

## Technical edge for competitive advantage by patenting: A study of Indian semiconductor industry

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### Abstract

*Every successful organization is a masterpiece of some brilliant minds and skills of knowledge workers. This can be seen in the fields like Pharmaceuticals, IT, Telecom, Electronics, Electricals Bio-technology, etc. They all emphasized on newer and competitive innovations resulting into patents for upliftment of their enterprises. This paper also tries to explain one such aspect of semiconductor industry. This paper establishes a relationship of patenting with competitive edge in the global market. The study is based on the analysis of selected 20 Indian semiconductor product manufacturing companies. On the basis of the results from data collected, it has been observed that the firms with more inclination towards technical edge through newer innovations are leading a competitive and comfortable advantage in global market. This added advantage happened due to increase in the number of patents by the companies. This result is supported by almost all the sample companies whether from telecom or electronic industry.*

### Keywords

*Patents, Competition, Semiconductor, Information Technology (IT), Trade Related Intellectual Property Rights (TRIPS), Technology.*

### 1. Introduction

Technological change has been found to have a decisive impact on the competitive structure in many industries. A study of the US hard drive industry showed that companies which had led the markets were driven out because they did not recognize the potential of new, disruptive technologies.[1] The importance of technology for competitive advantage has caused a substantial increase in industrial research and development (R&D) spending.[2] Maximizing the contribution of R&D to a firm's strategic and commercial objectives is the fundamental objective of technology management.

The exploitation of IP can form the basis for a business strategy. However, it is equally important for businesses to stay abreast of industry and competitive developments, including continuous monitoring of newly published patent documents. As Jelinek and Schoonhoven (1990)[3] highlight that in industries such as semiconductors, computers, and biotechnology success lies in not pulling it off once but replicate technological innovations repeatedly over the long run. Innovation in such industries relies on cutting edge developments in a number of basic scientific and engineering fields such as materials science, electrical engineering, and electro physics, e.g., IBM's development of a copper (instead of the aluminum usually used) interconnect for use on chips, which relied on breakthroughs in photolithography, electrical engineering, and design testing (Spooner 2000).[4] While the renewal of its technological knowledge base is crucial to a firm, this is by no means an easy task.[5]

This study revealed that continuous technical upliftment had a positive effect on the competitive environment of the sample companies. The study empirically analyzed 20 Indian semiconductor product manufacturing companies which are applying their patents in India. The sample includes both big giants as well as small companies.

### 2. Objective of the study

There are many Indian subsidiaries of the foreign based MNCs which are having their hands on the technical market of India. They have their research centers all over India and are collecting revenues on the basis of patents filed by them through their respective manufacturing units. This article is trying to identify the bonding factors between companies' technical advancement and their competitive positioning. The main objectives behind this paper are:

1. To establish a relationship of patenting with competitive edge in the global market.
2. To determine the existence of variation of responses among the sample.

### 3. Review of literature

The study is revolving around two main factors patents vis a vis technical change and competitive advantage. Many authors have their own views related to the inter-relationship among these factors. Amongst all, mostly agree to a point that there exists a prominent relationship between patents and technical change of a product in any company. They found that effective patent protection is an important source of competitive advantage.[6] Patented technology can be used externally to achieve important operational and strategic benefits such as access to technology by cross-licensing or R&D alliances. The latter aspect has become increasingly important in many industries in which a strong patent portfolio is a requirement for gaining access to important technological know-how from external sources.[7] Second, patents contain important information for technology management. The value of patent information can be attributed to a variety of reasons[8][9]: Patent data is available even for companies that are not required to report R&D data. In comparison with other information sources, patents are often considered to be the best source for the timely recognition of technological changes[10]. Results from empirical research show a positive relationship between patenting and company performance, if patent applications are weighted according to their quality [11][12][13][14][15][16].

### 4. Research methodology

The study is based on both primary and secondary data. For shortlisting the sample companies, stratified random sampling is used. The secondary data was extracted from majorly two sources: [www.bigpatents.org](http://www.bigpatents.org) for list of companies filing semiconductor patents and prowess & [www.moneycontrol.com](http://www.moneycontrol.com) for companies' financial performance. The primary data was collected through interview and filling of questionnaires. The sample includes 20 Indian IT semiconductor products manufacturing companies. The sample data collected is both nominal and ordinal in nature. Also, due to small number of companies, it cannot be presumed that the underlying population will fit the normal distribution. Hence, a non-parametric test is applied to it. Kendall's Coefficient of concordance is used for ordinal data and Chi-square test for nominal scale questions. For testing the reliability of data, CronBach's Alpha is used.

### 5. Patents and competitive advantage

The primary advantage of a patent is that it can provide the owner with a valuable competitive advantage. The patent data is interesting for several reasons. Patents are a leading, albeit imperfect, indicator of industrial R&D output. Analysis of such data over time gives us information about the inventive performance of firms and industries, the development of technologies and industries and the strategies that firms deploy to attain competitive advantage from their intellectual capital and inventive output. More recently, emerging markets such as Brazil, China and India have also exhibited large annual increase in patent grants, although 60<sup>th</sup>, 65% of this growth is due to increasing number of applications from United States, European and Japanese firms.[17] It helped in improving the economic compatibility of the firms across these countries. On the basis of these studies, we tried to prepare a qualitative study on Indian semiconductor industry. The focus of the study is to see the impact of patents on competitive state of the companies.

In this study, we have shortlisted 20 Indian / Indian subsidiaries of a foreign based IT and telecom companies, manufacturing semiconductor devices with their research and development centres in India. Companies like Bharat Heavy Electricals Limited (BHEL), Samsung India, Larsen and Tubro (L & T), International Business Machine (IBM) India, etc., who are heavily into innovations and getting them patented as soon as possible, agree that the quantum of innovations and patents help them to lead in the global market. Frequent innovations help them to remain in competition. Besides from these top slot of Indian semiconductor industry, almost all the companies admitted that they also have improved their economic compatibility with growth in patents applications file.

There are many companies like STMicroelectronics, Wipro, Sasken Communications, having few but very useful patents also keep on upgrading their innovations and inventing the new ones time and again to stay in the competition.

**Table 1: Respondents View regarding company's competitive edge in past 15 years**

	Increase(1)/Decrease(2) in the	Increase(2) / Decrease(3) in patent application	System of recording employees' innovation( Yes(1)/No(	Incentives to employees for innovati
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	revenues		2))	ons (Yes(1)/ No(2))
Mode	1	2	1	1
Median	1	2	1.5	1
St.Dev	0.82557794	1.46808145	0.967906	0.732695

Moreover, almost all the companies started giving proper weightage to the innovators so as to boost up the urge of working loyally and diligently for the company (refer Table 1). Many companies had started giving share in the profit, many started including innovators' name and other types of tangible and intangible incentives to the people involved.

## 6. Data analysis

The data analyzed is based on questionnaires filled by the senior executives of different Indian and foreign (with Indian subsidiaries) MNCs (Multinational Companies) manufacturing semiconductor devices and patenting the products too. The reliability of data filled was done with **CronBach's Alpha** quotient which comes out to be more than 0.8. Also, it shows that there exists a correlation between the variables of the study.

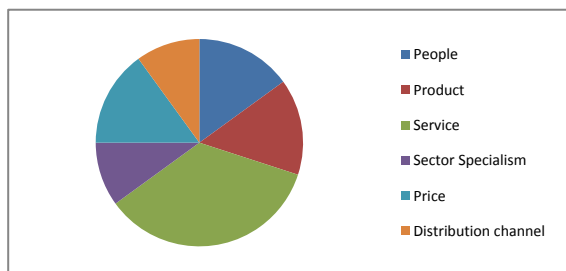


Figure 1: Important source of competitive advantage

The two major variables of the study are: patent application filed (independent variable) and competitive advantage (dependent variable). The data collected is both nominal and ordinal in nature. Two tests had been followed. **Chi-square Test** was used for nominal scale questions and **Kendall's coefficient of concordance (W)** for ordinal scale questions. The hypothesis was tested on 5% level of significance in both the tests. As mentioned above, there are basically two hypotheses in this article.

Table 2: Calculation of reliability test (CronBach's Alpha) and correlation among factors of the study

Cronbach's Alpha	0.806679822
Split-Half (odd-even) Correlation	0.687169857
Spearman-Brown Prophecy	0.814582899
Mean for Test	268.25
Standard Deviation for Test	28.0978202
KR21	1.587550964
KR20	1.835860465

Hypothesis 1: Impact of innovation on competitive advantage of the firm

Kendall's Coefficient of Concordance (W) is used to test this hypothesis. The values are calculated with the help of the following formula:

$$W = \frac{12 \sum_{i=1}^n (R_i)^2 - 3m^2 n(n+1)^2}{m^2 n(n^2-1) - m \sum_{j=1}^m (T_j)}$$

where  $R_i$  is the sum of the ranks for object  $i$ , and is the sum of the values of  $T_i$  over all  $m$  sets of ranks.

**Kendall's W** (also known as **Kendall's coefficient of concordance**) is a non-parametric statistics. It is a normalization of the statistic of the Friedman test, and can be used for assessing agreement among raters. Kendall's  $W$  ranges from 0 (no agreement) to 1 (complete agreement). It makes no assumptions regarding the nature of the probability distribution and can handle any number of distinct outcomes. There were ties in the data collected. The effect of ties is to reduce the value of  $W$ ; however, this effect is small unless there are a large number of ties. To correct for ties, assign ranks to tied values as above and compute the correction factors

$$T_j = \sum_{i=1}^{g_j} (t_i^3 - t_j)$$

where  $t_i$  is the number of tied ranks in the  $i$ th group of tied ranks, (where a group is a set of values having constant (tied) rank,) and  $g_j$  is the number of groups of ties in the set of ranks (ranging from 1 to  $n$ ) for judge  $j$ . Thus,  $T_j$  is the correction factor required for the set of ranks for judge  $j$ , i.e. the  $j$ th set of ranks.

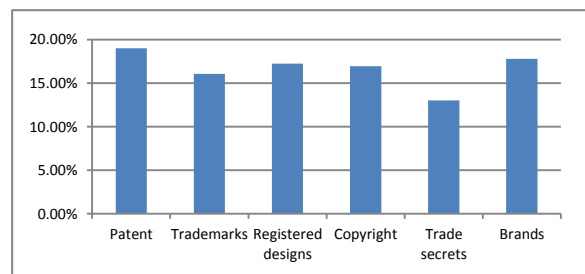


Figure 2: Most favored intellectual asset

The hypothesis was:

$H_0$  – Deepened innovation will not enhance the competition in the market.

$H_1$  – Deepened innovation will enhance competition in the market.

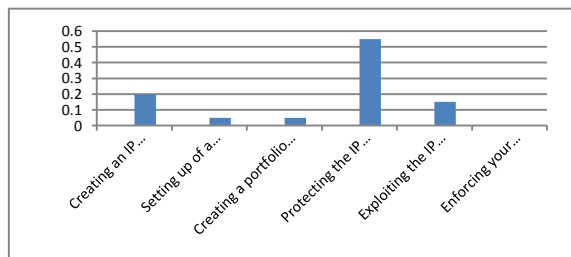
Here, in this study, the value of W was 764.4 as per critical value table of Kendall’s W. But in all four cases (important source of competitive advantage, most important intellectual asset for earning competitive advantage, present challenges in regards to handling patents by the companies and future challenges in regards to handling patents by the companies), where W was calculated, two cases were having their W value less than the table and two were having their values more than that of table value. It means in case 1 and case 2, respondents have their different views and choices but in case 3 and 4 respondents have almost same responses.

**Case 1: Important source of competitive advantage**

As per the data collected, most favored source of competitive advantage among the sample companies were, People, Product, Service, Sector Specialism, Price, Distribution Channel. Maximum respondents preferred service than to product or new products as an important source of competition (Refer Chart 1). 35% of respondents says that on the basis of after sales services, they are maintaining their competition in the market. Product, people and price bags the second preference supported by 15% of respondents each followed by sector specialization and distribution channel with 10% preference each.

**Case 2: Important intellectual asset for earning competitive advantage**

Out of all intellectual assets like Patents, Copyright, Trademarks, Registered designs, Trade secrets and brands, Patents was the most favored intellectual asset. Although there were other types of intellectual assets having equal preference but this was the most favored one. Around 19% of respondents selected



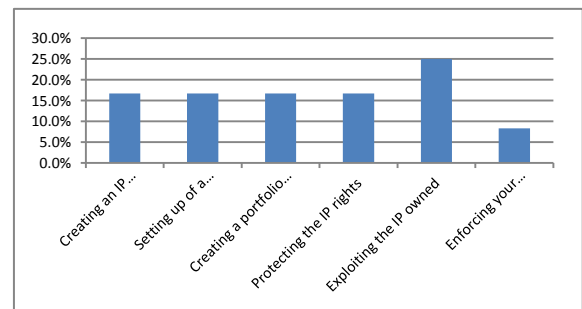
**Figure 3: Present challenges in regards to handling patents by the companies**

patents as their most favored asset followed by brands, registered designs, copyrights, trademarks and trade secrets by 18%, 17.3%, 17%, 16% and 12% respectively (Refer Chart 2).

**Case 3: Present challenges in regards to handling patents by the companies.**

Every company has to face a number of challenges while protecting patents. We tried to identify some major challenges a company may have to face. As per the respondents, the most threatening challenge among all is exploiting the IP owned. This fact was supported by 25% of the respondents. It was then followed by protection of IP rights, creation of a IP portfolio, setting up of dedicated IP rights, creation of IP strategy with 16.67% of respondents supporting the each factors respectively. The least faced challenge in the present scenario is enforcement of organization’s IP supported by 8.3% (Refer Chart 3).

**Case 4: Future challenges in regards to handling patents by the companies Companies have to face some future challenges in**



**Figure 4: Future challenges in regards to handling patents by the companies**

order to retain in the global market. After studying all the literature few challenges were shortlisted. On the basis of it, the responses were taken. As per this study, the biggest challenge for unforeseen future is protection of existing IP rights. This fact was supported by 55% of the respondents. The second biggest challenge is creation of IP strategy supported by 20% of respondents following by 15% respondents saying exploitation of owned IP as their biggest challenge. 5% of respondents from each category says that creation of a IP portfolio, setting up of dedicated IP rights, creation of IP strategy are the future challenges (Refer Chart 4).

Now, when these preferences were tested on Kendall’s Coefficient of concordance (W), it was found that in Case 1 and Case 2, respondents have different views. It is varying from one option to other options. But in

case 3 and case 4, most of the respondents go for same preferences. There is unanimity upto a very high scale.

**Hypothesis 2:** Variation in the responses

H<sub>0</sub> – There is no variability in data and the change is due to chance

H<sub>1</sub> – There is significant variability in data.

In the other test for second hypothesis i.e. Chi-square Test, the nominal data was tested on the basis of following formula.

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

Here, O is observed frequency and E is expected frequency. Also, all the frequencies are hypothetically equal in each category. On the basis of given frequencies, expected frequencies were calculated and further calculations were done. As per this study, the degree of freedom is 19(20-1). The chi-square critical value comes out to be 30.14. In all cases, the evaluated value of chi-square is less than the critical value of chi-square. It means Chi-square is accepted in all the cases and hence, there is no variability in data. The data is genuine. It means all the respondents have a same point of view for all the queries and have same point of view for Indian semiconductor industry.

## 7. Interpretation and suggestions

The study comprises of a series of tests and calculations which were discussed in previous sections. On the basis of it, we found some observations. Firstly, all the sample respondents have a view that with an increase in innovative activities, their financial position also upgraded. They believe that active and deepened innovations have positively affected the company's performance and competitive advantage over other competitors. Secondly, with every new innovation, the responsibility to hold it also comes. When the respondents were asked about the challenges they have to face after any invention is made. They responded in almost same way (Refer Chart 1 and chart 2). 25% people refer that exploiting the existing owned IP is the biggest challenge for the companies (as per chart 3) and for upcoming innovations and patents, 55% respondents says the biggest challenge will be to protect the IP rights from competitors (as per chart 4).

## 8. Conclusion

From a cursory view, it is clear that whether a company is big or small, the respondents have a almost same view regarding the impact of innovations on company's advantage over its competitors. There are few observations from this study. Firstly, new and continuous invention is a key to stay competitively in the global market. If any company (IT, Telecom and Electronics), stays with few or no innovations, it is very hard for them to compete. Even the service companies, like Tata Consultancy Services (TCS), Sasken Communication, Tejas, Wipro, etc. have to go for some research and development for staying in competition in the market. Some companies had even gone for multiple R & D centres at different locations throughout the country for more and extensive innovations done. Secondly, it does not matter how many patents a company has but the quality also plays a vital role. Some companies with lesser patents but unique patents are also heading the market. Thirdly, with increasing patents, the responsibility to hold them also comes. It means every company is taking innovations and patents that seriously that they have a special department with them to take care of all legal protections for such innovations and they are doing it very diligently. Fourthly, the strategy makers of the company are very much clear that the market condition changes with newer innovations. They are always very watchful of their competitors move. Simultaneously, they take care of their knowledge workers. They have their fixed patent policy which is always being communicated to all the employees well in advance and in detail. Fifthly, the companies are very much vigilant about their patents and their trade secrets. No employee is allowed to share and information with anybody and no outsider is allowed to interfere in their patent strategies. Another conclusion is that due to this conservative approach, not all companies are supportive enough to share their views and approach about patents. Seventhly, the unanimity of responses shows that Indian semiconductor industry has a very positive approach about newer innovations and their patents granted worldwide. The environment has become so competitive that it has become hindrance for new entrants to make their presence countable. Lastly, the scope of patents is very large in India.

The law is also very supportive and watchful too. The patent law is so open that many foreign MNCs with Indian subsidiaries can easily file their patents here and, if lawfully correct, can enjoy the positive inputs from it.

Through this study, it is clear that Indian semiconductor industry is a very wide and evergreen field to support newer innovations and patents and hence, our hypothesis of positive impact of deepened innovations on enhanced competition in market is true.

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### Appendices

**Table 3: Kendall’s Coefficient of Concordance (W)**

	Sum of ranks ( $\sum R_j$ ) <sup>1</sup>	$(R_j - \bar{R}_j) * (R_j - \bar{R}_j)$ <sup>1</sup>	t1	Sum of ranks ( $\sum R_j$ ) <sup>2</sup>	$(R_j - \bar{R}_j) * (R_j - \bar{R}_j)$ <sup>2</sup>	t2	Sum of ranks ( $\sum R_j$ ) <sup>3</sup>	$(R_j - \bar{R}_j) * (R_j - \bar{R}_j)$ <sup>3</sup>	t3	Sum of ranks ( $\sum R_j$ ) <sup>4</sup>	$(R_j - \bar{R}_j) * (R_j - \bar{R}_j)$ <sup>4</sup>	t4
	65.50	18.78	27.00	87.00	113.78	143.50	52.00	205.44	57.00	69.00	0.00	48.00
	75.00	26.69	25.50	73.50	8.03	14.50	53.00	177.78	43.50	61.00	64.00	117.00
	63.00	46.69	34.00	79.00	7.11	66.50	65.00	1.78	40.50	76.00	49.00	75.00
	75.50	32.11	23.00	77.50	1.36	49.50	67.00	0.44	25.50	45.00	576.00	114.50
	76.00	38.03	14.00	59.50	283.36	72.00	72.00	32.11	40.50	67.00	4.00	38.00
	64.00	34.03	30.50	81.50	26.69	87.00	89.00	513.78	50.00	96.00	729.00	149.00
<b>Total</b>	419.00	196.33	154.00	458.00	440.33	433.00	398.00	931.33	257.00	414.00	1422.00	541.50
<b>R<sub>j</sub></b>	69.83			76.33			66.33			69.00		
<b>W</b>	0.12			0.33			0.62			1.00		



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