

## **R & D : A Strategic Marketing Enabler – An Empirical Analysis of Pharmaceutical Industry in India**

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### **INTRODUCTION**

The paper aims to provide a comprehensive overview of the patterns of the R & D expenditures and to explain the economics behind technology and research environment in simple terms in context of pharma industry in India. *"To enable Indian pharmaceutical industry to play a leading role in the global market and to ensure abundant availability, at reasonable prices within the country, of good quality pharmaceuticals of mass consumption"* is the formal vision statement of Department of Pharmaceutical, Ministry of Chemical and Fertilizer, Government of India. To achieve this vision R & D certainly has an influential role to play. In no other industry segment innovative R & D is as critical as in pharma industry. Earlier research cites that the major players within the pharmaceutical industry have long positioned themselves as global players (KPMG, 2006).

The major opportunities for the Indian pharmaceutical industry are in the areas of : Generics (including biotechnology generics), biotechnology, outsourcing (including contract manufacturing, information technology (IT) and R&D outsourcing. So it is imperative to study R & D expenditure patterns and its output. The paper is organized as follows. Section 1 presents the literature review on R & D and the role of R & D in enhancing competitiveness of business. Section 2 analyses the regulatory regime and trends of the R & D expenditures to provide insights into R & D and technology absorption scene prevalent in pharmaceutical inductor in India. Policy implications for policy makers to augment country's ability to improve the competitive position for future as well as conclusions are drawn in section 3.

## RESEARCH AND DEVELOPMENT AND STRATEGIC MARKETING IMPLICATIONS

In pharmaceuticals sector the R & D has the influential role in strategy formulation for success, e.g. innovation, is crucial to compete in the pharmaceutical sector, including drug discovery, exploiting generic markets, collaborating research, and new technologies in drug delivery has led to success of Ranbaxy. Eureka moment of next blockbuster products is something every pharmaceutical company yearns for, as patents provide time limited protection. The cost of drug discovery is huge, the widest possible global sales are needed to recoup the investment, reinvest in the next generation of research and development, and make a decent profit (KPMG report, 2006). Because of the deterring cost of obtaining patents in the US, MNCs shift the technology and innovation development to lesser costly Asian countries like India and China. Drug discovery through R & D has implication upon sales and profits. The Aurobindo mentions its in-house R & D team of ability to convert its knowledge of complex chemistry and pharmacopoeia into a key competitive advantage of Aurobindo. The R & D team also focused on product development - searching for promising products to meet customer and quality development - continuously improving the quality of existing products. In the same way Swiss-based Novartis tasted huge success after having new medicines approved by the Food and Drug Administration (FDA) in the USA. Aurobindo pharma also claims that the product offering was widened through intelligent research and fast tracked the company (annual report, Aurobindo 2009).

With the policies of liberalisation and reforms in 1991, competition has increased at global level and importing technologies by Indian firms became easier. This also led to increased in-house R & D and many multinational companies set up new R & D centres (Bowonder and Richardson, 2000). Moreover, the R & D focus of world is changing. While the US and the Western Europe have been the traditional locus of R & D, China and India are emerging as the destinations for R & D (Li and Zhong, 2003; Sun and Wen, 2007; see Asakawa & Som, 2008 for comprehensive review). The R & D costs are massive, the results uncertain. A viewpoint on pharma companies has recommended them to keep investing in R & D (as the force named "karma" in Buddhist and Hindu religions) as a necessity for future success (Pharma's global karma : Focus on Novartis, Pfizer and Ranbaxy). The pharmaceutical industry being the knowledge based industry seems to be a good representative of technological and innovative environment in India. The government of India has the focus to develop the technology absorption and research under the aegis of central bodies like Council of scientific and industrial research (CSIR).

India is a huge market for pharmaceutical companies with more than one

billion population and emerging affluent middle class with higher disposable incomes as well as access to medical insurance. So a huge opportunity lies ahead of leading drug manufacturers, the pharma companies in India need to invest in R & D to exploit this opportunity.

### THE INDIAN PHARMACEUTICAL INDUSTRY

This is one of the fastest growing sectors of Indian economy. This sector is now presently valued at estimated 1,00,000 crores (USD 20 billion), has tremendous potential. Mckinsey and Company has predicted growth rate of 10-14% in this industry. The Indian pharmaceutical market is expected to touch USD 40 billion by 2015. Indian pharmaceuticals meet about 70% of country's demand. There are about 250 large units and about 8000 small units (including five Central public sector units). Large 250 units control about the 70% of the market. The "organized" sector of India's pharmaceutical industry consists of 250 to 300 companies, which account for 70 per cent of products on the market, with the top 10 firms representing 30 per cent. However, the total sector is estimated at nearly 20,000 businesses, some of which are extremely small. Approximately 75 per cent of India's demand for medicines is met by local manufacturing. The sector is plagued with severe price competition and government control.

| Country  | Growth Rate | Expected Size |
|--|-------------|---------------|
| US market (world's largest)  | 1-2%        | NA            |
| Japan (world's 2nd largest)  | 4-5%        | 84-88         |
| Top five EU countries (France, Germany, Italy, Spain, U.K)                   | 3-4%        | 162-172       |
| Emerging countries China, Brazil, Turkey, Russia, Mexico, South Korea, India | 14 -15%     | 105-115       |
| Overall global pharmacy market   | 4.5 -5.5 %  | 820           |
| India  | 12-13%      | 30 (by 2020)  |

Source : Annual reports of various companies, NA : Not Available

The industry is going through plateau of new product approvals, generic drug substitution, and new opportunities for outsourcing R&D in developing country. The CRAMS (Custom/ Contract Research and Manufacturing Services) basically innovation driven is expected to grow at around 15%. With approximately \$70- 80 billion worth of patent protected drugs to go off-patent by 2012 and inclusion of healthcare reforms in 2010 budget plan of US, a wide opportunity is waiting in its wings.

## REGULATORY REGIME

On January 1, 2005, India introduced a system of product patents (before that, only patents for processes were permitted, this led to domestic industry's great success as a global exporter of high quality generic drugs. It also proved to be influential in bringing back pharma MNCs after they had left India in 1970s. Now India is a preferred destination for strengths in contract manufacturing and for research and development (R&D), particularly in the conduct of clinical trials and other services.

## OBJECTIVES

The purpose of this paper is :

1. To analyse total R & D expenditures and its constituent parts i.e. the capital and revenue expenditure.
2. To investigate variations in R & D of Indian and MNCs Pharmaceutical firms.
3. To find out the association between R & D expenditures and Sales and profit after tax (PAT).
4. To analyse the research output of the selected companies using DMF (Drug Master Files) registered with FDA (Food and Drug Authority, U.S.) as a proxy of research output.
5. To investigate the research orientation of the top 20 pharma companies in India.

## DESIGN/METHODOLOGY

The study is an exploratory and empirical study of R& D expenditures of top 20 companies in pharmaceutical sector in the year 2010 selected on the basis of market capitalisation. The study has used the US DMF's (Drug Master Files) as a surrogate measure for the R & D output from India. The grant of patents/DMF has been considered as a tangible, measurable and recorded output of the technology development process previously.

The descriptive statistics has been used to compare and analyse the R & D expenditures patterns and to study inter- firm variations in the pharma sector of India. Further, mean R & D is calculated to find out the inter company variation in disclosures.  $\chi^2$  (Chi Square) test has been used to test the significance of variation in R & D expenditures. Kruskal-Wallis Test has been used whereas the skewness and Kurtosis of data indicated some deviation from normality. Correlation of R & D expenditures with sales and PAT has been conducted on the collected data. The significance of correlation is tested. The SES has been estimated roughly

to check the normality assumption (Tabachnick & Fidell, 1996; Brown, 1996). Values of 2 standard errors of skewness (ses) or more (regardless of sign) are probably skewed to a significant degree. SPSS 16 and Stat graphic Centurion XV have been used to compute correlation, significance of correlation etc.

### **TIME PERIOD OF THE STUDY AND DATABASE**

The annual reports of the selected companies are collected from the Ludhiana Stock Exchange/websites. The data includes all US DMF's (Drug master files) as reported in the annual reports of selected companies for the year 2010. Since long, the use of annual reports has been validated by earlier researches for accessibility, consistency, timeliness and finally it being an audited and comprehensive document; perceived to be more reliable than other documents (Chander, 1992; Brennan, 2001; Olsson, 2001).

**Sample Selection :** Top 20 pharma companies in India have been selected on the basis of market capitalisation. The large firms are expected to make more investments towards new drug discovery and innovation. Rao (2008) also stated that large firms are rapidly moving towards discovery and development of new drugs, while medium and small firms engage in the production of off-patent generics and contract manufacturing, respectively. Varukolu and Park-Poaps, (2009) reported that firm's technology adoption was significantly related to firm size positively in apparel industry.

### **REVIEW OF LITERATURE**

A lot of literature on R & D concentrate on internationalisation and changing trends of research (Walsh, 2007; Bowonder and Richardson, 2000; Feinberg and Majumdar, 2001; for comprehensive review see Asakawa and Som, 2008). Chakrabarti and Bhaumik (2009) have argued that the multinational companies from the US outsourcing have driven the recent growth in Indian patenting and are using more of all-Indian teams for patentable research. The importance of technology absorption and foresight in industries is well accepted. If India wants to maintain the momentum of growth in corporate R & D, it faces the challenge of upgrading its higher education in producing technical graduates at master's and doctoral levels. Wonglimpiyarat (2006) studied the technological potential of the Thai industry and suggested to devise development policies necessary to make the Thai industry successful by the year 2020. Bhaumik and Chakrabarti (2009) found that both China and India have achieved very high growth rates in patents granted. Varukolu and Park-Poaps, (2009) in a study of apparel manufacturers in Tripura town, found that the level of a firm's technology adoption was significantly related to firm size positively and its export orientation negatively. Singh, (2005)

shows the importance of technology in emergence of information society in India. Todd and Javalgi, (2007) have emphasized the internalisation of SME with advancements in information technology and improvements in communication infrastructure. Nagesh and Aggarwal (2005) found determinants of R & D behaviour of Indian enterprises and their impact on the R&D behaviour of MNE affiliates and local enterprises.

**Analysis and Discussion :** The study proposes and tests the following hypotheses :

**H<sub>1</sub>** : There are not any significant variations in R & D expenditures by top 20 pharma companies.

To test this the R&D expenditures of top 20 pharma companies are collected as reported in latest available annual report of the companies.

It is seen that where the companies like Glaxosmithkline (0.42%) are making least expenditures on R & D, the companies like Cadila (11.58%) making maximum expenditures on R & D as a percentage of sales. The recurring R & D expenditures are more than the capital R & D expenditures of the companies. The average R & D expenditure as a percentage of sales is 5.4725%. 11 companies namely GlaxoSmithKline (0.42%), Abbott (.80%), Piramal (1.50%), Alembic (4.27%), orchid chemicals (4.33%), Aurobindo (3.6%), Pfizer (3.79%), IPCA (3.71%), Aventis (1.35%), Cipla (5%), Divi's labs (2.31%), are spending less than average whereas the nine companies namely Cadila (11.58%), Ranbaxy (10.9%) Panacea Biotec (9.10%), Dr. Reddy's Lab (8.79%), Lupin (8.70%), Torrent (8.62%), Sun pharma (8.50%), Wockhardt (6.42%), Biocon (6.3%), spend more than average R & D expenditures.

Mean capital expenditure is 175 million rupees and mean recurring expenditure is app. 1204 million of rupees. The table 2B shows summary statistics for each of the selected data variables. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here is the standardized skewness, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would have tended to invalidate many of the statistical procedures normally applied to this data. The coefficient of variation is found to be least in R & D expenditures when figures are considered in percentages so, further analysis of the R & D expenditures as a percentage of sales has been used. The calculated value of  $\chi^2$  is 41.46 is more than the table value 30.14 at 19 d.f. therefore; null hypothesis proposing no variations in R & D expenditures by top 20 companies is rejected. So, R & D expenditures vary between company to company widely.

In 2005 the pharmaceutical companies in India were making R&D expenditures at 2 per cent of sales which was far below the global level of 10 to

**Table 2A**  
**R&D expenditures of selected companies**

| Name of Company                      | Research Exp.      | Capital | Recur-<br>ring | Total R&D<br>Expen-<br>ditures | As %<br>of<br>turnover |
|--------------------------------------|--------------------|---------|----------------|--------------------------------|------------------------|
|                                      | In Millions Rupees |         |                |                                |                        |
| Abbott India Limited                 |                    | 1.01    | 59.357         | 60.367                         | 0.80                   |
| Alembic Limited                      |                    | 57.7    | 432.7          | 490.4                          | 4.27                   |
| Aurobindo Pharma Limited             |                    | 42.1    | 972.7          | 1014.8                         | 3.06                   |
| Aventis Pharma Limited               |                    | 81      | 51             | 132                            | 1.35                   |
| Biocon Limited                       |                    | 129     | 1126           | 1255                           | 6.3                    |
| Zydus Cadila Limited                 |                    | 385     | 1763           | 2148                           | 11.58                  |
| Cipla Limited                        |                    | 119.9   | 2506.9         | 2626.8                         | 5                      |
| Divi's Laboratories Limited          |                    | 101.7   | 112.8          | 214.5                          | 2.31                   |
| Dr. Reddy Laboratories Limited       |                    | 254     | 3643           | 3897                           | 8.79                   |
| GlaxoSmithKline Pharmaceuticals Ltd. |                    | 33.46   | 46.68          | 80.14                          | 0.42                   |
| IPCA Labs                            |                    | 67.6    | 505.2          | 572.8                          | 3.71                   |
| Lupin Pharmaceuticals                |                    | 681     | 3438.1         | 4119.1                         | 8.70                   |
| Orchid Chemicals Ltd.                |                    | 5.775   | 538.849        | 544.624                        | 4.33                   |
| Panacea Biotech                      |                    | 231.4   | 577.2          | 808.6                          | 9.10                   |
| Pfizer Limited                       |                    | 0.906   | 291.751        | 292.657                        | 3.79                   |
| Piramal Health Limited               |                    | 41.9    | 361.9          | 403.8                          | 1.50                   |
| Ranbaxy Laboratories Limited         |                    | 221.98  | 4721.84        | 4943.82                        | 10.9                   |
| Sun Pharmaceuticals Industries Ltd.  |                    | 159     | 1440.8         | 1599.8                         | 8.50                   |
| Torrent Pharmaceuticals Limited      |                    | 104.8   | 1090.7         | 1195.5                         | 8.62                   |
| Wockhardt Limited                    |                    | 799.58  | 399.08         | 1198.66                        | 6.42                   |

**Source :** Compiled from the annual reports of respective companies)

**Note :** In case of Lupin and Panacea the figures in column four are as a % of net turnover instead of Gross turnover.

**Table 2B****Descriptive statistics of R&D expenditures of selected companies***(In Millions Rupees)*

|                          | Capital exp | Recurring | Total    | Total R&D exp. As a % of sales |
|--------------------------|-------------|-----------|----------|--------------------------------|
| N Valid                  | 20          | 20        | 20       | 20                             |
| Mean                     | 175.9406    | 1,203.98  | 1,379.92 | 5.47                           |
| Std. Deviation           | 217.19703   | 1,352.02  | 1,449.08 | 3.46                           |
| Coefficient of variation | 1.24        | 1.12      | 1.05     | 0.63                           |
| Std. Error of Skewness   | 0.512       | 0.512     | 0.512    | 0.512                          |
| Range                    | 798.67      | 4,675.16  | 4,883.45 | 11.16                          |
| Minimum                  | 0.91        | 46.68     | 60.37    | 0.42                           |
| Maximum                  | 799.58      | 4,721.84  | 4,943.82 | 11.58                          |

20 per cent. Nevertheless, the domestic industry is still spending far too little on R&D, which must change quickly if it is even to begin to address these new opportunities and challenges (KPMG report, 2006). Within five years the figure has risen to 5.4725%, still almost half of lowest in U.S companies. The R & D expenditures of selected firms were benchmarked against the minimum of R & D expenditures incurred by U.S. firms. For this t-test has been run. The null hypothesis proposing no difference between minimum of R & D expenditures of U.S. firms and selected firms was rejected for  $t = 5.85958$   $P\text{-value} = 8.8712$  for  $\alpha = 0.05$ .

**H<sub>2</sub>** : There is no significant difference between the R & D of Pharmaceuticals Indian and Pharmaceuticals MNC's.

Average R & D expenditures are 6.44 % of sales in Indian companies and 1.59 % in MNCs. The maximum R & D expenditures incurred by Indian firms are 11.58% and by MNCs pharma is 3.79% of total sales. The C.V of Indian companies is almost half of mean R & D expenditures incurred by MNCs pharma, thus indicating that there is more variation in R & D expenditures by MNCs pharma. To check whether mean R & D expenditures of Indian pharma differs significantly from MNCs pharma the ANOVA test has been conducted.

The ANOVA table decomposes the variance of total R & D expenditures into two components : a between-group component and a within-group component. Since F-ratio equals 8.95499, Since the P-value of the F-test is less than 0.05, the null hypothesis is rejected, indicating a statistically significant difference between the mean total R & D expenditures from MNCs to domestic firms at the 95.0% confidence level. To determine which means are significantly different from which



**Table 3A****Total R & D expenditures for MNCs and Indian pharma companies**

| Type of Firm | N  | Average R&D | S.D.    | C.V.     | Mini-mum | Maxi-mum | Range | SES       |
|--------------|----|-------------|---------|----------|----------|----------|-------|-----------|
| Indian       | 16 | 6.44312     | 3.10489 | 48.1892% | 1.5      | 11.58    | 10.08 | 0.0542079 |
| MNCs         | 4  | 1.59        | 1.51554 | 95.3171% | 0.42     | 3.79     | 3.37  | 1.33534   |
| Total        | 20 | 5.4725      | 3.45547 | 63.1424% | 0.42     | 11.58    | 11.16 | 0.369866  |

**Table 3B****ANOVA Table for total R & D expenditures of Indian and MNCs pharma.**

| Source         | Sum of Squares | D.f | Mean Square | F-Ratio | P-Value |
|----------------|----------------|-----|-------------|---------|---------|
| Between groups | 75.369         | 1   | 75.369      | 8.95    | 0.0078  |
| Within groups  | 151.496        | 18  | 8.41643     |         |         |
| Total (Corr.)  | 226.865        | 19  |             |         |         |

others, Multiple Range Tests have been conducted.

It also shows the standard error of each mean, a measure of its sampling variability. The table also displays an interval around each mean. The intervals currently displayed are based on Fisher's least significant difference (LSD) procedure.

As the total R & D expenditures distribution was found to be skewed, and reporting the median along with the mean in skewed distributions is a generally

**Table 3C****Mean R & D expenditures Indian and MNCs pharma with 95.0 percent LSD intervals**

| Col.        | Count | Mean    | Std. Error (pooled s) | Lower limit | Upper limit |
|-------------|-------|---------|-----------------------|-------------|-------------|
| Indian      | 16    | 6.44312 | 0.725277              | 5.36567     | 7.52058     |
| MNCs pharma | 4     | 1.59    | 1.45055               | -0.564913   | 3.74491     |
| Total       | 20    | 5.4725  |                       |             |             |

good idea, the Kruskal-Wallis test is conducted. Since the P-value is less than 0.05, there is a statistically significant difference amongst the medians at the 95.0% confidence level.

$H_3$  : There is no significant difference between the R & D of Pharmaceuticals Indian and Pharmaceuticals MNC's.

**Table 3D****Kruskal-Wallis Test for total R & D expenditures of Indian and MNCs pharma.**

| Type of Organisation | Sample Size | Average Rank |
|----------------------|-------------|--------------|
| Indian               | 16          | 12.25        |
| MNCs pharma          | 4           | 3.5          |

Test statistic = 7.0 P-Value = 0.00814917

The present study established Pearson product moment correlation between R & D expenditures and sales. It was found that a positive and weak correlation exists between these two variables at 0.0743 (Table 4). Although it was expected that the companies with higher value of sales might be spending more but the statistical test proved that the P-value being more than .05, the correlation is not significant. So, R & D expenditures are weakly and positively but not significantly related to its turnover. After this the R & D expenditures have been checked for any correlation with PAT.

**Table 4****Correlation between R & D expenditures and sales and PAT**

|                          |                     | Sales  | PAT    |
|--------------------------|---------------------|--------|--------|
| Total R & D expenditures | Pearson Correlation | 0.0743 | 0.0275 |
|                          | N                   | (20)   | (20)   |
|                          | Sig. (2-tailed)     | 0.7557 | 0.9083 |

The results, although do not show any significant correlation the between R & D expenditures and profit after tax. P-values above 0.05 indicate statistically non significant zero correlations at the 95.0% confidence level.

Table 5 shows the DMFs filed by sample companies from India with FDA (Food and Drug Authority, U.S.) from 1.1.1940 to October, 2010. Maximum DMFs have been filed by Cipla Ltd 156, followed by Aurobindo Pharma Ltd 146, then closely followed by Cadila Healthcare Limited with 140 DMFs. FDA website does not show any entries in name of Panacea Biotec and Aventis Pharma Ltd. Cipla Limited spends merely 5% of sales on R&D, but has been able to file maximum DMF, in the same fashion, Aurobindo Pharma still less (3.06% of sales), but holds 2nd position in DMF fillings. This seems to be confounding to some extent. It requires further insights into factors that influence the R&D inputs and outputs. This investigation is apparently outside the scope of this paper.

## **R & D ORIENTATIONS OF PHARMA INDUSTRY IN INDIA**

The issues of R & D which have been reported by almost all the sample companies and remain key areas of each company's strategy are; Innovation,

**Table 5****DMFs filed by sample companies with FDA from India since 1940**

| <b>Sr. No.</b> | <b>Company</b>                          | <b>DMFs Filled</b> |
|----------------|---|--------------------|
| 1.             | Abbott India Limited                    | 20                 |
| 2.             | Alembic Limited (API Division)          | 41                 |
| 3.             | Aurobindo Pharma Limited                | 146                |
| 4.             | Aventis Pharma Limited                  | Nil                |
| 5.             | Biocon India Limited                    | 24                 |
| 6.             | Cadila Healthcare Limited               | 140                |
| 7.             | Cipla Limited                           | 156                |
| 8.             | Divis Laboratories Limited              | 41                 |
| 9.             | Doctor Reddy's Laboratories Limited     | 56                 |
| 10.            | GlaxoSmithKline Pharmaceuticals Limited | 13                 |
| 11.            | IPCA Laboratories                       | 70                 |
| 12.            | Lupin Pharmaceuticals                   | 103                |
| 13.            | Orchid Chemicals Limited                | 85                 |
| 14.            | Panacea Biotech                         | Nil                |
| 15.            | Pfizer Limited                          | 51                 |
| 16.            | Piramal Health Limited                  | 9                  |
| 17.            | Ranbaxy Laboratories Limited            | 114                |
| 18.            | Sun Pharmaceuticals Industries Limited  | 95                 |
| 19.            | Torrent Gujarat biotech Limited         | 23                 |
| 20.            | Wockhardt Limited                       | 66                 |

reduction in energy consumption, improvement in product quality, development of cheap raw material and high productivity. Other specific areas of R & D which find mention in annual reports of selected companies are summarised as below :

Aurobindo focused on process for manufacture of bulk drug and technology oriented R&D driven health care Company have yielded results by way of improved processes in the commercial production.

Biocon achieved global presence in supply of fermentation based small molecules to the Generic Industry in regulated markets and came out with safe and environment friendly processes.

Cadila claims to have tried hard for resources and diversification of risk by developing innovative products in basic research and target in focus therapy continue to develop proprietary formulation technologies for oral drug delivery and expand its research in newer areas like nanotechnology based formulations.

Cipla is making research efforts in direction of development of agro-technology (Indigenous System Development) genetics and biotechnology for cultivation of medicinal plants, development of methods to improve safety procedures, effluent control, pollution control, development of products related to the indigenous system of medicines. Benefits derived as a result of the above efforts are reduction in batch hours, increase in batch sizes, better solvent recovery and simplification of processes, maximum utilisation of indigenous raw materials.

Dr. Reddy's research in global generics, pharmaceutical services and active proprietary products modification of existing manufacturing processes for some of the products and significant savings in cost of production reduce the time cycle

GlaxoSmithKline has latest technology like computer controlled compression machines, IBC systems to avoid dust exposure and electronic tablet counter to fill the bottles, using innovative techniques to minimise manual handling, development of NIR methods for raw material identification.

IPCA is working on new formulations and line extensions, development of new markets, adaptation to meet export requirements, quality up-gradation and cost reduction.

Lupin has taken initiatives in different drug delivery platforms, Bio-adhesive and gastro retentive technologies were deployed Equivalence (BA/BE), clinical studies spread over 23500 square feet with a capacity of 56 beds, became fully operational. The said facility carries out Pilot and Pivotal BE studies for generics as also investigations for new products and ADDS.

Orchid is reported to have been paving way for new CRAMS business opportunity. To improve the profitability, productivity and meet the additional markets, your Company has continued its development and upgraded the manufacturing process of certain carbapenems.

Panacea IPR oriented company paves its way for bio-pharmaceuticals research for development of novel preventive & therapeutic vaccines, therapeutic fully human monoclonal antibodies and therapeutic peptides. It has 5 highly sophisticated ultra-modern R&D centres with around 300 quailed and experienced scientists for its various research endeavours.

Pfizer is studying feasibility of using new manufacturing technology in existing dosage forms and new dosage formulations, pharmaceutical and animal health, development of ancillary technology, for packaging materials and machinery is undertaken

Piramal has installed fill-seal machines, to form bottles suitable to fit tamper proof caps, thereby reducing wastage of, high efficiency air wash system installed, jet printing machine installed on all packing lines for overprinting show boxes to reduce rejection.

Ranbaxy claims to have safe and environment friendly processes and working aggressively on generation of intellectual wealth .

Sun Pharma claims that they are among the few selected companies that have set up completely integrated manufacturing capability for the production of anti-cancer, hormones, peptide, cephalosporin's and steroidal drugs

Torrent has been building capabilities and infrastructure for preclinical development and clinical trials required for NCEs, is being pursued aggressively.

Fifty per cent of the firms have shown patents (filed as well as approved) in quantitative form. Only Orchid attaches monetary values to internally generated DMF's and ANDAs. With 159 ANDAs, Dr. Reddy Labs expects to generate innovator revenues of about U.S. \$ 12 billion (IMS MAT, December, 2008).

#### **RESEARCH LIMITATIONS/IMPLICATIONS:**

Limitations of the study include the validity of DMFs as the measure of innovation and technology development. Only the large firms in pharmaceutical sector have been considered. The result may not be generalised for other sectors or for smaller firms.

#### **PRACTICAL IMPLICATIONS AND SUGGESTIONS**

This paper contributes towards the direction and formulation of feasible technological and research policies for Indian pharma companies. The information about the patterns of R & D expenditures pharma sector in India and the orientation of R & D and technological development can help government to frame appropriate policies for promotion of R & D in India. The current emphasis may not be sufficient as the Managing director and chief operating officer of Dr Reddy's Laboratories Ltd, Satish Reddy, calls on the government to provide a strategy for R&D in India, with specific incentives. "Tax breaks are simply not enough; R&D grants need to be provided in some form, and with a proper framework."

#### **CONCLUSION AND FINDINGS**

The recurring R & D expenditures are more than the capital R & D expenditures of the companies. The average R & D expenditure as a percentage of sales is 5.4725%. Mean capital expenditure is 175 million rupees and mean recurring expenditure is app. 1204 million of rupees. In 2005 the pharmaceutical companies in India were making R&D expenditures at 2 per cent of sales which was far below the global level of 10 to 20 percent. Nevertheless, the domestic industry is still spending far too little on R&D, which must change quickly if it is even to begin to address these new opportunities and challenges. The R & D expenditures of selected firms were benchmarked against the minimum of R & D

expenditures incurred by U.S. firms. The null hypothesis proposing no difference between minimum of R & D expenditures of U.S. R & D expenditures vary between company to company widely. Average R & D expenditures are 6.44 % of sales in Indian companies and 1.59 % in MNCs. It was found that a positive and weak correlation exists between these two variables at 0.0743. There is no significant correlation the between R & D expenditures and profit after tax. Maximum DMFs have been filed by Cipla Ltd 156, followed by Aurobindo Pharma Ltd 146, then closely followed by Cadila Healthcare Limited with 140 DMFs. Key areas of each company's strategy are; Innovation, reduction in energy consumption, improvement in product quality, development of cheap raw material and high productivity.

### References :

- Asakawa, K.; and Som, A. (2008), "Internationalization of R&D in China and India: Conventional wisdom versus reality", *Asia Pacific Journal of Management*, Vol. 25, pp 375-394
- Bagla, P. (2005), "India Rewrites Patent Laws", *Science*, Vol. 30, No. 8, pp. 33.
- Bowonder, B.; and Richardson, P.K. (2000), "Liberalization and the Growth of business-led R&D : The Case of India", *R&D Management*, Volume 30, No. 4, pp. 279-288.
- Bowonder, B.; and Mastakar, N. (2005), "Strategic Business Leadership Through Innovation and Globalization: a case study of Ranbaxy Limited", *International Journal of Technology Management*, Vol. 32 Nos. 1-2, pp. 176-98.
- Brown, J. D. (1996), "Testing in Language Programs Upper Saddle River", NJ : Prentice Hall.
- Bhaumik, P. K.; Chakrabarti, A. K.; and Mäkinen, S. (2009) "Technology Development in China and India: A Comparative Evaluation", *Journal of Indian Business Research*, Vol. 1 No. : 4, pp.213 - 237
- Bhaumik, P. K.; and Chakrabarti, A. K. (2009), "Internationalization of Technology development in India", *Journal of Indian Business Research*, Vol. 1 No. 1, pp. 26 - 38
- Brennan, N. (2001), "Reporting Intellectual Capital in Annual Reports: Evidence from Ireland", *Accounting, Auditing & Accountability Journal*, Vol.14, No.4, pp. 423-36
- Chadha A.; and Æ Oriani, R. (2010), "R&D market value under weak intellectual property Rights protection : the case of India" *Scientometrics*, Vol.82, pp. 59-74
- Chander, S. (1992), "Corporate Reporting Practices in Public and Private Sectors", Deep & Deep Publications, New Delhi, India

- Feinberg, S.; and Majumdar, S. (2001), "Technology Spillovers From Foreign Direct Investment In The Indian Pharmaceutical Industry", *Journal of International Business Studies*, Vol. 32, No.3, pp. 421-438.
- Li, J.; and Zhong, J. (2003), Explaining The Growth Of International R&D Alliances In China, *Managerial and Decision Economics*, Vol. 24 (Special No. ), pp. 101-105.
- Olsson, B. (2001), "Annual Reporting Practices: Information About Human Resources in Corporate Annual Reports In Major Swedish Companies", *Journal of Human Resource Costing and Accounting*, Vol.6, No.1, pp. 39-52.
- Kumar, Nagesh; and Aggarwal, A. (2005), 'Liberalization, Outward Orientation And in-House R&D Activity of Multinational and Local Firms : A Quantitative Exploration for Indian Manufacturing', *Research Policy*, Vol. 34, No. 4, pp. 441-460.
- Rao, P. M. (2008), "The Emergence of The Pharmaceutical Industry in The Developing World and its Implications for Multinational Enterprise Strategies", *International Journal of Pharmaceutical and Healthcare Marketing*, Vol. 2, No. 2, pp. 103-116.
- Singh, S. P. (2005), "The Role of Technology in The Emergence of The Information Society in India", *The Electronic Library*, Vol. 23 No. 6, pp. 678-690.
- Tabachnick, B. G.; and Fidell, L. S. (1996), *Using Multivariate Statistics* (3rd Ed.). New York : Harper Collins.
- Todd, P. R.; and Javalgi, R. G. (2007), "Internationalization of SMEs in India : Fostering Entrepreneurship by Leveraging Information Technology", *International Journal of Emerging Markets*, Vol. 2, No. 2, pp. 166-180.
- Varukolu, V.; and Park-Poaps, H. (2009), "Technology Adoption by Apparel Manufacturers in Tirupur Town, India", *Journal of Fashion Marketing and Management*, Vol. 13, No. 2, pp. 201-214.
- Pharma's Global karma : Focus on Novartis, Pfizer and Ranbaxy Strategic Direction*, Vol. 22 No. 1, pp. 5-8
- KPMG Research Report (2006), accessed on November 15,2010
- Wonglimpiyarat, J. (2006), "Technology Foresight : Creating the Future of Thailand's Industries", *Foresight*, Vol. 8, No. 4, pp. 23-33
- Walsh, K. (2007), "China R&D : A High-Tech Field of Dreams", *Asia Pacific Business Review*, Vol. 13, No. 3, pp. 311-319.
- Henderson, R.; and Cockburn, I. (1994), "Measuring Competence? Exploring Firm Effects in Pharmaceutical Research", *Strategic Management Journal*, Vol. 15, pp. 63-84.
- Sun, Y.; and Wen, K. (2007), "Uncertainties, Imitative Behaviours and Foreign R&D Location: Explaining the Over-Concentration of Foreign R&D in Beijing and Shanghai within China", *Asia Pacific Business Review*, Vol. 13, No. 3, pp. 405-424.
- Venkatesh, M., (2007, February 14), "More R&D Needed for Competence, *Financial Express*

Griliches, Z. (1981), "Market value, R&D and Patents", *Economics Letters*, Vol. 7, pp. 183-187.

#### **Web Sources**

<http://www.pharmaceuticals.gov.in/>  
<http://www.idma-assn.org/patents.html>  
<http://www.indiainbusiness.nic.in/industry-infrastructure/industrial-sectors/drug-pharma.htm>  
[http://jalt.org/test/bro\\_1.htm](http://jalt.org/test/bro_1.htm)  
[www.abbott.co.in/AnnualReport.htm](http://www.abbott.co.in/AnnualReport.htm)  
[http://www.alembic-india.com/financials\\_annual\\_report.asp](http://www.alembic-india.com/financials_annual_report.asp)  
<http://www.aurobindo.com/annualreports.htm>  
<http://www.aventispharmaindia.com/>  
[http://www.biocon.com/biocon\\_invrelation\\_annual\\_reports.asp?subLink=finance](http://www.biocon.com/biocon_invrelation_annual_reports.asp?subLink=finance)  
<http://www.zyduscadila.com/financials.html>  
<http://www.cipla.com/corporateprofile/financialprofile.htm>  
[www.divisilabs.com/inside/annual.asp](http://www.divisilabs.com/inside/annual.asp)  
[www.drreddys.com/media/annual\\_reports.htm](http://www.drreddys.com/media/annual_reports.htm)  
[www.gsk-india.com/investor-annualreports.htm](http://www.gsk-india.com/investor-annualreports.htm)  
<http://www.ipcalabs.com/financials/>  
[www.lupinworld.com/annualreport.htm](http://www.lupinworld.com/annualreport.htm)  
<http://www.orchidpharma.com/pages/in-annrep.asp>  
[www.panacea-biotec.com/report.html](http://www.panacea-biotec.com/report.html)  
[http://www.pfizer.com/investors/financial\\_reports/financial\\_reports.jsp](http://www.pfizer.com/investors/financial_reports/financial_reports.jsp)  
[www.piramalhealthcare.com/archive.aspx](http://www.piramalhealthcare.com/archive.aspx)  
[http://www.ranbaxy.com/investorinformation/finance\\_archive.aspx](http://www.ranbaxy.com/investorinformation/finance_archive.aspx)  
<http://www.sunpharma.in/annual-reports.htm>  
<http://www.torrentpharma.com/general%20info.php>  
[http://www.wockhardtin.com/aq\\_results.aspx?current=show](http://www.wockhardtin.com/aq_results.aspx?current=show)