

Research Investments in Large Indian Software Companies

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Summary. A few of the software companies in India have already crossed the \$1 Billion mark and there are others on the threshold. The billion marks is a big psychological barrier, crossing which puts the company in the league of the big ones. It also means that the path for future growth may be different from the previous path and newer strategies and techniques will be needed. One of the tools for achieving objectives of a large company is investments in research. Indeed, most of the large companies in India have either already started investing in research, or are examining the issues. However, the role and purpose of research is sometimes not clearly understood or articulated. This note argues why investment in research is important for large Indian companies, and how research may be managed. It may be worth noting that Microsoft also started its research unit around when it crossed the billion dollar mark.

Need for Research in Indian Service Companies

The goal of research is to create new knowledge. The purpose of a research group in a company is to create new knowledge which other parts of the company can use to improve the business. Research is typically not a business or a profit center but a long term investment, which helps a company generate more revenue and profits. The level of investment in R&D depends on the nature of business, but some have suggested that high growth and technology intensive industries spend about 10% of their revenues in R&D, with about 1% in pure research. Microsoft and Cisco, for example, spend about 15% of their revenue in R&D (for Microsoft this translates to over \$6Billion), while IBM spends about \$6B, which is about 7%. Indian companies, though much smaller than these IT giants, have also started spending on R&D, but it is not clear what the percentages are though it is likely that they are less than one percent (a 1% spend on R&D translates to \$20Million for a \$2Billion company).

A technology player needs research simply to develop new technologies that it can then use to bring out newer products in the market place. But why does a service company need investment in research to generate new knowledge? As most large Indian companies are primarily in services business, this question must be answered satisfactorily. For a small service company clearly there is no real need to invest in research – it can do its business by using existing knowledge to provide the desired services. But this mode of operation is not sufficient for a large company for many reasons which make it almost necessary that it invests in research. Let us look at some of the key reasons.

A large corporation desires to assert an independent identity over a long time. Existing over a long period of time will necessarily require it to adapt to changes that will take place. In software service companies, these changes can be far more rapid as the technology being used is constantly changing. Investment in R&D is an instrument to help the corporation foresee the changes coming and in devising strategies and processes for adapting to the change, and also help influence the changes. The ability to adapt to changes and the readiness for absorbing changes in

technology can help the company build a leadership position in leveraging the new technology for offering higher value in services.

Taking a leadership position in exploiting some technologies requires depth of knowledge in these areas, and regular monitoring of latest developments in the technology and methodologies. This competence can be built if there is a research group working in the area – without a research activity it can be very hard to even keep track of the developments and properly understand their implications. R&D manpower can monitor the developments in research and adapt the useful research for the corporation to leverage. This proactive approach can help the company develop higher value and innovative services, which cannot happen if the usage of technology is solely driven by the clients.

Tied to the need for long-lasting and unique identity is branding. A company does branding to define a unique identity for itself. A large company, as its sphere of influence increases, wishes to have its identity known in different circles, including the R&D circles. Having a presence in R&D circles, which often include academics, thinkers, other researchers, and government folks, clearly requires a R&D group which can develop new knowledge and report the results in suitable forums. In other words, the nature of branding, as a company becomes larger, often requires it to have a presence in R&D circles, which requires investment in R&D.

In services there is a constant demand for improvement in quality and lowering of costs. For a large company, costs usually are higher, and hence it cannot compete on the cost front for increasing its business. Hence, it is essential that it continuously improves on the quality and service front to ensure that existing customers return and new customers come to it. When the organization is trying to distinguish itself from others so it can command a premium, it cannot just rely on past knowledge to provide the service. A large company has to try to create higher value in newer ways for which investment in research is useful.

The basic business model of a software service company is to provide solutions to customer problems. And for finding the solutions, engineers and managers are employed. Engineers, by training, try to use existing knowledge to provide a solution that can best serve the customer. Managers also, by training, stick to proven methods to reduce risks. Improving the solutions often require looking at the problem in a fresh manner and create innovative solutions. This can be done through R&D. Often this type of R&D can result in new tools or methods, which can then be used in other projects for improvement. Sometimes when these tools are general purpose, they can even be sold along with services to customers – a strategy used by some companies.

Then there is the issue of scale. Most software service companies in the start work with smaller projects requiring a few people over a few months. When the problem scale increases by an order of magnitude, complexities increase dramatically. Such projects are risky and are more prone to failures. Public domain knowledge is often not sufficient for such high value, high complexity engagements. So, for example, enough public knowledge about how to design, build, and test a large multi-technology system is really not available. And an organization which wishes to do such projects will have to find solutions on its own, which is facilitated by R&D investment. Viewing it in another way, to mitigate the risks in these projects due to problems for which existing knowledge may not be sufficient, investment in R&D is needed. In fact, often for executing such projects, different processes are used which incorporate R&D support. So, as the scale of engagements increases, investment in R&D becomes necessary to improve the chances of executing these successfully. This need is also felt by the customers of such projects and presence of R&D provides them the confidence on the ability of the company to execute such projects.

Large software service companies in India desire to get into consulting. Consulting, by its nature, addresses non-routine problems that are less well defined and often requires richer conceptualization and creative and innovative solutions. There are standard consulting practices and processes, but just like large projects, often consulting assignments have unique problems that are not adequately addressed by existing public-domain knowledge. R&D becomes a useful tool for such engagements. Besides the possibility of improving the solutions, the presence of R&D outfits offers a comforting feeling to the customer as it shows the depth of knowledge as well as the ability that the company will not be limited by the current state of knowledge for providing the solutions but can go beyond. Companies like IBM use their R&D staff effectively in their consulting businesses.

Besides these company-specific reasons, there is a general industry-wide reason as well. So far, most of the research has been done in the west as their businesses needed the innovation. It is clear that the software services business is shifting to India and other countries and in future this work will probably shrink further in the west. There is already apprehension on this front and companies are adapting their strategies accordingly, and students are choosing their professions keeping this in mind. As the activity shifts, the investments in research related to software services will reduce. That is, Indian companies which relied on knowledge from the west may find the ready flow of new knowledge reducing. In other words, as the work shifts to India, there is a need for R&D to also shift, so the innovation does not suffer and research becomes more aligned to the needs of the dominant business model of outsourcing.

These are only some of the general reasons why investments in research is necessary for large software companies in India as they charter an individual, high value course for themselves. Besides these, specific companies will have other specific reasons depending on their strategy for growth and long-term existence. Though 5% to 10% of the revenue that product or technology companies invest in R&D will be towards the higher side, a large services company should probably be investing 2% to 3% in R&D, with about one-fifth of it going to basic research.

Let us now look at what should be the nature of research and types of areas software service companies should focus on in their research programs.

Research Agenda

It should be clear that the nature of research in a service company should be different from the nature of research in technology or product companies as the needs and business models are different. So, for example, just focusing on research in some types of technologies, as is done by product companies, is not the proper approach for a service company.

We have identified some of the key reasons for why large software service companies in India need to invest in research. Starting from these reasons and using some peculiar characteristics of the Indian companies and scenario, some current research agenda can be determined. A few research areas are listed below. This is by no means an exhaustive list, but is primarily to illustrate that there are areas in which investments in research can benefit the Indian software companies.

- **Services.** Much of the research in software and IT has often focused around technology. Little work is done on services itself – how to improve IT services, technology needed to improve it, etc. Some aspects of services get covered under different topics, but the area has not been researched well in a holistic manner.

- **Global software delivery.** This is the model that many companies in India are championing. However, in the research world, this area has not been researched much at all and little research has been done to properly leverage this model and exploit its immense possibilities. Research in this area will naturally tie with the business goals of the companies.
- **Outsourcing.** This is another area that has not been given due attention, particularly from the supplier side. Whatever little work has been done, has been done mostly in the west and they have focused mostly on the impact on their industry and society. There is clearly a need to explore this topic from the supplier/vendor perspective also, so robust methods, technologies, and frameworks can emerge.
- **Software reliability and dependability.** Most Indian companies have focused so far on the process quality. Though that is essential, it is important to look beyond to reliability and dependability of software, as need for higher reliability/dependability is increasing and vendors that can demonstrate ability to deliver on these fronts can command a premium.
- **Alternative paradigms for software development.** Many of the Indian companies are in a unique position of having long term relationships with many clients and having variety of contracts in different vertical domains. Currently, the domain expertise and continuity in time is exploited mostly through expertise of people. However, these also render themselves to the possibility of developing alternate approaches to software development, that can enhance productivity and quality.
- **Experimental software engineering.** Thanks to the process maturity movement, Indian companies have all developed good systems for data collection, as well as a temperament and culture to support it. Having good data is a foundation on which experimental work in software engineering rests. As this foundation is in place, this paradigm can be leveraged to bring a research temperament in creating hypothesis and evaluating them. Large companies can easily occupy a leadership role in developing alternatives using this paradigm, and also continually improve their performance.
- **Software engineering education.** This has not been a very active area for research. However, the software companies in India have innovated on this and are in a unique position of almost running universities to train their people. This level of training in the software sector is unsurpassed anywhere else in the world. It is also clear that companies are still looking for improved ways for training and education to handle the trained manpower shortage, making this a clear area for research which can provide rich dividends to the companies (and also is an area which seems unique to the Indian scenario hence others may not really be researching it actively).
- **Individual productivity.** This is again an area with immense possibilities. Some work has been done in this area (e.g. PSP), but by-and-large, this is not a well studied area. Again, Indian companies are unique here in that the profile of people working in the industry seems to differ quite widely from that of the west. Good results in this area can have a huge impact on a companies capability to deliver (and consequently, on its business parameters) and profitability.
- **Focused technology areas.** Technologies in which a company aims to have special expertise and high-value offerings also form natural areas for research, as through research expertise will develop and will provide the readiness. The areas will clearly depend on the strategy of the company but can include technology areas like very large databases, software and application security, middleware, etc.
- **Heterogeneous systems and integration.** Most large systems today are composed of a wide variety of different systems that are interconnected. Though technology for interconnection has developed well, many issues relating to heterogeneity and integration need better understanding, which can lead to better execution of such projects.

Managing Research

If a company invests in research, it will need to organize and manage it to provide the best value. First question that needs to be asked is how should research be organized in a company. One way to organize research is to have some research manpower associated with the different business groups. Though this approach can allow better aligning of research to business, it has a serious shortcoming in terms of manpower. Research has cultural aspects and its manpower share some paradigms and values, which are sometimes at odds with business groups. Hence, having some research personnel in different business groups, though has been tried, has not worked well.

Currently the most common method of organizing research is to have an independent research group (or groups) with share common values and its own performance evaluation and career planning. What constitutes a research group? Creation of new knowledge or answering questions to which answers are not known is a challenging task. It requires specialized skills and training, which generally are imparted through the PhD training, and then further refined and developed during the course of research career. So, it is best to staff the research groups mostly with PhDs. To give direction to the researchers in the group, it is best that the group is headed by a respectable and accomplished researcher, who can be respected by the group members. That is how research groups in most multinationals are run.

How are research efforts evaluated? As the purpose of research is to answer unanswered questions, the value of research is primarily in the nature of question that is answered, and in the elegance and generality of the answer itself. Researchers are always trying to come up with results and ideas that will shake the community. Keeping these in mind, the research output can be evaluated by its impact on its community. For pure research, the domain for impact is the world.

However, when research is done within a business organization, then this view is not sustainable. The business organization exists to make profits and research is viewed as long term investment for growth. Hence, directly or indirectly research must contribute towards the goals of the company. That is, the domain for impact is not just the world, but the organization itself. Therefore, besides global impact, research in an organization must have impact on its own organization. This internal impact could be in terms of visibility, competence development, providing new solutions or new tools that improve some aspect of the organization, setting direction, developing new methods, tools, methodologies, etc.

Funding of research is another tricky issue. Typically, a R&D unit will undertake many projects, generally with small teams of one to a few people working on each project. To ensure that the R&D has suitable impact on the organization, linkages should be built between the R&D projects undertaken and the main business. This can be done by joint sponsorship of projects, or with formal mechanisms for establishing linkages like having in-house customers for research, or by having methods to transfer knowledge from R&D to production, etc.

Conclusion. Though there is now talk about R&D investments in IT companies of India, many a times there is no clarity on what research is and its purpose, or whether there is a need to invest in research. This is a good time for Indian companies to increase their investments in research in meaningful ways, as it is easier to make these investments when the going is good, rather than when profits are under pressure, as the case may be in future. Many Indian companies have already taken steps in this direction, but the investment needs to be increased to 2-3% of the revenue. It remains to be seen how and when these companies will ramp up their R&D efforts.