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The Uneven Profile of Indian Software Exports

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Abstract

Indian software exports have shown very high growth rates for many years. Yet, behind this success lie a number of skews. These skews are discussed in this paper, which is based on fieldwork and secondary surveys conducted in India over the past ten years. In particular, software exports have been epitomised by the export of programmers who go to work for a client in the US: so-called 'body shopping'. Software exports have also been dominated by large firms located in a few metropolitan areas, notably in Bangalore. The paper discusses each one of these skews; presents analysis that explains why they exist and persist; and, looking especially at growth in offshore working, why they may change. Conclusions are drawn about the benefits, costs and likely trajectory of the current uneven profile of Indian software exports.

Introduction

By almost any standards, the growth of India's software exports has been phenomenal. Exports began in 1974 but made limited impact until the 1980s. From that time on, growth rates have been consistently high, as Table 1 illustrates.

Table 1: Indian Software Exports and Growth Rates (1980-1997/98)

Year	Software Exports (US$m)	Growth Rate
1980	4.0	
1981	6.8	70%
1982	13.5	99%
1983	18.2	35%
1984	25.3	39%
1985	27.7	9%
1986	38.9	40%
1987	54.1	39%
1988/89 (Apr-Mar)	69.7	29%
1989/90	105.4	51%
1990/91	131.2	24%
1991/92	173.9	33%
1992/93	219.8	26%
1993/94	314.0	43%
1994/95	480.9	53%
1995/96	668.0	39%
1996/97	997.0	49%
1997/98	1650.0	65%

Source: Heeks (1996), Dataquest (1998)

However, all is not quite what it seems. For example, as noted elsewhere (Heeks 1996), these 'headline' figures represent gross foreign exchange earnings. Net earnings (less outflow of foreign exchange from India to pay for travel and living allowances of Indian software workers who undertake their contracts overseas, marketing, multinational profit repatriation, importation of hardware and software, etc.) are now estimated to be around 40% of the gross figures.

This industry has also been characterised by an uneven profile along several dimensions. These skews have important implications for both the growth and earnings potential of Indian software, as described below.

A. Uneven Output: Services not Packages

Indian software exports have been dominated by export of software *services*, in the form of custom software work, rather than export of software *products*, in the form of packages. This helps explain the recent rise in growth rates. This rise has partly taken place because of the explosion of services work on the 'Year 2000 problem'; now estimated to make up nearly 40% of current software export work from India. By contrast, at the very most, just under 5% of exports came from packages in 1997/98, and even this figure – as discussed below – is not all it seems (Dataquest 1998).

Why have packages not taken off despite India's low labour cost advantages? Because, notwithstanding the low cost at which Indian companies can develop such packages, there are serious barriers to entry into this market which are worse than those for software services.

Indian firms and their developers are not sufficiently familiar with the foreign package markets they seek to penetrate, and their distance from those markets makes it hard to keep up with changing needs and standards. The Indian domestic market is a poor guide for software developers thanks to differences in user needs, in work and hardware environments, and thanks to the generally low level of innovation.

Secondly, any low cost advantage in development is quickly eroded:

> "Market barriers to new software products have risen significantly … with the cost of bringing a product to market becoming a heavy expense. Although software is relatively inexpensive to develop, the costly advertising and marketing effort needed to catch the attention of potential customers has increased dramatically." (Kehoe 1986:5)

Software multinationals can spend 40-50% of annual revenue on package sales and marketing, and 10-15% on research and development for packages (Economist 1994). For a single large firm, this can represent billions of US dollars-worth of investment: more than the entire output of all Indian software producers.

Due to India's lack of reputation as a software package source and its lack of any software brand names in a relatively brand-loyal market, high sales would not be expected, making the unit cost of marketing and distribution even higher. Providing support, maintenance and upgrades for a product in a foreign market is also either difficult or very costly.

Lastly, all this assumes success with the product, yet experience suggests that only about 1-5% of software packages succeed, in which case huge investments are required, which are not readily available within India. Even if available, neither government policy nor managerial attitudes have generally encouraged the high-risk, long-term investments necessary.

Because of these constraints, some Indian companies have agreed to undertake custom software work at cut price for a foreign client on the understanding that they will subsequently try to market the developed system as a package for a niche market.

Firms and official surveys frequently classify this as 'package exports' but such 'packages' – sometimes more accurately identified as 'semi-packaged software' – often end up being used merely as marketing or development platforms for further customisation. Exports of what would traditionally be thought of as a software package – something wholly created by an Indian company in India and sold through a foreign distributor in a shrink-wrapped package – therefore represent far, far less than the 5% figure cited above.

The alternative option for Indian exporters seeking to work on packages is to collaborate with a foreign firm which will supply the package specifications, marketing, support and finance. The drawback is that the Indian company ends up just supplying programming services in return for a very small share of any revenue. Nor will its reputation be much-enhanced for, as with original equipment manufacturing in other fields, the product will emerge under the foreign firm's brand name.

B. Uneven Export Destination: US Domination

Indian companies have exported software to more than forty countries but there is a heavy reliance on the US market, as Table 2 indicates.

Table 2: Breakdown of Indian Software Exports by Destination (1997/98)

Destination	Proportion of Total Exports
US	65%
UK	10%
Other Europe	10%
Japan	5%
Other	10%

Source: Dataquest (1998)

The US market dominates Indian software exports partly because it is by far the world's largest software market, constituting around half of all software sales in the 1990s, and partly because "American information technology and financial services companies have moved much more quickly than their European counterparts to take advantage of offshore programming." (Tilley 1990). The US has also had more liberal immigration rules for work or residence than most other developed countries, despite the post-1993 changes described below.

However, India is also more 'locked-in' to the US market than others because many Indian businesses have links through family members or friends who are US residents; because many software developers are US-trained and so understand that market best; and because there is a vast predominance of US firms in the all-important collaborations which provide so much of India's software export market.

The US-orientation of exports might present a limitation to future growth because US share of the world market is slowly declining. However, the American market is still expanding substantially in absolute terms plus, since the early 1990s, Indian software exports have shown their ability to grow in other markets, such as those of Asia and Europe.

C. Uneven Divisions of Labour: 'Body Shopping Prison'

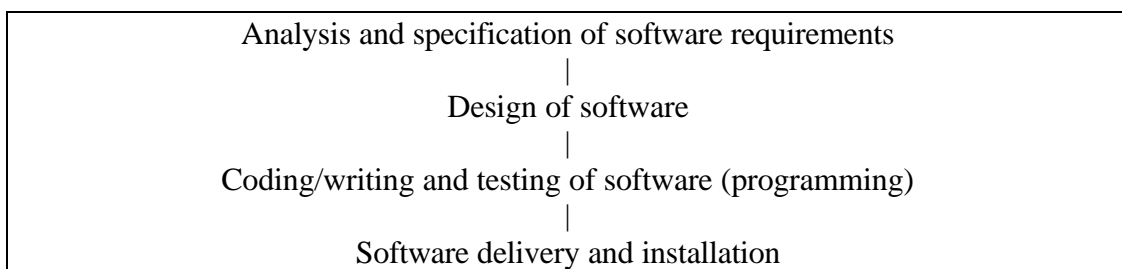## Uneven Locational Divisions: Onsite and Offshore Work

Much of India's export work developing custom software is actually carried out at the client's site overseas ('onsite') rather than offshore in India. Back in 1988, an average of 65% of export contracts were carried out wholly at the client site, while 35% contained <u>some</u> offshore elements (Heeks 1991). This translated into just under 75% of Indian software export development taking place overseas and only 25% in India. This was even true of work in India's export processing zones, which were intended to be bases for offshore work.

Subsequent surveys have shown that the amount of work carried out offshore has increased within individual firms. The trend is particularly noticeable in the subsidiaries of multinational firms. However, a significant amount of onsite work has remained within the industry overall so that, by 1997/98, it was still true that more than half of all software services export earnings came from onsite work (<u>Dataquest</u> 1998). This forms the basis for an *international <u>locational</u> division of labour* within India's software export trade.

Uneven Skill Divisions: Dominance of Programming

Software development is usually seen as being broken down into a series of relatively standardised production steps, as shown in Figure 1.

Figure 1: Software Production Stages

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Analysis and specification of software requirements
                        |
                 Design of software
                        |
Coding/writing and testing of software (programming)
                        |
          Software delivery and installation
```

Actual software development is 'messier' than this simple picture would suggest, with various processes being conducted in parallel and some iteration such that later processes feed back into improved repetition of earlier ones. Nevertheless, for the purposes of this discussion, this model is a close enough approximation to reality; indicating that software development has been fragmented and standardised and, thus, made into a production process[1].

Software production overall is a skilled task, but this fragmentation forms the basis for a skill division of labour because the earlier stages of analysis and design require higher

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[1] A historical view of this fragmentation is provided by Greenbaum (1976) and Kraft (1979).

levels of skill and experience, whereas those of coding and testing are relatively less skill-intensive but more labour-intensive:

> ```
> "Coding is a relatively simple process … it does not rely
> on   creativity,   organizational   understanding,   or
> consultation with end users.  Common business programming
> representing  more  than  80%  of  the  world's  programming
> requires   comparatively   low-level   skills"   (Schware
> 1987:1257)
> ```

During the period 1988-1998, at least 65% of export contracts were solely for programming work billed on a 'time and materials' basis, with programming figuring strongly in the remaining one-third of contracts (Heeks 1996, Dataquest 1998). As with offshore work, there have been changes within individual client-contractor relationships, but there has been much less change within overall industry averages.

So, in general terms, India's software export trade has been characterised by an *international skill division of labour* such that the majority of software contracts allocate only the less-skilled coding and testing stages to Indian workers. That is to say, Indian workers have far more often been used as programmers, working to requirements and design specifications set by foreign software developers, rather than as systems analysts or designers.

In the Indian context, the combination of onsite and programming work has come to be known as 'body shopping'. Amongst other things, this has helped to reinforce a further *gender division of labour*. Only some 10% of Indian software developers are female. Women face particular difficulties because software development often entails working unsocial hours and, more significantly, working overseas. Onsite programming in particular is seen, as one manager put it, as "the young, single man's game". On the other hand, women interviewees felt that software development offered a more relaxed and less discriminatory atmosphere than many other Indian employment options (see also Jayanthi & Madhavan 1985).

The Persistence of International Divisions of Labour

Onsite programming services persist for a number of reasons:

- *Trust and Risk*. According to interviewees, there is a lack of trust and a perception of risk among clients, who are uncertain of the skills, capabilities and credibility of potential Indian sub-contractors. In order to reduce the risk, many clients choose to retain as much control as they can over production, only contracting out the relatively unproblematic tasks of coding and testing, and having the work carried out onsite. Work will only be allowed offshore if there are fairly tight, formalised specifications, but exporters are caught in the bind that such projects are then more amenable to automated software tools.

- *Other Client Attitudes*. Client attitudes perpetuate onsite work in other ways. According to InfoTech's (1992) survey the important factors guiding foreign firms over onsite work are – in order – cost, credentials, productivity and quality. Indian firms working onsite tend to score quite well on these. However, there is a different picture for offshore or turnkey assignments (those involving all stages from

analysis to installation). In these cases, cost is less important while management skills, quality, proven expertise (a Catch-22 for many firms) and access to technology all become much more important. Indian firms working offshore tend to score much less well on these, making a transition that much less likely to occur from onsite programming to offshore turnkey assignments.

- *Project Size*. Project size affects the division of labour since small contracts are not worth sending overseas. Nicholas (1994), for example, recommends a minimum project size of US$100,000 before it becomes worth the time, effort and risk to consider sending work offshore. Smaller contracts than this do come offshore but the issue remains a serious one for an industry in which, at least in numerical terms, the great majority of contracts falls under this minimum recommended threshold.

- *Need for Interaction*. Continuous client-developer interaction is an essential part of software development. Despite good communications links, interaction sometimes needs to be face-to-face, which means the developers going to the client rather than vice versa. Thus, even with offshore turnkey contracts, the requirements analysis, preliminary design, installation and implementation generally need to be done onsite[2].

- *Uneven Skills Profile*. The average software development project requires less than half the labour input to come from programmers. Yet 85% of workers in Indian software exports are programmers (Heeks 1996). This 'programmer heavy' skills profile, reinforced by losses of experienced staff to the overseas 'brain drain', encourages programming-only contracts. This and constraints on the availability of IT and project management resources within India also reduce offshore productivity and quality in some companies, making onsite work more attractive.

- *Indian Managerial Perceptions*. Apart from the external 'push' factors noted above, there is an internal 'pull' in favour of onsite programming because managers perceive it to bring benefits. It produces quick revenue for low investment, which suits the lack of risk-taking favoured by many Indian business managers, particularly given uncertainties that exist about policy and about the global and Indian economies. It helps by exposing staff to foreign market trends, skills and standards. Many Indian staff also want to work overseas and, if denied the opportunity by one company, will simply join another which will send them abroad. This motivates most companies to retain a measure of onsite work.

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[2] In the increasingly-popular rapid application development contracts, which create a prototype for user comments, interaction becomes even more important.

Challenges to the International Divisions of Labour

It was noted above that, during the past ten years, individual client-developer collaborations have been able to move away from the skill and locational divisions of labour, especially the latter, even though shifts have been more limited in the industry as a whole. Factors which have encouraged this change include:

- *The 'Trust Curve'*. Once an Indian company has carried out a few contracts for the same client and has proved itself able to follow a set of instructions or specifications and to deliver on time and to the required quality, then it may be entrusted with a little more of the software development process and/or may be allowed to carry out more of the work offshore.

  Some Indian software companies have therefore moved slowly up a 'trust curve' in terms of skills, firstly taking on only the least skilled elements of software production, then also creating the design, and finally accepting responsibility for the entire software development process starting from the client's 'statement of the problem'. More commonly, with location, it becomes increasingly possible that work will be sent offshore.

  Change has not been great, at least in the division of skills, because it has been constrained by the available skills profile, but this does indicate the importance of trust, credibility and of the client-developer relationship in guiding the division of labour.

- *US Visa Policy*. The US government has also affected the divisions of labour when, periodically during the 1990s, it has issued tougher guidelines on work visas. The main change came with the arrival of the Clinton administration, partly in response to the desire of local labour unions to halt or reduce the use of foreign workers in the US. Indian workers were channelled into taking temporary work visas (rather than student or training or even tourist visas as in the past); the limit on the total number of visas to be issued was lowered; and equal remuneration and US taxation rules were applied more thoroughly. Large numbers of Indian software workers continue to undertake contract work in the US. However, the visa policy changes pulled a number of Indian companies out of their complacency about onsite work and led them to try to increase their offshore working.

- *Telecommunications Technology*. For software exports, international telecommunications links combine the three key aspects of technology that have underpinned globalisation: they are a technology that transports intermediate and final products; they are a technology of communications; and they are a technology of managerial co-ordination and control (Dicken 1992). It is therefore not surprising that use of these links by Indian software companies has expanded rapidly during the 1990s.

  By 1996, more than forty software export firms were actively using high-speed international data links, and by 1998 several hundred more had Internet connectivity. Links are used in a variety of ways: to access the client's mainframe computer, based overseas, from terminals based in India, thus overcoming any problem of hardware availability in India; to send and receive electronic mail; to

pass files between members of a joint development team split between India and overseas; and to undertake remote diagnosis and maintenance work.

Telecommunications links also enhance the ability of foreign clients and Indian developers to interact on a daily basis; allowing software under development to be sent back and forth and modified according to client wishes[3]. With greater and improved interaction, there is reduced risk and greater control for foreign clients, which encourages greater trust.

Judging from interviews, the use of new telecommunications technology has not had much impact on the skill division of labour, but it does attack many of the major problems associated with onsite working – client trust, hardware availability, and client-developer interaction – and it appears to be leading to more offshore working within those firms which have access to the technology. By reducing the need for onsite work, such links, though expensive, can also help to save on travel, visa and living allowance costs.

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[3] Time differences between India and the US have created a modern fairy tale for the software industry – reminiscent of the old tale of the elves and the shoemaker. Client staff in the US can post a problem on the computer in the evening. It will be picked up by staff in India arriving for work a few hours later. They then work on it all day and post the solution just before the Americans arrive back at work on what is – for them – the following morning.

D. Uneven Market Share: Economic Concentration of Production

Production of Indian software exports is a heavily-concentrated affair. By 1998, one may estimate that there were 400-500 active software export firms. Most, however, were single-contract firms employing just a handful of staff. By contrast, the top five firms were responsible for more than 40% of all exports, and the top twenty for 70% (Dataquest 1998).

Large firms have dominated software exports thanks to the economies of scale and entry barriers that exist in software production. Economies of scale and barriers include those of hardware, of staff training, of marketing and, less tangibly, of credibility and reputation.

Since Indian software exports are services rather than goods, examples cannot easily be displayed to potential buyers to establish credibility. There is therefore a heavy reliance on reputation, track record, references and the skills and appearance of the marketing team, which all go together to determine the Indian firm's credibility. All these credibility-related factors, which principally hinge on track record and spending on marketing, obviously work to the advantage of larger, longer-established firms. As an example, a few firms have had to invest in export marketing for two or three years before getting their first export order.

The only short cut occurs if a new firm is set up by an ex-member of one of the large IT companies. In this case the individual can make use of his or her personal contacts and credibility. However, this does not enable the firms to overcome technology, skills and finance barriers. This explains their initial reliance on onsite programming services, for which there are few scale economies, and the fact that few of them have made significant long-term headway in software exports.

There are also biases against small and start-up companies in terms of obtaining foreign collaborations and technology, and in dealing with the bureaucracy (Heeks 1996). For example, despite the falling real prices of powerful computers and telecommunications, these technologies remain beyond the reach of many small Indian firms. Similarly, access to government support tends to be the preserve of the larger firms.

E. Uneven Siting: Locational Concentration of Production

Software companies are not distributed evenly throughout India, but are mainly located around a few major Indian cities, especially around Bangalore. Table 3 indicates the location of company headquarters for over 550 software companies (including a number focused on the domestic market).

Table 3: Location of Indian Software Company Headquarters

City	Number of Software Firm HQs
Bangalore	152
Mumbai (Bombay)	122
Chennai (Madras)	93
Delhi/New Delhi	86
Hyderabad/Secunderabad	34
Calcutta	27
Pune	22
Other	22
Total	*558*

Source: Dataquest (1998)

The table underrepresents the importance of Mumbai, which is still home to several of the largest software companies (though almost all of these have offices in several other cities). However, as in IT in general, Bangalore in particular has grown at its expense since the mid-1980s when Mumbai led the field in terms of numbers. Though there are many differences with its California counterpart, Bangalore has now come to be seen as India's 'Silicon Plateau'.

To understand why, one must understand history. The software industry started in Mumbai, in the business district around Nariman Point in the late 1970s. When prices and commute times began to rise there, part of the industry decamped up to the Santa Cruz Electronics Export Processing Zone (SEEPZ) in the north of the city, so Mumbai was still the centre of the software industry until at least the mid-1980s.

This began to change because Mumbai's problems still reached up to SEEPZ. Software firms were fast running out of labour, partly due to the overseas brain drain, plus high prices in the city and poor quality of life. These firms – and, more importantly, foreign investors and individual entrepreneurs considering the creation of new software companies – began comparing location in Mumbai with location elsewhere. What was it, then, in the mid-1980s that made Bangalore compare favourably, leading to its current predominance?

Haug's (1991) work has shown that five main factors play a part in the locational decisions of new software companies. One of these – proximity to customers – is of

limited relevance in the context of software exports. Three other factors, however, *are* found to have guided locational decisions in India:

- ***Labour Availability***. Bangalore was seen to have abundant labour that could be drawn from its long-standing research laboratories, educational institutes and public sector electronics firms. Key institutions included Bharat Electricals Ltd, the Indian Institute of Management and the Indian Institute of Science. These have been a key source of both software employees and – in later years – entrepreneurs.

- ***Quality of Life***. Bangalore benefited from its reputation for a good climate and social life. IT workers were rapidly integrated into the city's social fabric and its 'pub culture'. As a result, Bangalore is the locus for the semi-serious BAIT (Beer-drinkers Association of Information Technology), which regularly brings together senior IT industry managers to discuss strategy, on the condition that they drink a minimum of six mugs of beer during the evening. By contrast Mumbai has had a long and troubled history of both communal and labour relations strife, both of which were comparatively unknown in Bangalore.

- ***Infrastructure***. The infrastructure in Bangalore looked a lot better than it did in Mumbai in the mid-1980s. You could get across town in a matter of minutes in a car, where it might take hours at peak times to get in or out of Mumbai. Bangalore also promised a plentiful supply of both power and water.

From the evidence of interviews in India, it appears that the perception of these factors as much as their reality has coloured locational decisions. These perceptions were strengthened by a key event in Bangalore's history: the decision of US company Texas Instruments to set up its subsidiary there. Once TI arrived and set up operations in 1986, it was the first proper offshore software facility, using satellite-based telecommunication links, and this was constantly reported in the home and international media. TI was known to have cut through many red tape barriers, particularly on imports, and this further encouraged firms to go to Bangalore.

From this point on, the Bangalore 'snowball effect' began. As firms started to locate in Bangalore, Haug's fifth factor guiding location came into play:

- ***Proximity to Previous Employer and Residence***. A large number of software firms in India have come into existence when employees leave their previous firm and decide to set up on their own. It is this – together with labour and infrastructural factors – which has contributed especially to self-reinforcement of location and, hence, to the intense clustering of software firms that is observed in India.

F. Conclusions

The Uneven Profile of Indian Software Exports

Despite some degree of variation within the exports of the Indian software industry, these have been epitomised by the export of programmers who go to work for a client in the US. There have been signs of change. The trend within some individual, established firms (such as multinational subsidiaries) has been, gradually, towards more offshore, more highly-skilled work – even to a small amount of package exports in some cases – and towards diversification away from the US. In particular, there have been changes in the locational division of labour to bring much more work into India.

Some have therefore been able to use onsite 'body shopping' services as a stepping stone to better things. However, with new entrants often relying solely on US-based onsite programming, average change within the industry is much slower and this form of exports has been remarkably persistent.

There have been benefits to this form of software export. Because they are carried out onsite, these exports do not require the purchase of hardware or software by the Indian company or the provision of any significant technology infrastructure within the country. Because they rely on programming skills, these exports do not require a build-up of higher-level skills. Because they rely on links with foreign collaborators, these exports do not require such a level of marketing and financing as competition within the open market would.

This helps to explain why Indian software firms have been able to move into exports with relative ease: they have chosen a path of almost 'inputless' exports which requires only a contact overseas, a little finance, and the names of some local programmers who can be hired if a contract is forthcoming. Such a path can also be followed relatively independent of government policy measures, particularly those on imports, because no imports are needed. Apart from their low entry barriers, such exports also expose Indian workers to foreign market trends, skills, needs and standards.

However, there is also a negative picture. This form of export is susceptible to changes in labour migration laws; to automation from new technology; to competition from other countries; to alterations in the attitude or financial health of one's collaborator; and to other changes in the macroeconomy. The combination of global economic slowdown and collapse of Year 2000 work predicted for 1999-2000 could therefore make a severe dent in current growth rates.

Onsite working increases the opportunities for a 'brain drain' of talent, while offering programming services can become self-reinforcing with little skill being built up, so that the higher skills necessary for software innovation remain the preserve of developed countries. Therefore, "this type of export arrangement may leave developing countries little room for creating self-reliant capacities in software production" (Schware 1987) and may also leave the Indian industry unable to move significantly to a different form of exports, such as package exports.

Reliance on services limits revenue-earning potential. Exporting one-off custom software services, for example, means that earnings are directly proportional to the

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number of people working in the industry. By contrast, successful packages can go on earning for a number of years quite independently of the number of people involved in writing them, thus offering a potential increase in revenue productivity. Similarly, reliance on programming limits revenue-earning potential. Coding is the lowest paid part of the software development process, earning only 10-15% of total project revenue (Bhatnagar & Jain 1991).

Understanding the Uneven Profile

Diversifying away from this uneven export profile will not be easy for India. Many constraints and barriers within software production and within the global software market have led to the persistence of India's pattern of software exports which are low-skill, low-technology, low-investment, and low-return relative to other options. The barriers include: access to finance, access to new technology, credibility and other elements of the client-developer relationship, marketing and marketing costs, level of available skills and training, managerial attitudes, and a weak domestic market.
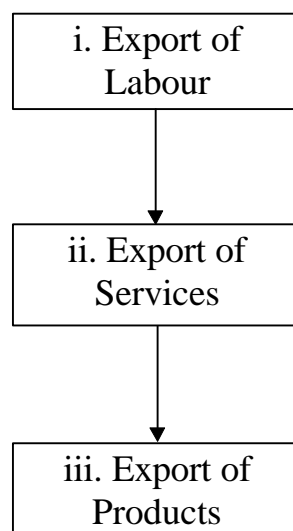
The only area in which some change is taking place is in the growth of offshore working, thanks to the combination of new telecommunication links and the difficulties imposed by restrictive visa policies. Greater development of credibility as client-developer relationships build, greater availability of suitable hardware within India, and the lower costs of offshore working have also helped.

Correa (1993) outlines three main strategies for growth in software exports followed by developing countries:
i) Export of labour, i.e. onsite services.
ii) Export of services, i.e. offshore work.
iii) Export of products, i.e. package export.

This paper has highlighted the difficulties of following the last two paths and suggests that much of the growth achieved by Indian software exports may have come from its industry's dogged following of the low-risk, low-barrier first path.

Figure 2: Potential Software Strategy Development Path

```
        ┌──────────────────┐
        │   i. Export of   │
        │      Labour      │
        └──────────────────┘
                 │
                 ▼
        ┌──────────────────┐
        │  ii. Export of   │
        │     Services     │
        └──────────────────┘
                 │
                 ▼
        ┌──────────────────┐
        │  iii. Export of  │
        │     Products     │
        └──────────────────┘
```

One might envisage – as indicated in Figure 2 – a development path from strategy i) to ii) to iii) as skills, reputations and facilities are built up. Looking to India, there is some support for this stage model from the behaviour of individual Indian exporters, particularly for transition from first to second stage, but there are only limited signs of this model within the overall pattern of software exports.

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