LITERATURE REVIEW

Ashish Arora a, V.S. Arunachalam (1999): The Indian software services industry

The Indian software exports have grown in spectacular fashion. Its success has, for the most part, been a combination of resource endowments, a mixture of benign neglect and active encouragement from a normally intrusive government, and good timing. The bulk of the Indian software exports have consisted of fairly mundane services such as low level programming and maintenance. The marked reliance on access to low cost human capital has prompted considerable scepticism about the ability of the Indian software industry to sustain its performance, given the rapid growth in the demand for engineers and the relatively inelastic supply of engineers. This paper reports on the results of research on the Indian software industry. We use a variety of sources, including a questionnaire survey of Indian software firms, and field visits and interviews with industry participants, observers, and US based clients. Although, maintaining the current rate of growth will pose a number of challenges, these challenges are not insurmountable. Not only can the available pool of human capital be expanded by tapping and training the very large pool of English-speaking college graduates, the leading Indian firms are making strong efforts to move up the value chain by acquiring better software project management capability and deeper knowledge of business domains, and reducing costs and improving quality by developing superior methodologies and tools.

Ashish Arora1, V. S. Arunachalam2, Jai Asundi3, Ronald Fernandes (1999): The Indian Software Industry

This paper reports on the results of research on the Indian software industry, carried out at Carnegie Mellon University. We use a variety of sources, including a questionnaire survey of Indian software firms, and field visits and interviews with industry participants, observers, and US based clients. The Indian software industry is remarkable in a number of respects. It is service rather than product oriented, heavily export oriented, and is largely managed by professional and entrepreneurial managements. Also, domestic market experience and expertise appears to have very little benefits for successful importers. Although the industry has grown in spectacular fashion, sustaining this performance will pose a number of challenges. In order to
counteract the widely reported shortages of skilled software professionals and the possible
competition from other low wage, human capital rich countries, Indian firms are trying to move
up the value chain by acquiring deeper knowledge of business domains and management
capability, and to reduce costs by developing superior methodologies and tools. Whether firms
will succeed will depend critically on their management skills and willingness to invest along a
number of dimensions. From a social perspective, the disconnect between domestic and export
markets is a major challenge, but one that the growing diffusion of computers and the
improvement of the communication infrastructure should make easier to confront. In the end, the
greatest impact the software industry is likely to have on the Indian economy is indirect, in its
role as an exemplar of the new business organisational form and as an inspiration to other
entrepreneurs.

Ashok Desai (2003): The Dynamics of the Indian Information Technology Industry

The perception of an industry is generally shaped by official statistics. In the case of the
Indian information (IT) industry, the statistics are not even official. All statistics on it are
generated by National Association of Software and Service Companies (NASSCOM).
This energetic industry association had 850 members at the end of 2002 (NASSCOM 2003a:17);
it claimed that they accounted for over 95 per cent of the industry’s revenue. There are clearly
many firms in the industry that are not members of NASSCOM; a single directory, for instance,
lists over 4000 firms (EFY 2002). Although there is no reason to expect a bias in NASSCOM’s
figures, they are projections from its members’ figures. A comparison with IT export figures
recently released by Reserve Bank of India shows that NASSCOM’s figures are within 10 per
cent of gross exports. Imports are less than 10 per cent of exports; NASSCOM does not estimate
them. The official and NASSCOM figures are comparable; the difference between them could
be due to leads and lags. In the rest of the paper we will use the NASSCOM figures. But we
should at the outset point out the shortcomings of defining the Indian IT industry in terms of
what happens within India’s borders. Thus defined, the industry includes the subsidiaries of
multinational companies, which are an integral part of their global operations. NASSCOM
estimates their share in the sales of the Indian industry in 2001-02 at 26.6 percent. On the other
hand, Indian companies have affiliates and subsidiaries abroad. The accounts of selected IT
companies show financial investments to have been 24 per cent of their gross assets in 2001-02;
virtually all of those would be abroad.

The rapid globalization of the software industry in recent years has focused a great deal of attention on India whose software industry is now a small but a growing part of the international division of labor. Our study had two major objectives: To understand and describe the main features of the Indian software industry, especially its competence and weaknesses; and to understand its links with the American software industry and with the American economy more generally. To get at these issues, we collected data from a number of sources, including a questionnaire survey of over a 100 Indian software firms, and visited over 45 Indian software firms in Delhi, Bombay, Madras, Bangalore, and Hyderabad. We followed up with a smaller number of phone interviews with U.S. firms that have outsourced software development to India. We also had brief structured interviews with 61 Indian programmers to understand better where and how they are trained and the nature of the work they do. In addition, we interviewed a number of government officials in India and industry experts in both India and the U.S. The results of this research illuminate a number of issues related to the Indian software industry, confirming some impressionistic accounts but contradicting others. In particular, nearly two thirds of the revenues of the Indian software industry are from exports, with a much smaller domestic market.

Helsinki University of Technology (2009): National Software Industry Survey

This report presents the results of the twelfth National Software Industry Survey. The software industry is a challenging one for survey research due to the pervasive nature of software; Software is a key component of many modern technology products, and can be also used as an integrated element when producing services. Moreover, it is difficult to separate the software industry from other information product industries1 and the recent boom in online services has further increased the challenges in defining the boundaries of the industry2. Software industry is a subset of professional software development. We classify these activities into four categories as shown. Software business has been traditionally divided into software products and custom made software3. This classification is reflected on the horizontal axis of our
classification. Recently the boundaries between software industry and other industries have become increasingly blurred due to trends that are discussed more in the next section. Hardware producers are relying on software for functionality and differentiation. In some cases firms considered traditionally to be solely device or machinery vendors have expanded their business to include also complementary software products or services that have a significant software component.

**Indian Embassy (2008): India’s Information Technology Industry**

The Indian software industry has grown from a mere US $ 150 million in 1991-92 to a staggering US $ 5.7 billion (including over $4 billion worth of software exports) in 1999-2000. No other Indian industry has performed so well against the global competition. The annual growth rate of India’s software exports has been consistently over 50 percent since 1991. As per the projections made by the National Association of Software and Services Companies (NASSCOM) for 2000-2001 (April 1, 2000 - March 31, 2001), India’s software exports would be around $ 6.3 billion, in addition to $ 2.5 billion in domestic sale.


In the highly competitive environment of enterprise software, catching the next technological wave used to be the way to win. Being the first to market with an innovative new technology could mean emerging as the “next new thing” instead of being folded into a larger company. Similarly, for customers, early adoption of the right emerging technology could provide the incremental boost needed to pull ahead of the competition.

Today, companies are no longer pursuing these strategies. Unfortunately for both vendors and clients, no major innovations are expected in the enterprise software market in the next three to five years. No new concepts as significant as supply chain management (SCM) or customer relationship management (CRM) are on the near horizon—just a constant pressure to make incremental improvements. Meanwhile, virtually every company that needed to add enterprise software to its application portfolio has already done so. With no radically new technologies
imminent and with most markets saturated, the enterprise software sector can expect to see the shakeout cycle typical of any maturing industry, as companies consolidate and rationalize. Oracle’s 2005 acquisition of PeopleSoft and pending acquisition of Siebel Systems illustrate a trend that most observers believe is highly likely to continue.

Driven by the need to grow, enterprise software providers that don’t merge will further encroach on one another’s territory. At the same time, customer CIOs will try to take advantage of their vendors’ competitive vulnerabilities as they begin to rationalize their application portfolios. With fewer opportunities for growth in untapped markets, and with the scale economies of the largest players posing increasing risks to small and midsized firms, most enterprise software providers now face a harsh new environment.


Software companies will need to make business models and processes that match this diffusion pattern equally important to product and services innovation to be successful. In a survey of software customers the vast majority are looking for business models other than the traditional license and maintenance model: 80 percent plan some spending in subscription or on-demand models, 60 percent plan to spend in a transaction-based model, and 33 percent plan software purchases funded at least in part by advertising.

Models to engage the end user across all elements of the business system processes have rapidly taken hold: “netnography” is a powerful new inbound marketing tool, “mass innovation” approaches are drawing users into the innovation and development process, “participatory media marketing” has turned outbound marketing into a two-way conversation, “end-user focused sales” is required to capture the imagination of the increasingly powerful end user, and “virtual support desks” driven by end-user communities are improving quality, driving down support costs.

**Lee Prangnell (2008): The Software Industry Analysis**

Software industry analysis is the comprehensive financial analysis and evaluation of the global software market. It involves analyzing quantitative statistical data such as the size of a particular
market and the market share for specific software companies. The analysis can be conducted by a variety of corporate entities, including business corporations and not-for-profit organizations. Business in general is heavily dependent on computer software to perform a variety of daily functions and as such, the software industry is vast. Therefore, software industry analysis is a very important process for corporations that are involved in the global software market. There are several areas that must be covered in software industry analysis, including analysis of software industry trends, market size, and sales statistics. It is also typically important to identify consumer demographics and the geographical scope of the analysis. Computer software applications, such as accounting and spreadsheet programs, are heavily used in this area of works. For example, a financial analyst might gather statistical data and implement the data in an existing spreadsheet, from which graphical representations of the data can be derived.


Software design is one of the most important and key activities in the system development life cycle (SDLC) phase that ensures the quality of software. Different key areas of design are very vital to be taken into consideration while designing software. Software design describes how the software system is decomposed and managed in smaller components. Object-oriented (OO) paradigm has facilitated software industry with more reliable and manageable software and its design. The quality of the software design can be measured through different metrics such as Chidamber and Kemerer (CK) design metrics, Mood Metrics & Lorenz and Kidd metrics. CK metrics is one of the oldest and most reliable metrics among all metrics available to software industry to evaluate OO design. This paper presents an evaluation of CK metrics to propose an improved CK design metrics values to reduce the defects during software design phase in software. This paper will also describe that whether a significant effect of any CK design metrics exists on total number of defects per module or not. This is achieved by conducting survey in two software development companies.
Meoli Kashorda(2007): Emerging Trends in Information and Communications Technology Education in Kenyan Universities

Information and Communication Technology (ICT) degree programs in private and public universities remain very popular and attract very good students. In recent past, there has been an increase in the enrolment in ICT degree programs in the traditional areas of computer science, electronic engineering, computer engineering and in the newer areas of information systems and software engineering. This paper identifies some of the local and global drivers of this demand. It then uses the open networking model to analyze the future demand for ICT graduates. Using the model, the paper concludes that the focus of Kenyan universities should be in the academic areas of computer science, information systems and electronic engineering. In order to have an impact on the Kenyan economy and the ICT industry, there is an urgent need for universities to seek professional accreditation of the different ICT degree programs and therefore achieve international standards of quality.

The paper recommends adopting the E-campus concept to develop a world-class learning environment for students and faculty that overcomes the low penetration of ICT in Kenya. Although ICT profession will remain popular because of the increasing use of ICT applications in businesses and governments in the region, the challenge for the universities is to attract, retain and develop doctoral-level ICT faculty.

In the past 5 years, there has been an increase in the number of Information and Communication Technology (ICT) degree programs offered by Kenyan universities. For example, all of the 13 private universities in Kenya that have been chartered or given interim letters of authority by the Commission for Higher Education (CHE) offer ICT degree programs. The existing public universities continue to introduce new ICT degree programs and to expand the existing ones. The increase in total enrolment means that there is a strong demand for degree-level ICT education in Kenya. However, the author is not aware of any labour market analysis data that the universities have used to start or expand the ICT degree programs.
Michael Davis (2005): *Software Industry- An Analysis*

Since 1950 innovations in semiconductors, data storage devices, computer architecture, software, and data communications have revolutionized information technology throughout three distinct eras - Mainframe/ Minicomputer, PC, and Internet. Software is classified as either a business service or publishing, and is a subset of the larger $1 Trillion computer industry.

Software remains one of the most innovative and fastest growing sectors of the global economy, generating revenues of nearly $200 billion every year. About half of those sales come from software applications, with the remainder split between development tools and infrastructure software.

Mikko Rönkkö, Jukka Ylitalo, Juhana Peltonen (2010): *Software Industry Survey*

Software industry can be considered from two perspectives: It consists of parts of the computing services industry1 and parts of the publishing industry2. These two industries cover all companies whose main activities are providing software as either products or services to their Customers, but also include many other business activities relating to selling and operating software systems. Moreover, industry classification captures all revenue of firms whereas in this report we focus only on activities directly related to software business.

Software industry is also a small but a part of all professional software development. We classify these activities into four categories. The traditional categorization of software business has into software products and custom made software3 is reflected on the horizontal axis of our classification. The vertical axis “visibility of software in the offering” refers to how apparent it is for the customer that part of the product or service being purchased has software as a central component or is produced by software4. This is related to trend that software is becoming more and more ubiquitous and software development a central part of product development and service design.

Mikko Rönkkö, OlliPekka, Mutanen, Nina Koivisto(2008): *Overview of Finnished Software Industry*

Software industry is a challenging one for survey research due to the pervasive nature of software; Software is a key component of many modern technology products, and can be also used as an integrated element when producing services. Moreover, it is difficult to separate the
software industry from other information product industries. The recent boom in online services has further increased the challenges in defining the boundaries of the industry. The main focus of this report is on the software product business, but non-product or service businesses are covered to some extent as well.

Software industry is a subset of professional software development. We classify these activities into four categories as shown. Software business is traditionally divided into software products and custom made software. This classification is reflected on the horizontal axis of our classification.

**Rafiq Dossani (2000): Origins and Growth of the Software Industry in India:**
The paper explains the evolution of India’s software industry. Domestic entrepreneurship emerges as the key factor for origination, survival and innovation in a hostile industrial policy environment. The maturing of the industry required a shift to a supportive government policy; maturation was also critically enabled by the modularization of the programming function through new technologies. These changes favored domestic firms that provided programming services. Later policy and technological changes induced transnational entry and led to higher value-added output. The paper shows that technologically sophisticated industries can develop even when many conditions typically present elsewhere are missing. We provide conditions under which this may happen and show their effect on subsequent developments.

The paper explained the evolution of India’s software industry from its origins in 1974 to the present time. Domestic entrepreneurship drove the industry’s origination, survival and innovation during a time when the state used policy to promote SOEs and to crowd out the private sector. The state’s policies effectively prevented the private development of software in India. The private sector, in collaboration with TNCs, found an innovative solution, that of exporting programmers instead.

After the dotcom bubble burst in 2000, there was a worldwide cut back in corporate spend on technology. The Software Products and Information Technology Services Industry has since made a good recovery, and was worth USD1.13 trillion in 2005, with a year on year growth of 11.37%. Increasing reliance on internet based technology and shifts in the industry’s business model have contributed to change and growth within the industry as a whole.
The market was dominated in 2005 by the US and the EU, which together accounted for over 60% of the global market, with the US alone making up 41% of the industry. The Software Products and Information Technology Services Industry remains highly fragmented, with the top six companies constituting only 13% of the market. However there was a marked increase in M&A levels, with around 3000 deals in 2005. Microsoft, IBM and EDS were the market leaders in 2003 in terms of revenue. The industry has appeared more uncertain and unpredictable than many other global industries over recent years, although its future is assured. Breakthroughs can and do appear from anywhere, often creating large scale change and causing the industry to branch out in unexpected directions.

REPORT OF AN INDUSTRY EXPERT GROUP (2009): TOWARDS A EUROPEAN SOFTWARE STRATEGY

The need to develop a European Software Strategy was raised by Commissioner Redding in her speech "Towards a European Software Strategy" at the Truffle 100 event (19 November 2007), and reiterated at the Microsoft Innovation Day (4 December 2007). The Commissioner appealed directly to industry on this matter. Subsequently, a number of key organizations in the software sector have sent to Commissioner Redding their views on the issues that should influence such a strategy, and have suggested elements that might form part of a strategy. This led to a position paper which was presented and debated on January 20th during a meeting with Industry and European Commission representatives. As follow-on it was proposed by the Commission to organize seven workgroups, each in charge of refining the position papers views on a particular Aspect; Workgroup n°7 was in charge of Open Source Software (OSS) and produced the present report. The OSS workgroup has been very active and probably like all other workgroups, we felt that our ideas refinement and passionate debates were only limited by the deadline set for this work. Our group included members from various sectors and line of thoughts, The group included a non-profit centre of competence for OSS, industry representation with partial or high OSS degree for their revenue model, as well as organizations that base their entire revenue on the proprietary mode.

Recently a lot of people have been debating about the future of Indian software industry, whether it is a good career move for people out of college or not. More and more students in college are asking "Should I go in software or not". In the last few months I have been doing a research on this topic, reading the predictions and projections of various experts on the internet, and even talking of many software professionals about the future of Indian IT industry. In this article I will share my thoughts with you including the pros and cons of software profession. I have divided this analysis into three sections - Positives, Negatives and Final Conclusion.

Additionally, software is a white collar job, meaning you are mostly sitting in a nice air-conditioned office/cubicle and unlike many other professions you do not have to run around to get your work done. There are plenty of jobs and you can change companies every two years and your salary increases each time you do so. International competition increasing: Countries like China, Mexico and Philippines are slowly catching up. Several Indian companies have already opened their offices there. Did you know that China produces more engineers than India but they really lack ability to speak English. The upcoming Chinese generations are much better and will certainly compete with India in future.


The 2010 survey, approximately two-thirds of all respondents identified themselves as being part of senior and executive management, with a quarter of all respondents identifying themselves as having strategic and fiduciary responsibilities. These are significant groups to weigh as we look further into survey data and analyze responses on business challenges and industry outlook.

Another large group of respondents identified themselves as being involved in the technical aspects of software development – a little over 19% described themselves as part of technical management, engineering, and related consultative services.

As with last year’s survey, 2011 respondents are professionals either predominately involved in strategic business decisions with regard to software development or directly implementing those decisions. To gain a more complete perspective of the survey results, it is also important to understand the types of organizations these business leaders and software professionals
represent. As in the 2010 survey, the largest group of 2011 survey respondents identified themselves as Independent Software Vendors (ISVs), whose core business is software development. This group represents nearly 60% of all respondents.

**Software Survey (2010): Business Information Centre**

It is important to keep up to date with what is happening in any industry in order to plan your company strategy effectively. The Business Information Centre can provide a wealth of information on all aspects of the software industry from the global industry as a whole to the more specific sub sectors. In addition, Enterprise Europe NI is hosted by Invest Northern Ireland. The network can provide direct contact with market research centres throughout Europe and is a first point of contact for researching European software markets. This guide has been designed to assist with desk research and shows examples of reports and websites that might be useful. It is only possible to give an idea of the content of databases and websites. Invest NI does not endorse any of the websites or information providers mentioned.

**Subhash Bhatnagar(20004): India’s software industry**

The objective of the study is to understand how the Indian software industry has been able to catch up successful access, learn and develop to the technological standards of global leaders while others in the developing world lag behind. The focus of the study is to on explaining the factors that contributed to the phenomenal growth of software export from India including the role of institutions and government policies.

The Indian software industry has remarkable story. It has grown more than 30% annually or 20 years with 2008 exports projected at closed to $60billion. India exports services to more than 60 countries with 2/3 to the United States, including half of fortune 500. Economic policy has undergone substantial revision driven by this sector and India began to open up. Foreign reservations are high markets great influence policy and a string of coalition governments have not deviated from economic liberalization.

The Indian Software Industry appears to provide a startling confirmation of the benefits of multinational investment in a fledgling industrial sector. The main question is explored in this paper is how and why this happened. We find that multinational firms had an important analyzing effect on the industry’s evolution, even through foreign firms established by expatriate Indians probably exerted more competitive pressure. We do not accept the popular view which ascribes this benign influence in the development of human capital. We argue it was tight labour markets due to the foreign competition which induced the domestic firms to both acquiring unique organizational abilities and to improve the value adding strategies of multinational firms.

TOSHIAKI KUROKAWA, MASATO SHINAGAWA (2008): Technical Trends and Challenges of Software

Software tests are (herein referred to as software testing) commonly known as “a test to verify if there is no problem with software”. Software testing, in this sense, may seem to be similar to tests of various “artifacts (products)” such as ones to check the safety of confectioneries, whether batteries are produced as specified, or whether an aircraft has any problems concerning its flight. In fact, many problems have been revealed concerning inspections and testing of these products in recent years. On the other hand, unlike such tangible products, software would have different types of problems because problems in software are hard to see by users until such problems actually are visualized by a series of defects. In the case of tangible products, you may notice some indication before the serious problem occurs. In other words, unless the certain conditions are tested for the defects, the software is considered and treated to be at normal state, or “no problem”. In a more extreme statement, it can be said that problems attributed to software are caused by insufficiency of its testing. Recent software related problems are largely caused by lack of testing, and have actually brought social problems and financial losses. For example, there was a failure with the New Derivation Trading System, which deals with derivative products, of Tokyo Stock Exchange on February 8,
2008. Due to this problem, the trading system operation have been suspended until the 12th of the month. The reported reason of the failure was an “initialization error with the memory within the server, and no initialization were conducted under a certain condition”.


The Indian software industry epitomizes all that market forces and liberalization can bring to a rather insulated economy. Expanding market opportunities, exponential growth prospects, access to the latest technology, increased income levels, better corporate governance etc have been some of the key benefits that this industry has witnessed over the years. India continues to be a rather small player in the global IT landscape with a share of around 20.0 percent in the global customized software market and less than 1.0 percent in the products and packages market in the year 2000. However, domestic majors have started to create a mark for themselves in the global software industry, especially in the services segment. The success of the offshore model (a model that facilitates the development/ execution of projects based in India and transmitting the deliverables through high-speed data links etc) has resulted in software export revenues growing exponentially over the last decade. During this period this segment clocked growth rates in excess of 50.0 percent per annum. The current year’s (2001-02) software export targets are pegged at around US$ 6.2 billion, a share of around 13.0 percent of the country’s total export revenues.