Chapter 3

Software Products and Services Offered by Indian Industry
In the earlier chapter, we have argued that long-term sustainability of growth of any industry or country in the global market is dependent on the choice of activities. Those activities have to be knowledge intensive to create a competitive knowledge advantage. In this chapter, we shall investigate where the knowledge advantage resides in the global software industry and where we can position the Indian industry in the value chain of the software development process to ensure sustainability.

This chapter\(^9\) is divided into three parts. In the first part, we seek to understand the software industry in terms of general economic terminology. This is necessary for a better understanding of the software industry and also for deciphering the missing link between software and hardware segment of IT industry of India. In this context, the second part attempts to discuss the features of the products and services offered by the Indian software industry. The last part presents summary and broad observations.

3.1 Software in Economic Terminology

In technical terminology software is the interface between computers and human commands. Software is a program that translates the system of human logic into a set of electromagnetic impulses. In general "the term software refers both to the instruction that direct the operation of computer equipment and the information content, or data, that computers manipulate (Schware, 1992). Much of software is in the nature of an intermediate input. It facilitates processing of information in other services and manufacturing industries. Software is also like capital goods, whose deployment can enhance increased productivity and efficiency in a wide range of economic activities (D’costa 2002). What is it as an economic product in terms of its uses? To attempt an

\(^9^\) For an earlier version of some of the results derived here, see Nath & Hazra (2002).
answer, we try to arrive at some understanding of software as a product, commodity, its producers, users and uses.

3.11 Use and Users of Software

Use wise computer software can be broadly divided into two categories:

System software - This is used to manage the components of computer system - for example, computer operating systems that control input and output operations (Schware, 1992). In other words, system software controls the basic functions of computer.

Application software – This software is designed to apply computer power to the performance of tasks such as materials and facilities in hospitals, budget and payroll administration, computer-aided design etc. (Schware, 1992).

Application software can be further divided into three broad groups:

Customized Software – It is primarily application software that is used to customize the user's computer system so that it can fulfill particular user needs or functions (Kopetz, 1995). Customized software is used for data processing and interpersonal/inter organizational communication for routine operations and management. The importance of this software has grown in banks, government services and management of large institutions that become increasingly dependent on computer-based technologies.

Shrink-wrapped Software Packages – This type of software is used on personal computers and allows the user to work independently. It addresses genuine user need. ease of use, flawless documentation to allow the user to be self-sufficient etc. (Kopetz, 1995). Operating systems like Windows, spreadsheets like Microsoft Excel or Lotus 1-2-
3 and word-processing programs like, MS Word, Word Perfect are some example of packaged software. Used mainly in personal computer sector, it is considered to be the driving force behind the personal computer revolution, office automation, productivity tools, and computer-aided design.

**Embedded Software** – This is considered to be the key element in a complex industrial product. It is increasingly being used in all aspects of existing business to improve or enhance the existing product by new functionality based on software (Kopetz 1995). This type of software is the core of industrial automation, machine tool industries, precision control systems, power generation and distribution, electronic products and telecommunications. Software in this category comes as part of capital goods and consumer goods.

Embedded software is used in making “intelligent” devices that have some sort of logical decision-making capability and the ability to interact with their task environment and the user in real time. The embedded software used in such devices is focused on doing only the specific task that it is meant to perform. The device takes very specific inputs from its usage environment, processes these and produces very specific outputs as per the design. The usage of this software includes the defense industry that supports national operations and produces the weapons systems that ensure national security. The technology is used in military applications and space technology due to the inherent advantages of robustness, compactness of design and lower power consumption. It also includes civil agencies that provide essential services like air traffic control and social security and regulatory agencies that administer the infrastructure of nation like the internal revenue service and immigration. Innovative use of microelectronics devices in
industrial automation and industrial products has made embedded software as key to competitive advantage of the industrialized and newly industrialized countries. Generally, development and application of embedded software forms part of a company strategy for enhancing production efficiency, new product development and product differentiation.

Success in embedded software segment depends on a firm’s ability to design software and development tools that are high in quality, reliability and performance. In 2000, the global embedded systems market was approximately $71 billion, out of which, the US accounting for approximately $41 billion. The industry is expected to grow 16% per year through 2004. In recent years, the embedded software space has seen significant merger and acquisition. The enormous potential for smart devices in the automobile, telecommunication, Internet and consumer electronics market is expected to continue to fuel strong growth in the embedded software segment for the foreseeable future.

3.12 Producers of Software:

Producers of software can be categorized in three broad divisions:

Software made by users - Users themselves create in-house software development capability as a part of its business plan, to enhance its operational efficiency, and also for various control systems and optimization problems. Although for in-house use, many such software have demand, depending on the success of the in-house application, across production units and industries. The original developer and user of such software may find profitable business outside. There are examples where the original developer has created independent profit centers or a spin-off firm for dealing with the successful software developed for internal use.

19 The Mirue Online Newsletter (July 2001), http://www.imakenews.com
Software made by hardware makers - Here hardware means machine and not the computer hardware. Such hardware has computing system in-built and associated highly specialized software adds new features, efficiency, dependability and intelligent performance of machines - both capital goods and consumer durables. Such firms will have highly skilled hardware and software professionals capable of closely integrating software with hardware design. This is the embedded software segment described earlier. It is to be noted that embedded software segment needs matching capabilities of both hardware and software.

Software made by independent software firms - Such firms have their own projects for use specific (and not only user specific) software development. Packages for word processing, statistical exercises, account keeping etc. are the examples of products from such projects. These firms may also work for the projects of the earlier two categories, depending on their credibility and contacts.

3.13 Software Market

Given the sketches of the producers of software, it is easy to guess that software market can be divided into two categories:

Invisible, unaccounted, inaccessible market - The first two categories of software products create a market that is not visible because either they are developed for own use and therefore not traded in the market or they come as a part of hardware (embedded software) and therefore not separately accounted for in the market. This part of the software market being a part of the business strategy of the firms is not accessible by others.
Visible open market - The visible part of the total software market is therefore the part that comes under the services and products offered by the independent software firms. The part of the software development projects contracted out by the other two categories is accounted in the activities of the independent software firms. Separation of software and hardware in the 80s (Breshanahan et al 1999) helped establishment of independent software houses that are the key players' in this market.

The core of the software market is to be understood in terms of its development process. Widely acknowledged model of software development process is known as Waterfall model (depicted below) proposed by Royce in 1970 (Arora et al 2001).

The model allows departmentalization and independent managerial control of each phase. From the first phase to the end the development moves from concept, through design, implementation, testing, installation, troubleshooting to the last phase of operation and maintenance. Each phase of development proceeds in strict order, without any overlapping or iterative steps. The value-add is typically greatest in early stages of development – namely requirement analysis and high-level design. Here the idea of the software is conceived and the specific requirements are analyzed and designed, which requires mature and sophisticated levels of skills and experiences. The later stages of coding and testing involve actual writing of program and testing of its effectiveness in applications. This refers basically to the non-creative routine segments of production process and hence requires relatively lower level of skills. Initial phases of the software development process, therefore, are inside the user firms or with the highly skilled and experienced independent software firms that can articulate the requirement and design of
the software for users. These phases are part of the firms' growth strategy and constitute the inaccessible high investment/high risk and high skill activities part of the market.

Figure 1: Waterfall Model of Software Development
Activities in the remaining part of the phases constitute the visible part of the market. These are the contractible jobs. Figure 2 shows the distinction between contractible and non-contractible software jobs in terms of skill and risk involved (NASSCOM-Mckinsey report 1999). Both user firms having in-house capability or independent software firms would outsource the contractible components of the software development process on least cost basis. By doing this they would try to focus increasingly on core competencies (such as developing applications for old computer platforms).

We observe from the above discussion that most advanced capability in software is located at the initial phases of the software development process. We have also observed that such capability is closely linked with the manufacturing industry, either in the form of in-house capability or in the form of independent software firms.

For historical reasons\textsuperscript{30} independent software houses were born within the computer hardware industry of USA. The process has been accelerated by extensive

\textsuperscript{26}In 1950s and 1960s, the large, vertically integrated computer companies, (like IBM, Apple Macintosh) with in-built software sold their computer in the market. The bundling of closed standards led virtually no competition in the computer software market. There were broadly three forces that gave birth to software
software needs by the defense industry and space research. The user industries also found outsourcing more economical because of ever increasing maintenance and development cost for in-house arrangements. This forged a relationship between software user industry (mainly in the form of embedded software) and the independent software firms. There was no comparable growth of independent software firms in other industrialized countries like Japan and Germany. User industries in these countries continued their reliance on in-house capabilities. It is only lately that these countries have realized the economic advantage of outsourcing software. Although the firms in these countries have strong in-house capabilities for undertaking the core activities in the software development process, the development of independent software firms in these countries are greatly constrained by the manpower that can take up the activities required at later phases of the waterfall model.

It is also to be noted that existence of independent software firms is not sufficient condition for creating the most advanced capability in software development. In case of Germany and Japan, because of in-house nature of software development, capability has been built around finely tailored software and semi-developed independent software industry could not compete successfully in the packaged software market (Baba et al, 1995). On the other hand, even if a country has fully developed independent software industry in late 1960s as a separate industry and led to the emergence of independent vendors for producing software for the clients.

• Extensive need of software for defense industry and space research in the United States in the 1960s
• Increasing software development and maintenance costs over hardware cost
• The United States Department of Justice's anti-trust policy in 1968.

By the 1980s, software became a major industry and started to overtake hardware in total revenue generation. Gradually outsourcing of software using the capability of independent software houses became the dominant market trend. It was also found cost effective. (Breshanahan et al 1999)
industry that is not closely linked with its manufacturing industry, and thrives on the visible part of the market, it is unlikely that the industry will be able to emerge as software super power.

With this understanding we examine the software products and services offered by the Indian software industry.

3.2 Products and Services Offered by Indian Software Industry

According to Schware (1992), ‘India’s software sector has focused on onsite services abroad, otherwise known as “body-shopping” or “manpower contracts,” in which Indian firms undertake mostly the routine tasks of coding and debugging (rather than design, analysis and project management)” Indian presence in high value and high skill segment is negligible.

However, recently the Indian software industry has become worth of billions of rupees. With a modest beginning around 1984-85, software and services exports moved up to Rs. 25.2 billion (US$ 734 million) in 1995-96 and to Rs.171.5 billion (US$ 4 billion) in 1999-2000 and exported to more than 91 countries around the world. It was expected that export revenue would grow to US$ 50 billion by the end of 2008\(^\text{24}\). The industry has clearly emerged as a major export earner for the country, contributing 8 per cent of total merchandise exports.

The software sector has already grown from 0.3 per cent contribution to the GDP in 1990-91 to 1.5 percent in 1999. At the same time it is also to be noted that despite rapid growth and having many cost-related and technical advantages in this sector the share of Indian software products and services in the global export market is around only

1 percent and has stagnated there for quite some time. This indicates that the global market is expanding at a much faster rate than the capability of Indian software industry in expanding its share in the global market. Table 1 shows the performance of the industry in recent past in the domestic and export market. The table clearly brings out increasing export dependence of the industry. We, therefore, observe two conflicting trends of growing export dependence and stagnant share in the world market. Is it because of limited innovative capability of Indian software companies that the industry in general could not expand its market share in the expanding global market?

Table 1: Domestic and Export Market of Indian Software

<table>
<thead>
<tr>
<th>Year</th>
<th>Software Market (Rs. Million)</th>
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<tbody>
<tr>
<td></td>
<td>Domestic (per cent)</td>
<td>Exports (per cent)</td>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>1994-95</td>
<td>10,700 (41)</td>
<td>15,350 (59)</td>
<td>26,050</td>
<td></td>
</tr>
<tr>
<td>1995-96</td>
<td>16,700 (40)</td>
<td>25,200 (60)</td>
<td>41,900</td>
<td></td>
</tr>
<tr>
<td>1996-97</td>
<td>24,100 (38)</td>
<td>39,000 (62)</td>
<td>63,100</td>
<td></td>
</tr>
<tr>
<td>1997-98</td>
<td>35,100 (35)</td>
<td>65,300 (65)</td>
<td>100,400</td>
<td></td>
</tr>
<tr>
<td>1998-99</td>
<td>49,500 (31)</td>
<td>109,400 (69)</td>
<td>158,900</td>
<td></td>
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</tbody>
</table>

D’costa (2002) has demonstrated theoretical reasons as to why innovation may not be a pervasive feature of Indian software firms. Notwithstanding the immense benefits accruing from the external orientation, such as global competitiveness, better resource utilization, increased learning-by-doing, rising productivity, increasing income etc., excessive export dependence and concentrating primarily on one single market (the US), according to D’costa, leads to a lower innovative trajectory. Moreover, the sector’s weak domestic orientation truncates the immense technological spin-offs possible to solve local problems by finding suitable software solutions.
We would now attempt to understand the dilemma of export dependence and stagnant world market share by breaking down the products and services offered by the Indian software companies. Moreover, to have better understanding about the technological capability that Indian software industry so far developed, firms have been classified according to their technical areas of specialization and their expertise in application areas in the subsequent chapter.

NASSCOM has divided software products and services in four major groups, depicted in figure 3. Groups are: IT services, software products, IT-enabled services and E-business. Under these product headings the table shows various product or service types within each columns. As we move from top to bottom of the columns, the product and services groups are distinguished in terms of high value/high skill requirement to low value/low skill requirement for developing these products and services. Indian companies operate within the area shaded in the figure 3, which has been reported by NASSCOM McKinsey study (1999).

The product profile of the industry, separately for domestic and export markets, is shown in table 2. It is to be noted that 'products and packages' constitute the largest segment in the domestic market and lowest in the export market. In the domestic market this includes mainly selling imported packages in the domestic market. Indian firms in the late 1980s produced some moderately successful software products like accounting packages and word processing packages in Indian languages for the Indian markets and a few customized software packages for domestic clients.
In the area of ERP packages, a couple of firms were trying to compete with global giants like SPA, BAAN and PeopleSoft in the domestic market. More than four fifth of the export earning comes from 'projects' and 'professional services'. Projects are 'contracted out' components of the major software projects undertaken by the software firms in USA. Professional services are essentially exports of manpower to fix the
problems of the companies in USA. In popular jargon it is known as 'onsite service' or 'body shopping', and considered to be low risk activity. There is little export of products (and packages) due to large start-up costs in marketing non-branded products and the inherent risks associated with innovations.

In the world software market the comparative advantage of India, therefore, is in low-value, low-skill jobs. As Schware has observed, from 1979 onwards the trend in the software industry has been towards packaged software, and away from customized programming services. As we have mentioned above India's presence in packaged software is insignificant. Again top Indian software firms had acquired substantial market presence in customized programming services, the segment that is not growing and already left by leading software companies. This is, however, a common and much discussed less developed country characteristics. One face of it is the trade pattern featuring export of raw material and import of finished products. In case of modern software industry it is export of low skill human resources and import of finished product like packaged software. The other face is industrialization of the periphery with discarded product and manufacturing practices catering to the leftovers of a dying market. Less developed countries, in such cases, are actually the backyards of discarded knowledge of the developed countries. The vagaries of such trade pattern and miseries of such relationship for less developed countries are well documented in economic literature (Hobsbawm 1972).

Indian companies can not be expected to rush into the highly lucrative applications or generic products segment as the risk of failure is quite high. Based on the risk reward trade-off, a value chain can be generated, where the quality of work is
represented by the height of the pyramid (figure: 4). At the lower end of the value chain the risk of failure is the least and so also is the rewards, but at the higher ends both risk and rewards are high. At the top there exists product business, which requires different skills, and resources as developing products require critical knowledge and expertise. At the same time, research and development and marketing efforts take time to bear fruit. This is unlike software development services where orders are executed based on client requirements. Risk involved in this type of activity is much less.

**Figure: 4 Value Pyramid**

![Value Pyramid Diagram]

Source: Business Standard, The Smart Investor, 10th April 2000

The services offered by Indian companies can be classified as low-end and high-end services. Data entry jobs, re-engineering of legacy operations, porting of applications from one platform to another, maintenance of existing software etc. constitute low-end offshore services. Most of the big companies in India are engaged in this type of services (like for example TCS, WIPRO, Pentafour, Satyam, Tata Infotech etc.), which ensure
them stable revenue streams and steer the companies onto the high-growth path. High­end offshore services include taking over the complete project (referred in NASSCOM McKinsey study). Only handful Indian companies are capable to offer this type of services. Very few companies nowadays have moved to only niche product segment (niche products are products which cater to some specific segments of IT users, for example products for the banking industry). The only business model that is relevant for the future is one that is best at maximizing value creation. Value addition rather than low risk activity is the key to success in today’s business. However, the software industry in India is highly relied on low-end professional services. It has limited expertise in high value added activities such as package development, IT consulting services and R&D. This reflects that the presence of Indian software company is at the bottom of the value chain pyramid. Indian companies may not be able to uphold its phenomenal success of (export) growth (in recent past) unless they try to rush into the highly lucrative applications or generic product segments to focus on value creating activity, which will help them to move up the value chain.

If we read the product profile of the Indian software industry together with the foregoing general description of use and users of software we can see that Indian basket of products and services totally exclude the embedded software category. The basket is mainly constituted of a few packages and customized software projects for the domestic market, and contracted out projects/jobs from the software companies of (mainly) USA. These jobs are done either onsite, or offshore depending on the cost and availability of suitable infrastructure. In a typical year of 1998-99 the break-up of the nature of activities that generated total revenue in the domestic and export market is shown in table 3.
Referring back to the Waterfall model of software development process we can relate these activities with the bottom three boxes of activities, namely, Integration and product verification, Implementation and system test, Operation and maintenance and revalidation. These are the contractible parts of the software development process and fall into the low value/low risk zones shown in figure 1. The NASSCOM-Mckinsey report (1999) on Indian software industry also identifies these products as low risk/low skill activities (fall under the shaded area depicted in figure 3). In the value chain pyramid, these low value/low risk activities fall at the bottom end.

**Table 3: Types of Software Services in 1998-99**

<table>
<thead>
<tr>
<th>Type of Services</th>
<th>Rs. Million</th>
<th>Percentage</th>
</tr>
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<tbody>
<tr>
<td>Onsite Services</td>
<td>63,650</td>
<td>58.18%</td>
</tr>
<tr>
<td>Offshore Services</td>
<td>37,100</td>
<td>33.92%</td>
</tr>
<tr>
<td>Products &amp; Packages</td>
<td>8,650</td>
<td>7.90%</td>
</tr>
</tbody>
</table>

*Source: Indian IT Software & Services Directory, NASSCOM (1999-2000)*

Plausible reason behind absence of Indian software activities in the 'embedded software' segment is the result of limited industrial automation. India has perennial weakness in the capital goods sector, as it is evident on high import dependence for capital goods. Application of micro electronic devices has revolutionized the operation, control and efficiency of the machines. Indian capital goods industry has virtually remained untouched by this revolution. By the time Indian capital goods industry mastered the designing and manufacturing of hardware components of a machine, introduction of embedded software in machines changed the capital goods industry all over the world. An example from textile machine manufacturing industry will help clarification of the point. After considerable time and investment a few textile machine manufacturers have developed the capability of designing and manufacturing complex
hardware system for yarn twisting machine only to discover that the computerized control system, that has become general feature of any such machine in the world market, has to be imported at a cost that does not make the venture profitable in the domestic as well as in the world market (Nath et al 1998). While the import dependence of capital goods sector perpetuates, India becomes a major derived importer of embedded software as part of the imported capital goods. It is not known how much of this derived import of embedded software is, if at all, actually accounted for.

Development of embedded software is a high investment, high risk and high skill venture. Such major ventures by Indian manufacturing industry, if not unknown, are insignificant. Are Indian software firms equipped enough to take up major innovations and associated high R&D costs for developing its own hi-tech core rooted in the manufacturing industry of India? Such a venture and ensuing experience will not only help high value addition to the products of Indian industries; it will also create high value market for Indian software industry overseas. This is perhaps the way by which sustainability and global supremacy of Indian software industry can be achieved. The ability of the Indian software industry to achieve this high pedestal depends on the structure of the industry that would uphold the high value/high risk activities.

3.3 Summary and Observations

In this chapter, we have identified the location of the Indian software industry in terms of product, producer and market category. It has been observed that the presence of Indian software and services in high value/high skill segment is negligible although software industry has become worth of billions of rupees. The services offered by Indian companies have been identified as low value/low risk/low skilled activities and fall at the
bottom of the value pyramid. Embedded software, which is considered as the core of industrial automation and can flourish with wide applications of microelectronics in the industrial products and processes, is absent in Indian software product basket. As a result, there exists a weak linkage of software industry with domestic manufacturing industry.

In the next chapter we examine how such products/activities create a compatible industry structure. We try to evaluate the industry structure to suggest its ability to move up the value chain and create competitive advantage.