

Innovation in Indian Software Industry: An Empirical analysis

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Abstract: Indian software industry’s meteoric rise in the global software market since the 1990s has attracted the attention of academics and corporations alike. While numerous domestic and global corporations have set up their units in India, academics on the other hand, have been studying the software industry from various perspectives. The evolution of the industry from a position of obscurity in the 1980s to its pre-eminent role in the global software market today has been a remarkable transformation. This paper is an attempt to study the pattern of innovations that have enabled this transformation of the software industry.

Keywords: Innovation, Indian Software Industry, Iterative Innovation model, Software sector

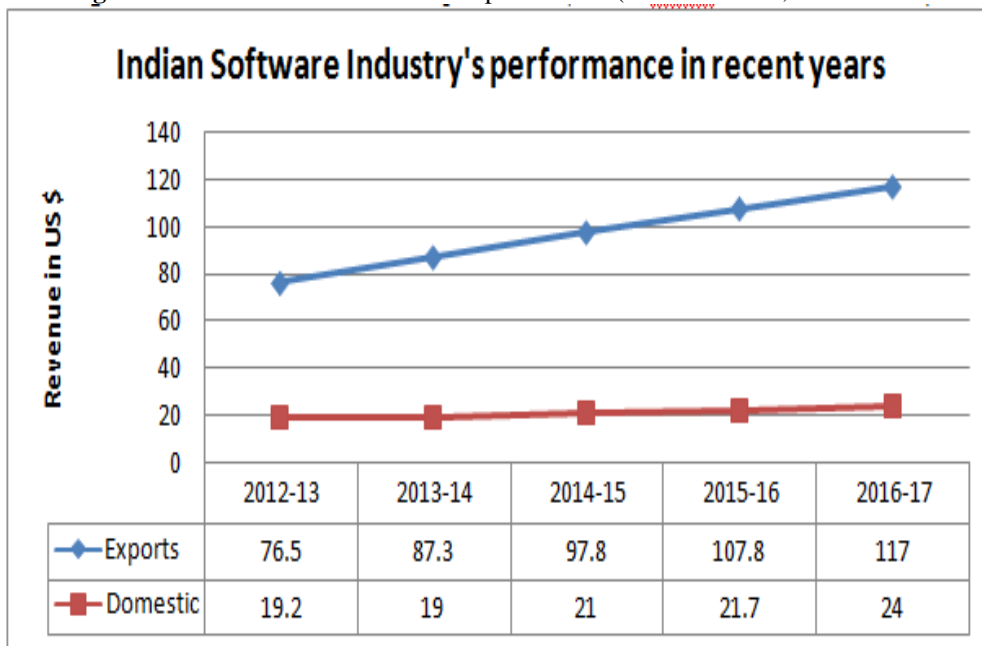
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I. INTRODUCTION

Indian software sector has transformed itself from an obscure little industry in the 1980s to a vital constituent of the Indian economy today. In 2015, it had contributed well over five percent of the GDP of India with a colossal turnover of \$129 billion[1]. The software industry’s success in the export market has contributed immensely to the nation’s foreign exchange reserves (*see Figure 1*). It has also resulted in several ‘spill over’ benefits like: improvement in perception and attitude of people towards enterprise and entrepreneurs who play an important role in innovation[2]; accumulation of a globally competitive technological capability in software design and development; and emergence of India as a major hub for software & services which has prompted many top global companies to set up their Research & Development (R&D) and software development centres in India. So, what were the innovations in software services that enabled India to become a prominent exporter? What was the trajectory of Indian software firms as they moved up the value chain? What was the pattern of technological up gradation and innovation by Indian firms? In this paper we try to explore these questions by analysing the evolution and growth of the Indian software industry since its formative years.

Figure 1 Revenue from domestic & export market (Source: MietY, Government of India)



II. LITERATURE REVIEW

There has been a global academic interest in the Indian Software Industry since 1990s. However, much of the existing literature is focussed on the nature of success of the industry. While some academics have studied India's comparative advantage in software services, some others have researched idiosyncratic factors like India's abundance of English speaking human resource, linkages to the main export market, convenient time zone vis-a-vis the main export market in the US, and government support in facilitation of infrastructure for communications and trading that may have played an important role in the success of Indian IT industry [[3];[4];[4];[5];[6];[7]]. Some of the later academics have deliberated at length about different aspects of export orientation of the software industry [[8];[9]]. Arora & Asundi have studied the industry from the perspective of quality certification and its forbearance on the firms' growth[10]. However, a comprehensive study on the pattern of innovation in the Indian software industry along its evolutionary trajectory needs to be explored. The current proposal is to explore this aspect of the industry along its growth path. In the next section we have discussed the methodology adopted for this research paper.

III. METHODOLOGY

Focus Group Discussion, Interviews, seminars apart from various other secondary sources were the basis for this study. Focus Group Discussion is a form of qualitative research tool that is used in various disciplines including Business studies, Social Sciences, Library & Information Sciences and in Engineering for evaluating usability of products and solutions [[11];[12]]. Typically, Focus Group Discussion involves a discussion on a specific area of interest amongst a group of people from similar backgrounds or experiences.

For the purpose of this study, Focus Group Discussion and interviews of software industry professionals were conducted to discuss the innovation trends in the software services industry. This was supplemented by inputs from industry seminars and survey of literature from the software companies and from other secondary sources. The outcome of the study has been delineated in the following sections.

IV. INNOVATION IN SOFTWARE SERVICES BY INDIAN SOFTWARE FIRMS

Since its inception, the software industry has been taking various innovative measures for remaining competitive and profitable in the global software industry. Various steps taken by the firms of this industry to move up the value chain along its evolutionary path are discussed below.

4.1 Progress from 'Body shopping' to value added services

The initial thrust for the industry's growth was provided by the government's policy of export obligations. Firms were allowed to import computers only if they agreed to meet the export commitments[13]. Further, the government issued threats of confiscation of computers if the firms failed to meet their export obligations. The combination of the government pressure and the software firms' survival instincts resulted in 'body shopping' as a means of meeting the export obligations. 'Body shopping' is a derogatory term used to refer to the dispatch of Indian programmers to a foreign destination on a contract basis to write software code for a foreign customer.

Though the software industry's initial start was based on the wage differential between India and the advanced countries where the required labour was sent, Indian companies have been striving to upgrade themselves to provide value added services. They have been very adept at quickly upgrading themselves from providers of manpower to providers of software solutions.

4.2 Custom application development and application outsourcing

In their quest for increasing profitability and providing better services to their clients, Indian software firms had climbed from 'body shopping' to custom application development and application outsourcing.

Typically, custom software is developed for a single customer to accommodate that customer's particular preferences and expectations especially when such software is not available on the market or, the available packaged solutions and software aren't sufficient or flexible enough for the specific needs of the enterprise[14]. While custom application development is about giving customized solutions for the customers' problems, Application outsourcing includes developing either full products or some modules for MNCs in close coordination with them. The outsourcing arrangement could be for a wide variety of application services including new development, legacy systems maintenance, offshore programming, and management of packaged applications[15].

4.3 IT Consulting

Indian companies were able to tap the lucrative IT consulting market due to their well established domain knowledge in various fields. Top Indian companies like Wipro, TCS, and Infosys successfully leveraged their brand's reputation to target potential customers. While larger firms acquired boutique consulting firms across the globe, the smaller ones took the joint venture route with consulting firms to penetrate the consultancy market.

IT consulting requires an end-to-end approach for creating solutions. Other than being more profitable, IT consulting has the additional advantage of drawing in contractual works at the lower level of the value chain.

4.4 Enterprise Application Integration

Lately, Indian companies have forayed into the more profitable business of Enterprise Application Integration (EAI) involving high technology skills to integrate the customers' existing applications for enabling better sharing of data and information, controlling costs, and ensuring better return on previous investments. EAI solutions were provided by Indian firms at six different levels: platform integration, data integration, component integration, application integration, process integration, and business-to-business (B2B) integration[16]. EAI solutions enable companies to exchange data across various enterprise applications, and facilitate easy and reliable access of corporate information.

Indian companies have not only upgraded technologically but lately they have built considerable domain expertise. Most large software firms have formed divisions to cater to various customer domains such as manufacturing, oil and gas, retailing, insurance, and telecom. These firms have built teams of domain experts to help the company develop software solutions in various domains.

4.5 Package Implementation and Support

Indian companies have also made considerable progress in the Package Implementation and Support market. This is the market that accounts for about 15 percent of the total global IT spending. In 2002-03, the industry had grown 17 percent to touch US\$ 350 million in this segment[16]. This is a segment that not only requires the companies to develop domain skills and expertise in various industry verticals, but also overcome the competition from large MNCs operating in this space.

Other than the above-mentioned measures of technological and business innovations, Indian software industry has made some process innovations that have played an important role in the growth of the industry (see 4.6 & 4.7).

4.6 Global Delivery Model

In their continuous effort to remain competitive and enhance their margins Indian companies have been seeking innovative ways of delivering software and services economically. Their efforts had resulted in a new delivery model in which a considerable portion of the software development was carried out offshore rather than at the client site. NASSCOM estimated that offshore revenues as a proportion of total revenues had increased from nearly 35 percent in 1999-00 to 56 percent in 2002-03. The proportion of onsite revenues during the same period, on the other hand, had reduced from 57 percent to nearly 43 percent[16]. The proportion of offshore revenue continues to overshadow onsite revenue of Indian software firms even today.

The Global Delivery Model includes several components for delivering software and services. NASSCOM has classified four such components.

- *Onshore* (same country as client) location for delivering services like account management, consulting assistance by domain experts, high level design, emergency bug fixes, and assessment/estimates.
- *On-site* (client site) for project management, requirement definition, prototyping, user interface design, usability testing, integration testing, acceptance testing, implementation, user training, and warranty maintenance.
- *Nearshore* (country near to client country) for high level design, quick turnaround development, emergency bug fixes, interactive development, prime-time support, testing, risk diversification for onshore/offshore tasks, on line applications management.
- *Offshore* (India) for project management, detailed design, coding, unit testing, preliminary usability testing, documentation, bug fixing, warranty maintenance, and ongoing maintenance.

The Global Delivery Model has become a standard industry practice among Indian firms.

4.7 Quality Management Systems

Beginning with the ISO 9000 certifications, which ensured a consistent and orderly execution of software development contracts and provided a framework for measurable improvement, Indian companies have graduated to software engineering specific CMM framework for assessment and certification. The importance attached to quality management systems can be gauged from the fact that India had the largest number of SEI

CMM Level 5¹ companies in the world. By December 2003, India had about 65 companies at SEI CMM Level 5 assessment. The quality maturity of the Indian software and ITES-BPO² industry can be measured from the fact that already 275 Indian software and ITES-BPO companies had acquired quality certification and about 80 more companies were in pipeline by the end of the same year. Not content at having achieved the highest level of certification for software engineering, many Indian software companies have embarked upon the next level of quality consciousness. This level of consciousness is driven by the desire to institute processes, metrics and a framework for improvement in all areas including those relating to sales, billing and collection, people management, and after sales support. Typically, this is characterised by companies aligning their internal practices with the People CMM framework and by the use of the Six Sigma methodology for reducing variation and assuring “end-to-end” quality in all company operations.

Though some cynics have questioned the potential benefits from further efforts to improve quality processes, there is little doubt that the industry or at least the larger companies have internalised strong process orientation. Their ability to continually upgrade their processes has been recognised by their customers in terms of large contracts and a growing business. Obtaining certification has been a powerful signalling device in winning these contracts. All the above mentioned innovations can be understood from the Iterative Innovations Model theorised in the following section.

V. THE ITERATIVE INNOVATIONS MODEL

The proposed 'Iterative Innovation Model' (*Figure 2*) is inspired by the Bhatnagar & Dixit's Multiple stage innovations model[17]. However, unlike the multiple stage innovations model, this one concentrates overwhelmingly on the client and it isn't broken up into different stages. As the name suggests, it is an iterative model in which a firm improves its software development capability by innovating iteratively, thus, climbing up the value chain with every cycle. In this model, a firm begins with initial software development capability and tries to satisfy initial client expectations and subsequent ones through innovations. As it satisfies the client's expectations by meeting their stipulated standards, the firm moves up the value chain or the 'trust curve' of the client. Each successful execution of a task increases the client's trust in the company's software development capability. As the customer grows more confident about the firm's technological capability, it awards the firm with more complex assignments. In this process of climbing up the value chain, the company enhances its reputation and its capacity to draw in more clients.

The Iterative Innovation Model predicts that as long as the client's expectations are met, the relationship between the client and the firm persist. The entire procedure of innovations with the assistance of internal and external enablers to satisfy newer customer expectations also continues iteratively.

Internal enablers comprise of the leadership style of the top administration, the culture of experimentation and tolerance towards failure, the atmosphere of learning and sharing, acknowledgment of innovation as a part of mission of the company, and appraisal and recognition frameworks of the administration. **External enablers**, on the other hand, include financial institutions, R&D laboratories, the investors and their confidence on the local enterprise, clients and their feedback, and public policy agents.

All the different phases of technological value addition and business or process innovations mentioned above, for instance, custom application development and application outsourcing, application integration, IT consulting, quality appraisals & certifications, offshore development, etc, can be conceived in the iterative procedure of innovation depicted in the model.

The external environments in which the external enablers are situated play an influential role in a company's innovation orientation and technological advancement. The environment consists of colleges, universities and research institutions of the academia, Competitors, Sub-Contractors and Partners, Government R& D Institutions and funding organizations. All these components of the environment and companies themselves are influenced by the current policy environment comprising of Science and Technology Policy, Trade Policy, Education Policy, and Monetary Policy. These policy frameworks either have direct or indirect bearing on the companies' growth and innovation orientation. A good policy framework with strong Intellectual Property Rights and anti piracy laws, for instance, may inspire firms to take up software product development. A sound Science and Technology strategy can give incentives to innovative firms. It can lay the foundation for public sector R&D and innovation that can have 'spill over' effect on the private sector firms. Favourable monetary policies like tax benefits for R&D spending by firms can accelerate innovation. Favourable industrial and labour policies also positively affect firms' innovation orientation. A good Education policy with substantial

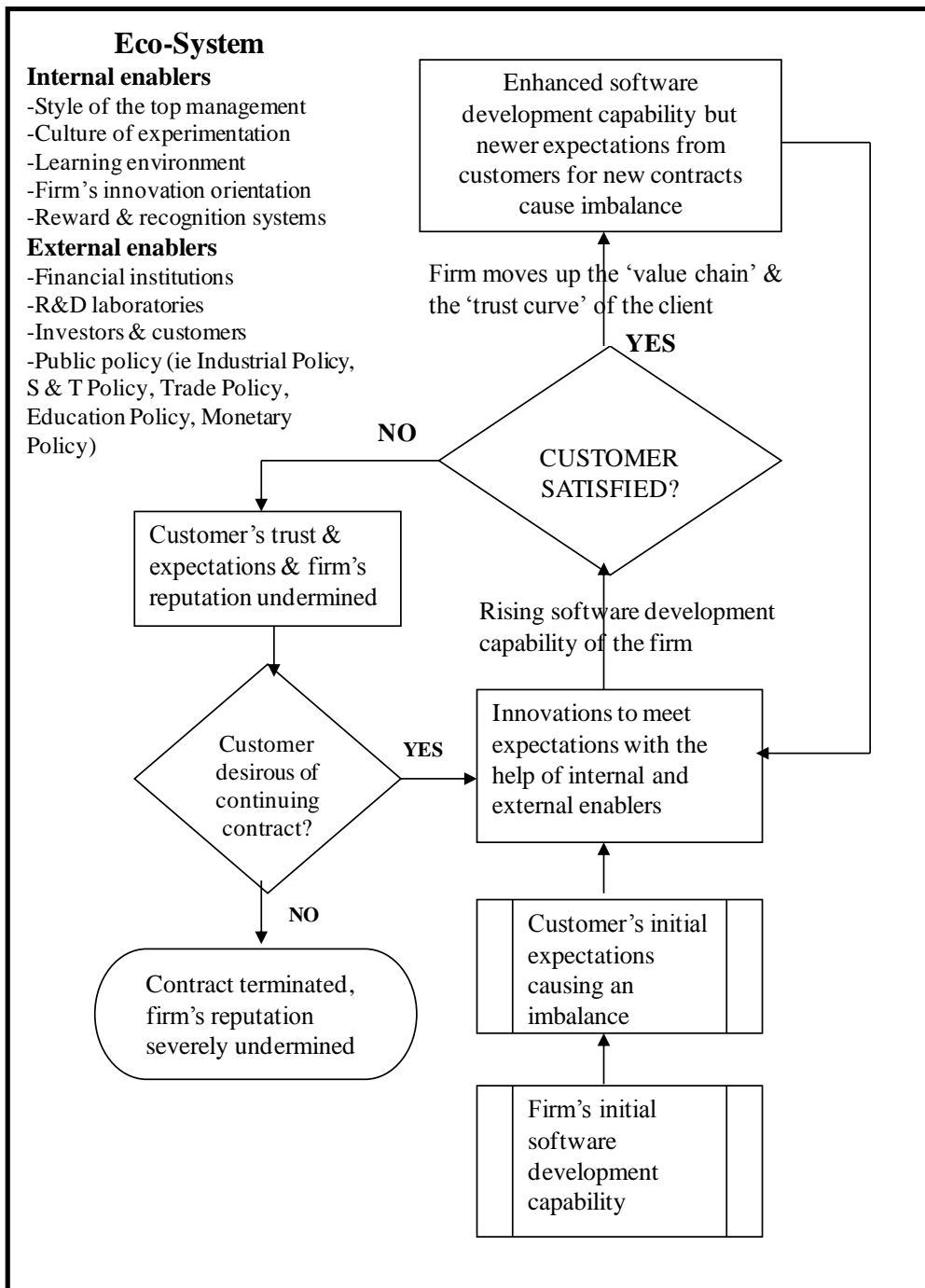
¹ SEI stands for the Software Engineering Institute of the Carnegie Mellon University, which has developed the Capability Maturity Model frameworks for quality assessment of software companies, which is done at various levels, Level 5 being the highest.

² ITES stands for Information Technology Enabled Services and BPO stands for Business Process Outsourcing.

investments in higher education can enable steady supply of skilled human resource for meeting the staffing needs of the high tech industry.

Figure 2 Iterative Innovations Model

Iterative Innovations Framework depicting capability building & innovations by Indian software firms



According to this model, at any stage in the process of iterative innovation, if the customer is dissatisfied with the firm's work it may either decide to continue the relationship or terminate the contract. However, even if the customer decides to continue the relationship, it is unlikely that it will outsource more complex (value adding) activities to the firm. Thus, in a way, inhibit the technological learning and

advancement of the firm. Additionally, termination of the contract can severely affect the firm's reputation in the market and may have a bearing on its ability to attract new high value customers.

The model delineates the typical relationship between the client and the firm and it is likely that the firm may have numerous other customers. It may happen that the firm executes projects satisfactorily for most clients excepting a few. While the disappointment of a few clients will adversely affect the future prospects of the firm, it may not be disastrous. However, if the number of such dissatisfied customers keeps on increasing unabatedly the firm may have to confront prosecutions for not delivering services according to the agreement (expected) standards. The negative publicity earned in light of these litigations can damage the firm's reputation and may result in declining numbers of customers. If the declining trend continues, the firm may have to shut down its business due to lack of new orders and termination of existing contracts by its clients.

The Iterative Innovations Model appears to be sufficient for mapping the process of innovation and technological capability building by software firms in the Indian context where a dominant section of the industry is engaged in software services business as opposed to products. It accurately captures the one to one relationship between the firm and its clients for whom it provides software services. The model provides an insight on the ways in which the clients influence the conduct of a firm's innovation.

VI. CONCLUSIONS

During the early years, Indian software industry was engaged with lower level tasks of the 'waterfall model' of software development. Starting initially with the business of supplying software workers for foreign engagements, Indian firms gradually moved up the value chain to deliver value added software services. Subsequently, Indian firms acted swiftly to adopt quality systems like CMM and ISO and sophisticated modes of software delivery. They were also quick in adopting new programming techniques and propagating those techniques amongst the engineers within the company. Some examples of this capability building include: the absorption of the Unix technology in the early days of the industry; development of solutions for the Y2k problem, and adoption of Internet and e-commerce technologies few years later. Thus, the software industry which had initially started with the derisive practice of 'body shopping' has now developed the requisite technological capability to deliver high end R&D services and product development services.

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