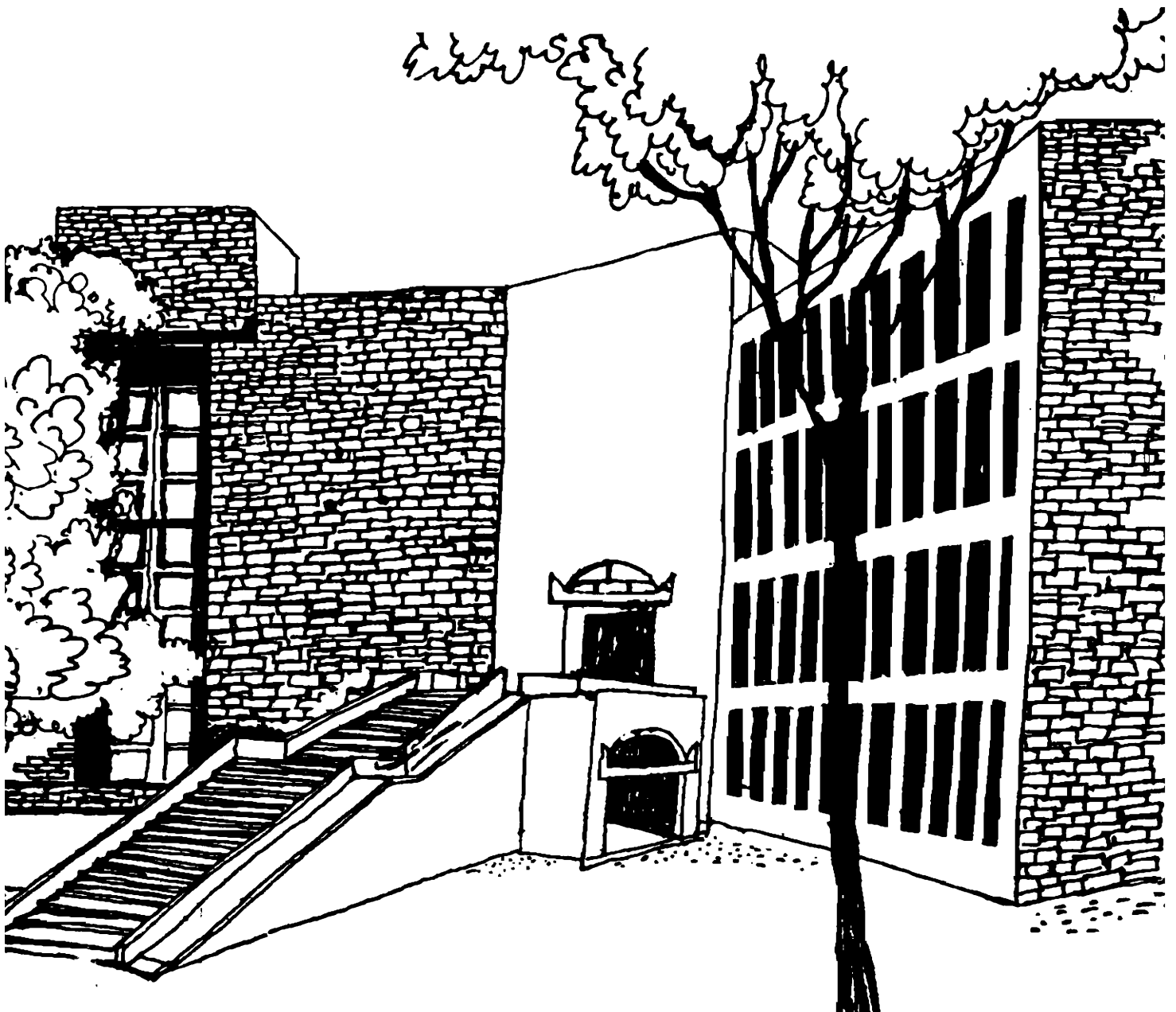




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INTERNATIONAL TRANSFER OF
TECHNOLOGY TO INDIA:
PROBLEMS, PROSPECTS AND POLICY ISSUES

By

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**INTERNATIONAL TRANSFER OF TECHNOLOGY TO INDIA:
PROBLEMS, PROSPECTS AND POLICY ISSUES**

Shekhar Chaudhuri

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INTERNATIONAL TRANSFER OF TECHNOLOGY TO INDIA: PROBLEMS, PROSPECTS AND POLICY ISSUES

ABSTRACT

Transborder movement of technology is being increasingly felt in international business. A large proportion of worldwide international transfer of technology (ITT) occurs between industrially advanced countries. But for developing countries ITT is considered critical, as it is seen to be an important route for acquiring technological capabilities necessary for industrial development and economic growth.

India has had a fairly long history of acquiring technology from abroad. Since the adoption of the New Economic Policy in mid 1991 the government has placed considerable emphasis on ITT with the expectation that it would enhance the international competitiveness of the country's industries through technological upgradation of the country's industries.

The policies of the government have undergone changes over the past four decades in response to the overall philosophy of development as well as industry's needs and conditions characterizing the supply of technology. This paper analyses the trends in international technology transfer to the country, discusses the government's policies on technology import in an evolutionary framework and evaluates the technological capabilities of Indian industries. It also presents a picture of the prospects of ITT to India and discusses the major problems and policy issues that need to be addressed by policy makers.

INTERNATIONAL TRANSFER OF TECHNOLOGY TO INDIA: PROBLEMS, PROSPECTS AND POLICY ISSUES

1. INTRODUCTION

International transfer of technology (ITT) is considered to be an important vehicle for firms and nations to acquire technological capabilities.

Though Japan is now considered to be a technological power house its economy did not reach its present position of eminence on the basis of indigenous technology, but instead on ITT. Between 1951 and 1983 Japan entered into 41972 technology import agreements (*Abegglen and Stalk, 1985, p.127*). During the same period Japan paid US \$ 17181 for importing technology. However it must also be mentioned that some technologies were also exported by Japanese firms. On an overall basis the balance of receipts/payments ratio during the period was 22 per cent which indicates that Japan was a net recipient of foreign technical knowledge. In South Korea too imported technology played an important role in her economic development though less than in Japan. South Korea, one of the prominent NICs was at a technologically low level in the aftermath of World War II. During the period 1962 to 1984 Korea entered into 3073 foreign collaborations (*Enos and Park, 1988*).

The importance of transborder movement of technology in international business is being increasingly felt. *Simon* notes that "... the quest for global technological leadership has become so intense and the rivalry so strong that one recent book has referred to the pulling and tugging among companies and their home countries as a "technology war" (*Agmon and Glinow, 1991*). International transfer of technology, though quite significant among industrially developed countries is critical from the perspective of developing countries. Japan and South Korea's post-war development stand testimony to this. In India too acquisition of foreign technology has played an important role in her economic development, though importance given to it by the central government has varied over time. In this paper we attempt to understand the role of the governmental policy and international transfer of technology in the technological development of Indian industry. Specifically the objectives of this paper are to; (a) understand the evolution of the policy framework of the central government impinging on ITT; (b) examine the broad trends in import of technology; (c) assess the technological capability of Indian industry; (d) explore the future prospects of ITT to India; and finally (e) discuss some problems and policy issues.

2. EVOLUTION OF GOVERNMENT POLICY ON FOREIGN COLLABORATION

The foreign collaboration policy of the Government of India has evolved from developments in the industrial policy and foreign investment policy and has changed over time in response to the prevailing circumstances. This section draws upon the following sources; *Chaudhuri (1980) (Appendix)*; *RBI (1968)*; *RBI (1974)*; *RBI (1985)*; *Desai (1988)*; *Chaudhuri and Dixit (1994)*;

Jain (1996). Very shortly after attaining independence the Indian Parliament adopted the Industrial Policy Resolution in 1948. The IPR of 1948 recognized that participation of foreign capital and enterprise could help in the rapid industrialization of the country. An increasing need for foreign capital was felt as domestic capital was not forthcoming. The advantage of foreign capital in terms of its ability to graft technical and managerial skills on to an Indian industry was realized by the government. However, the government was keen to regulate the conditions under which foreign collaboration would be allowed. It was decided that effective control through major interest in ownership was always to be in Indian hands and training of Indian personnel was to be insisted upon.

Foreign capital, however, was assured non-discriminatory treatment vis-a-vis Indian enterprises with regard to licence requirements, facilities for repatriation of profits and capital as well as payment of fair compensation in the event of compulsory acquisition of the enterprises through nationalization. The policy envisaged that each individual case would be treated on its own merits and employment of foreign personnel would be permitted in the event of non-availability of suitable Indians.

No rigid criteria were laid down for screening collaboration agreements though government approval was necessary for all proposals. In the absence of specific criteria the government was free to judge each collaboration application on its own merit. However, the normal policy was to restrict foreign collaboration to those cases where indigenous capability was lacking or where domestic capital was not forthcoming or inadequate. Favourable treatment was given to those projects which effected savings in foreign exchange through import substitution or earned foreign exchange through exports.

In the mid 1950s, when industrialization gathered momentum with the launch of the Second Five Year Plan, there was a sizeable increase in pure technical collaboration agreements (not involving foreign investment). Minority equity participation became predominant during the period 1956-64; the foreign equity being used for import of machinery and equipments. Some collaborators also accepted equity participation in lieu of royalties and technical fees.

Towards the end of the decade of the 50s difficulties started emerging. In 1959 India's foreign exchange reserves nearly ran out. As a result manufacturers' import licences were progressively cut and new manufacturers had to agree to progressive import reduction before they were allowed to import technology. The country's dependence on tied bilateral aid increased as a result of which manufacturers were often given import licences in currency other than that of the technology exporters. According to *Desai (1988)* the technology exporter could no longer depend on export of intermediate products to realize a part of the price of technology. As a result from 1959 onwards there was a sharp rise in agreements involving outright payments and royalty rates on new agreements also rose (*NACER, 1971*). There was a shift in the dominant pattern of technology payments from transfer pricing to royalties and outright payments. The industrial boom which started in the mid 1950s continued till 1965. The high rate of growth made royalties attractive as a form of payment.

The economic boom, however, ended in 1965 and there was an increase in domestic competition. Large scale import of technology in the immediately preceding years invited severe criticism of the implementation of foreign collaboration policy. As a result the Monopolies and Restricted Trade Practices Act (MRTPA) of 1969 introduced new controls on large conglomerate groups and subsidiaries of foreign firms and special privileges were introduced for small firms through the reservation of certain industries only for them. Small firms were also given more liberal import licences. *Desai (1988)* avers that the liberal import entitlement resulted in the domination of industries like radios, television sets, calculators and other electronic consumer goods by small firms.

In 1968 the government introduced a new policy to regulate domestic competition, reduce dependence on foreign technology and accelerate import substitution. Three categories of industries were identified: (a) where both financial and technical collaboration would be permitted; (b) where pure technology collaboration would be permitted (without foreign investment) and (c) where no foreign collaboration would be allowed. The Foreign Investment Board was established by the government. The Secretary in the Ministry of Finance was designated Chairman of the Board, which had representatives from different ministries concerned with foreign investment and collaboration, Director General of Technology Development, the Capital Goods Committee, the CSIR and the Planning Commission. Applications for foreign investment/collaboration had to be submitted to the Secretary of the Board.

During 1969-70 the government further tightened its policy on foreign collaboration and decided to allow foreign collaboration only for meeting "critical technology gaps"; and it was not to be allowed at all in consumer goods. In 1970 following the recommendations of the *Dutt Committee* the government published a list of 121 items where significant technology gaps existed thus offering scope for foreign technology collaboration. Actual terms and conditions were to be decided within the frame work of the existing policy. Provision was made for some relaxation in the case of substantial export oriented projects or projects in small scale industries sector. Larger industrial houses were expected to focus on development of complex and heavy investment industries that were categorized as belonging to the "core sector". The core sector industries were those whose products entered into the production process of a large number of other industries; those which were potentially capable of production for defence and those whose development was crucial for the overall economic growth of the country including among other basic metals, heavy machine building and heavy chemicals.

In sum, the main features of the policy which emerged between 1965-68 (*Desai, 1988, p.12*) were; (a) royalty ceilings prescribed for various industries; (b) duration of agreements reduced from 10 to 5 years with renewals allowed only for more advanced or different technology; (c) export restriction permitted only in those countries where the technology exporter had operations or licencees; (d) use of the technology supplier's trade mark was not allowed and with the enactment of the Indian Patent Act in 1971 protection to patents was reduced; and (e) no restrictions were allowed in the technology importers' right to sell or sub-license the technology.

Most of the aspects of the foreign collaboration policy in vogue during the 1970s continued during the 1980s. From time to time, however, the government revised the policy in response to the existing circumstances.

The beginning of the decade of the 90s saw a major change in the economic thinking of the government. In mid 1991 the government's approach regarding foreign collaboration underwent a radical change, (*GOI, Ministry of Finance, 1991-92*). A new industrial policy initiating far reaching structural reforms was adopted in July 1991 to lead Indian industry away from a regulatory and protected regime to a free, market oriented, competitive and globalized environment. The government acknowledged that the decade of the 1980s had witnessed a rapid expansion of industrial activity due in a major way to the reforms in industrial and trade policies that had been in the early and mid 1980s.

The new policy adopted in mid 1991 was aimed at deregulating the industrial economy substantially. Broadly the major objectives of the new policy were to maintain sustained growth in productivity and gainful employment, encourage growth of entrepreneurship and upgrade technology to achieve international competitiveness. The new policy covered all sectors of industry; small, medium and large, belonging to the public, private and cooperative sectors. The salient features of the new policy package which has had considerable impact on foreign technical collaborations are given below.

1. The number of industries which were reserved only for the public sector were reduced from 17 to 8. Industries like iron and steel, electricity, air transport, ship building, heavy machinery industries such as heavy electrical plants, telecommunication cables and instruments were removed from the reserved list. Industries which were retained in the "reserved list" were those where security and strategic concerns were predominant.
2. Until the early 1980s Indian industry had functioned under a tight regulatory industrial licensing regime. The new policy, however, abolished all industrial licensing, irrespective of the level of investment, except for certain industries related to security and strategic concerns, social reasons, concerns related to safety, and overriding environmental issues and manufacture of products of hazardous nature. Existing industries were allowed to expand capacity according to market needs without prior clearance from the government.
3. The new policy allowed firms to freely manufacture any product in response to market needs except for those subject to licensing.
4. With the government's announcement of devaluation of the rupee and various trade policy reforms, the government decided to do away with the "phased manufacturing programme", which had been in force in a number of engineering and electronic industries. The government decided that in future there would no such programme to force the pace of indigenization.

5. The MRTPA was amended to place greater emphasis on prevention and control of monopolistic, restrictive and unfair trade practices to ensure protection to consumers. This was a major change from the earlier emphasis on control which required separate approvals by large firms under the Act for any investment proposals.
6. For a specified list of high-technology, high-investment priority industries, the government decided to give automatic approval to firms to enter into foreign technology agreements. The new policy envisaged royalty payments upto 5 per cent of domestic sales and 8 per cent of export sales, alongwith lumpsum technology payments of upto Rs.10 million.
7. Under the new policy no permission was required for hiring of foreign technicians and testing of indigenously developed technology abroad.
8. Automatic permission would be available for foreign equity upto 51 per cent in the high priority industries referred to above. This facility would be open to firms which were able to finance capital equipment imports through their foreign equity. This was a major departure from the existing policy which required case by case approval of foreign investment normally limited to 40 per cent equity participation. The government also decided to invite foreign equity holding of upto 51 per cent by international trading companies and in other tourism related areas.
9. A special Board (Foreign Investment Promotion Board) was set up to consider large foreign investment projects where higher foreign equity limits of more than 51 per cent could be permitted.

Since 1991 several amendments have been made to the industrial, foreign investment, trade and fiscal policies. These policies, in combination, provide the framework for industrial activity in general and ITT to India.

In the following section we consider the broad trends in collaboration.

3. TRENDS IN ACQUISITION OF FOREIGN TECHNOLOGY

3.1 Overall Growth and Trends in Nature of Foreign Collaboration

Table I provides data on the number of foreign collaboration approvals given by the Government during the period 1948-94. The table also gives compound growth rates of foreign collaboration approvals during Plan periods. During the period 1948-94 there has been a large increase in the number of foreign collaborations though there have been some fluctuations. During the Second Five Year Plan period (1956-57--1960-61) the number of collaborations signed annually increased steadily from 81 in 1957 to 403 in 1961. However, there was a sharp decline during

the period 1962-63 to 298 followed by a sharp increase again in 1964 to 403 from which it went on steadily declining to 134 in 1969. During the Fourth Five Year Plan (1969-70--1973-74) the number of collaborations again increased to 359. During the Fifth Five Year Plan (1974-75--1978-79) there was again a decrease but not as sharp as during the earlier period.

The beginning of the 1980s saw a major increase in the number of collaborations. This was the time when the economic liberalization had its beginning. The highest number of collaborations signed in any year during the decade of the 80s was 1041 in 1985 and the lowest was 389 in 1981. With the adoption of the New Industrial Policy in mid 1991 the increasing trend in the number of collaborations has been maintained. From 976 collaborations signed 1991 the figure went up to 1854 during 1994.

Table 1 also provides data on collaborations involving foreign investments which has been seen as an important vehicle for international technology transfer. On an overall basis for the period 1948 to 1994 the number of collaborations involving foreign investments formed about 30 per cent of the total. However, here too there were considerable year to year variations. In 1961 collaborations involving financial investments formed about 41 per cent of the total. This percentage declined gradually during the Third Five Year Plan period (1961-62--1965-66). This trend continued till the end of the decade of the 1970s with some fluctuations. The lowest intensity of collaborations involving foreign investments was approximately 10 per cent in 1977. The decade of the 1980s recorded a resurgence in collaborations involving foreign investments, which could be attributed to the early efforts of the government at economic liberalization. The highest intensity of collaborations with foreign investments was recorded in 1994 with a percentage of 57 approximately.

3.2 Industrial Sectorwise Collaborations

Table 2 provides data on industrial sectorwise distribution of foreign collaboration approvals from 1976 to 1994. It is evident from the table that the chemical, electrical and electronics, industrial machinery, mechanical engineering, metallurgical and transport industries have been important in terms of foreign collaboration approvals at different periods. In the recent past consultancy and other services have assumed importance. Till 1988 this sector accounted for a minuscule proportion of the foreign collaborations approved. But in 1989 the number of collaborations in the sector suddenly increased and accounted for almost 4 per cent of the total. The next year saw a very major jump to approximately 12 per cent of the total. This trends continued till 1994 when it cornered about 17 per cent of all collaborations. The "miscellaneous" sector has also been quite significant throughout the period 1976 to 1994. However, as this consists of several industries we have not attempted to do a disaggregated analysis of this sector.

If we consider the post-reform period there are 3 sectors that stand out: chemicals, electricals and electronics and consultancy and other services. The chemicals sector attracted around 14 per cent; electricals and electronics about 15 per cent; consultancy and other services about 14 per cent of all collaborations. Two other sectors were also important but their significance in terms of

foreign collaboration approvals has declined during the period and these are industrial machinery and mechanical engineering. The machine tools sector attracted a very small percentage of the foreign collaborations. Closely following this sector was the textiles sector. The metallurgical and transport sectors were somewhat better.

From these trends it is evident that efforts at obtaining technology have been higher in the chemicals, electric and electronics and consultancy and other services. However, there are concerns regarding the decline in other important areas viz. industrial machinery, mechanical engineering and machine tools. Though the transport and the textiles sectors are also low in terms of foreign collaboration intensity there are some redeeming features. The textiles sector has shown a small increase during the period 1991 to 1994 while the transport sector has maintained its share of foreign collaborations at around 4 per cent. Another area of concern is the low intensity of foreign collaboration in the Alternative and Renewable Energy sector although there has been some increase in the absolute number of collaborations during the period 1991 to 1994.

3.3 Countrywise Distribution of Foreign Collaborations

Table 3 provides data on countrywise distribution of foreign collaborations. On an overall basis it is evident that the US has been the most significant provider of technology to Indian firms during the period 1981-94 with an average of 20.84 per cent of the total number of approvals. Germany and the UK follow in the same order accounting for 16.15 and 13.89 per cent of the total. Japan comes fourth in terms of share of foreign collaboration but far behind the UK at 8.48 per cent. If we take Europe as a whole covering Germany, UK, Italy, Switzerland, France, Netherlands and Sweden, the proportion of foreign collaborations accounted for by them comes to around 49.5 per cent - clearly the largest.

At a disaggregated level we find that during the post-reform period from 1991 to 1994 the US was able to improve upon its share from 17.83 per cent in 1991 to 19.42 per cent in 1994. Germany, UK, Italy, Switzerland, Netherlands and Sweden all experienced a decline in the percentage of annual foreign collaboration approvals. Even Japan experienced a slight decline in the percentage of collaborations from 7.58 in 1991 to 7.23 in 1994.

An important trend is visible from the data. The category "others" has increased its share from 18.55 in 1991 to 33.76 in 1994. It perhaps shows that companies from countries other than those traditionally known as technology suppliers have become active in this field. It may also point to another conclusion and that is that the Indian firms have started diversifying their sources of technology.

In sum, the foregoing discussion in conjunction with the discussion on evolution of the policy framework in section 2 leads us to the following conclusions:

- a) there has been an overall growth in the number of collaborations entered into by Indian and foreign firms;
- b) the growth pattern of collaborations has been strongly influenced amongst others by the central government's industrial and foreign investment policies and the economic situation existing in the country;
- c) generally, collaborative activity has increased with economic liberalization which has intensified further in the post-reform period;
- d) on an overall basis the industrial sectors sought to be given importance by the government -- chemicals, electrical and electronics, industrial machinery, etc. -- also seem to be quite significant in terms of the number of collaborations, thus providing some evidence of successful implementation of policy;
- e) overall, the US, Germany and the UK have supplied a large chunk of the country's technology requirements; however, in the post-reform period some changes in this pattern seem to be emerging with the US increasing its share and the European countries experiencing a decline.

In what way has IIT contributed to India's technological capability? We take a look at this question in the next section.

4. INDIA'S TECHNOLOGICAL CAPABILITY

It is estimated that around 50 per cent of the country's production of goods is based on imported technology. Of the remaining 50 per cent the major chunk is based on adapted and indigenized foreign technology and a mere 5 per cent of the country's industrial production is based on indigenous R&D (*Economic Times, 1991*). These views have been supported by amongst others *Lavakare and Gulati (1989)*, *Jain and Uberoy (1993)*, *Patel (1989)*, *Bhattacharya (1988)* and *Parthasarathi (1994)*.

According to *Desai (1988)*, technology adaptation as an element of indigenous innovation is characteristic of a number of Indian firms which are market leaders in their industries. Some of them had built up their capabilities on the basis of imported technology. However, the innovations carried out by them could not be termed as major innovations that could have enabled them to establish a large and stable export market. *Desai* mentions that the level of originality in most cases was low and the achievement generally was the production of a cheap, sturdy, reliable product suited to the Indian market. On the basis of his earlier study (*Desai, 1980*) he concluded that a growing number of Indian firms were engaged in R&D aimed at product and process adaptation, though the scope for such technological change was considerable.

Scott-Kemmis and Bell (1988, pp.71-74) mention that British technology suppliers had a very high regard for their Indian partners' technological capabilities and technology improvement efforts. Some of them estimated that their Indian partners' rate of technological improvement of the imported technology was equal to their own rate of improvement of the same technology. However, in the majority of cases they thought their Indian partners' rate of technical improvement was considerably lower than theirs. According to the authors, these views of the technology suppliers were generally consistent with the opinion of Indian firms interviewed by them. The authors specifically mentioned the following:

- a. Many Indian firms possessed the capability to develop production capacity for a new product on the basis of imported specifications but largely locally supplied equipment and engineering services.
- b. Most British technology suppliers continually raised product and production performance over time through on-going efforts. The industrial milieu in India and hence the objectives and approaches of many Indian firms, however, differed considerably from the British pattern. A constant effort to improve technology was less common in Indian than in British firms.
- c. Comparison of technological change in British technology suppliers and Indian technology recipient firms pointed out that in the former technical change involved three closely related components: incremental improvement and adaptation, major innovation and product divergence, whereas in the Indian context the pattern of technical change was very different. Much of the technical change efforts in Indian firms focused only on one aspect: adaptation or indigenization. This, according to the authors, led to an increasing gap between technologies in use in India and those used elsewhere in the world. This in turn resulted in reliance on foreign technology suppliers for new vintages of technology to replace or update the previously imported technology.

Pillai (1979) on the basis of forty studies of assimilation of foreign technology that the core technology continued to be imported by Indian firms while technical change involved only substitution of peripheral elements. The firms had the capacity to productionize, given the drawings. But that capability could not be translated into innovative efforts.

Nayar (1983) studied the evolution of governmental policy on foreign investment and collaboration and its effect on the country's technological development. According to him India has made considerable progress in acquiring capabilities in the area of descaling. The whole gamut of capabilities in regard to "... assimilation, adaptation, unpackaging and descaling of technology across a broad spectrum of industries has brought about, on the technological scene in India, a broad consciousness of the greater sophistication and strength of the country in bargaining..." He observes a shift over time from more comprehensive collaboration to more narrowly conceived collaboration agreements. The first generation technology agreements were more of a 'foreign exchange gap' filling agreements. These were more onerous and did not

attempt to look around for the best party and best possible term. Also, the technology had to be obtained on a packaged basis. Over time, he adds the country became technologically self reliant in a wide variety of consumer goods industries (such as textiles and sugar), consumer durable industries (such as air conditioners and refrigerators), engineering industries, electricity generation, railways and common chemicals. On the other hand technological gaps in such industries as aero space, pharmaceuticals, certain lines of chemicals and computers were serious.

Nayar (1983, p.189) studied the process of technology acquisition and assimilation in TELCO, Bajaj Auto, IDL Chemicals, Kirloskar Cummins and Bharat Electronics as part of his larger research project and concluded that the experience of these firms demonstrated a pattern of technology development in the Third World that was very different from the "dependency" or "under development" paradigm that posited that Third World countries suffered from a situation characterized by borrowing of technology perpetually as a result of lack of assimilation and alienation of local research and development.

The firms mentioned in the foregoing followed the following approach to technology management: (a) import of foreign technology; (b) assimilation and adaptation of imported technology in the process of productionization; (c) import substitution in a protected market replacing manufactured goods earlier procured from abroad; (d) export of manufactured products based on imported technology; (e) local R&D to adapt and improve imported technology and even to generate new technology; and (f) export of assimilated, adapted or improved technology.

Chaudhuri's study of technology acquisition and assimilation (1980, 1986a and 1986b) in the Indian tractor industry reveals a fairly high level of capability development in descaling, adaptation of imported materials and processes to local conditions, design and development of fairly complex machinery with the objective of reduction of capital cost, development of local vendors through technical and managerial inputs and managing complex production plants. However, most of the firms studied lacked product improvement and new product development skills of a high order. Eicher Tractors, HMT, Escorts, International Tractors (now Mahindra and Mahindra) and Punjab Tractors (PTL) had developed technology adaptation and descaling skills to a very high level though only one, PTL, could be considered to have developed fairly strong product improvement and new product development capabilities.

A case study of Gujarat Narmada Valley Fertilizers Company (GNFC) reportedly having the largest single stream ammonia and urea plant in the world with fuel oil as feedstock reveals that in spite of several technical problems faced by it at inception due to certain design flaws, power failures and lack of experience with the new technology it was able to increase capacity utilization from 53.4 per cent in the first year to 105.2 per cent over a period of four years. This was possible because of a learning approach of the technical management team, creation of an R&D group in the initial stages, use of clearly defined objectives to direct technical activities, strong result orientation of the top management and evolutionary organizational changes matching the technical tasks (*Chaudhuri, 1991*).

Lall (1984); Nayar (1983, Vol.2); Chaudhuri (1988); and Morris (1996) have documented technology export activity by Indian firms which goes to show the capabilities of certain Indian firms. Though technology export has been undertaken by Indian firms in a number of industries its incidence is not very wide spread, nor does it constitute a major activity of the technology exporting firms. It needs to be noted that the technologies exported are basically adapted versions of those imported by the firms previously for production of goods in India.

Another study of industrial technology development throws light on the capabilities developed by Indian firms (*Chaudhuri, et.al, 1996*). The Indian part of the study was a part of a larger international research project led by The World Bank. In India the study covered seven industries; machine tools, automotive parts, foundry, polymer, textiles, computer software and pharmaceuticals.

Within the industrial sectors there were inter-firm variations in technological capabilities. The medium sized and large firms in most of the sectors had developed, fairly good project preparation and execution capabilities. Machinery suppliers, however, provided services for installation and training as required while supplying new machinery. Skills related to project identification, feasibility studies, product range specification, specification of input requirement, deciding on plant scale, technology, negotiation with collaborators when required for acquiring new technical know-how, negotiation with consultants, building contractors, equipment search, procurement, vendor development, plant commissioning, training were fairly well developed. However, even, medium sized and large firms occasionally involved consultants when plant expansion was very large and technologically complex. Quite often depending on the sector, basic process design and detailed engineering work was contracted out to indigenous engineering consultants.

The same could not, however, be said of the small scale industry in the various sectors though the products manufactured by them were technologically simpler. As a result small firms quite often took the help of friends, and consultants in the industry in identifying technology, selecting machinery and product and even part time help of engineers and technicians who worked full time in large organizations.

Some large firms had highly developed project preparation and execution capabilities as evident from the example of a textile firm which was one of the leaders domestically and was aiming to become a leading company worldwide in denim manufacture. This company not only decided to choose an unusual route for the manufacture of denim but also provided technical ideas to a Japanese machinery supplier to modify the design of its existing machinery to suit its requirements. In its quest for further modernization and capacity expansion it decided to obtain foreign exchange loans from the International Finance Corporation. It made a successful presentation to the international financial institution and was in the process of augmenting its capacity and improving technology further.

Machinery manufactured by Indian companies was generally found to be quite far behind developed country standards, hence, the productivity levels attainable by the use of Indian made

machines was generally lower. However, these machines had been found to be appropriate by a large majority of firms. Firms aiming to become important players in the international market, however, preferred to procure machinery from foreign suppliers, which had high speeds, and were less energy, using more automated and therefore less labour using. Machinery suppliers for the higher end of the market were therefore not very well developed in India. This was true of most of the sectors covered in the study.

Firms in the manufacturing sectors in India have achieved a fairly high degree of process engineering capabilities. This is more true of large sized firms which have specialized organizational departments charged with this responsibility. In the engineering companies process planning, manufacturing planning, plant engineering, maintenance departments, welding engineering, etc. all cater to this task. One company bought over a closed textile unit and transformed it into a major contender in the Indian textile industry. Though it purchased the latest machinery it made most process changes through in-house efforts. In many cases the objective of process changes was to reduce costs. The Indian denim giant referred to previously pioneered an indigenous process of producing denim though the company did not use it for mass production as its engineers found imported technology to be more cost effective at large volumes. However, the technical capability that the company's R&D had developed played a significant role during the negotiation with the collaborator and also with the machinery supplier.

One pharmaceutical company which is today the largest manufacturer of IV fluids in the country is very clear about pursuing competitive strategies to attain cost leadership. To achieve a low cost position it decided to go for large volume manufacture through the use of highly productive imported machinery while focusing on all possible cost cutting strategies like reducing raw material usage through optimization of material cutting techniques, material changes, layout changes, good machinery maintenance, etc.

Only a few organizations could be identified amongst the middle sized and large ones in each industry that had made partial progress in reaching the stage of technology improvement and development. The textile firm with global ambitions certainly had acquired some of the characteristics of this stage of evolution. A pharmaceutical company, set up in 1907 by three persons and credited with having been the first in the private sector to produce penicillin could be considered to have partially acquired characteristics of such an organization. One multinational subsidiary in the pharmaceutical industry had an R&D set up which was part of the parent company's global R&D system. Only a few aspects of the whole chain of activities starting from search for new plant molecules to their conversion into a commercial drug were carried out in India and the results of studies done in India were fed into other research centres of the parent company.

Only a limited number of larger organizations in the sample could qualify to be in the stage of technology improvement and development. Though large they did not have the resources and risk taking capability to launch themselves into full scale new product development. Interviews with senior executives in the pharmaceuticals industry revealed that development of a new drug might require on an average Rs.200 crores which is more than the annual turnover of most of the

companies in India. Though most medium sized and large firms have absorbed the originally imported technology, adapted it to suit local conditions and also improved it to meet customers' requirements they still lack the capability to engineer completely new products on their own.

In sum it is evident from the above discussion that the major technological strength of Indian firms is in adapting imported technology to suit local conditions. This technological capability got built up in response to the protected environment created by the government's industrial and foreign investment policies which was evolved to implement the import substitution model of economic growth. Our discussion, however, revealed a major weakness of Indian firms. Only a small fraction of them have acquired the capability of improving products in response to customer feedback and designing, developing and commercializing new products.

5. PROBLEMS AND POLICY ISSUES

Several researchers in the past have documented problems related to ITT to India. Though they are somewhat dated these studies do provide some insights into problems that might still be present in the current scenario or may crop up in the future. Since studies focussing on ITT during the post-reform period (1991-96) are not available we shall also use some anecdotal information available in the business press.

5.1 Inter-Partner Tension in JVs

In the recent past there have been reports of the break-up of several joint ventures between Indian and foreign firms. Many joint ventures even though they have not split up have experienced heightened tension due to differences in strategic objectives of the partners. So much so that the Secretary General of the Confederation of Indian Industry Mr. Tarun Das thought it fit to come out in the open and talk about this trend in 1996. Recently Mr. Ratan Tata, Chairman of Tata Sons Limited, the holding company of the Tata empire alleged that foreign and multinational companies initially seek on entry into the Indian market in partnership with Indian firms to reduce the risk associated with the new venture. After acquiring familiarity with the product-market conditions, legal environment, labour market, etc. they strive to take over control.

Examples of joint ventures which have broken apart or have gone through difficult times abound. A few are; Godrej and Procter and Gamble (detergents and personal care products); Modi and Lufthansa (airlines); Jagatjit Industries and Allied Domneq Spirits & Wines; Guestline Management & Hospitality Development and Days Inn (hotels); Videocon and Mission Energy (power); RPG Power and Power Gen (power); Bharat Gold Mines Limited and Normandy Anglo Asian Limited (mining); ITC and British American Tobacco (cigarettes);, Tatas and IBM (computers); Tatas and Unisys (computers); Maruti Udyog and Suzuki Corporation (cars) and the State Government of Maharashtra and Enron (power).

In the context of economic liberalization set in motion by the government one may take the view that Indian and foreign firms now have considerable freedom to structure collaborative ventures that would suit their strategic requirements and needs of the market place within the policy framework established by the government and hence the government has no role in it. In some situations like the Enron case problems may be created because of the existing political situation the government is likely to come under increasing pressure from Indian as well as foreign firms to take some action in terms of changes in policy. If the pressure from Indian firms increases there might be a cap on the share of foreign equity in a joint venture's share capital. However, that might be a retrograde step and might jeopardize the government's objective of increasing FDI and new technology to the country.

5.2 Difficulties in Obtaining Technology

Denial of technology is another important issue. In the recent past India experienced considerable difficulties in obtaining technology from abroad in specific cases. Supercomputers and cryogenic engines are two very recent examples. The denial of technology by the US in the case of supercomputers and back tracking by Russia because of pressure from the US on an agreement to transfer technology for cryogenic engines seem to have had a positive impact. The Centre for Development of Advanced Computing (C-DAC) set up by the Central Government has already successfully developed supercomputers, some of which have been exported to Canada. The Indian Space Research Organization (ISRO) is reportedly on the verge of coming up with its indigenous design of cryogenic engines. Notwithstanding the above mentioned successes in technology development denial of sophisticated technology for manufacturing products in the country has been an important issue. This issue is also likely to increase in importance in years to come. This is likely due to the liberalization of conditions for entry into the Indian market by multinationals as well as on account of the growing capabilities of Indian firms which are likely to be perceived by foreign companies as threats to their dominance in their areas of expertise.

5.3 Inflow of DFI in the Post Reform Period

In a previous section we examined the trend in foreign collaboration approvals during 1948-94. From the data in Table 1 it is evident that there has been a considerable increase in foreign collaboration approvals in the post-reform period. Though data on actual number of collaborations implemented was not readily available some indication is available from data on actual inflow of direct foreign investment. The table reveals that actual inflow of DFI has increased consistently from 1991 till 1995. In 1996, however, there was a sudden dip due to a variety of reasons (*MOF, Economic Survey 1996-97*).

Prior to the enunciation of the New Economic Policy in mid 1991 FDI was not significant. This is evident from the fact that the Economic Survey published before 1992-93 did not discuss this aspect in any detail. In recent years FDI has been accorded some importance in India. Nevertheless there is room for increasing the technology transfer through the route of FDI.

India's share of FDI inflow into all developing countries has been very small. In 1990 it was 0.48 per cent which decreased to 0.30 per cent in 1992. Since 1992 it has increased consistently and in 1995 there was a jump to 1.71 per cent from 0.71 per cent in 1994. In 1995 China was far ahead, attracting 37.6 per cent of FDI into all developing countries. Even Hong Kong, Indonesia, Malaysia and Singapore were ahead of India (*MOF, Economic Survey, 1996-97, p.99*). The fact that India lags behind the aforementioned Asian countries is a cause for concern.

Another cause for concern is the fact that actual inflow of technology in association with foreign investment as a percentage of approvals has also been low. Overall, from 1991 to 1996 actual inflow as a percentage of approvals was only 19 per cent. In 1991 it was 48 per cent but has fluctuated between 13 and 20 per cent during the following years.

But a positive sign in the inflow of FDI into the country is the fact that in 1995 FDI into India was US \$ 1750 million which was higher than the FDI into South Korea (US \$ 1500 m) and Taiwan (US \$ 1470 m).

The above analysis provides mixed indications. In absolute terms there has been a considerable increase in the number of collaborations. The share of financial-cum-technical collaborations has also increased significantly thus showing the positive effect of the policy changes. However, the gap between approvals and actually implemented agreements perhaps points to either lack of sufficient interest of the foreign collaborators in transferring technology to Indian firms or difficulties in implementing the projects. Comparison with most of the rapidly growing Asian countries indicates that India has not been able to attract FDI commensurate with its potential.

5.4 Perceptions of European and Japanese Technology Suppliers

A study of transfer of technology between the European Community and India (*Desai, 1988, p.24*) provides some insights into the problems faced by European and Japanese technology suppliers in transferring technology to Indian firms. Table 5 gives a list of problems as perceived by the technology suppliers. A total of 162 suppliers were surveyed. Bureaucratic inefficiency, control on royalties, inadequate price of technology, problems related to industrial licensing, import restrictions, local supply of materials and taxes were the most important issues raised by the surveyed technology suppliers. Of the above mentioned issues, the first five seem to be the predominant ones with each one of them being pointed out by at least a third of the total number of suppliers.

With the adoption of the New Economic Policy in mid 1991 some of the above issues would have been, if not eliminated, reduced significantly. However, inspite of changes in the regulations there may still be difficulties because of a lag in implementation of new regulations by bureaucrats. There is also a lag between reforms made by the central government and the required changes at the state level. This also creates problems for collaborative ventures.

There are six issues which have been explicitly dealt with by the central government in formulating the existing regulations regarding foreign collaborations and technology transfer; payment of royalties, price of technology, industrial licensing, import restrictions, taxes and repatriation of profits. It is expected that most of the irritants related to these issues would have been reduced considerably. The other issues; local supply of materials, educational level of labour, reliability of Indian partner, quality of management and trade unions have also been addressed by the central and state governments; however, these would perhaps require a long term approach to be addressed appropriately.

5.5 Dependence and Excessive Import of Technology?

In recent years the question of dependence of Indian industry on foreign technology has been raised in the popular and business press by eminent persons. The contention of persons from the scientific community is that with liberalization of the economy Indian firms can easily obtain the technology they require and now that foreign equity participation of upto 51 per cent being allowed automatically and even higher percentage under certain conditions, it is felt that local R&D by Indian companies would get dampened. The scope of local R&D would get reduced to only adaptive research and indigenization activities in areas where it would be cheaper to produce certain components or materials indigenously. From the perspective of the Indian firm as well as the foreign partner this would make eminent sense, however, from the national perspective scientists feel this would not be proper as the technological skills developed over the past 40 years or so would be lost.

In the context of the current technology import policy is the amount of technology being imported appropriate? In our previous analysis we noted that Indian firms have entered into a large number of collaborations, both pure technical as well as financial-cum-technical. In absolute terms the total number of collaborations entered into by Indian firms amounts to about 20,000 since independence. We have seen that the number of collaborations signed every year has varied over time in response to the extant government regulation. During the post-reform period there has been a significant increase in the collaboration signed annually though the increasing trend was visible even at the beginning of the decade of the 80s. How do we judge whether the number of collaborations signed are compatible with the country's needs? The most appropriate method to explore this issue would be perhaps to determine industry's needs through a comprehensive survey which however would require large resources as well as time. In the absence of such a study one way to get a feel for this would be to look at the experiences of Japan and South Korea. Between 1951 and 1983 Japan had entered into a total of 41972 technology import agreements averaging to 1312 annually. This figure is indeed much larger than the figure for India upto 1983. Japan's technology import upto 1983 was more than double the figure for India upto 1994. This indicates that the absolute number of collaborations signed by Indian firms is meager compared to that of Japan. As noted in a previous section South Korea entered into 3073 collaborations during the period 1963-84. Compared to this India signed 7503 collaborations which is significantly larger. If we take Japan as the benchmark it is evident that there is great scope for further import of technology, on the other hand comparison with South

Korea might indicate that there has been an excessive amount of technology import. Evidence from other studies (*Nayar, 1983, Vol.2*) indicates that the criticism of excessive import of technology is not valid. South Korea seems to have, on the basis of partial information, managed its technology assimilation and development process more effectively and efficiently to transform its borrowed technological capabilities into new product and process design capabilities. India may, therefore, have to look at South Korea's experience to understand how it was done.

Information regarding technology import by other countries may help us get a better idea about whether India's technology import has been excessive or not. In the absence of data on technology import by other countries we shall use FDI inflows as a surrogate measure. During 1996-97 China, Hong Kong, Indonesia, Malaysia and Singapore attracted much larger FDI inflows than India. It is notable that except for China the remaining Asian countries are much smaller in size than India (*GOI, MOF, 1996-97, p.99*).

A somewhat dated study (*Desai, 1988*) estimated that perhaps more than 7.5 per cent of the agreements during 1977-80 were "repeats" between the same firms for the same class of products. This is an indication of the inefficiencies in the system; however, keeping in mind the new economic policies introduced by the government since 1991 the onus for signing appropriate collaboration agreements would lie on the Indian firm rather than on a regulatory body. This is also in keeping with the improved technological and managerial capabilities of Indian industries and the worldwide trend of economic liberalization.

On an overall basis, therefore, it seems that there is still considerable scope for increasing the flow of technology into the country with the objective of improving Indian industries competitiveness. However, a major shift is required in the character of local R&D to transform capabilities acquired through ITT into technology improvement and new product and process development skills.

5.6 Content of Technology Import Agreements

Data on the content of technology import agreements during the post-reform period were not readily available. However, useful insights are available from some previous studies. *Desai (1988)*, referring to a study of international transfer of technology to India from several European countries mentions that there were wide variations in the content of technology agreements. Although almost all agreements involved transfer of some documentation about 25 per cent of them did not provide for "explanations" required for its utilization. Sixty per cent did not involve any regular flows of information. Half the agreements did not embody foreign technicians' visit to India and Indian technicians' visit to the collaborator's works. Fifty per cent of the agreements did not allow Indian firms access to their collaborators' laboratories and design offices. All these aspects of the agreements indicate that the foreign collaborators did attempt to restrict flow of technology. This may have been due to the weaker negotiating capability of the Indian firms. A related issue is that of the inclusion of restrictive clauses in the agreements by technology suppliers.

Nayar's (1983, Vol.2, p.125) analysis reveals that about three-fifths of the 1098 agreements in the private sector during the period 1964-70 had restrictive clauses in contrast with only 50 per cent during 1960-64. Restrictions on export more than doubled during the period. Export restrictive clauses constituted nearly three-fourths of the 1285 restrictive clauses, primarily prohibiting exports to the foreign collaborator's home country or to countries where it had similar operations, or requiring its permission for exports. The export restriction in the private sector applied mostly to foreign minority companies and Indian companies. The increase in such clauses may have been due to the growing perception of foreign collaborators of the competence of the Indian firms. The increase in restrictions could also be due to the predominance of small and medium firms rather than large firms among technology importers in India. Small and medium firms are characteristically weaker in bargaining power

Foreign collaboration agreements are basically negotiated by potential partners. Each partner would have its own strategic objectives and therefore must ensure that they are taken care of in the collaboration agreement. In the context of economic liberalization and globalization the role of the government would be small. The government may help by actions that can enhance the bargaining capability of weaker firms by providing information, opportunities for skill development, facilitating interaction between firms and technology institutions, etc.

5.7 Assimilation of Imported Technology

To a large extent imported technology has enabled Indian firms to produce products using locally available materials and machinery. Indian firms in a wide range of industries have acquired the capability to descale and adapt the technology in use at their collaborators' works. However, as we have seen one of the major technological weaknesses of Indian firms is in the area of technological innovation. In the context of economic liberalization and the trend towards globalization Indian firms in certain industries are likely to face another technological problem. Till now descaling was considered to be a strength; however, in several industries such as certain petrochemical products, chemicals, pharmaceuticals, denim fabric, certain pesticides, etc. Indian firms are setting up global scale plants. Henceforth plant upscaling will be an important capability, at least in certain industrial sectors.

Studies have shown a weak link between Indian industry and the publicly funded technology infrastructure (*Alam and Langrish, 1984; Chaudhuri, 1986, Crane, 1977; Chaudhuri and Dixit, 1996*). The policy issue that seems to emerge is how can more effective assimilation of foreign technology be achieved using the already existing TI infrastructure. In recent years several changes have been made in the management of the national laboratories under the CSIR to make them more oriented towards the needs of industry under the leadership of Dr. R.A. Mashelkar, currently the director general of CSIR. Some of the laboratories under CSIR have been successful in their efforts to increase revenues from industrial problem solving activities but the task at hand is very large indeed with 40 laboratories under its fold. In sum, blending imported technological inputs with indigenous R&D to develop innovative and upscaling skills will be a major issue for both policy makers as well as enterprise managers.

6. PROSPECTS OF ITT

The factors that are likely to figure prominently in influencing ITT are; (a) economic performance, (b) government policies, (c) technology gaps in different industries, (d) political situation and (e) miscellaneous factors including market size , technical skill availability, low labour cost, legal system and language of business communication, etc. In this section we attempt to make a broad assessment of the prospects of ITT.

Performance of the economy in general and industry in particular are important factors that influence demand for technology and its supply from foreign sources. Here we do a brief review of the economic scenario at the end of the Eighth Five Year Plan period on the basis of the annual economic survey brought out by the Ministry of Finance (1995-96 and 1996-97). During 1995-96 the economy experienced a GDP growth rate of 7.1 per cent. the slackening of reforms preceding and immediately following the election in mid 1996 may have resulted in some loss of momentum that had been generated through earlier actions of the government. Economic growth during 1996-97 was around 6.8 per cent (GDP at factor cost). It is expected that the Eighth Five Year Plan would end with an average growth of 6.5 per cent per annum, 0.9 per cent higher than the target rate for 5.6 per cent, and 0.5 per cent higher than the actual achievement of the Seventh Five Year Plan (see Table 6).

The achievements during the Eighth Five Year Plan period may be considered remarkable given the crisis the country faced during the period 1990-91. Some of the key points that emerge from a comparison of economic performance during the Eighth and Seventh Five Year Plan periods are:

- * Faster overall economic growth achieved during Eighty Five year Plan period.
- * Annual growth rate of manufacturing sector was 2 per cent higher during Eighth Five Year Plan period.
- * Both exports and imports grew significantly faster during the Eighth Five Year Plan period.
- * BOP position has improved considerably.
- * Central government's fiscal deficit as a proportion of GDP has declined considerably.
- * Average gross domestic savings rate improved to 23.6 per cent of GDP during the first four years of the Eighth Five Year Plan against 20.6 per cent during the Seventh Five Year Plan.
- * Rate of growth of infrastructure sectors (with the exception of telecommunications) was slower during the Eighth Five Year Plan.

- * Rate of inflation increased somewhat during the Eighth Five Year Plan though remaining below.

The slow down in economic growth during the last year of the Eighth Five Year Plan period has been mainly attributed to (a) infrastructure inadequacies; (b) high cost of credit; (c) slump in capital market; (d) high cost of energy; and (e) erosion of investors' confidence due to the uncertain political situation.

The stockmarket scam of 1992, the post-agreement dispute between the Government of Maharashtra and the multinational Enron; the determined protests by environmentalists against the construction of a dam across the Narmada; several mini-scams and corruption scandals, increasing judicial activism against polluting industries and the difficulties faced by the 13-party United Front Government are other important factors that probably have dampened economic and industrial growth. It is therefore likely that in the immediate future foreign investors and technology suppliers would adopt a 'wait and watch' approach epitomized by the Japanese MNCs so far. However, in the long term (beyond 5 years) other factors like (a) size of the market, (b) rate of market growth, (c) technical skills available in the country, (d) low labour cost, (e) strength of the legal system, (f) familiarity of a large proportion of the population with English would play an important role in shaping the perceptions of would-be investors regarding India as a destination for investing for long term performance.

One of the important factors that is likely to play a very critical role in this is political situation existing in the country. India was ruled by the Congress Party during the period 1991-96 with a slender majority; nevertheless, reforms of far reaching magnitude were introduced during that period. The progress of reforms did suffer during the period preceding and immediately following the elections in 1996. We must keep in mind the difficulties faced by a 13 party coalition government. Considering that India is relatively new to the system of coalition governments the performance of the government during the 1996-97 was commendable. In early 1997 again the country was on the brink of another political crisis but with the installation of Mr. I.K. Gujral as the new Prime Minister of the coalition government it is likely that the country would have some stability for the next of couple of years. It would be worthwhile to note that the coalition government of ex-Prime Minister H.D. Deve Gowda announced one of the most industry and investor friendly budgets in recent times in February 1997 which has been adopted by the succeeding government of Prime Minister Gujral albeit with some modifications.

Some of the salient points of the budget of 1997-98 are:

- * Reduction in personal and corporate income tax, custom duties rationalization of excise duties to have a mean rate of 18 per cent in coming year, abolition of corporate surcharge;
- * Incentives for investment in oil exploration to increase domestic oil production;

- * Package of measures to boost investment in capital market including buy-back of shares'
- * Increase in investment limit for FIIs and NRIs;
- * Replacing FERA with the Foreign Exchange Management Act (FEMA);
- * Signalling a move to capital account convertibility;
- * Partial opening up of insurance sector to private investment.

Post-budget developments include:

- * Setting up of a Committee on Capital Account Convertibility to lay down ground rules and time frame;
- * New Exploration Licensing Policy (NELP);
- * Export-import (EXIM) Policy for 1997-2001 marking a further shift to free trade regime by removing quantitative restrictions and making the policy more transparent and easy to administer.

Overall, the economic reforms have had a positive impact on the investment climate in the country. The development of the capital market has been re-inforced by an increasing number of capital issues by Indian as well as multinational companies and upgrading of Indian credit rating by international credit rating agencies. The exchange rate of rupee is now determined by the market and exchange control has been relaxed significantly through amendments to the FERA. Capital goods, raw materials, intermediates, components, consumables, spares parts, accessories and instruments are now importable without any restrictions. Conditions prohibiting use of foreign brand names/trade marks have been removed. Provisions relating to foreign companies opening branch and liaison offices in India have been substantially relaxed.

Foreign investment is permitted in virtually every sector of the economy. Majority foreign equity, even upto 100 per cent in some sectors, is encouraged and special investment incentives are provided in areas such as power, software, computer hardware, electronics, telecom, air-transport, construction, maintenance, operation of roads, ships repairs and maintenance, maintenance of airports infrastructure and part of railway transport (*Jain, 1996*).

On balance, there are certain factors which are likely to pull international technology suppliers to the country whereas there are others which probably would discourage them. It may be noted that even in the post reform period when there were major conflicts between MNCs and the Maharashtra government the backlash on foreign investment inflow was not very severe. Again in the aftermath of the demolition of the Babri Masjid in December 1991 though there was an

impact on foreign investors' perception of the market conditions it was probably more of a short term phenomenon.

India is passing through a period of transition from a protected environment to a free and competitive economy. It is very likely that she will pass through several problems but my assessment is that they are likely to be short term in nature. In the long run (5 to 10 years) the demand for international technology is likely to be strong.

Certain industries have been identified by ASSOCHAM, an important industry association, which would need major technology inputs for making them internationally competitive. They are; cement, steel, aluminium, foundries, engineering, engine valves, agro-chemicals, tyres, tobacco and paper.

If the problems and policy issues raised in the previous section are tackled expeditiously it is likely that India would be able to attract a much larger share of international technology flows.

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Table 1 : Foreign Collaboration Approvals: 1948-94

Year	Total No. of Collaboration Approvals	Growth Rate Involving Foreign Investment	Cases Involving Foreign Investment	Percentage Ratio	Year	Total No. of Collaboration Approvals	Growth Rate Involving Foreign Investment	Cases Involving Foreign Investment	Percentage Ratio
1948-55	284	-	-	-	1975	271	-24.51	40	14.76
1956	82	130.99	-	-	1976	277	2.21	39	14.08
1957	81	-1.22	-	-	1977	267	-3.61	27	10.11
1958	103	27.16	-	-	1978	307	14.98	44	14.33
1959	150	45.63	-	-	1979	267	-13.03	32	11.99
1960	380	153.33	-	-	1980	526	97.00	65	12.36
1961	403	6.05	165	40.94	1981	389	-26.05	56	14.40
1962	298	-26.05	124	41.61	1982	588	51.16	113	19.22
1963	298	0.00	115	38.59	1983	673	14.46	129	19.17
1964	403	35.23	123	30.52	1984	740	9.96	148	20.00
1965	241	-40.20	71	29.46	1985	1041	40.68	256	24.59
1966	202	-16.18	49	24.26	1986	960	-7.78	256	26.67
1967	182	-9.90	62	34.07	1987	903	-5.94	259	28.68
1968	131	-28.02	30	22.90	1988	957	5.98	289	30.20
1969	134	2.29	29	21.64	1989	639	-33.23	212	33.18
1970	183	36.57	32	17.49	1990	703	10.02	201	28.59
1971	245	33.88	46	18.78	1991	976	38.83	298	30.53
1972	257	4.90	36	14.01	1992	1520	55.74	736	48.42
1973	265	3.11	34	12.83	1993	1476	-2.89	762	51.63
1974	359	35.47	55	15.32	1994	1854	25.61	1054	56.85
					Total	20015		5987	29.91

**Compound Growth Rates of
Foreign Collaboration Approvals
During the Plan Period**

YEAR	COMPOUND GROWTH RATE
1956/57-1960/61	46.72
1961/62-1965/66	-8.71
1966/67-1968/69	-18.39
1969/70-1973/74	15.13
1974/75-78/79	2.99
1979/80	-13.03
1980/81-1984/85	22.62
1985/86-1989/90	-2.89
1990/91-1995/96	23.74

Source : GOI, DSIR, A Compilation of Foreign Collaboration Approvals, 1994 (New Delhi) for basic data.

Table 2 : Foreign Collaboration Approvals 1976-1994: Sectorwise Distribution

Year	Alternate/ Renewable Energy Sources	% Ratio	Chemical % Ratio	Electrical & Electronics Ratio	% Ratio	Industrial Machinery Ratio	% Ratio	Mechanical Engineering Ratio	% Ratio	Machine Tools Ratio	% Ratio	
1976	-	0	32	11.55	63	22.74	57	20.58	13	4.69	19	6.86
1977	-	0	23	8.61	67	25.09	74	27.72	4	1.50	10	3.75
1978	-	0	30	9.77	48	15.64	76	24.76	7	2.28	20	6.51
1979	-	0	24	8.99	52	19.48	72	26.97	15	5.62	14	5.24
1980	-	0	52	9.89	114	21.67	121	23.00	29	5.51	26	4.94
1981*	-	0	27	6.94	55	14.14	96	24.68	49	12.60	5	1.29
1982	3	0.51	54	9.18	134	22.79	110	18.71	125	21.26	6	1.02
1983	5	0.78	76	11.82	149	23.17	144	22.40	69	10.73	24	3.73
1984	4	0.54	85	11.49	162	21.89	169	22.84	99	13.38	27	3.65
1985	14	1.34	69	6.63	315	30.26	215	20.65	89	8.55	38	3.65
1986	5	0.52	135	14.06	246	25.63	87	9.06	145	15.10	28	2.92
1987	4	0.44	138	15.28	227	25.14	165	18.27	83	9.19	24	2.66
1988	3	0.31	136	14.21	243	25.39	170	17.76	92	9.61	24	2.51
1989	2	0.31	80	12.52	111	17.37	74	11.58	75	11.74	11	1.72
1990	2	0.28	76	10.81	146	20.77	159	22.62	66	9.39	8	1.14
1991	1	0.10	136	13.93	175	17.93	191	19.57	92	9.43	12	1.23
1992	8	0.53	243	15.99	215	14.14	101	6.64	166	10.92	14	0.92
1993	10	0.68	212	14.36	222	15.04	101	6.84	124	8.40	11	0.75
1994	10	0.54	239	12.89	250	13.48	110	5.93	136	7.34	13	0.70

Year	Metallurgical % Ratio	% Ratio	Textile % Ratio	% Ratio	Transport % Ratio	% Ratio	Consultancy % & Other Services Ratio	% Ratio	Misc. % Ratio	% Ratio	Total
1976	12	4.33	2	0.72	19	6.86	-	0	60	21.66	277
1977	7	2.62	2	0.75	19	7.12	-	0	61	22.85	267
1978	18	5.86	2	0.65	22	7.17	-	0	84	27.36	307
1979	12	4.49	-	0.00	26	9.74	-	0	52	19.48	267
1980	31	5.89	6	1.14	41	7.79	-	0	106	20.15	526
1981*	9	2.31	5	1.29	19	4.88	-	0	42	10.80	389
1982	36	6.12	7	1.19	24	4.08	7	1.19	82	13.95	588
1983	24	3.73	3	0.47	34	5.29	11	1.71	134	20.84	643
1984	32	4.32	7	0.95	25	3.38	10	1.35	120	16.22	740
1985	54	5.19	13	1.25	52	5.00	20	1.92	162	15.56	1041
1986	69	7.19	16	1.67	54	5.63	-	0.00	175	18.23	960
1987	35	3.88	11	1.22	39	4.32	9	1.00	168	18.60	903
1988	55	5.75	25	2.61	40	4.18	18	1.88	151	15.78	957
1989	35	5.48	11	1.72	18	2.82	25	3.91	197	30.83	639
1990	31	4.41	8	1.14	38	5.41	84	11.95	85	12.09	703
1991	40	4.10	9	0.92	58	5.94	118	12.09	144	14.75	976
1992	67	4.41	30	1.97	56	3.68	195	12.83	425	27.96	1520
1993	70	4.74	44	2.98	81	5.49	196	13.28	405	27.44	1476
1994	71	3.83	55	2.97	81	4.37	314	16.94	575	31.01	1854

* There were 82 cases cleared under delegated power by various Administrative Ministries.

These 82 cases are included in the total figure of 389 but are not included in the sectorwise breakup.

Source : GOI, DSIR, A Compilation of Foreign Collaboration Approvals, 1994 (New Delhi) for basic data.

Table 3 : Countrywise Distribution of Foreign Collaboration Approvals (1981-1994)

COUNTRY	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Total
USA	85	109	135	143	229	203	217	200	137	142	174	344	318	360	2796
% Ratio	21.85	18.54	20.06	19.32	22.00	21.15	24.03	20.90	21.44	20.20	17.83	22.63	21.54	19.42	20.84
Germany	74	110	129	132	187	188	154	179	114	141	167	199	177	216	2167
% Ratio	19.02	18.71	19.17	17.84	17.96	19.58	17.05	18.70	17.84	20.06	17.11	13.09	11.99	11.65	16.15
UK	80	105	119	123	149	134	130	142	78	107	140	183	175	199	1864
% Ratio	20.57	17.86	17.68	16.62	14.31	13.96	14.40	14.84	12.21	15.22	14.34	12.04	11.86	10.73	13.89
Japan	27	51	58	78	111	111	82	98	63	55	74	101	95	134	1138
% Ratio	6.94	8.67	8.62	10.54	10.66	11.56	9.08	10.24	9.86	7.82	7.58	6.64	6.44	7.23	8.48
Italy	18	37	30	37	59	58	54	59	42	43	64	71	58	88	718
% Ratio	4.63	6.29	4.46	5.00	5.67	6.04	5.98	6.17	6.57	6.12	6.56	4.67	3.93	4.75	5.35
Switzerland	26	41	47	30	43	32	32	45	25	36	55	83	63	51	609
% Ratio	6.68	6.97	6.98	4.05	4.13	3.33	3.54	4.70	3.91	5.12	5.64	5.46	4.27	2.75	4.54
France	23	28	40	38	63	40	43	46	25	39	40	59	49	62	595
% Ratio	5.91	4.76	5.94	5.14	6.05	4.17	4.76	4.81	3.91	5.55	4.10	3.88	3.32	3.34	4.43
Netherland	9	13	13	14	18	24	23	16	15	13	51	57	55	94	415
% Ratio	2.31	2.21	1.93	1.89	1.73	2.50	2.55	1.67	2.35	1.85	5.23	3.75	3.73	5.07	3.09
Sweden	11	15	15	14	32	30	20	12	21	15	30	30	10	24	279
% Ratio	2.83	2.55	2.23	1.89	3.07	3.13	2.21	1.25	3.29	2.13	3.07	1.97	0.68	1.29	2.08
Others	36	79	87	131	150	140	148	160	119	112	181	393	476	626	2838
% Ratio	9.25	13.44	12.93	17.70	14.41	14.58	16.39	16.72	18.62	15.93	18.55	25.86	32.25	33.76	21.15
TOTAL	389	588	673	740	1041	960	903	957	639	703	976	1520	1476	1854	13419

COUNTRY	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Total
USA	85	109	135	143	229	203	217	200	137	142	174	344	318	360	2796
USA-% Ratio	21.85	18.54	20.06	19.32	22.00	21.15	24.03	20.90	21.44	20.20	17.83	22.63	21.54	19.42	20.84
EUROPE	241	349	393	388	551	506	456	499	320	394	547	682	587	734	6647
EUROPE-% Ratio	61.95	59.35	58.40	52.43	52.93	52.71	50.50	52.14	50.08	56.05	56.05	44.87	39.77	39.59	49.53
JAPAN	27	51	58	78	111	111	82	98	63	55	74	101	95	134	1138
JAPAN-% Ratio	6.94	8.67	8.62	10.54	10.66	11.56	9.08	10.24	9.86	7.82	7.58	6.64	6.44	7.23	8.48
OTHERS	36	79	87	131	150	140	148	160	119	112	181	393	476	626	2838
OTHERS-% Ratio	9.25	13.44	12.93	17.70	14.41	14.58	16.39	16.72	18.62	15.93	18.55	25.86	32.25	33.76	21.15
TOTAL	389	588	673	740	1041	960	903	957	639	703	976	1520	1476	1854	13419

Source : GOI, DSIR, A Compilation of Foreign Collaboration Approvals, 1994 (New Delhi) for basic data.

Table 4 : Direct Foreign Investment : Actual Inflows vs. Approvals

	1991	1992	1993	1994	1995	1996*	Total (1991 to 1996*)
Approvals							
Rs crore	739	5256	11189	13591	37489	29513	97777
US \$ million	325	1781	3559	4332	11245	8367	29608
Actual inflows							
Rs crore	351	675	1786	3009	6720	5877	18418
US \$ million	155	233	574	959	2100	1670	5690
Actual as % of Approvals	48	13	16	22	19	20	19

1 Upto September, 1996.

Note : The approval and actual figures include NRI Direct Investment approved by RBI.

Source: GOI, Ministry of Finance, Economic Survey, 1996-97, p.99.

**Table 5 : Impediments Considered Serious or Very Serious by
Technology Suppliers, Selected Countries**

	West Germany	France	Italy	Denmark	Japan	Total
Total number of suppliers	81	28	29	9	15	162
Bureaucratic inefficiency	49	24	18	8	14	113
Control on royalties	30	14	11	6	14	75
Inadequate price of technology	25	15	15	5	13	73
Industrial licensing	25	12	8	6	12	63
Import restrictions	37	11	2	4	2	56
Local supply of materials	24	13	5	1	5	48
Taxes	24	6	11	0	5	46
Difficulties in repatriation of pro	14	10	7	4	6	41
Educational level of labour	15	8	5	2	5	35
Reliability of Indian partner	14	9	5	1	5	34
Quality of management	12	3	4	1	9	29
Trade unions	12	5	1	0	3	21

*Source: Ashok V. Desai (ed.), Technology Absorption in Indian Industry
(New Delhi: Wiley Eastern Ltd.), 1988, p.24.*

Table 6 : Sectoral Real Growth Rates

Industry	Average Percentage Change Over the Previous year					Average	
	7th Plan	1992-93	1993-94	1994-95	1995-96	1996-97	8th Plan
	(1985-90)			(P)	(Q)	(A)	(1992-97)
(in per cent)							
I. Agriculture and Allied Sectors	3.4	6.1	3.6	4.6	-0.1	3.7	3.6
II. Industry	7.5	4.2	6.8	9.4	11.6	8.7	8.1
1. Mining and quarrying	9	1.1	2	8.1	7	1.7	4
2. Manufacturing	7.7	4.2	8.5	10.2	13.6	10.6	9.4
3. Electricity, gas and water supply	9.5	8.4	7.1	8.6	9.1	4.2	7.5
4. Construction	5.2	3.4	1.3	6.9	5.3	4.6	4.3
III. Services	7.4	5.5	7.3	7.5	8.8	7.4	7.3
5. Trade, hotel, transport and communication	7.1	6.3	7.5	10	13.3	9.4	9.3
6. Financing, insurance, real estate and business services	8.3	4.6	10.5	7.1	4	6.3	6.5
7. Community, social and personal services	7.3	5	3.9	3.8	6.2	4.9	4.7
Total Gross Domestic Product at Factor Cost	6	5.3	6	7.2	7.1	6.8	6.5

Note : P = Provisional Q = Quick Estimates A = Advance Estimates

Source : GOI, MOF, Economic Survey, 1996-97.

