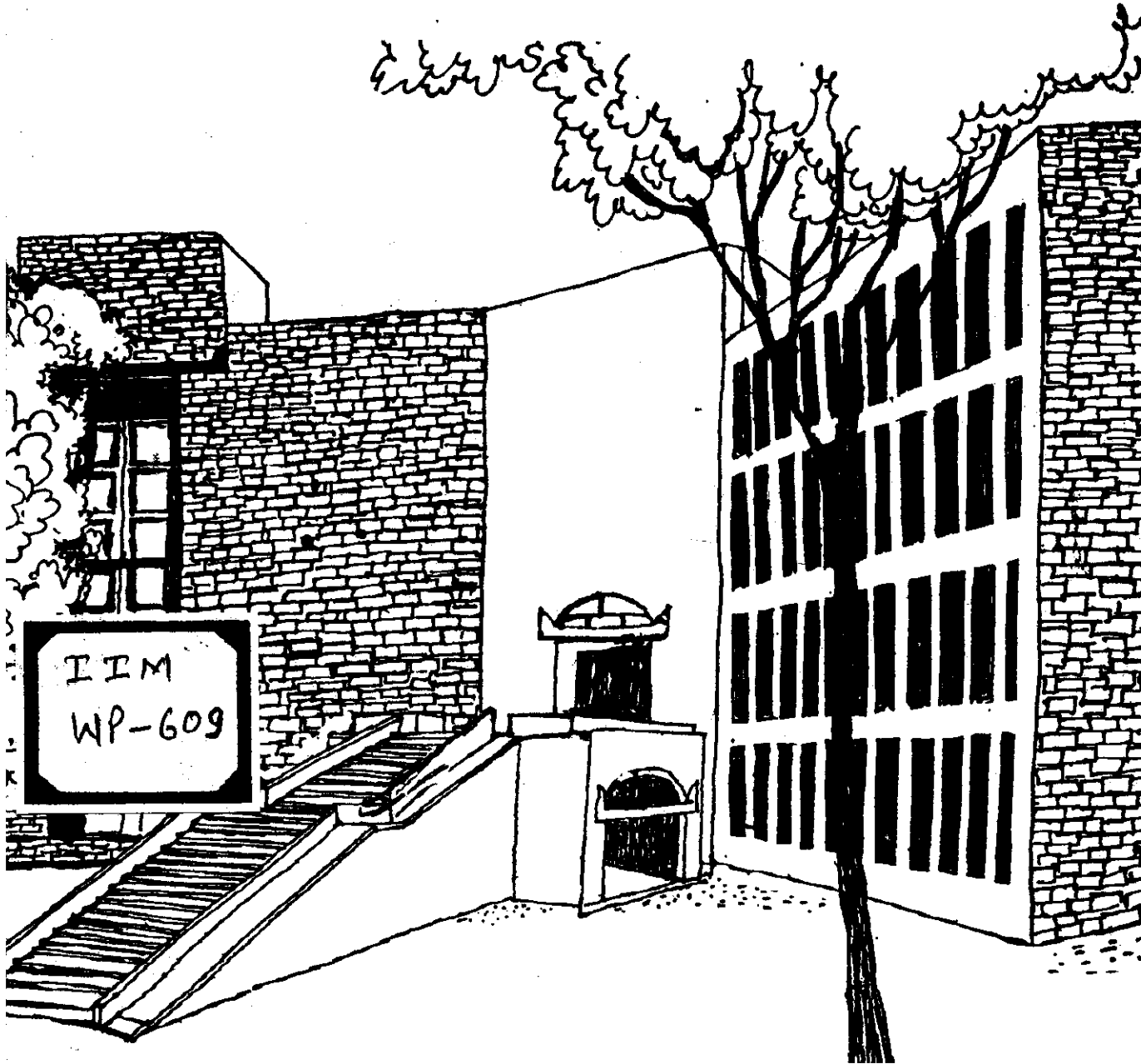




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Working Paper



TRANSFER OF TECHNOLOGY TO INDIA: THE CASE
OF INDO-FRG INDUSTRIAL COOPERATION

By

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TRANSFER OF TECHNOLOGY TO INDIA:

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Shekhar Chaudhuri

1.0 Introduction

The international arena in science and technology shows a predominance of the industrialised countries of the west. An overwhelming proportion of the industrial output of the developing countries is based on technologies imported from the developed countries. The dominance of the industrially advanced countries in terms of generation of new technology is evident from Table 1 which shows the per capita R&D effort by a number of countries. In the list of 21 countries, including both advanced as well as developing countries, the U.S. topped with a per capita expenditure on research and development of \$129.13. There were 12 countries with expenditure above \$10.00. Pakistan was last with \$0.08 and India was slightly better off with \$0.47.

One implication of the above inference regarding the level of technological development in the advanced and the developing countries is that the vast expenditure on science and technology by the former represents a store-house of technology which can be relied upon and utilized by the latter. By being late-comers to the process of technological development, the developing countries have the advantage of being able to import directly the technologies already available in the advanced countries without having to expend time and effort in "re-inventing" these technologies.

Table 1

International Comparison of R&D Effort

Country	Per Capita G.N.P. in U.S.Dollars at current prices	R&D Expendi- ture as per- centage of GNP	Per Capita R&D Expenditure in U.S.Dollars at current prices
1	2	3	4
1. Argentina	904	0.2	1.86
2. Belgium	2176	1.3	30.20
3. Canada	3097	1.3	46.87
4. Czechoslovakia	1370	3.6	114.65
5. France	2525	2.0	50.81
6. Germany (FRG)	2238	1.8	50.16
7. Ghana	220	0.2	0.23
8. Iran	334	0.3	1.35
9. India	100	0.4	0.47
10. Italy	1439	0.9	13.96
11. Japan	1658	1.8	29.10
12. Republic of Korea	220	0.5	1.03
13. Mexico	632	0.1	0.80
14. Netherlands	2012	2.2	48.43
15. Nigeria	83	0.5	0.50
16. Pakistan	132	0.1	0.08
17. Sweden	3365	1.2	37.66
18. U.K.	1716	2.5	43.87
19. U.S.A.	4139	2.8	129.13
20. U.S.S.R.	1198	4.2	58.01
21. Yugoslavia	580	1.0	4.9

Source: Research and Development Statistics, National Committee on Science and Technology, May, 1975, p.15 quoted in V. Sriram et. al Top 300 Companies: Exports, Imports, Foreign Collaboration Agreements and R&D (New Delhi: Economic and Scientific Research Foundation, 1979).

The other alternative open to a developing country is to carry out its own organized research, development, and innovation and diffuse throughout the country the results of its own work. However, the development of an adequate scientific and technological capability is a very long and complex process. Even when a strong indigenous capability exists a great deal can be gained from acquiring technology from advanced nations where a pool of tested, tried and perfected scientific and technical know-how exists. It is believed by some economists that if this technological heritage were not available, economic growth in the underdeveloped world would be even slower than it promises to be.

Foreign collaborations have played an important role in the building up of the industrial infrastructure in the country. In fact it has increased considerably during the last few years with the gradual liberalization of governmental policies towards industry. Over the years Indian firms have acquired technology from a number of countries. The United States, United Kingdom and the Federal Republic of Germany have been the top three sources of technology.

The objectives of this paper are to:

- i) describe broadly the major sources of foreign technology over the years;
- ii) describe the changing patterns in the number and nature of foreign collaboration agreements;
- iii) highlight the role of Indo-FRG industrial cooperation and describe the changing nature of the collaboration agreements;

- iv) discuss briefly the factors that are likely to influence Indo-FRG industrial cooperation and finally
- v) raise some issues for research.

2.0 Foreign Industrial Cooperation

Since independence India has gradually transformed her economy into one in which industry plays a very significant role and in this import of technology has been a dominant source for the technical know-how inspite of the fact that a large scientific and technological infrastructure has been built up in the country. Table 2 provides information on the foreign collaboration agreements entered into by Indian and foreign companies. It is evident from the table that during the period 1963 to 1968 there was a gradual decline in the number of collaborations approved by the government. However, the decline was arrested in 1968 and between 1969 and 1974 it increased gradually. With the enactment of the FERA in 1975 there was again a dip in the number of collaboration agreements approved during the period 1975 to 1979. During the eighties there has been a general up trend in keeping with the trend in liberalisation of government's policy towards foreign collaboration. On an average, the number of collaboration agreements approved during the period 1957-63 was higher than the number of agreements approved till 1977, with the exception of 1974. However, at a disaggregated level there was a significant difference in the number of collaborations approved each year as seen

Table 2

Indo-Foreign Collaborations Sanctioned Annually, 1957/1983

Country	1957/ 1963	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1957/ 1983
U.K.	603	60	44	50	19	34	39	55	38	53	59	54	54	59	61	63	110	79	107	119	1760
U.S.A.	360	48	42	34	36	18	33	43	62	48	79	55	69	54	59	48	125	85	110	135	1543
Federal Republic of Germany	304	44	41	24	22	23	36	42	49	60	71	59	60	55	58	55	100	74	110	129	1421
Japan	172	26	19	21	12	17	15	35	27	38	20	23	10	20	20	12	34	27	51	58	672
Switzerland	92	18	10	6	6	7	13	14	15	10	33	27	22	23	18	14	38	26	41	47	480
France	71	12	11	9	8	7	7	15	14	13	22	13	17	14	21	17	24	23	28	40	586
Italy	59	7	3	6	3	3	8	5	8	5	16	10	8	10	18	18	25	18	37	30	290
Sweden	28	3	5	8	4	2	3	3	4	7	11	4	6	4	8	5	10	11	15	15	156
Netherlands	33	2	3	4	2	3	3	4	4	2	3	1	6	4	10	6	8	9	14	13	134
DDR	49	6	3	2	2	5	5	5	3	4	2	3	7	3	8	6	4	4	2	10	133
Czechoslovakia	21	3	3	1	4	1	5	5	6	5	5	3	1	1	1	2	4	-	5	2	78
Denmark	26	1	1	1	4	2	1	2	1	3	4	-	4	3	2	3	6	1	4	3	72
Austria	20	1	2	2	-	-	3	1	1	2	2	2	4	2	2	2	5	8	8	3	67
Belgium	20	-	3	1	1	2	2	3	3	2	5	5	2	2	2	2	2	1	4	8	64
Canada	14	1	2	2	-	2	-	1	1	2	3	6	1	2	3	2	-	2	1	6	51
Hungary	8	1	3	1	1	1	1	1	3	1	2	1	2	3	1	1	2	3	3	2	41
Poland	14	2	2	-	-	-	-	-	-	1	-	-	2	1	1	1	2	4	4	1	35
Yugoslavia	7	1	3	1	2	2	-	-	2	1	2	2	-	-	-	-	3	1	2	-	23
Finland	4	-	-	-	-	1	1	-	-	-	3	1	-	2	1	3	5	2	4	1	28
Others	211	6	3	9	5	4	9	11	17	9	12	5	7	5	12	8	19	11	41	51	455
TOTAL	2116	242	202	182	131	135	183	245	257	265	359	271	281	267	307	267	526	389	591	673	7889

from Table 3. In 1961 and again in 1964, 403 agreements were approved, a record which was not surpassed till 1982. However, after that there has been a spurt in the number of agreements signed annually, the record being 740 in the year 1984.

Table 4 provides information on the industrywise distribution of foreign collaborations. The machine-making, electrical and chemicals, pharmaceutical industries were the top three sectors in descending order.

Table 5 provides information on the nature of collaboration agreements entered into by Indian firms. It is evident that joint ventures as a mode of collaboration is not a favoured one. It was the highest as a percentage of total number of collaborations in 1968 and it could not reach that figure. There was a gradual decrease in the incidence of joint ventures from 1968 till 1973, then again it fluctuated around 13-14 per cent, and finally increased to slightly more than 19 per cent in 1982. The total investment made has exhibited a fluctuating behaviour till around 1976. Since then the overall trend has been towards an increase in the investment with occasional dips.

3.0 Indo-FRG Technical Cooperation

From Table 2 it appears that the Federal Republic of Germany has played an important role as a supplier of technology to India. An all time high in the number of new sanctions for foreign collaborations was reached in 1983. A total of 129 agreements were approved by the Government of India. Notwithstanding the various modes of collaboration

Foreign Collaboration Approvals

Year	Number of Agreements
1984-85	284
1956	82
1957	81
1958	103
1959	150
1960	380
1961	403
1962	298
1963	298
2964	403
1964	241

Source: Foreign Collaboration in Indian Industry: Survey Report 1965 (Reserve Bank of India)

Table 4

Industry-wise distribution of
Foreign Collaboration Agreements.

Industry	Number of approved Agreements (as of 1.1.1982)	
		Percentage
Machine-making industries, (incl. agricultural machinery and metallurgical equipment)	2642	39.4
Electrical industries (incl. telecommunications)	1236	18.4
Chemicals, Pharmaceuticals and allied industries	1034	15.4
Transport equipment (incl. material handling and construction equipment)	576	8.5
Others (eg. Cement, Fuel and Food Industries)	1214	18.1
Total	6702	

Table 5

Nature of Indo-Foreign Collaboration Agreements

Year	Total (a)	Joint Ventures (b)	Percentage of Joint Ventures $\frac{(b)}{(a)} \times 100$	Investment (Rs. Million)
1968	132	30	22.72	60.2
1969	135	29	21.48	3636.2
1970	183	32	17.48	24.6
1971	245	46	18.77	58.4
1972	256	35	13.67	62.3
1973	265	34	12.83	28.2
1974	359	55	15.32	67.0
1975	271	40	14.76	32.0
1976	281	39	13.87	9.8
1977	267	27	10.11	30.0
1978	307	44	14.33	94.0
1979	267	32	11.98	56.4
1980	526	73	13.87	96.3
1981	389	57	14.65	108.7
1982	591	114	19.28	628.1
1983	673	129	19.16	618.7

Source: Adapted from several issues of Indo-German Economic Cooperation Annual Reports.

available to Indian firms three forms have been basically in use. According to the Indo-German Chamber of Commerce licence agreements continue to account for the largest share of Indo-German industrial collaboration agreements. This is in line with the overall trend in Indo-foreign collaboration which is in keeping with the declared policy of the Government of India towards foreign collaboration. Of late, outright purchase of know-how through import of designs and drawings has been gaining importance. There has also been a relative increase in the number of joint ventures approved during the year 1983.

On a comparative basis, the Federal Republic of Germany occupied the third place in terms of the cumulative number of collaboration agreements signed with Indian firms till 1983. The U.K. occupied the first position with the U.S. in the second position. Table 6 provides information on country-wise share in foreign collaboration agreements since 1965. During the period 1957-63 the U.K. had the largest share with 28.5 per cent of the collaboration, the U.S.A. second place with 17.0 per cent and FRG with 14.4 per cent. However, there was a gradual erosion of the position of the top shareholder during the next two decades. Over the period 1957-83, the share of UK went down to 22.3 per cent, that of the USA went up to 19.6 and that of the FRG increased substantially by about 3.6 per cent to 18.0 per cent. Japan's share increased slightly but that of Switzerland, France and Italy substantially in relative terms.

Table 6
Country-wise Share in For

Country	1957/ 63	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
UK	28.5	24.8	21.8	27.5	14.5	25.2	21.3	22.4	14.8	20.0	16.4	19.9	19.2	22.1	19.9	23.6	20.9	20.3	13.1	17.2
U.S.A.	17.0	19.8	20.9	18.7	27.5	13.3	10.0	17.6	24.1	13.1	22.0	20.3	24.6	23.2	19.2	17.9	23.8	21.9	10.6	20.1
F.R.G.	14.4	10.2	20.3	13.2	16.8	20.7	19.7	17.1	19.1	22.6	19.8	21.8	21.4	20.6	10.9	20.6	19.0	19.0	18.6	19.2
Japan	8.1	10.7	8.9	11.5	9.2	12.6	8.2	14.3	10.5	14.3	7.8	8.5	3.6	7.5	9.1	4.5	6.5	6.9	8.6	8.6
Switzerland	4.3	7.4	4.9	3.3	4.6	5.2	7.1	5.7	5.8	3.8	9.2	9.9	7.8	8.6	5.9	5.2	7.2	6.7	6.9	7.0
France	3.4	4.9	5.4	4.9	6.1	5.2	3.8	6.1	5.4	4.9	6.1	4.8	6.0	5.2	6.8	6.0	4.6	5.9	4.7	5.9
Italy	2.9	2.9	1.5	4.4	2.3	2.2	4.4	2.0	3.1	1.9	4.5	3.7	2.8	3.7	4.2	1.9	4.8	4.6	6.3	4.5

Source: Prepared by the author from data provided in Annual Reports of Indo-German Chamber of Commerce.

The nature of foreign collaboration agreements signed between Indian and West German firms is seen from Table 7.

Table 7

Nature of Indo-German Collaboration Agreements 1960-1983

Year	Total Nos.	Financial-cum-Technical Nos.	%
1960	58	16	27.6
1961	67	26	23.9
1962	42	21	50.0
1963	48	20	41.7
1964	68	16	23.5
1965	44	13	29.5
1966	41	17	41.5
1967	24	5	20.8
1968	22	4	18.2
1970	36	10	27.8
1971	40	7	17.5
1972	50	5	10.0
1973	60	7	11.7
1974	71	10	14.1
1975	59	11	18.6
1976	60	8	13.3
1977	55	5	9.1
1978	58	8	13.8
1979	55	5	9.1
1980	100	10	10.0
1981	74	14	18.9
1982	110	19	17.3
1983	129	22	17.1

Source: Prepared by the author from data from Directory of Foreign Collaborations and Annual Reports of the Indo-German Chamber of Commerce.

It is evident that pure technical collaboration is the most preferred mode of industrial cooperation between India and West German firms. This is in accordance with the general trend in Indo-foreign collaborations. However, there has been a considerable degree of fluctuation in the relative emphasis on financial-cum-technical collaboration and the pure technical route which may be traced to the emphasis of government's policy in a particular year which has been described in a previous section. The highest percentage (50) of financial-cum-technical agreements was reached in 1962 which dropped to the lowest point (9.1) in 1977. However signs of closer links became visible from the beginning of the current decade. According to the Indo-West German Chamber of Commerce India's image amongst West German industrialists began to improve and the number of delegations and individual businessmen visiting India started increasing. In 1980 West German private investment in India rose by 7.4% after years of stagnation. This increased interest of West German firms in India could be traced to the changes in India's foreign collaboration policy by way of extension of the duration of technical agreements, clarification of the basis for royalty and lumpsum payments, and permission to either of the parties to bear tax liability on lumpsum payments indicated a further liberalisation in the approach to industrial cooperation, which has been dealt with in detail in a previous section.

During the period 1974 to 1983 the industrial machinery sector continued to be the most favoured among the various industries in which new Indo-German collaboration agreements were signed. It was followed by electrical machinery and equipment. Among the existing collaborations the highest percentage was accounted for by industrial machinery (56% in 1983) followed by chemicals and pharmaceuticals (about 11%). The machinery and electric and electronic products sectors of the company had the largest and second largest share in the joint ventures signed between Indian and West German firms on a cumulative basis between 1949 and 1983. The next two were the automobiles and chemicals and pharmaceuticals sectors. This is evident from Table 8.

Table 8

Indo-German Joint Ventures 1949-1983
(Industrywise)

Machinery	33.6%
Electric and Electronic Products	12.1%
Chemicals and Pharmaceuticals	10.7%
Automobiles	11.4%
Machine tools, small tools and instruments	10.1%
Consultation and engineering services	4.7%
Metal Products	3.4%
Others	14.1%

Source: Annual Report of Indo- German Chamber
of Commerce.

Framework of International Industrial Cooperation

The framework within which industrial cooperation takes place is determined by a host of factors; interests of foreign and national partners; interests of their governments; existing laws, treaties, regulations, codes of practice; and basic conditions, which include market potential, stability of markets, labour market, etc. The primary objective of national as well as foreign collaborators is to manufacture products for markets on a continuing basis. The foreign collaborator demands adequate compensation for the service it provides which may include goods, technology and funds. It may also like to retain managerial control if it is to be held responsible for the quality of products, especially if the products are to be sold under its brand name. It may require permission of the host country to transfer expatriate managers and technical specialists.

The host company or national partner would demand a fair return for its own contribution. Governments have a considerable impact on the nature of the cooperation between the two partners through laws and administrative measures as we have seen earlier.

Figure 1 shows diagrammatically the major stakeholders and factors that may influence the process of technology transfer across international borders.

The success or failure of any collaboration therefore is influenced by a very large number of variables. The

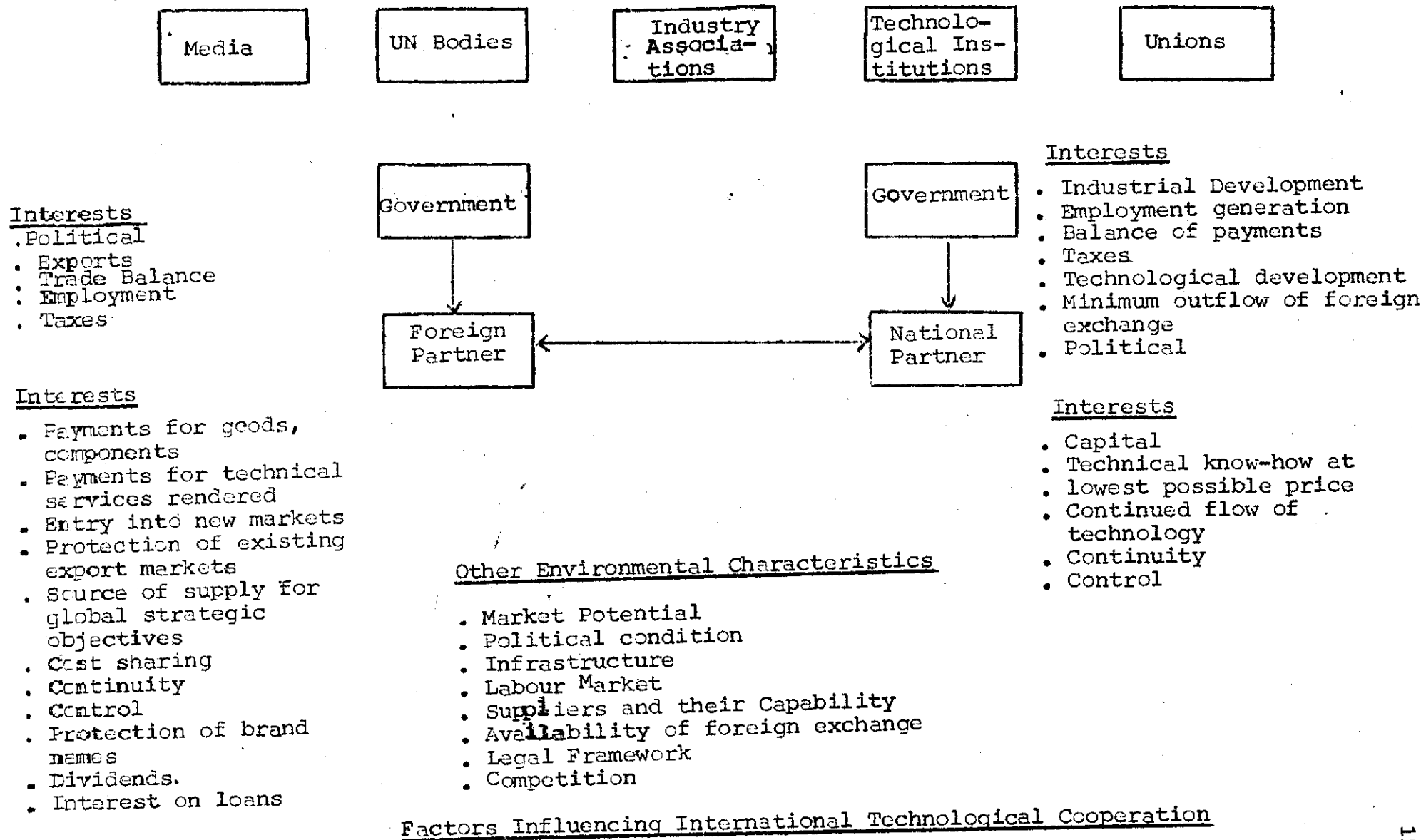


Figure 1

The success or failure of any collaboration therefore is influenced by a very large number of variables. The terms success or failure also are relative, what may be a success from the point of view of the enterprise may be a failure from the point of view of the Government. From the point of view of the host company success in the ultimate analysis would be judged by whether it is able to use the acquired technology to produce the products of the desired quality at a high level of capacity utilisation. Certain firms may be satisfied with only minor adaptations to the acquired technology necessitated by the need to scale down the size or to use indigenous raw materials, etc. However, there could be firms which may not be satisfied with only assimilating the acquired technology but may wish to gradually start product and process improvements and new product development. These differences may be traced to preferences, goals and strategies of the managements of the individual firms. Ultimately, whatever strategies firms may adopt they would also need to be viable from the financial point of view.

From the point of view of the host country the interests would be the contribution to industrial developments, employment foreign exchange, taxes, and technological developments, etc.

Other institutions like technological institutions, UN bodies, media, industry associations, unions, etc., may

also play an important role. Transfer of technology can take place only when certain basic conditions are satisfied; these have been termed as "other environmental characteristics" in Figure 1.

5.0 Prospects for Indo-FRG Technical Cooperation

The factors that may influence the prospects for technological cooperation between India and the Federal Republic of Germany have been depicted in the previous section. Government of India's policies were identified as a very important determinant of technology transfer from FRG to India. In this section some aspects of Government policy which are likely to have long term impact on the transfer of technology from FRG to India are described. However, before we discuss that it may be useful to review a recent survey of German firms' attitude towards industrial co-operation. This study¹ was based on responses from a total of 3,153 firms. Out of these 670 either had or planned a foreign involvement other than by exports. Most of these 670 firms (481) were engaged in industrialized countries and 289 were involved in developing countries. The industries which were strong on foreign involvement were road transport equipment; aerospace industry; electro-technical industry; mechanical engineering; steel and light metal structures; railway equipment; precision instruments and optics. Within the consumer goods industries only China, ceramics and glass industries had as high an intensity of foreign involvement. The survey also revealed that foreign co-operation activities increased with the size

of the technology transferring firm. There seemed to be a rising preference for more flexible instruments of collaboration like minority participation. This it seemed was on the one hand due to the felt need for increasing internationalization of production and on the other hand the perceived risk of those new markets and also scarce corporate resources limiting world-wide expansion through wholly or majority owned subsidiaries. The preference for non-equity cooperation was relatively strong with small and to some less extent with medium sized firms, but not dominant with big firms.

The same survey states the following in regard to German firms' attitude towards the Government of India's foreign collaboration policy:

"The business community in Germany ... has never been enthusiastic on selective and restrictive foreign investment policies. This becomes evident in numerous publications of business and industry associations complaining about state intervention, complicated regulations and other red-tape."

"The same applies to export restrictions, another controversial point in the assessment of restrictive practices from the stand point of firms in industrialized and developing countries. While exports to some neighbouring countries are generally tolerated, German firms, like

those of other OECD countries, try to limit the export of goods produced using the know-how made available by them...".

"Additional difficulties arise in agreeing on the price for technology and on which services on the part of the supplier are covered by the regular license fee and a lump-sum payment usually made on conclusion of the agreement or on transmission of the documents, and which are to be charged for separately. To the extent that the scope of the services required can be estimated in advance while negotiating the co-operation there is no real problem; but in most cases the difficulties involved in taking over the manufacturing process are underestimated by the licensee and this leads to their wanting additional services from the German partner. The conflict tends to arise because the Indian firm frequently takes the view that these services which are necessary for the **success** of the project come under the licensing firm's service obligations and have thus already been paid for in the license fee. The technology supplier on the other hand regards them as additional services which should accordingly command additional payment. In addition on this problem of arranging the different services, difficulties also arise for German firms when the Indian partner accepts his obligation to pay for additional services, but payment is not authorised by the authorities. The reason is that the responsible authorities see additional services and payment for them

as an attempt to bypass limits on the value of license fees once the agreement approved."

From the above it seems there are number of factors which are probably limiting the possibilities of Indo-FRG technical cooperation. However, it needs to be noted that the attitudes of German firms is undergoing change for the better. This is evidenced by the recent increase in the number of collaborations signed as well as by the spurt in West German investment in India. This has been caused by recent liberalisations in the Government of India's policies as well as an increased effort made by various organizations to clarify current policy orientations; and various promotional measures adopted to aid the process of developing closer industrial cooperation.

Starting from 1980 the Government of India has made conscious efforts to attract foreign technology by liberalising many of its policies towards foreign collaboration.

Some liberalisation was announced during the year 1980. They are as follows:

1. The restriction of 5 per cent on royalties payable on technology imports was no longer applicable to export sales. No limit was specified regarding the percentage applicable. However, the ceiling of 5% was applicable to domestic sales.

2. The government also announced that it would consider technology imports against lumpsum payment more liberally no matter whether the production was meant for exports or for the domestic market.

In 1981, certain changes were implemented in India's foreign collaboration policy. The policy announced by the government favoured technology transfers where no foreign equity participation was involved. Outright purchase of know-how was preferred to licence agreements. Joint ventures were to be sanctioned only in cases where sophisticated technology was involved, or the goods manufactured were intended for export, or if the industry fell within the priority sector. As in 1975, there were 22 industries where no foreign equity participation was involved. Outright purchase of know-how was preferred to licence agreements. Joint ventures were to be sanctioned only in cases where sophisticated technology was involved, or the goods manufactured were intended for export, or if the industry fell within the priority sector. As in 1975, there were 22 industries where no foreign equity participation was permitted though technical collaboration was allowed in certain cases given below.

- 1) Existing technology in India is not available to all firms owing to the existence of competitive conditions.

- ii) outdated technology has to be replaced in order to be able to cover domestic demand or to improve the competitive position of Indian goods on world markets.
- iii) foreign technology is required for the production of highly export oriented goods where export is guaranteed by buy-back arrangements.

Some minor liberalisation was announced during the next year. The policy announced by the government stressed that the total remuneration comprising of the lumpsum fees and/or royalty payments was not to exceed 8% of the total sales value of the output during the period of the collaboration agreement. Firms seeking only import of designs and drawings, as distinct from a regular licence agreement, could import the same once a year under a simpler procedure, subject to a value of Rs.10 lakhs. The lump sum fees to foreign collaborators could be given without any tax deduction at source, if the Indian party was ready to bear the tax liability. The duration of an agreement could be upto 10 years inclusive of the preparatory period before going into production. Though the declared policy on foreign collaboration remained more or less the same, the administration of the policy was more favourably disposed towards collaborations.

During the next three years the main pillars of the government's foreign collaboration policy were the Foreign

Exchange Regulation Act (FERA) of 1973, the Industrial Policy (1980), the Drug Policy on the basis of the Hathi Committee Report (1978) and several press notes released by the government from time to time. Though no major changes were announced during the period 1981-84 the policy became more pragmatic, especially with regard to companies which were neither under the purview of FERA or MRTP.

During the year 1985, however, the new government under the stewardship of Prime Minister Rajiv Gandhi announced a number of policy changes. The decisions are aimed at achieving improved efficiency in public sector production; and providing a more congenial climate for the private sector by offering greater opportunities for modernisation of equipments, diversification of the product range and expansion of scale of production. In the case of the public sector plan outlays of the individual companies are being rationed in such a manner that projects in the pipeline are realised first before new projects are floated. Regarding the private sector concessions allowed by the Union Budget on corporate direct taxes, the raised minimum investment level for registration under the Monopoly and Restrictive Trade Practices Act, the new textile policy, the broadening of the definition of capacity for industrial licensing purposes and the speedier clearance of foreign collaboration agreements are all steps in consonance with the objectives stated above. Substantial liberalisation has also been effected in the

existing regulations on import of technology of complete projects, of computer systems and of spare parts of all electronic goods including computers.

During the last 3 decades or so after independence the majority of foreign collaborations were for acquiring technical know-how for manufacturing products which were hitherto being imported. However, this is likely to change in the near future. Technology would need to be imported for producing products which would be new to this environment. With the current accent on modernization and liberalisation of Government of India's industrial policies to generate competition firms will have to select technologies and technology suppliers very carefully. The problem of technology assimilation is likely to be very acute in high technology areas. The mode of collaboration might have to be tailored to individual companies' needs depending upon organizational capabilities, technological infrastructure in the country, overall goals and strategies, type of technology being acquired, etc.

6.0 Issues for Research

The Association of Indian Engineering Industry considers 1985 as a watershed. According to it, "In the recent changes in Government Policy, one sees a clear shift in direction which gives hope that industry is at the threshold of momentous change. Industry perceives an environment which essentially free, supported by a policy framework which would help to

rapidly widen the production base; a renewed emphasis on productivity to improve competitiveness; a technology bias with greater concern for quality and a recognition to give the consumer value for money."²

A number of areas have been identified as growth areas. These are electronics, informatics, communications including fibre optics, bio-technology, aerospace industry, energy including renewables, oil and gas, afforestation, raw materials, medical equipment, laser technology, voice and data transmission systems; photovoltaics; and membrane (filtration) technologies. Most of these technologies are science-based and hence are going to experience rapid rates of change. Corporate managements need to recognize that these new technologies will demand new skills, new organizational structures; new motivational and control systems, new decision-making systems and much quicker responses. Policy makers at the national level need to recognize that it might require changes in various policies to motivate firms possessing the new technologies mentioned above to transfer them to Indian companies. It may be necessary to explore the possibilities of attracting foreign capital along with technology as a **rapid** rate of economic growth of the nation would require a larger quantum of funds. Newer forms of collaboration might be required to launch India on a different level of industrialization.

However in recent times there has been a concern with the technological backwardness of many sectors of Indian industry. Most products produced in India were based on designs imported in the 1950's and 1960's, but by the mid-1970s wide gaps in costs and quality had developed between the Indian products and similar products manufactured in the advanced industrialised countries. There has also been a concern with the slow rate of growth in productivity in Indian industries. It seemed that the efforts of Indian manufacturers had focused on adaptations and modifications for local conditions and the originally imported manufacturing technology had not been updated. It seemed that the capacity necessary to maintain ongoing technological improvement at a sufficient pace had not been built. One reason advanced for this state of affairs is technical collaboration acts as an obstacle to the process of indigenous technological development. Unwillingness of the technology supplier has been considered a major factor responsible for the limited flow of technology.

The above discussion raises a number of issues which may be explored through systematic research:

1. To what extent have Indo-FRG foreign collaboration agreements contributed to the development of technological capability of the Indian firms involved and what are the possible reasons for the same?
2. Is there a variation in the development of technological capability of Indian firms across industries, or regions and if so why?
3. What effects would the introduction of new technologies have on Indian firms?
 - a) Productivity, Workforce, skill levels, wage levels and industrial climate.
 - b) Organizational structure and systems, decision-making processes and organizational culture.

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