, 2016). Stern (2005) highlights that for creating competitive advantage, management must focus on exploiting IP during a product's lifecycle, which would encompass resource management and IP strategy. IP protection is a strategy that helps in formulating new strategies for protection of innovations and sustainable development. Patent data, its legal status and litigation data can be used for business intelligence purposes such as IP portfolio valuation, patent valuation, identification of competitors and their R&D efforts, assessment of active researchers in a particular field, assessment of patent quality, research quality, market trends, discover human capital, and to anticipate product launches (Sagacious Research, 2017). Patent analysis enables firms to make more informed decisions about their IP strategy and create value for their business (Great Dome Associates, 2018). Analysis of patent data accelerates innovation, saving time and money (Cubicibuc, 2017). A patent portfolio can be analyzed by carrying out patent landscaping (Tekic, 2014). Intellectual property landscaping is a strategic tool providing valuable business intelligence to ensure maximum understanding of the potential opportunities and competitive threats (hee.org, 2018). Patent landscaping provides insights which guide business strategies that include cost optimization, enforcement, licensing, R&D and mergers and acquisitions. Patent landscaping supports business strategies that help in the development of a quality patent portfolio, which in turn generates revenue and mitigates risk (ip.com, 2017).

IP strategy as a subset of the business strategy requires analysis of a firm's own inventive capabilities along with the IP landscape (Barrett,2005). A patent landscape can give a new perspective on a market by illustrating the players, their technologies and their filing history and behaviors over time. A comprehensive landscape informs companies about the strength of their IP and how it compares to other companies operating in the same market. Looking at IP in a broad perspective and applying business intelligence provides decision makers with actionable insights and a clear view of potential outcomes for various strategies (clearviewip, 2017).

Business intelligence is a systematic way of gathering data, analyzing and utilizing the same while making decisions in expanding, launching a new product, while carrying out mergers and acquisitions or for implementation of corporate strategies. Business intelligence from intellectual property rights helps organizations to follow a proactive approach (Siddhast.com). It provides information that will allow organizations to predict the behavior of their competitors, suppliers, customers, technologies, acquisitions, markets, products and services, and the general business environment with a degree of certainty (Vedder et al., 1999; Jourdan et al., 2008)

Stern (2005) reports that managing IP as a strategic driver helps businesses become market leaders, align their business strategy with product IP strategy and protect their technology via means of maintaining a product monopoly. This provides a competitive

advantage, thereby encouraging and defining measures for IP evolution and exploitation. Wang (2011) highlights how patent intelligence can be used to make an intellectual property strategy. Citing various researchers, Wang (2011) reports that patent data can be used in core areas of technology management. Jürgensa and Solanab (2016) provide insights on the use of patent information for technology watch activities, classifying patent indicators for performance, technology, patent value and collaboration indicators. They report that to gain insights and competitive advantage in a specific technical domain, patent intelligence is used, which is also referred to as technology watch, technology intelligence or technology monitoring. This is a subdomain of competitive intelligence, a methodology for gathering analyzing and managing external information that can affect the organizations plans, decisions and operations. Citing various researchers Jürgensa and Solanab (2016), report that competitive intelligence through patent data allows one to measure current technical competitiveness and forecast technological trends in specific sectors. Highlighting a case study of the nanotechnology industry in Spain, Jürgensa and Solanab (2016) report that statistical analysis of patent information and its visualization is a powerful and successful way to gain insights into a technology that can be further used to monitor and evaluate technology activities.

Patents encourage and promote innovation by the disclosure of a technology in the public domain (Moser, 2005; Walaski, 2004). Patents also promote technology transfers and cross licensing. It is reported that countries that support stronger patent protection laws are much preferred destinations for foreign investments, new innovations and technology advancements (Goswami & Yadav, 2010; McGowan et al., 2007). Patenting does not always lead to a monopoly in pricing as it helps recover the R&D investment cost (Spinello, 2007) and hence the IP law allows the developer to profit from their creation (McGowan, Stephens & Gruber 2007). Increased incentives for patents have pushed firms towards "patent thickets" (Cockburn and MacGarvie, 2011). Patent thickets constitute a potentially imposing obstacle and do not allow freedom to operate for other businesses (Clarkson & Dekorte, 2006). Patent flooding and thickets have been used as anticompetitive tools to lock out competitors, especially in fast moving technological markets (Weatherall et al., 2013). The higher number of patent applications by firms also increases transactional costs and thereby opens the doors for strategic collaboration for patent pooling and cross-licensing so that the negative effects of patent thickets can be reduced (Zekos, 2006; Cockburn & MacGarvie, 2011). Patent laws have been interpreted over time to provide protection to the desired licensee. Even unwilling infringements by means of ignorance are not an excuse to avoid prosecution (Biles & Mann, 1992). Patent trolls have made an impact on business and innovation in the ICT sector. Trolls are becoming professional patent exploiters that have high quality technological patents (Pohlmann & Opitz, 2013). The trolls' blackmailing tactics can have adverse effects on the whole industry, which in turn may slow down innovation processes (Pohlmann & Opitz, 2013). Bessen & Hunt (2007) have warned that strategic patenting by non-R&D firms may pressurize firms to engage in a patent "arms race." However, Useche (2015) reports that a high number of patents reduces the risk of failure and acquisition, while quality increases their attractiveness as an acquisition target. Patents may give a firm an upper hand and a competitively advantageous position, thereby adversely affecting the competitor firms' market values (Chung et. al, 2016).

Large companies see IPRs as incentives to compete in IPR portfolios and patents as strategic assets to protect from competition, give design freedom, offer complementary protection and form a basis for new alliances. At the same time, SMEs see IPRs as restrictions and market barriers and they need to build their own IPR portfolio to make themselves more credible players in the market (Välimäki, 2001). One strategy followed by successful Chinese multinationals was to skip filling in the domestic market and go directly to developed countries by collaborating with the world's major companies, pointing out that high application does not result in profit (Nakai & Tanaka, 2010). Companies strongly involved in collaborating with customers that are experienced using patents are more inclined to use patents (Blind, 2007).

Among the many strategies used by companies, technology disclosures can be a rational offensive strategy to make its presence felt in a particular technological domain (Baker & Mezzetti 2005). This helps to make the patent office aware of its availability of

potential prior art. This is done intentionally to create prior art that might stop rivals from patenting and making it more difficult to patent, hence extending the patent race through disclosure. Disclosing the intermediate results in a multi-stage patent context signals a firms' commitment to a research project, which may induce the rival to exit the competition or provide its followers ground to work ahead on the technology, depending on the knowledge spill over (Gill 2008). This at times leads to future acquisition or collaboration with its followers and at the same time prevents its competitors from working in the same domain.

Open source software (OSS) is attracting increasing commercial interest among firms as they take royalties over patented technologies of products and services sold as top-ups for OSS products (Fosfuri et al., 2008; Wen et. al., 2015). Firms with software patents highjack an OSS project and direct its development in a particularly favorable direction by threatening or exercising enforcement rights. Fosfuri et al. (2008) also states that patenting by firms that support OSS can also be for defensive purposes, thereby supporting their defensive strategies. Firms with large stocks of software patents or with large stocks of hardware trademarks are more likely to release OSS products (Fosfuri et al., 2008). Red Hat is making a profit from the sales, service and support of Linux even though Linux is open source (McGowan et al., 2007). It is seen that Red Hat has patent filings to protect its commercial interests (Shaikh & Londhe, 2016).

Firms patent not only to prevent imitation, but also to obtain bargaining power and improve their corporate image, to freely operate in the market, to extract value of their patents through licensing and royalties, to collaborate with technology leaders and to seek a competitive advantage. To strengthen a firm's technological leadership and to protect its innovation, patents serve as influential instruments of corporate strategy and have become an important source of competitive advantage (Grindley & Teece, 1997; Sullivan, 2001; Holgersson, 2012). Studies have pointed out the need for integrating and aligning patent strategy with a firm's business and technology strategy to generate valuable returns (Alexy et al., 2009; Granstrand, 2000; Smith & Hansen, 2002; Reitzig, 2004; Davoudi et.al., 2018; Lynskey 2009; Holgersson & Grandstrand, 2017).

The software market was born in the US and it still acts as a trendsetter for software patenting by opening its doors to software and business method patents (Cameron et al., 2006). Other countries are following the US to protect the interest of their researchers, as the failure to protect might affect a company's ability to operate freely at the basic level in the global market (Clarkson & Dekorte, 2006), which in turn would threaten their own existence (Dedrick & Kraemer, 1993; Jyoti et al., 2010). The best way to survive is to study and learn from the patenting strategies followed by the market leaders who are successfully protecting their inventions via means of patenting. Since no publication or public disclosure about IP strategies is available, the only way to understand such IP strategies is to look at the patent filings, analyze them and based on the trends, deduce their strategy. These insights thus obtained may help the IT industry to customize its strategy with respect to patent acquisition.

3. METHODOLOGY

The study covers patent data published from 2005 to 2014 from five Indian and five US ICT companies. The list of these companies is given in Table 1. The Derwent Innovation Database (https://clarivate.com/products/derwent-innovation/) was used to retrieve the relevant patent data for the study. The text mining and visualization tool Vantage Point (www.thevantagepoint.com) was used to clean, normalize and analyze the patent data. As the data retrieved was huge, it was also imported into a relational database for further filtering.

The search strategy consisted of assignee names of the ten firms. As the study was to find the technological trends and strategies, the patents searched were based on the application year (Trippe, 2015). The exemplary search strategy was:

CMP=("company names") AND
(AD>=(20050101) AND AD<=(20143112))

As patents are territorial in nature, the same invention may be duplicated by way of multiple fillings in different countries, which can be referred to as patent families. To reduce this form of duplication, one representative of each family was retained to obtain the data set highlighted in Table 1.

The bibliographic details of patents such as the title, abstract, claim, priority date, assignee name, inventor name, INPADOC family

members, and citations have been used for the analysis.

Table 1 Companies with patent data sets and patent families.

Company	Patent Data Set	Patent Families
International Business Machines Corp.	87,086	24,206
Samsung Electronics Co. Ltd.	168,170	26,885
Microsoft Corp.	118,860	19,274
Google Inc.	57,589	8,931
Qualcomm Inc.	179,640	13,899
Tata Consultancy Services Ltd	1,803	414
Infosys Ltd	644	273
Wipro Ltd	799	375
HCL Technologies Ltd	316	205
Mahindra IT & Business Services	523	263

4. ANALYSIS AND VISUALIZATION

4.1 Patenting trends for US and Indian IT companies

The overall patenting activity for these US and Indian IT companies between 2005 and 2014 can be seen in Figure 1 and Figure 2, respectively. The figures highlight that the patenting activity of the US companies is higher than their Indian counterparts, which lag in protection of software innovations. The US companies applied for about 93,000 patents, while the Indian companies applied for less than 2% of that quantity, with about 1500 patent applications in the same time period.

It is observed that the patent applications of Google and Qualcomm have gradually increased in the study period, while that of Microsoft decreased. Samsung leads the application rate for almost 5 years, with more than 3,000 patents each year. On the other hand, Indian companies such as TCS, HCL and Wipro aggressively started patenting their activities only in 2010, 2011 and 2012, respectively. Infosys and Mahindra made their

Figure 1 : Patent Application Trend of US companies

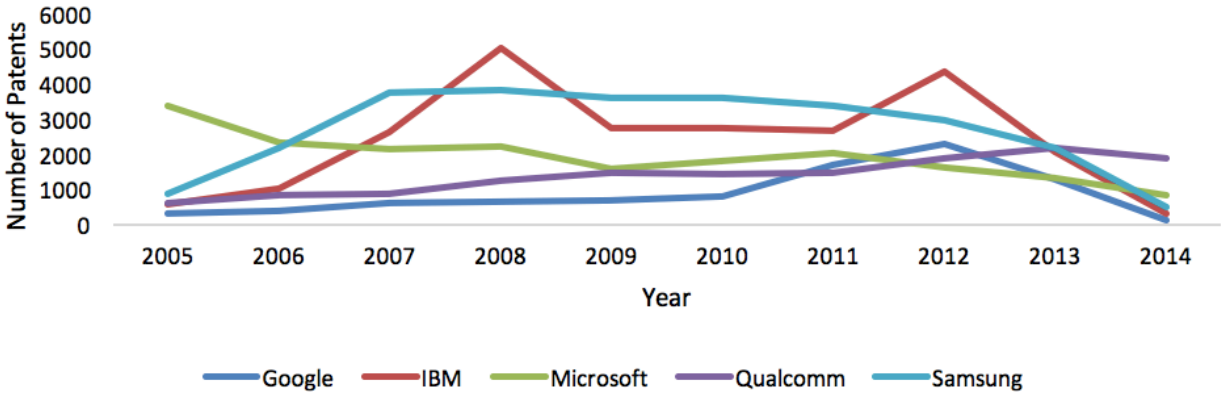
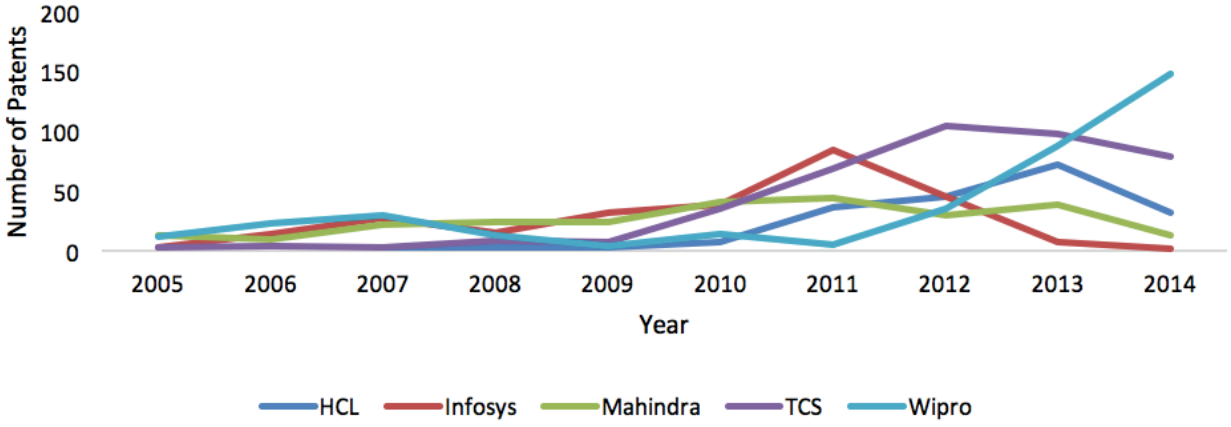
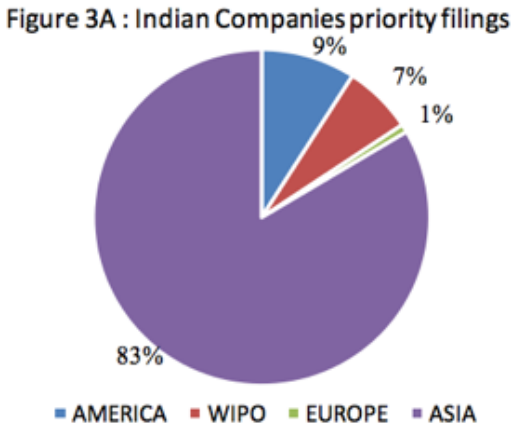
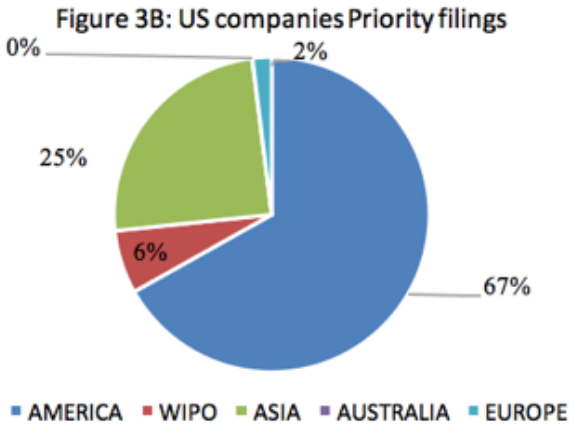


Figure 2 : Patent Application Trend of Indian companies







presence felt throughout the decade under consideration. After comparing the Indian and the US firms it can be said that the Indian companies entered late into the patenting foray.

4.2 Origin of Inventions for US and Indian IT companies

The origin of an invention can be found by using patent data (Trippe, 2015). The priority filing country in the patent document is considered to be an indicator for the origin of a particular invention, as companies usually prefer to first file for a patent in the same country in which the technology is invented. Figure 3 illustrates the priority country filing trends for the Indian and US IT companies.

During the study, it was observed that the majority of the patents (67%) claim the US as the priority country. However, a closer look revealed that the Indian companies have India as their origin of invention. A further analysis of the top filers from India reveals Wipro has its patent origins in at least 9 countries while TCS has its origin of invention in 4 countries, Infosys and HCL in 3, and Mahindra had its origin of inventions in 2 countries. The study of major US filers reveals that Samsung leads the way by priority filing around 78% of its patents first in Korea followed by 18% in the US. Samsung and Qualcomm have priority filings in at least 12 countries and 78% of Qualcomm's, and 86% of Microsoft's, inventions originated from the US. Microsoft has filings for origin of inventions from 13 countries. IBM has a spread across 14 countries and has about 88% of its inventions' priority filings in the USA. Around 5% of IBM's inventions originate in Europe. The reason that the US-based companies have many countries as their origins of invention can be attributed to their global presence in the form of technology and R&D centers in multiple countries, along with their collaboration in research. However, this is not the case of the Indian companies, as they operate in selected markets other than India such as the USA and Europe only. Wipro is the only Indian company with priority filings for inventions from at least 9 countries. It is also interesting to note that WIPRO has around 16% of its patents in the USA and 3% of patents originating in Singapore.

4.3 Patent legal status for US and Indian IT companies

Patents' legal statuses are an important component of patent information. They show whether a patent is dead or alive. They can also throw light on the various strategies used by the patenting firms, such as which technology is still protected and where, or whether it will soon become freely available in the public domain (WIPO-a). Alive patents are the ones that are valid and can be enforced. The dead patents are the ones whose applications are either withdrawn, rejected or the granted patent has expired, lapsed or been revoked for various reasons such as non-payment of maintenance fees. There is also a third category in the legal status known as "indeterminate," where patents are assumed to be applications undergoing examination, the examination is pending or whose status is not known.

Table 2 highlights the legal status of patents in percentage for the 10 companies studied. It is interesting to note that Infosys has around 92% of its patents live and enforceable. Inversely, about 30% of IBM's patents are unenforceable due to withdrawal of the application, rejection, lapse or revocation. This may be seen as an offensive tactic by IBM to make data public via means of disclosure to

force firms out of competition and at the same time save costs incurred on prosecution or maintenance of patents. It might also be due to the technology in IBM's patents becoming absolute. Even then a figure of 30% is quite high.

Table 2 Patent legality status in percentage.

Company Name	Living Patents	Dead Patents	Indt.
IBM	67	30	3
Samsung	85	9	6
Microsoft	81	9	10
Qualcomm	74	10	16
Google	82	6	12
TCS	77	3	20
HCL	9	0	91
Mahindra	26	0	74
Infosys	92	2	6
Wipro	41	0	59

4.4 Technological trends of US and Indian IT companies.

The International Patent Classification (IPC) is used in a patent document to classify the patent according to the technical fields it claims. An analysis into the top IPC-4 digit for the 10 companies studied revealed that 7 companies (IBM, Microsoft, Google, HCL, Infosys, TCS and Wipro) lead with maximum patenting in G06F which indicates "Electrical Digital Data Processing" (Table 3).

Around 62% of Microsoft's patents were in the IPC-4 digit class G06F, while IBM has around 55% of its patents in G06F and about half of Google's patents were in G06F IPC-4 digits. Samsung lead with the majority of their patents in H01L, with 17% of its total filings in the class indicating "Semiconductor Devices" while Qualcomm has about 34% of its patent filings in H04W, indicating "wireless communication networks" and Mahindra with 9% in B60R, or "Vehicles".

Table 3 Count of Patents for Top IPC-4 digits of each companies.

	IPC-4 Digit			
	G06F	H01L	H04W	B60R
Google	4456			
IBM	13192			
Samsung		4519		
Microsoft	11889			
Qualcomm			4750	
HCL	91			
TCS	184			
Infosys	187			
Wipro	188			
Mahindra				24

Table 4 Count of patents for the top 3 IPCs of each company.

IPC	Google	IBM	Samsung	Microsoft	Qualcomm	HCL	TCS	Infosys	Wipro	Mahindra
G06F001730	1510	2138	-	2900	-	9	61	37	-	-
G06F001516	685	1544	-	1675	-	-	-	27	-	-
G06F000700	481	-	-	-	-	-	-	-	-	-
G06F000944	-	1540	-	1548	-	-	-	43	-	-
H04W000400	-	-	924	-	912	-	-	-	-	-
H01L002100	-	-	504	-	-	-	-	-	-	-
G09G000500	-	-	437	-	-	-	-	-	-	-
H04L002906	-	-	-	-	520	-	-	-	-	-
H04L000100	-	-	-	-	508	-	-	-	-	-
G06Q001000	-	-	-	-	-	9	-	-	-	-
G06F000944	-	-	-	-	-	7	27	-	-	-
G06F001700	-	-	-	-	-	-	-	-	14	-
G06Q001000	-	-	-	-	-	-	-	-	13	-
G06F001730	-	-	-	-	-	-	-	-	12	-
G06Q001006	-	-	-	-	-	-	29	-	-	-
B60R002100	-	-	-	-	-	-	-	-	-	4
B05B001500	-	-	-	-	-	-	-	-	-	3
B60K002000	-	-	-	-	-	-	-	-	-	3

Table 5 Claim count in patent applications.

Claim Count	Google	IBM	Samsung	Microsoft	Qualcomm	HCL	TCS	Infosys	Wipro	Mahindra
0-10	833	48	7341	6890	1347	200	169	31	308	258
11-20	4539	15349	13533	11448	2844	27	234	128	90	9
21-30	3026	4144	4599	689	3717	12	20	90	74	0
30-50	757	415	1289	214	4179	6	6	25	8	0
51-75	107	16	117	28	1374	0	2	1	1	0
76-100	27	4	11	4	336	0	0	0	0	0
>100	11	0	2	1	103	0	0	0	0	0

Table 6 Illustration of counts for family size, claim count, citations, number of inventors and assignee count. *Rounded off to the nearest whole digit.

	IBM	Samsung	Microsoft	Qualcomm	Google	TCS	HCL	Mahindra	Infosys	Wipro
Average Family Country*	4	6	6	13	6	4	1	2	2	2
Average Claim Count*	17	16	15	33	21	14	19	6	21	20
Maximum Claim Count	99	126	113	208	119	59	50	18	56	54
Minimum Claim Count	1	1	1	1	1	1	3	1	1	5
Maximum Assignee Count	62	23	19	21	16	13	6	5	11	9
Average Assignee Count*	3	2	2	2	2	2	1	1	3	1
Maximum Backward Reference	571	598	1248	1509	2007	37	15	26	148	51
Minimum Backward Reference	1	1	1	1	1	1	1	2	1	1
Average Backward Reference*	23	16	27	29	26	6	5	10	12	9
Maximum Forward Reference	112	151	189	85	206	32	6	50	101	28
Minimum Forward Reference	1	1	1	1	1	1	1	1	1	1
Average Forward Reference*	4	5	9	4	9	3	2	19	5	5
Maximum Inventor Count	61	21	60	20	29	12	10	8	10	8
Average Inventor Count*	4	3	4	3	3	3	3	3	3	2

A further analysis of the IPCs taking into consideration the full IPC revealed that all these companies are working in different domains with a minimum domain mapping with each other. This is highlighted in Table 4 for the top 3 patenting technologies of each company based on the IPC. Google has around 17% of its technologies patented in G06F001730 ("information retrieval"), while Microsoft and IBM map the same technology with around 15% and 9% of their total patents, respectively. Qualcomm and Samsung work in the same domain of H04W000400 ("services specially adapted for wireless communication networks") with about 7% and 3% of their total patent filings in this domain.

Even though Microsoft leads in G06F001730 ("information retrieval"), a closer look of its filings reveals that it has decreased its applications in information retrieval for the last 10 years. At the same time, Google has increased its activity in this field.

4.5 Claims filed by US and Indian IT companies

Claims play an important role in patent document. The patent description reveals how to make and use the invention, while the claims define the scope of legal protection and provide boundaries of the patent owner's exclusive rights. Hence, patent assertion for novelty depends on its claims (Merges & Nelson, 1990). Thus the number of claims of a patent document determines the depth and breadth of the technology for which protection is sought.

Table 5 shows the claim counts for each of the companies in this study. Usually, patent claims are in the range of 1-10, as claims above 10 incur additional filing charges. However, as seen above, less than 20% of the patents have claim counts of less than 10. Around 53% of the patents have claim counts between 11 and 20. All of the US-based companies have the maximum patent applications with claims in the range of 11-30. One important thing to note is that the US-based companies also have about 3% of their patents with more than 50 claims in a patent document. At the same time, Qualcomm has more than 13% of its patents with more than 50 claims each. Google has 11 patents with claim counts of over 100, Qualcomm has 103 (about 1%) patents with claim counts of over 100. This is much higher than the average patent claim counts. Google can be seen in Table 5 with a patent having 119 claims, whereas Qualcomm had a patent (application number EP2559309A1) with 208 claims. It can also be seen that Qualcomm leads with the highest average claim count in patents with more than 33 and Google following it with an average of about 21 claims per patent document. Indian companies Infosys, Wipro and HCL have an average of around 20 claims per patent document.

4.6 Analysis based on patent family size, claims count, number of citations, number of inventors and assignees for Indian and US IT companies

As highlighted in Table 6, the average family size of a patent is 4.7, while all the Indian companies are below this average count, US companies, baring IBM, have an average family size per patent higher than 6. Qualcomm has the highest average family, around 13 per patent. Base on this, it can be derived that Qualcomm tries to enforce its inventions in most countries simultaneously. However, IBM, which has much higher patent families than Qualcomm, has an average family size of around 4. This is the lowest for the US-based companies. If correlated with the origin of inventions, IBM has the maximum presence, in 13 countries, from where its technology has emerged. Hence it can be deduced that IBM's strategy is to enforce particular technologies in specific countries only and not in many countries, as in the case of Qualcomm.

A patent application contains references to other patent documents in its description (WIPO-b). These references can be forward or backward references. While the backward citations refer to the publicly available technological documents to form prior-art, the forward citations highlight all other patents and refer to the new patent application (WIPO-c). These citations, when analyzed, give insights into the evaluation of a particular technology (Breitzman, 2010).

Table 6 shows that all of the US based companies have an average backward citation above 20, except for Samsung which has an average citation above 16. With respect to the Indian companies, the average backward citation is less than 10. The US-based companies had at least one patent with a maximum backward citation of more than 500. Google had a patent with 2007 citations, whereas Qualcomm and Microsoft have patent publication with maximum backward citations of 1509 and 1248, respectively.

The forward citations are also useful from a competitive or business intelligence perspective to identify players working in a similar area or technology to the new patent application. Monitoring the forward citations of a new patent application allows a user to identify new competitors entering a similar field of technology, potential infringers and possibly, potential licensing opportunities (Minesoft). Google and Microsoft have the highest average forward citations for patents, with an average of about 9 forward references per patent, while HCL had the minimum with 2. Thus it can be inferred that patents of Google and Microsoft are used by other players to advance their technologies. Google has a patent with the maximum of 206 forward citations, while Microsoft has 189 forward cited patents for its publication. Infosys tops the list on the Indian side with 101 forward references in its patent publication number US7787887B2.

The number of inventors per patent is summarized in Table 6. It can be seen that for all of the companies the average inventor count per patent is around 3. Even then, IBM and Microsoft have patents with inventor counts of more than 60, and they are the only two companies with an average inventor count around 3.5.

5. CONCLUSION

Business intelligence in general and competitive intelligence in particular has been traditionally used for inputs related to sales, marketing and finance. However, the use of

patents as strategic business tools has opened a new horizon for the use of patent analytics in gaining inputs based on business intelligence and competitive intelligence. Patent analytics based on competitive intelligence can be used for understanding the strategies used by companies in advocating their patent portfolio and aligning their business with patenting activities.

It can be seen from the study that the ICT companies in the study are not directly competing with each other in the same technological domain, except for G06F001730 (information retrieval). Indian companies are far behind in protecting their IP, although they are now on course correction and have started aggressively protecting their inventions. It is observed that the patent filing strategy of Qualcomm differs from its competitor IBM because Qualcomm is filing patents in all major countries while IBM has it presence felt only in specific countries, which can be seen from average patent family countries count. Claims in the patent document highlight the technological depth and breadth of patent applications, and Qualcomm seeks protection to maximum claims, thereby revealing its strategy of covering many aspects of a technology within a single patent application. Based on forward and backward citations, it appears that Microsoft and Google possess high quality patents. It is apparent that IBM uses disclosure strategies, as 30% of IBMs patents are dead, resulting in the technology coming into the public domain. This may be a tactic to force competitors out of their activities. Contrary to IBM's tactics, Samsung has 85% of its patents enforced, while rentaining the highest number of patent families, proving it to be a serious player in protecting its intellectual property. Business and competitive intelligence, when use to study IP competitive analysis, can yield IP strategies that may enable firms to align their IP strategy with their business strategy.

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