

Outsourcing R&D

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Globalization of business has forced many firms to locate the best place for performing various activities in terms of cost, availability of skills, and their own capacity limitations. Software Development, Business Process Engineering and Call Center operations are being increasingly outsourced to low cost countries, especially India where there is an abundant supply of educated workforce.

In recent years another important activity is also moving to India and to other Asian countries—corporate R&D. US and European firms are discovering the advantages of setting up R&D laboratories in India. Many major technology firms have either set up or planning to set up R&D facilities in India. This paper examines the growth in R&D outsourcing/offshoring to India. Based on a recent on site study it will explore the reasons why companies are setting up such facilities and examine the organization and control mechanisms employed by these firms to increase the productivity of R&D activities in the labs as well as to protect the IP of the firm.

1. Introduction

Work usually moves to locations where labor is cheaper and where the required skills are available in sufficient quantity. In the 70s and 80s of the last century manufacturing moved out of many industrialized nations when it was discovered that the cost of producing an item and shipping it all the way from half way around the world was cheaper than making at home as the cost differential was substantial. We have enjoyed the fruits of such offshoring in the lower prices we pay for many consumer goods.

Outsourcing and offshoring have been very much in the news in recent years, though the activity has been going on for quite some time. A major reason for the attention being paid to this is the fact that now many non-manufacturing jobs are also being outsourced. In the last decade of the last century there was a big fear about Y2K, when all computers were expected to work improperly putting the industrial world into chaos. Many programmers were needed to fix the software problems in every system. The lack of personnel in the US to handle these tasks made it necessary to import software programmers to rectify the Y2K problem.

The large influx of Indian software engineers during this time demonstrated that India had not only skilled software

engineers but also that there were large numbers of them available. With this knowledge, many US firms decided to either open their own software houses in India or hire Indian software firms to do the programming jobs. The costs were very favorable – an Indian software engineer's wages were about 20% of the US personnel's wages. It also relieved the US firms of the burden of recruiting software professionals from a diminishing pool in the US.

The Indian firms were very aggressive in selling their services and over a period of time moved into more creative areas such as improving the business processes of firms, which was traditionally performed by major consulting firms in the US – EDS, Accenture and IBM, to name a few. Their relative low cost, their adherence to strict quality standards in documentation, and their level of service enabled them to gain a big market share in software development and in Business Process Engineering (BPE).

With the success of offshoring some of the highly technical jobs to India, some US firms started looking at other jobs that could be sent out to save costs without hurting their strategic strengths. Some aspects of R&D belong to this group and firms started to move some of the work to Indian organizations.

This paper describes the R&D outsourcing phenomenon and its growth in recent years including the movement of

R&D activities abroad by US and European corporations. It will also examine some of the major issues that help or hinder these activities.

2. Need for outsourcing R&D

As competitive pressures increase on firms to bring out new products at an ever rapid pace the pressure on the R&D department increases. An additional pressure is for the firm to be responsive to technical problems as they appear. To cope with this pressure, firms have to increase their R&D budgets or find ways to utilize the resources in a more productive way. Though many problems can be resolved by local R&D personnel, there are situations when a firm may consider sending some of its R&D work abroad either to a company laboratory or to a contract research organization. Reasons why a firm could consider offshoring or outsourcing are:

- a) new product design does not work
- b) project time and cost overruns
- c) loss of key staff
- d) competitive event
- e) problems of quality/yield.

A major expense in R&D is the personnel. If qualified and experienced personnel can be hired at a lower wage rate then it becomes necessary to do so.

The key drivers for R&D outsourcing are emerging mass markets and availability of expertise in the field. In this context the two largest countries in the world – China and India – fill the bill. Both have over a billion people each, of whom over 100 million in each country can be considered to be middle class or above. Both countries produce over 200,000 engineers and science graduates each year.

Other strategic drivers for outsourcing R&D are access to expertise and intellectual property, and building expertise in the firm, filling gaps in the capabilities of the R&D function, managing risk better, reducing the time to market, and focusing on the core activities of the firm.

3. Benefits of outsourcing R&D

Outsourcing or offshoring R&D has a number of benefits in addition to cost factors. They are:

- a) access to 24/7 global processes

Since the time difference between the head quarters and the offshore site is significant (10 to 12 hours between the US and India, and 12 hours between the US and China) research activities can be passed on between two teams in the two locations so that work can be carried on continuously. This results in a compressed time for the project completion.

It will also require that communication channels be very good between the two locations, and tasks are very clearly defined.

- b) ability to employ skilled pool of labor

Since the main target countries for outsourcing R&D (China and India) have been emphasizing higher

education, the pool of technical and scientific labor is big and growing.

- c) higher volumes of innovation

The lower wages (at least for the present) enables the employment of large number of researchers leading to an increased volume of innovations.

- d) speedier introduction of new products to market

The 24/7 schedule that can be implemented will result in compressing the project time. This will speed up the introduction of new products.

- e) ability to tailor goods and services to specific markets.

The location of R&D facilities in off shore countries will help in obtaining the local market preferences and can lead to developing products and services suited to those locations.

4. R&D activities

Industrial R&D consists of two major parts – research and development. Research consists of exploring the nature of materials and phenomena with a view to developing new technical knowledge that is of benefit to society, while development pertains to transforming the technical knowledge into useful products or services.

Research itself can be further classified into two types – basic and applied. Firms usually focus on applied research that may lead to useful technologies resulting finally in marketable products or services.

The development activities consist of a number of different types:

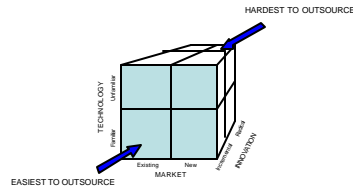
- a) Technology development – the needed technology is developed for the product/process under development.
- b) Engineering designs - the product idea is transformed into designs using the necessary technology.
- c) Process designs – development of the manufacturing process.
- d) Prototype manufacture – use the product design and the process to produce prototypes.
- e) Ramp up production – fine tune the manufacturing process to produce the product in required quantities.

However, not all activities could be outsourced. Activities that are of strategic importance to the firm may not be outsourced; they can however, be offshored to a company's own laboratory located in a different low wage country. One caveat is the protection of intellectual property rights. The next section discusses some of the issues that should be considered while deciding to offshore R&D activities.

5. Types of activities that could be outsourced

The decision to outsource/offshore the type of R&D activities can be analyzed using a simple framework developed by Balachandra and Friar (1997). This framework suggests that all R&D and new product development projects can be classified on three dimensions – market (existing or new), technology (familiar or

unfamiliar) and innovation (incremental or radical). (figure 1).



Source: Balachandra and Friar (1997).

Figure 1 The contextual cube of R&D Projects

As seen from the figure above, if the R&D activities pertain to developing a new product targeted for an existing market, with a technology with which the firm is familiar, and is an incremental innovation, the R&D activities can be easily outsourced. The tasks connected with this activity are relatively routine that can be budgeted in terms of both cost and time, and can be managed from a distance. These projects are relatively routine and require a systematic approach to managing them.

On the other hand, R&D activities relating to a new product that is targeted for a new market, involving unfamiliar technology and incorporating a radical innovation may be done best in-house. These projects require a more flexible approach where the budgets and time schedules are flexible, and the management has to be able to react quickly to change directions. (See Balachandra, and Friar, 1999, for a more complete discussion.)

From the above discussion it follows that firms can easily outsource R&D projects and activities that are routine – clinical or pathological testing for example. As a matter of fact this is one of the first set of activities that were outsourced by major pharmaceutical companies in the US to India. Looking at the business opportunity, many Indian firms started the clinical testing business. It is expected that India will generate almost £ 1 billion (US \$ 1.5 billion) from pathological testing outsourcing from Britain alone. (Hindustan Times, 2004).

Outsourcing to other firms may be considered risky in terms of protecting firm's technology and intellectual property and trade secrets. In such situations, it may be preferable to set up one's own R&D laboratories in the other country. This is the strategy adopted by many large US firms – General Electric, IBM, Microsoft, HP, Intel, to name a few. Setting up R&D laboratories in countries such as India is very attractive for a number of reasons such as availability of highly educated and trained personnel at much lower costs, proximity to research universities, infrastructure such as high speed communication. For some of these firms, this situation already exists as they have R&D laboratories in other countries – in Europe and Japan. What is different this time is that the facilities are now in a so called developing country.

6. R&D activities currently outsourced

This section will discuss some of the major R&D activities that are currently being outsourced. These activities can be broken into two types – activities that can be performed by other firms with minimum supervision and activities that are essential part of the company's strategy.

We will briefly describe the different sectors and the outsourced research activities in those sectors. A major sector, where such activities have been in existence for more than twenty years, is the pharmaceutical industry. Higgins and Rodriguez (2005) point out that pharmaceutical firms experiencing declines in internal productivity or are more desperate are more likely to engage in an outsourcing type of acquisition in an effort to replenish their research pipelines.

The first group of activities includes routine activities such as drug testing and drug development after the basic drug chemistry has been understood. Clinical testing of drugs in an important part of drug development as the drug cannot be released to the market if the tests conducted over a significant period on a sizeable sample of patients. Recruiting patients in sufficient numbers to volunteer for the tests can be both time consuming and expensive. In countries such as India and China it is not so difficult. With a large population both countries have large numbers of willing patients to be part of the testing pool.

There is a phenomenal growth of clinical drug testing activities in India in the last ten years. According to one estimate the clinical testing business will grow to over \$ 8 billion by 2008.

Many factors have fuelled the growth of Clinical Research in India.

- There is a positive change in the business environment in India. There has been a move to bring in regulations regarding data protection and data exclusivity.
- Infrastructure required for conducting clinical research is available. This includes connectivity with remote locations. It is possible to conduct meetings/training through audio-visual media.
- Since cost of drug research and development is high, pharmaceutical companies worldwide are attempting to lessen the time and cost required to bring a new drug to the patient. A large number of Contract Research Organizations have established operations in India, further influencing the clinical research culture.
- There is increased awareness regarding ICH-GCP (The International Conference on Harmonisation-Good Clinical Practice) guidelines for conduct of clinical research.
- The availability of a large pool of scientifically trained, English speaking personnel. (Pfizer Newsletter, 2004)

These factors have made India a very attractive country to perform clinical tests resulting in the establishment of a large number of contract research organizations to conduct these clinical tests for many US and European drug firms. Practically all major US and European drug firms have the clinical testing operations for new drugs in India performed by Indian contract research firms.

Drug development which is the first step in drug manufacture involves is also gradually moving offshore. A report by Ernst and Young (2004) identified India as an emerging hub for collaborative and outsourced research and development (R&D) and went on to observe that Indian pharmaceutical companies had topped drug filings with the US FDA for 2003, with a total of 126 DMFs (Drug Master Filings), accounting for 20 per cent of all drugs coming into the US market, higher than Spain, Italy, Israel, and China.

A few Indian pharmaceutical companies have started doing collaborative research with US and European companies. These activities are strictly not outsourcing.

The other major field is telecommunications and electronics. Since 1990 many U.S. and European firms have built R&D facilities in India for product and software development. Most of the research is done by the companies' own facilities with Indian employees. A major advantage claimed by these firms is that it provides for continuous work over the 24 hour day period.

7. Extent of R&D outsourcing

According to an OECD report in 2004, US offshore investment has grown by leaps and bounds between 1994 and 2000. (See table 1).

Table 1. US offshore R&D investment (in millions of US\$)

Country/Region	1994	2000
European Union	7,450	12,300
Canada	800	1,800
Japan	700	1,200
Rest of world	700	4,000
China	5	506

Source: OECD Report, 2004

Since 2000, however, the investments in R&D in China and India have ballooned. It is expected that the R&D investment in India will rise to over 8.0 Billion US \$ by 2010 (Frost and Sullivan, 2004). Most of the investment has gone to setting up their own R&D facilities, although there is a rapid growth in contract R&D by Indian firms, especially in the areas of clinical testing, drug development and development of agricultural chemicals.

Firms have established R&D facilities in Asia mainly in China and India. The following table 2 shows the type of research work done and the locations in Asia according to a testimony. This table focuses only on a few companies, as the objective of the testimony was to show the number of jobs lost or outsourced to other countries. There is a concern that high paying intellectual jobs are being outsourced.

Table 2. Major US R&D facilities in Asia

Firm	Country	Employees	Nature of work
Accenture	India	5000	Acct. and/Software
General Electric	India/China	20,000	Aircraft/Medical
Intel	India	3000	Chip design
Microsoft	India/China	500	Software
Oracle	India	4000	Software
Phillips	China	700	Cons.electronics

Source: Testimony of Ronil Hira, 2003 and Business Week.

The next section will describe the R&D activities by international firms in India. The information is only representative as there are many smaller firms that have dealings in India which cannot be reported in this paper due to space limitations.

8. R&D facilities in India

India has achieved phenomenal success in outsourcing. It started out as a little stream in the 90s when US firms were frantically changing over to new software to prevent any millennium end catastrophies and imported many Indian software engineers. Gradually it was realized that some jobs could be done in India much cheaper than even hiring Indian engineers and bringing them over to the US.

Over a period of time (in the last part of the last century) US firms realized that there was an enormous pool of software, scientific and engineering talent in India who could be hired at a fraction of the wages paid in the US.

This realization has led to the establishment of R&D facilities by major US and European corporations in India's and China's technological hubs – Bangalore and Hyderabad in India, Shanghai, and Beijing in China - or to outsource R&D activities.

Some major corporations have established their own R&D facilities in India, while others have used local firms to do the research for them on a contract basis. We will describe some of the major R&D establishments in India.

The largest R&D establishment in India is GE's John F. Welch Technology Center (JFWTC) in Bangalore. It has over 2400 employees and is second in size only to GE's main research facilities in New York. It has a completely diverse employment; its employees are from all over the world, though predominantly from India. Many of the managers are Indian who have either graduated from US universities and/or worked in the US with GE.

The research activities span a wide variety of fields in which GE is interested – mostly materials and energy related fields. Within three years of its starting, the center has proved its potential by filing for over 100 patents worldwide.

Other major firms have established R&D centers in India, though not on the scale of GE. Table 3 lists some of the major R&D laboratories in India and the work done by them.

According to Express Computer, MNCs are rushing to India to set up R&D laboratories with huge investments. See Table 3 for a brief description of the MNCs with established R&D presence in India as of 2003. In addition to doing basic research, many centers are doing a significant portion of product development in these centers. Some labs, such as HP's, focus on emerging markets only, while others focus on products for the entire company worldwide.

9. Challenges for outsourcing R&D

Outsourcing R&D has a number of challenges and problems listed below.

- Protection of intellectual property

This is one of the most crucial issues. The problem may not arise if the R&D facility is owned by the firm. However, governments in the outsourcing countries have been taking steps and enacting laws to assure firms that intellectual property is protected. For example, India passed the IP law in February 2005 giving greater protection for IP. This has encouraged many pharmaceutical firms to outsource their drug development activities.

- Making sure R&D is not duplicated at multiple locations

This is an organizational problem. The central command for R&D should plan the activities in each facility employing the most suitable capabilities available in the different facilities. Though duplication is wasteful, it may sometimes be necessary to have parallel efforts to speed up the process.

- Effective collaboration between international R&D teams

Establishing effective means for communication between the personnel at the outsource facility and the home office is necessary for effective use of the resources.

- Cultural differences

A major issue in dealing with outsourcing is the cultural differences between the contracting firm and the outsourcing firm's employees. A poor understanding of the cultural differences by the managers can lead to severe problems.

- Language barriers

This could be a problem in many situations. However, this problem is very limited with countries such as India as most of the professionals have been educated in English. As a matter of fact this is one of the reasons why many US firms are going to India.

- Different regulatory environments

The regulations governing foreign operations in India and other countries are sometimes not very helpful (and sometimes even restrictive) when it comes to protecting intellectual property, repatriation of profits and regulations regarding employment. However, India and other countries in the area have realized this problem and the governments are actively introducing new

regulations to help operating business in those countries easier.

- Security implications of sharing data across countries

Sharing data electronically as will be necessary with outsourcing can be risky. Proper security measures must be in place to prevent information from getting out.

- Monitoring progress of R&D activity

Most R&D labs with more than one location face this problem. However, this problem has been studied extensively and solutions are easily available.

- Aligning global R&D activity with business strategy

A strong central leadership at the R&D management is needed to maintain a coherent strategy for R&D that is in alignment with the company's strategy.

- Attracting the best R&D talent

This is a serious problem for firms that do not already have a recognizable name. For example, when Google advertised for openings in its research laboratory in Bangalore, India, it received over 100,000 applications for 100 openings. With such response the company can easily select the best. For other firms without that kind of image, it may be necessary to attract the right talent by offering suitable incentives.

10. Getting the most from R&D outsourcing

To get the most from outsourcing R&D firms must take a number of steps. They are:

- Have a clear vision and objectives

The firm should set a clear set of goals for the outsourced R&D activity. These could be in terms of budgets and time schedules and very specific product and process criteria.

- Understand the relevant drivers

The drivers for R&D outsourcing are different for different organizations. These include risk, time to market, and access to IP etc.

- Make a clear agreement

A clear unequivocal agreement between partners is absolutely essential as the firm may have to contend with different laws.

- Integrate organizations and cultures

To be effective the cultures and the organizations have to be integrated by exchanging personnel at frequent intervals for short periods of time.

- Manage the process and assess progress continuously

The firm has to set up appropriate control procedures to manage the R&D process effectively and to assess the progress of the projects.

- Motivate the partner

Success in outsourcing R&D depends to a large extent on a properly motivated team.

11. Conclusions

Outsourcing R&D is a growing phenomenon with the emergence of India and China as producers of large numbers young people trained in technology and the sciences. These countries have a comparative advantage in terms of wages and availability. In these days of globalization utilizing these human resources for doing R&D activities makes economic sense. We see, therefore, a large number of US and European firms making a bee line to India to set up R&D facilities of their own or to join with established Indian firms for doing their R&D. It can only grow much larger in the future.

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Table 3. Major US R&D facilities in India

R&D Centre	Highlights
Texas Instruments' R&D Centre, Bangalore	Established in 1984. The centre started with just 20 people, now has 900 people working on VLSI and embedded software, which goes along with a chip or into the chip.
Oracle's India Development Centre, spread across two locations in Bangalore and Hyderabad	The Bangalore centre was established in 1994; the Hyderabad one in 1999. Oracle's largest development centre outside the US has 2,700 people, which will be scaled up to 4,000 by the end of 2003. Does work on Oracle's database products, applications, business intelligence products and application development tools, besides other activities.
Sun Microsystems' India Engineering Centre, Bangalore	Established in mid-1999 with 20 people, has scaled up to 500 people today. Does work mainly on Sun's software which includes Solaris and Sun One.
i2 Technologies' R&D Centre spread across two locations in Bangalore and Mumbai	Established in 1988 with 20 people, has scaled up to 1,000 today. Drives nearly 60 percent of the company's global development delivery.
IBM's Software Lab spread across two locations in Bangalore and Pune	Established in 2001. Works on all IBM software like WebSphere, DB2, Lotus, Tivoli and Rational. The centre has added many new areas of activities such as middleware and business intelligence.
SAP Labs India, Bangalore	Established in November 1998 with 100 people, will be scaled up to 750 by September 2003. It is the largest single-location R&D lab for SAP outside Walldorf, Germany. Nearly 10 percent of SAP's total R&D work is carried out from the Indian lab.
Philips Innovation Campus, Bangalore	Established in 1996 with 10 people, has scaled up to 895 people today, and will be further scaled up to 1,000 before the end of 2003. Works on developing software for Philips products. Almost all Philips products that use software have some contribution from this centre. It is the largest software centre for Philips outside Holland.
HP Labs, Bangalore	Established in 2002 with just two people, has scaled up to 20 specialists today. Plans exist to double its headcount by the beginning of 2004. Is totally dedicated to high -level research on futuristic technologies, with special focus on emerging markets.
GE – JFWTC Bangalore	Set up in 2003. Employs over 2000 scientists and engineers. Largest GE lab outside US. Focuses on materials sciences and other related fields
Motorola, Delhi	Focuses mostly on telecommunication research. Over 300 employees.

Source: MNC R&D Centers mushroom in India, Express Computer, 9th June 2003 and news reports.