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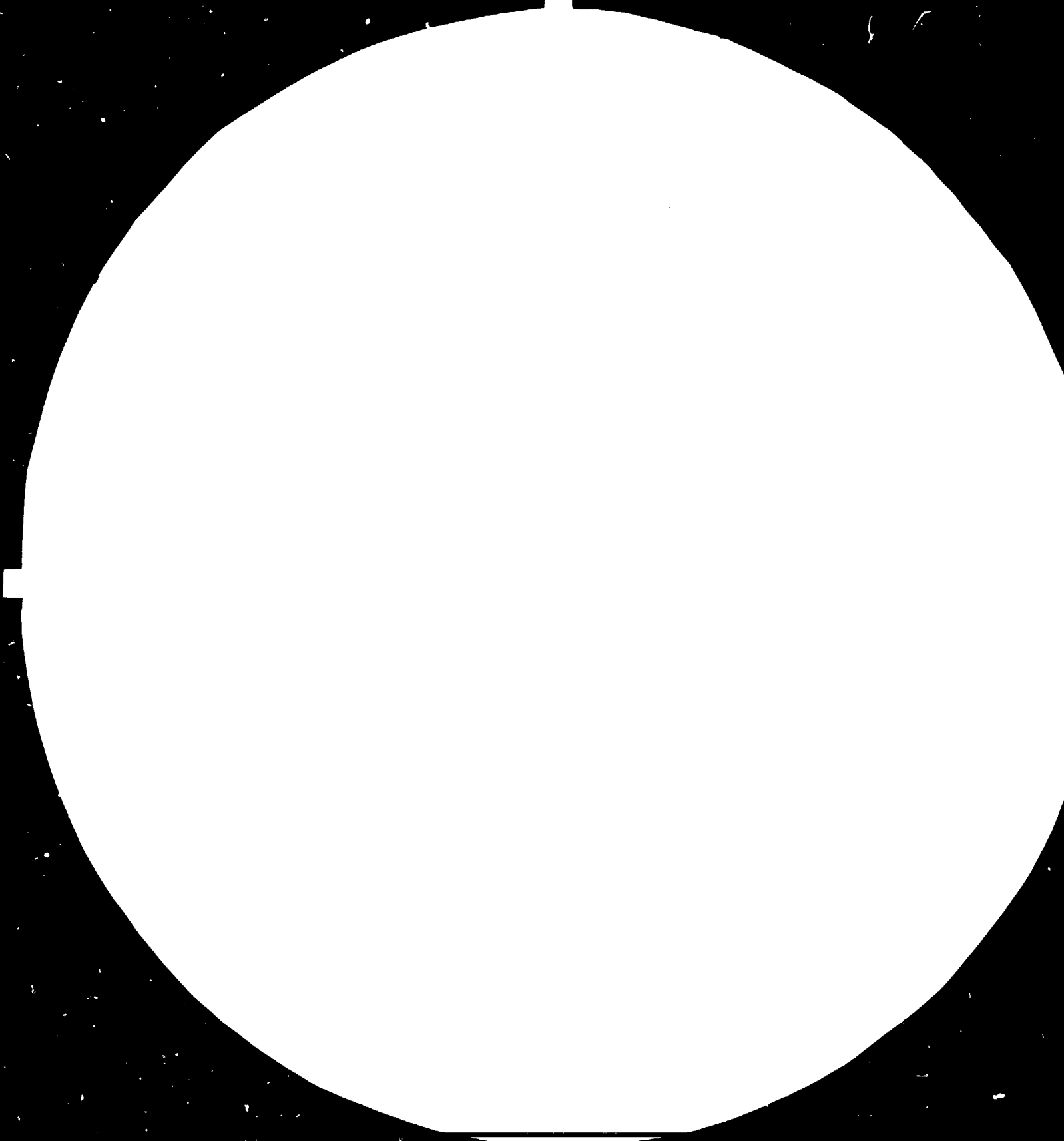

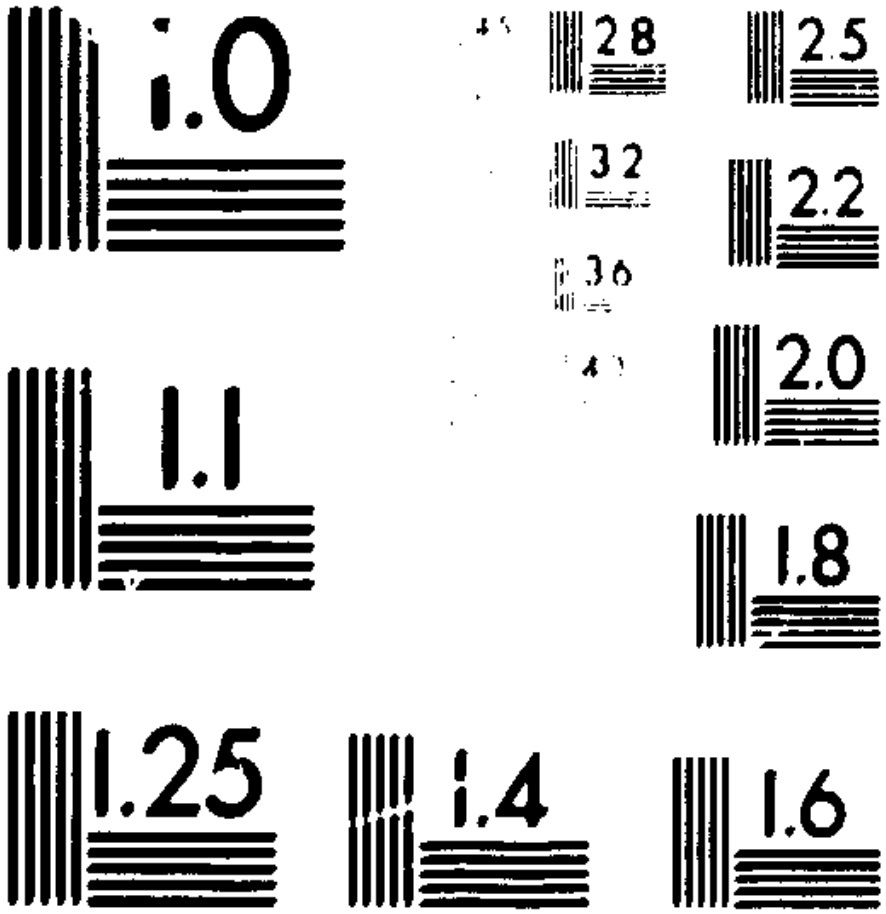

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TECHNOLOGY EXTRACTED FROM [illegible] INTERNAL

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CONTENTS

PREFACE

The present report attempts to summarize in a condensed form the principal findings of a four-year UNIDO research project on the development of technology exports from developing countries. The project was originally initiated by a brief desk study performed by the UNIDO secretariat and followed subsequently by field surveys in five selected countries: Argentina, Portugal, Egypt, Yugoslavia and Pakistan. The countries were selected on the basis of information generated during the course of the desk study in view of the evidence of their technology export activity. The countries differ substantially in terms of their development level: if measured by GNP per capita, we have the following picture for 1980: Yugoslavia - $ 2.630, Argentina - $ 2.490, Portugal - $ 2.350, Egypt - $ 580 and Pakistan - $ 300 pusured industrial policies, record of industrial development, political setting as well as in terms of their economic systems. Thus they provide a rich base for observation and cross-comparison. Principal instruments of the field surveys carried out at the enterprise level were specially prepared questionnaires addressed to actual and potential exporting organizations as well as direct interviews by UNIDO consultants. Despite a homogenous, standard methodology of research, the results obtained proved however to differ substantially depending on the peculiar characteristics of the country, available central statistical sources, extent of the assistance provided by administrative authorities, etc. As a result cross-country comparisons were not always possible and in many cases we could only use fragmentary observations.

An additional, albeit, very important source of information were the preliminary results of the research project on technology exports from developing countries undertaken by the World Bank. This project concentrated on the identification and evaluation of the export performance of India, Brazil and Mexico with supplementary observations with regard to the Republic of South Korea and Taiwan. Last but not least available published materials from various other sources were utilized.

The report starts with a presentation of a broad map of technology exports from developing countries with an implicit hypothesis that the recorded figures presumably represent only a fraction of the real phenomenon in question. First, exports of disembodied technology are discussed, followed by turnkey plant deliveries and direct foreign investments. Afterwards a bird's eye view, industry-wise, and country-wise of the structure of the phenomenon is presented.

The second chapter goes into the description of selected qualitative elements of the picture. It commences with a discussion on the nature of exported technology, in an attempt to verify some basic hypotheses spelled out in the available literature. It is followed by an analysis of exporting and importing organizations from three different points of view - ownership, size and the degree of foreign penetration. Finally, a discussion on motivations to export technology and the nature of comparative advantages enjoyed by developing country exporters is presented.

The third chapter intends to evaluate the significance and implications of the rise of technology exports from developing countries. First, a relationship between technology export and technology development is analysed. It is followed by a discussion on implications for technology receivers and some observations with regard to international consequences of the phenomenon.

Finally, a brief review of some concluding remarks and recommendations both for policy actions and research activity is provided.

The report is supplemented by some background statistics on technology outflows from developing countries.

1. Introduction

Despite voluminous literature on technology, technical change, technology transfer and the like, there are no universally accepted definitions of the aforementioned terms. Therefore, before going into the subsequent analysis we have to clarify basic notions used throughout the present report.

While defining technology some authors concentrate on its material aspects (1), (2), whereas some others underline its informative nature (3). Some authors attribute technology to scientific advances, defining it as an application of scientific advances and as an application of scientific knowledge to the process of production, (4) while others advocate the idea that technology is generated both by scientific effort as well as practical experience (5).

In the present report technology is defined as the set of properly ordered information pertaining to the knowledge on how to change the existing reality, be it in industry, agriculture, mining or services. This knowledge may be both a result of a conscious scientific effort as well as simple practical experience gained by means of executing some tasks or performing some functions. As a matter of fact, there is evidence that science was able to explain some technical knowledge only many years after its extensive utilization. Even today we still lack proper theoretical foundations for some basic phenomena - which does not preclude us from their practical utilization. thus a practical component of technology should not be underestimated. This seems to be particularly relevant in the case of developing economies.

Thus as it transpires that we favour an informative definition of technology as opposed to its material interpretation. Products, machines and processes are only the physical carriers and/or the results of its application. The sheer transfer of machines from one entity to another does not automatically result in technology transfer as the borrower of technology has to know how to use it, that is, he must obtain the relevant information. The informative nature of technology is well proven by recent developments in transnational computerized communication systems, giving rise among others to transborder flows of technical data (6). It is estimated that at present there are over 1,000 transnational computerized communication systems in the world. The importance of these systems for the operation of the companies was recently illustrated by the introduction of US sanctions against Soviet gas pipeline deliveries. One of the first US corporations which was affected was Dresser's French subsidiary. As Business Week pointed out, "all Dresser had to do to comply with Reagan's enbargo was to change the entry key to a computer in Pittsburgh on 26 August 1982, the day the sanctions took effect.

That effectively barred Dresser's French subsidiary from access to the technology it needs to complete orders it has on the books and to compete for new ones. Without access to Dresser's computerized data bank, Dresser France's engineers lack vital information to build the made-to-order compressors that account for about three quarters of the company's business. Without that computer, the only thing we can do is duplicate compressors we have already made, says a Dresser France systems engineer" (7).

Technology may be handed over by a broad variety of forms. However, there are only three carriers of it. These are:

people;
products, specially capital goods; and
pure inform tion, data, designs, descriptions, etc.

In practice, in any technological deal, these three carriers are present, though in different proportions, depending on the nature of the technology, the nature of the actors involved, the type of the contractual arrangement, etc.

Due to the informative nature of technology its movements both within the countries and across the countries are difficult to detect and measure statistically. As a way out of this situation some proxies are used. the common solution is the simple enumeration of the operations that are to represent technology flows. Being fully aware of the limitations of the method this approach has been used throughout the present report. Thus technology export was defined as totality of transactions among the countries which cover turnkey plant construction, direct overseas investment, engineering and management consultancy, licensing of patented and non-patented know-how as well as provision of other technical services.

2. Technology export from developing countries - a bird's eye view

Mapping out of technology exports from developing countries is an extremely difficult task for any researcher, as there are hardly any systematic statistics available. Hence we are forced to use various scattered data, collected under different methodological assumptions and at different

moments. This of course determines their validity particularly if cross-country comparisons come into question. Nevertheless, such as they are, collected facts and figures contribute substantially to our understanding of the phenomena.

2.1 Exports of disembodied technology

Disembodied technology is a broad notion comprising consultancy and engineering services, licences, know-how and related technical services. Its main feature is the fact that it is based to a large extent on the performance of highly qualified manpower and/or on original technical inventions.

Available data suggest that current export of disembodied technology from developing countries has reached in some cases quite impressive values. This is true particularly with regard to Brazil, Republic of Korea and India. Mexico too is noting substantial successes in this respect (8).

In some countries receipts from this export are covering quite an important part of payments resulting from disembodied technology imports.

In all the countries for which relevant data are available the bulk opf disembodied technology exports took place in the form of consultancy and engineering services and technical assistance agreements. consulting and engineering services comprise a variety of activities starting with preinvestment services such as surveys, prefeasibility and feasibility studies, right through to project execution and up to services for operation and maintenance.

As a rule, provisions of these services require with the exception of preinvestment feasibility, extensive practical on-the-job experience as well as highly specialized knowledge (10). It should be underlined that in developing countries consulting and engineering services are required most often by public sector users whereas private industry plays a secondary role.

The international market for consulting engineering has grown dynamically in the last few years. It is estimated that total billings for exports by the top 200 world consulting engineering firms reached $ 3,7 billion in 1982.

TABLE I

Consulting and engineering services at different stages of a project

	Type of services	Stage of project
1.	Preinvestment services	Prefeasibility studies/surveys, identification, evaluation, project feasibility study
2.	Project execution services	Project engineering/engineering survey, detailed engineering, organization and management, information systems, project implementation/procurement, construction, supervision/commissioning and start-up including personnel training
3.	Services for operation and maintenance	Production and maintenance/trouble shooting, repair

Source: A. Araoz - Consulting and engineering design organizations in developing countries, in: A. Araoz, Consulting and engineering design in developing countries, IDRC, Ottawa, 1981, p. 10.

Approximately 86 per cent of world international demand comes from the developing world whereas firms from developing countries cover only about 5 per cent of the supply.

TABLE 2

Foreign billings of largest international consulting firms [a]

Year	Total million $	Firms from developed countries [b]	Firms from developing countries [b]	Market share of developing countries
1979	1700	1630	70	4,1
1980	2600	2440	140	5,4
1981	3100	2935	165	5,3
1982	3700	3521	179	5,0

(a) Data for 1979 - 81 concerns billings of the top 150 firms, for 1982 - of the top 200 firms.

(b) Estimated

Source: UNCTAD TD/B/RBP/13, 27 September 1983, p. 3.

The major export market is the Middle East representing over 35 per cent of total world demand, followed by Africa (23-24 per cent) and Asia (ca. 20 per cent).

It is interesting to note that among the world's largest 200 consulting firms there were fifteen from developing countries, of which three were from Brazil, Lebanon and the Republic of Korea, two from Taiwan and India and one from Pakistan and Malta (11).

Consulting engineering in its broad sense includes construction and project management. These services require as a rule much less technological sophistication from the supplying companies but are more affected by financial and cost determinants. On the other hand, they tend to generate substantially higher payments than consulting engineering or licensing.

Export billings from contractors in the last few years have amounted to over $ 100 billion annually, reaching the level of around $ 123 billing in 1982. Around 80 per cent of the international demand stems from the developing world, whereas approximately only 16 per cent of the supply is delivered by firms coming from these countries (13). The 250 top world contractors in 1982 included 68 firms from developing countries, of which 30 were from the Republic of Korea, 10 from Yugoslavia, 4 each from India and the Philippines.

It should be underlined that in recent years contractors from developing countries have recorded some improvement of their international position and were able to displace some of the well-known firms from developed countries. This shift, however, was mostly confined to low-technology areas i.e. civil works, erection and to smaller, primarily fragmentary, ventures.

Consulting and engineering services are also closely related to technical assistance agreements which, in principle, encompass some of the activities covered by the former operation and maintenance with the difference in the source of technology supply. In the first instance these are specialized consulting and engineering companies whereas in the second one they are manufacturing entities.

Apart from consultancy and engineering services disembodied technology export comprises transactions related both to proprietary, patented, and non-proprietary, know-how and technological deals. Available data suggest that by and large developing countries remain a marginal supplier of licences. Portugal for example in 1974-1979 commercialized only six licences abroad; Pakistan only 3 licences, based on one technological solution, in 1974 - 1982. In some countries, however, exports of licences started to generate a meaningful income. Thus for example, Korean annual receipts from licences sold abroad are over $ 40 million.

The very existence of these transactions requires special attention as it is widely believed this kind of export is limited only to industrialized states. The reality however as we can see is not as simple as that.

2.2. Exports of embodied technology

Exports of embodied technology require the possession of a capital goods industry. At the initial stage of this industry exports take place primarily in the form of individual machinery and equipment. Thereafter it may be supplemented by the delivery of turnkey plants. It grew from about $ 1 billion in 1970 to well over $ 9.3 billion in 1978, however its share in world trade is still minor and increased from 1 per cent in 1970 to 2,5 per cent in 1978 (14). In value terms the exports of embodied technology is still very low.

A particularly interesting way of embodied technology export is the delivery of turnkey plants.

Export of turnkey plants cover a broad array of activities, including:

- preparation of relevant documentation;
- supply of relevant machinery, equipment, tools, etc.;
- assembling of machinery and equipment;
- erection of plant;
- start up of plant;
- supervision of plant operation in its initial stage.

Apart from the manufacturing unit supplying the plants at least three complementary agents of the turnkey deliveries are essential:

1. Consulting engineering companies;
2. International trading companies;
3. Financing and insurance groups capable of supplying credit facilities and providing relevant guarantees (15).

Consulting and engineering companies provide the services related to feasibility studies, detailed engineering, procurement of certain kinds of machinery and equipment, etc. Their presence in the deal is practically unavoidable if the turnkey seller is a medium or small sized corporation. In large companies these functions might be performed by specialized departments.

International trading companies, on the other hand, provide necessary services in marketing, transportation and legal arrangements as well as serving frequently as the initiators of the transactions, bringing potential

customers together (16). Again their presence is particularly essential in the case of smaller companies. According to data quoted by P. O'Brien, internatinal trading companies accounted for over 80 per cent of turnkey exports at the end of the 1970's (17).

The role of financing and insurance groups need not be discussed at length as it is well known that turnkey business requires proper credit facilities for the buyer as well as adequate risk coverage in the case of a seller. Participation in international tenders must be supported by letters of credit, and signing of the contract requires further credit guarantee.

However, it should be stressed that financial facilities attached to the projects often have a determining role in selecting the suppliers. In a recent study by UNCTAD, it was noted that in many instances developing countries with enough managerial and technical capability for becoming major suppliers of goods and services for some projects were not in a position to offer loans and other financial facilities to match the advantages offered by companies and governments from developed countries (18).

An additional and highly important aspect of the situation is the fact that the international banking community is by and large based in the leading developed countries, meaning that decisions to finance export projects are made in the light of the national interest of the bank's home country and are influenced by actual national regulations. As UNCTAD's study points out ... "several growing exporters from developing countries have been recently denied export project financing coverage by some international banks which were backing bidders from their country of origin". (19).

The rise of turnkey plants exports requires not only an attainment of certain level of technological capability on the part of the supplier but also an attainment of a certain level of manufacturing capability in investment goods. The demand for turnkey deliveries has been boosted over the last 10 -15 years as an effect of the forced industrialization drives of many developing countries without a domestic capital goods base, and particularly by voluminous industrialization programmes of the Middle-East oil exporting countries.

Available data suggest that some of the developing countries have become important sources of turnkey plant supply, particularly if we broaden this category to include turnkey projects covering all sorts of infrastructural and civil engineering projects. The cumulative total value of turnkey projects exported from India was estimated at around US$ 1.1 billion as of 1979; that of Argentina for 1973-1977 at over US$ 340 millions; that of Republic of Korea for 1973-1977, both completed and in hand, for nearly US$ 390 millions and that of Taiwan for 1976 alone of over US$ 16 millions (20).

In some countries turnkey contracts represent a major form of the overall technology export. This is the case with regard to India. Industrial turnkey project exports were three times as large as earnings from consultancy services from Brazil, Argentina and the Republic of Korea. A different picture is offered by Pakistan where only recently (1982) two small industrial plants were exported. The same holds for Portugal which companies seem rather reluctant to enter this field of activity.

2.3. Direct foreign investment (DFI)

Direct foreign investments (DFI) do not represent technology transfer occurring between the investing and the host country; however, it is well proved by now that in case of industrial DFI the technology factor is usually behind the deals. Of course this does not necessarily mean that this is so in all cases and there is some evidence that in several instances DFI was undertaken in order to obtain access to technologies available in the host countries. The most spectacular example is Japanese investment in the US computer industry. This observation may be of particular relevance to DFI in other developing countries. However, the initial assumption probably holds its validity.

If we look at the global developments in this field the first striking observation is that in the past 10-15 years, we have witnessed an accelerated development of the developing countries based multinational companies (MDC's). The real dimension of the phenomenon is difficult to assess as aggregate statistics on DFI on a world-wide basis are "incomplete, inaccurate, non comparable and biased usually downwards" (21). Therefore all conclusions based on the aggregate data must be taken as highly tentative.

What is characteristic however for DFI undertaken by developing countries is their relatively small size both in absolute terms as well as in comparison to DFI by multinational companies based in industrialized countries (MNC's) (22). It is argued however, that despite its small size and relatively small share in the overall stock of DFI in developing countries, DFI by MDC's are particularly important due to different types of technology which they offer as well as different conditions and means of transfer which they use in comparison to that associated with MNC's (23).

In recent years however the size of DFI by MDC's must have increased substantially which seems to be proved by the fact that out of the 483 largest multinational industrial corporations in 1977, 21 were based on developing countries, and if Spain is included this will make 27 (5.6 per cent) as compared to 6 (1,2 per cent) in 1967.

TABLE 3

Distribution of the 483 largest industrial corporations and their sales by country of origin

	1967		1977	
	Number of Firms	Sales $ US Millions	Number of Firms	Sales $ US Millions
United States	283	314668	240	924364
Western Europe excl. Spain	136	117004	135	503426
Other developed market economies	58	35961	81	196384
Developing countries incl. Spain	6	2654	27	80760
Argentina	2	702	-	-
Brazil	1	507	1	8284
India	1	277	2	3763
Mexico	1	799	1	3394
Netherlands Antilles	1	369	2	3416
Republic of Korea	-	-	4	6981
Spain	-	-	6	8307
Turkey	-	-	3	5487
Other	-	-	8	40628

Source: J.H. Dunning, R.F. Pearce, The World's Largest Industrial Enterprises, Gower, Farnborough, 1981 tables 3.1 and 3.2.

TABLE 4

Direct foreign investment within Latin America /Thousands of dollars/

Destination / Origin	Registered									Approved		
	Argentina /1976	Brazil /1979/	Colombia /1978/	Ecuador /1977/	Guatemala /1976/	Mexico /1978/	Peru /1978/	Venezuela /1979/	Subtotal	Bolivia 1972-1976	Chile 1974-1978	Total
Argentina	-	24425	1062	10846.	-	992	2531	2590	42446	441	662	43549
Bolivia	2605	-	5	-	-	-	886	191	3687	-	133	3820
Brazil	16889	-	2404	4752	-	734	3006	351	38136	1301	13969	43406
Colombia	22043	244	-	10347	-	5	913	1558	35110	-	50	35 160
Chile	355	290	195	11097	-	218	1776	84	14015	271	-	14286
Ecuador	-	152	17620	-	-	-	1786	21	19579	-	100	19679
Mexico	762	8236	4142	4771	7037	-	2073	1919	28940	-	2552	31492
Peru	8	-	1719	1186	-	133	-	200	3246	594	47	3887
Uruguay	7930	39365	1111	-	-	-	3742	3960	56108	-	300	56408
Venezuela	10090	13751	26123	5525	1926	1205	3813	-	52453	-	5697	68150
Other	-	276	278	-	9310	-	100	961	10935	-	82	1709
Total	60682	86741	54659	48542	18273	3287	20654	11635	304655	2607	23592	330854
Proportion of investment of Latin American origin in total DFI /%/	1.73	0.60	6.48	6.40	6.8	0.22	2.0	0.78			0.95	

Source: Technology exports from developing countries /1/: Argentina and Portugal, UNIDO, Development and Transfer of Technology Series No 17, New York 1983, p. 22.

Note: The data in this table are based on stocks in the recipient country at the end of the year shown.

Among the fifty world's largest industrial corporations in 1980, three of them were based in developing countries - Petroleos de Venezuela, ranking 20, Petrobras from Brazil, ranking 33, and Pemex from Mexico, ranking 34. In the 1970's, three groups of developing countries have emerged as major overseas investors in the developing world. These were some Latin American countries, South-East Asian countries and Middle East OPEC states. For 9 Latin American countries the intra-regional flow of DFI at the end of 1978 amounted to some US$ 274 million which represented around 1 percent of all DFI in the region. (24). The main source countries were Venezuela, Brazil, Argentina and Colombia with the main recipients being Argentina, Brazil, Colombia and Ecuador.

In Asia, the major investments are in the area of Hong Kong with a stock abroad in 1976 of more than US$ 750 million and Indonesia as the largest recipient with a 1976 accumulated stock of some US$ 1,3 billion.

TABLE 5

Intra-regional direct investment stock,[a] Asia, by origin, circa 1976 millions of dollars

Origin	Host country or territory			
	Thailand [b]	Indonesia	Philippines [c]	Hong Kong
Malaysia	5.0	42.7	0.3	-
Hong Kong	10.9	728.3	32.0	-
India	2.4	19.4	0.7	-
Philippines	0.9	272.1	-	3.4
Singapore	2.2	115.6	2.1	13.4
Republic of Korea	-	107.4	0.1	-
Thailand	-	-	-	29.7
Other Asian developing countries	22.1	102.9	4.0	7.3
Japan	74.5	1,216.6	161.6	56.8

(a) The data for Hong Kong and Thailand refer to assets: the data for Indonesia refer to approved projects as of 1976.
(b) 1975.
(c) As of 30 June 1978.

Source: P. O'Brien, S.A. Hasnain, E. Lechuga-Jimenez - Direct foreign investment and technology exports, op. cit. p. 121.

As far as OPEC countries are concerned their cumulative value of DFI in 1974-1979 is estimated at nearly US$ 60 billion, including shares and securities, (25). In a recent publication of the UN Centre on Transnational Corporations it is estimated that developing countries as a whole accounted for less than 2 per cent of total DFI outflows reported by the IMF for 1978-1980, which represents a marked increase over the 0.3 per cent recorded for 1970-1972 (26).

An interesting new phenomena is the significant increase during the 1970's of DFI from developing countries in the developed market economies. The net inflow of DFI from developing countries to the US over the period of 1978-1980 was more than US$ 1.5 billion or more that 13 per cent of the total net flow of inward foreign direct investment in the country. A similar picture was recorded by the Federal Republic of Germany which received US$ 800 million of DFI from developing countries over the period 1975-1979, equivalent to about 13 per cent of its total inflow. (27). Most of these inflows originate probably in the OPEC countries. Nevertheless it is an important development which should draw much more attention than it does so far.

2.4. Industrial and geographic distribution of technology exports

Available statistics on industry-wise distribution of technology exports from developing countries is very poor. It is no surprise as the main research effort so far has been concentrated rather on the general mapping out of the phenomenon without going into sectoral details.

Nevertheless, data for some countries are available. First of all it seems that the bulk of technology exports from developing countries takes place rather in civil construction than industrial technology (28). As far as industrial technologies are concerned there also exist some dominating patterns. Thus, for example, in the case of Yugoslavia, it was found that 47 enterprises from the metal processing industries, automobile, agricultural machinery, machine tools, etc, 25 enterprises from the chemical industry, cosmetics, pharmaceuticals and chemicals, 13 enterprises from the food processing industry, 11 enterprises from the construction and building materials industry and 7 from the electrical industry (29).

As far as Argentina is concerned most of the turnkey plant exports in 1973-1977 related to food processing (15 contracts out of the total 27) and chemicals 5 contracts. In value terms however, oil pump-line and pumping were the most important, representing over 60 per cent of the total receipts (30).

In the case of India, for which the most comprehensive figures are available, industrial project exports concentrated clearly in the power generation and distribution industry, consultancy earnings in steel mills and power generation whereas Indian DFI concentrated on paper and pulp and textiles.

In Mexico technology export contracts by manufacturing firms covered 10 different industrial subsectors such as capital goods for agriculture, chemicals and petrochemicals, glass and plastics, metal products, metal working and non-agricultural capital goods, mining, pharmaceuticals, pulp and paper, steel, textiles and fibres (31).

In a study on Portuguese machine building, electro-technical and chemical industries were identified as the leading technology exporters (32).

As far as Egyptian technology export is concerned it includes such branches as sugar manufacturing, automotive industries, machine-tools, paper and printing, iron and steel, mechanical engineering, chemicals, textiles, cables and wires (33).

As may be seen from the quoted data, technology export is basically concentrated in traditional industries i.e. metalworking, chemicals and food, for which the rate of technological advances is rather low and which are, to some extent, being phased out from the developed economies.

If we look at it from a different angle, we may arrive at the same conclusions as S. Lall did for India - that is, that intermediate goods producers tend to dominate over consumer and capital goods as far as the end users are concerned. A similar observation was recently noted with respect to technology exports from socialist countries of Eastern Europe where metallurgy and chemical industries were the pacesetters (34).

Table 7. Industry - wise distribution of technology exports from India

/in percentages/

	Industrial projects export /Cumulative end of 1979/	Consultancy export /1978-1979/	Direct investment /Value of equity end 1979/
Manufacturing			
Textiles, yarn	2,6	2,0	23,2
Sugar	5,3	4,9	3,6
Other food processing	0,3	0,1	10,2
Cement	10,9	0,5	-
Steel mills, other metals	6,5	24,5	1,2
Chemicals	9,7	10,7	6,4
Paper and pulp	0,5	-	29,4
Simple metal products	0,2	-	6,0
Machinery	5,6	-	3,8
Power generation	28,2	14,3	-
Power distribution	27,1	-	-
Transport equipment	0,8	-	3,3
Electronic, telecommunication	0,9	-	-
Other mfg	0,7	6,1	2,4
Sub-total	90,5	63,1	94,5
Other			
Steel structures	4,6	-	-
Water treatment, sewage	4,9	-	-
Railways	-	7,2	-
Other	-	29,7	5,5
Grand total	100,0	100,0	100,0

Source: S.Lall - Indian technology exports... op.cit. p.154.

Now let us turn to the geographic destination of technology export deals. Just as one would expect intuitively, there are two main features of geographic distribution of technology exports:

the overwhelming majority of the deals take place within the developing countries;

individual exporting countries tend to concentrate on certain geographic locations, mainly in the neighbouring countries.

The share of developing countries as recipients of the technology exported by selected developing countries stood as follows:

- in the case of Egypt - ca. 80 percent (35) - ca. 93 per cent of contracts go to outlet markets in Arab Countries;

- in the case of India, ca. 60-90 per cent in value terms, depending on the form of technology export: dominant outlet markets are Middle East, Africa and South East Asia (36);

- in the case of Pakistan, ca. 60 per cent of contracts (37) - ca. 90 per cent of which go to dominant markets in Muslim countries;

- in the case of Argentina, Brazil and Mexico, ca. 80-100 per cent in contract number depending on the form of technology export, go pre-dominantly to Latin American countries (38).

3. Exports of technology - qualitative assessment

After having presented a global-quantitative outline of technology export development, let us now turn to a more detailed analysis of the phenomenon. The most important questions that seem to arise in this respect may be formulated as follows:

What is the nature of the traded technology?

What is the nature of the exporting and importing organizations?
What are the forces behind the technology export activity?
What is the nature of the comparative advantages of developing countries exporters over industrialized competitors?

3.1. The nature of exported technology

When assessing the nature of exported technology three hypotheses can be spelled out (39):

(a) in some developing countries certain industries have moved on to world technological frontiers and have become innovators in absolute terms;

(b) in some developing countries certain companies have moved on to world technological frontiers thereby creating competitive ability in foreign markets;

(c) some developing countries, while still relying basically on foreign inputs, have managed to attain the "adaptive filter" capacity, transforming foreign technology according to the conditions prevailing in their economies and thus being able to provide more appropriate technology than their neighbours before provideing it for themselves.

Available data suggest that the third situation prevails as far as manufacturing technology and turn-key deals are concerned. Thus for example in a case study of technology export from Egypt by Tagi Sagafi-Nejad it was found that out of 14 exporters of manufacturing technology 13 have declared their basic reliance on imported technologies, some of which have been in use already for many years (40).

The only company that has claimed substantial technological independence - Egyptian Sugar and Distillation Company - has been in operation for more that 100 years. It has some patented technologies and has been amongst others licensing its technologies abroad.

The company also has significant R+D activities with over 100 persons employed in this capacity. Its major technological achievements include "an Egyptian cane diffusal" system, technology for the production of acetone butanol by the fermentation of molasses and development of a system for the purification of sodium sulphate. The fermentation process was so advanced to find a European based buyer (41). However, this was clearly an exception and technology replication dominates. A similar observation on the imitative nature of exported technology has been made in a study on Argentina and Portugal by P. O'Brien and J. Monkiewicz. In Portugal, for example, out of 12 manufacturing companies studies 6 of them claimed their total reliance on foreign inputs and 5 more defined it as "substantial" (42).

In a recent study on six manufacturing technology exporters from Pakistan it was detected that imported technological growth prevailed in four out of six companies. In the remaining two, Salika Sewing Machines and Buxly Paints, the technology generated was a "one man story". In both cases the founders were main innovators who built their businesses around their inventions (43).

Similar pictures emerge from the studies of export experiences for Brazil and Mexico. However, in the two last cases a number of observations were provided to support the hypothesis that some companies have already moved on to world technological frontiers. In a study on Mexico four such cases were identified - that of Hylsa which was responsible for the development of a process for the direct reduction of iron, successfully licensed to many foreign companies, that of Loreto y Pena Pobre - owner of a process to control smell pollution and recover heat and alkaly from waste liquids (paper industry), that of Dupont de Mexico - owner of a technology for downscaled plant of agricultural chemicals and explosives and that of Cussi - an inventor of several processes for producing paper from bagasse 944). Again what was characteristic for these cases was a determining importance of the personal input by main inventors.

Brazil on the other hand supplies some evidence to our first hypothesis related to the excellent level of certain industries. From the available data it seems that at least in two sectors, namely alcohol and steel production, Brazilian companies are able to compete technologically against advanced countries.

Let us now turn to consultancy and engineering services. In this case the local component of skills and knowledge seems to be much higher than in previous cases and thus it may be argued that a good part of these companies is at the world technological frontiers. Particularly illustrative examples are those of Technimexico and Construmexico from Mexico, Interbras from Brazil, Consultant International, Federal Construction Corporation, Gammon Pakistan Ltd. from Pakistan, NIDC, EIL and Mecon from India, Profabril and Lusotechna from Portugal, Shawki and Co., Engineering and Industrial Design Development Centre and the Arab Contractors from Egypt.

3.2. Characteristics of the exporting and importing organizations

The parties involved directly in technology transfer transactions may be evaluated from a broad variety of perspectives. We may look at them from the ownership status trying to find out what is the relative share of public versus private organizations. We may attempt to establish what is the relevant size of the organizations - small, medium or big, what is their main field of activity - manufacturing, consulting, contracting, etc. yet, we may try to conclude what is the relative importance of foreign versus locally owned entities. Not all aforementioned questions could be answered with available data, for some of them only tentative findings could be presented whereas for some others the emerging picture is clear cut.

Public versus private

Among the developing country exporters of technology most of the involved organizations are private owned companies. This observation is striking enough as for some reasons it could be argued that public sectors should have played the leading role. However, the available data for Portugal, Pakistan and India prove the opposite.

TABLE 8.

Ownership status of the exporting organizations

Country	Ownership status Private	Public
India of which	54	26
(a) turnkey projects	32	12
(b) Licences	10	3
(c) Consulting and engineering	12	11
Pakistan	10	7
Portugal */	66	40
Egypt	6	19

Note: */ in number of contracts registered in 1978 - 1980.

Source: S. Lall - Developing countries as exporters of technology ... op.cit. pp. 103-114; P. O'Brien, J. Monkiewicz - Technology exports from developing countries ... op.cit. p. 56; J. Monkiewicz - Technology export from developing countries, case study of Pakistan, pp. 54-55; Tagi Sagafi-Nejad - Technology exports from developing countries, the case of Egypt, pp. 21-23.

As we can see from the relevant data, the ratio of private to public is generally around 60:40. The only exception which confirms a conventional wisdom is Egypt where the majority of identified exporters were publicly owned.

The data quoted may however be highly misleading as they do not take into account, with the exception of Porgugal, the number of contracts undertaken or their value. Notwithstanding, they seem to point to a much higher propensity of private organizations in the technology export activity. This observation however requires additional research effort in order to clarify its validity as well as underlying causes.

As far as the ownership status of the receiving organizations is concerned, available evidence is rather poor. In his study on Egyptian technology exports Tagi Sagafi-Negad concluded that most of the recipient firms were state-owned entities, 16 out of 27, (45). This proportion was even higher in Pakistan for which around 80 per cent of the recipient organizations were state-owned. On this basis, it may be argued that due to the nature of the technologies offered the public sector could play an important role as a technology recipient, particularly with regard to various consulting and engineering services related to infrastructural projects, power generation, transmission, distribution, etc. This hypothesis has however to be varified.

Small versus large

It comes as no surprise that as a rule regular exporters of technology, be it manufacturing companies, consulting and engineering organizations or contractors are relatively large organizations in terms of their local environment. It cannot be otherwise, as servicing overseas operations requires the possession of adequate financial and human resources which cannot be found in small entities. As a matter of fact the most successful organizations were those of a consortium type, such as Construmexico and Tecnimexico of Mexico, Consultant International of Pakistan, Interbras of Brazil etc.

Many of the exporters from developing countries however still felt that their relatively small size put them in a handicaped position vis-a-vis developed country competitors. As a result they had to confine themselves to small projects for which competition was great (46). As a way out of the situation in many of the countries concerned various sorts of consortia-like organizations for export purposes have already been established or are being planned.

Foreign content among exporters

An important question with regard to technology exports from developing countries is to what degree identified flows originate in MNC's affilliates and thus represent an outside and intrafirm technology flow within MNC's network, as opposed to domestic technology. If the former were true, the whole phenomenon should be interpreted in terms of MNC's global technological advances of the countries concerned.

The data collected so far suggest,however, that technology exports from developing countries is being carried out by purely national companies and that MNC's affiliates are rather reluctant to develop such activities. In Portugal, for example, out of 154 technology export contracts registered over 1978-80, only 24 (or 15.6 per cent) were carried out by companies with foreign participation (47). In Egypt none of the companies studied had foreign participation (48). In Pakistan only one out of 26 technology exporters had some foreign participation (49). A similar situation seems to exist in Brazil, Argentina and the Republic of Korea (50).

3.3. Motiviation to export technology

Development of technology exports from developing countries is determined principally by three basic conditions:

(a) knowledge of market opportunities;
(b) possession of some competitive advantages over other competitors; and
(c) willingness to export technology overseas.

Let us now shortly elaborate on the transactions in two parts - those of arm-length contracts (non equity) and those associated with DFI.

With regard to the first set of transactions, luckily enough comparable data for four developing countries are available, namely, Portugal, Egypt, Yugoslavia and Pakistan (see table 9).

TABLE 9

Basic motives for technology exports(arm length agreements): number of observations

	Type of motivition	Portugal 19 companies	Egypt 17 companies	Yugoslavia via 29 companies	Pakistan 23 companies
1.	Higher profits abroad	3	8	6	1
2.	Existence of excessive capacity	6	4	9	4
3.	Corporate policy	6	9	11	9
4.	Offer of govt. subsidy	1	1	4	-
5.	Need to circumvent tariffs and quotas	1	-	3	-
6.	Exploit accumulated know-how	7	8	17	13
7.	Threats to existing markets	3	1	2	6
8.	Others	2	3	12	-
	T O T A L	29	34	64	30

Source: P. O'Brien, J. Monkiewicz - Technology export ... op.cit. p.61;
T. Sagafi-Nejad - Technology exports ... op.cit. p.39;
A. Zagorowski - Technology exports from developing countries - the case of Yugoslavia, UNIDO/IS.353, 16 November 1982, p.60;
J. Monkiewicz - Technology exports ... op.cit. p.66.

From the referred data it is evident that the major driving force behind the transactions was in all four cases a desire to exploit accumulated know-how. Its importance varied from about 24 per cent in Portugal, Egypt and Yugoslavia, up to 43 percent in Pakistan. It seems as if companies were aware of their otherwise idle know-how and were ready to make use of it when opportunity or need arose. It could also mean that to some extent this export had a non-economic motivation and had been inspired by a challenging desire to compete with OECD established technological dominance. To put it in a different way, it contained some spirit of a "joyful creation". The next on the list - again similar in all four cases - were corporate policy considerations, meaning that the development of overseas technology exports was seen as a long-term operation and constant component of the activities of the companies concerned. This observation, if valid, is of extreme importance

as it signifies an attainment of a certain level of maturity in the process of internationalization of the aforementioned organizations. Only third place on the list, against expectations, was occupied by the desire to utilize idle productive capacities. In general, the structure of motivating factors seem to differ substantially from that of developed countries' organizations. In the latter case basic motives are associated with the need to circumvent tarriffs and quotas and with the threats to existing export markets. This is well proved by the Vernon theory of the product life cycle and related theoretical systems.

Let us now turn to equity forms of technology export.

TABLE 10.

Alternative modes of overseas technology -
Utilization by US corporations in percentage of expected profits

	Subsidiary	Export of products	Licence	Joint venture	Total
1. Technologies with the expected rate of return less than 20%	36	19	38	7	100
20-39%	46	29	19	5	100
over 40%	100	0	0	0	100
2. Technologies for new products	72	4	24	0	100
3. Techologies for improved products	69	9	24	0	100
4. Technologies for new processes	17	83	0	0	100
5. Technologies for improved processes	45	53	2	1	100

Source: E. Mansfield, A. Romeo, S. Wagner - Foreign Trade and US Research and Development, Review of Economics and Statistics, June 1979, p.25.

In this case, however, the available evidence is scanty and we therefore have to rely more on individual examples than on cross-country comparisons.

It is an accepted belief that amongst the main motivating factors, domestic demand deficiencies play an important role. Three kinds of demand limitations can be spelled out: (51)

(a) where the domestic market is too small for any reasonable scale of activity (which is frequently the case for heavy industries in developing countries). In effect and in order to survive, the companies have to export their products or establish production abroad. An extreme example may be chemicals industry in Hong Kong which is actually supplying its limited local demand from overseas affiliates;

(b) where the domestic market is considered as too vulnerable in the long term;

(c) where the domestic market is subject to substantial cyclical contractions.

It is argued for instance that in recent years an important part of Indian involvement abroad was related to the stagnation of domestic demand for capital goods (52).

Another important motivation seems to be a desire to protect export markets (53). With the intensification of various trade barriers and quotas in industrialized countries, developing country companies tend to reallocate their manufacturing establishment to those countries which do not face such limitations. Apparently, this has motivated some Hong Kong firms to switch their operations to Sri Lanka. (54).

Diversification is seen as another motive for DFI from developing countries. Its significance is positively correlated with the uncertainity over economic policies affecting the operations of the companies involved. According to P. O'Brien, this motive amongst others, was particularly strong for investments from Singapore and Hong Kong (55).

Yet another factor worth mentioning is the search for raw materials which becomes more and more important in the resource poor countries.

It is interesting to note that the structure of motivating factors for DFI stemming from MNC's and LDC companies seem to be highly different.

TABLE 11.

Motivations for direct foreign investment in LDC's

	MNC's	LDC firms
Threats to existing markets	8	6
Diversification of risk (capital conservation)	1	7
High local return	3	6
Investing accumulated local funds	1	3
Exploit expereince with high technology production	8	1
Exploit expereince with labour intensive technology	1	5
Relatives, countrymen or business associates in LDC	1	5
Export capital equipment	2	4
A source of cheap labour	3	1
Export to the developed world	2	1
Use of marketing expertise	7	1
Small market at home	2	6
Circumvent tariff barriers and quotas in developed countries	1	2

Note: Numbers are average ratings by firms in the group on a scale of 1 = no importance, 10 = very important.

Source: D. Lecraw - Direct foreign investment by firms from less developed countries, Oxford Economic Papers, Oct. 1977, p.411.

3.4. The nature of comparative advantages

A final point of our deliberations is devoted to the analysis of relative advantages and disadvantages of developing country firms in their technology export ventures. Luckily enough we are again in a position to present some consistent cross-country data, table 12.

TABLE 12.

Exporters' advantages over competitors (in numbers of observations)

Nature of advantages	Portugal	Egypt	Yugoslavia	Pakistan
Cost of technology	8	7	9	14
Quality of production	6	4	9	1
Scale	2	-	-	-
Political, commercial or cultural links	5	14	11	10
Experience in dealing with foreign buyers	2	2	4	5
Other	2	2	-	-
T O T A L	25	29	33	30

Source: as in table 9.

As it could be intuitevely expected in all four cases, the dominant advnatages, as perceived by exporters, were associated with the costs of technologies offered and political, cultural and commercial links with the recipient countries (these two elements contributed from 60 to 80 per cent of the scores in all four countries). Of course, this is only a one-side picture perceived by the exporters, for which reason we may believe, for example, that the quality of the technology offered scored too high. It would be interesting to see the perceptions at the receiving end. However no information is available so far.

Let us now turn to perceived disadvantages. According to Portuguse expereince they were associated mainly with the lack of relevant national inputs in terms of equipment, raw materials, financial system, etc. that is associated with a general infrastructural weakness of the economy. It was followed by an inadequate government promotion system. A similar picture was observed in Yugoslavia where again a general infrastructural weakness of the economy dominated. Additionally, an important role was assigned to the poor brandname of Yugoslavian companies (late-comer's inheritance). As for Pakistan, a poor financial backing from the national banking and insurance system occupied the dominant position, followed by what was termed "colonial slave mentality" (in the sense of a strong preponderance for technology recipients from developing countries to rely on technologies from their ex-metropolies). The latter observation is well proven in an interesting study by Z. Mirza (see table 13).

TABLE 13.

Country "brand name" in engineering

Potential Country	Name of countries whose engineering firms have established more good will or are preferred (in order of preference		
Saudi Arabia	USA	South Korea	German
U.A.E.	British	Japan	France
Iraq	N.A	E. Europe	German
Jordan	USA	British	German
Kuwait	British	France	Japan
Libya	Italian	German	France
Bahrain	British	Japan	France
Iran	N.A.	N.A.	N.A.
Nigeria	British	Italian	German

Source: Z. Mirza - Preliminary recommendations on improving and co-ordinating efforts of public and private sector engineering organizations working abroad, Pakistan Engineering Council, February 1981 p.63.

According to Mirza's findings, based on extensive interviews among the exporting organizations from Pakistan, there was a clear pattern of perference with regard to engineering services for the companies housed in industrialized countries. Their nationality per se was a strong advantageous factor.

4. Export of technology - its significance and implications

Technology exports from developing countries may be viewed from at least three different perspectives:

(a) as a form of overseas operation by developing country firms (commercial approach);

(b) as an indicator of the level of internationalization of local firms (internationalization process approach);

(c) as an indicator of local technological maturity (technological approach).

When the first option is taken our interests concentrate around the nature of technology export deals with the broad context of the totality of the firms' overseas operations, its distinctive features, its significance for company activities and the like.

If, on the other hand, the second option is taken our main interest lies in the investigation of the phenomenon from the point of view of company development.

When at last the third option is taken, we have to look at the phenomenon in a broad context of technological developments taking place within developing countries.

All three approaches seem to be equally important in order to understand the multi-dimensionality of the development process and the phenomenon itself. However, due to obvious limitations arising from the lack of relevant theoretical infrastructure, as well as scarcity of facts and figures, we will basically limit ourselves to the last one.

4.1. Technology export and exporters' technological development

There was, and apparently still is, a widely held belief that developing countries do not create technology (56). The reason for such thinking is numerous. However, as was noted by S. Lall, two factors were the most important. One was the "dominating concern in the relevant empirical literature with major breakthroughs rather than with minor changes as the source of technical progress" and the other was a "theoretical characterization of technical progress in neo-classical economies" (57).

In this context the very existence of technology exports from developing countries, originating - as was shown - from local companies, is the most powerful evidence against the aforementioned hypothesis. The occurrence of technology export signifies an attainement of certain skills and capabilities requiring time and experience and implying certain technological maturation.

TABLE 14.

Profile of technological skills

Stages of technological capacity	Shopfloor mechanical skills and the development of technical culture	Specialized design engineering and productive facilities in machine building	Applied and theoretical, scientific knowledge	Domestic and international marketing capability
Assimilation	x			
Modification	x	x		
Replication	x	x	x	
Creation	x	x	x	
Export	x	x	x	x

Source: Industry 2000. New Perspectives, UNIDO, UN New York 1979, p.191.

As was pointed out elsewhere the creation of a technology export capacity should be viewed in the sequence of technological as well as general competence building (58). Of course, most of the developing country companies are not at the frontiers of technological advances and hence their technological effort must logically be more concentrated on searching and adapting activities than on pacesetting.

This is well illustrated by some findings of S. Teitel with regard to the Latin American experience (table 15). For a variety of institutional and infrastructural reasons, the innovative activity taking place in developing countries is substantially different from that to be observed in developed market economies (59).

These differences could be spelled out as follows (60):

(a) different relative factor prices favours more labour intensive products;

(b) lack of trained manpower slows down the rate of innovations;

(c) different demand conditions lead to biased product innovation in certain directions - simpler design, longer life, less specialized equipment, easier maintenance and descaling;

(d) need to use local materials requires import substituting research and leads to changes in product design; and

(e) lack of a fully developed, specialized component industry leads to a much bigger technical effort of the user industries.

Now, if we look at the technological competence building (or technological mastery as proposed by Westphal and Dahlman) from a broader perspective, five major stages of the aforementioned process may be identified (61). These are:

- production engineering capability comprising the knowledge and skills needed for the successful operation of a plant;

- project perparation capability comprising the knowledge and skills for project identification as well as the search and selection of the technology which is best suited to local needs;

- project execution capability encompassing the knowledge and skills for thenexecution of the given development project (engineering, installation, start up);

- capital goods capability - the ability for the manufacturing and creation of new equipment; and

- innovation capability - capability to create new products and processes.

Production engineering capability, will be reflected in terms of technology export in various technical assistance assignments, project preparation in consulting services, project execution in consulting engineering and contracting activity, capital goods capability in turn-key plants and innovation capability in licensing arrangements. Of course this is only a tentative and highly oversimplified classification; however it seems to be a very useful tool for the more systematic analysis and assessment of technology export development.

It is interesting to note how these stages were reflected in the technology exports from selected countries (table 16). The picture that comes out pretty well confirms our expectations.

First, as we can see that there is a clear dominance of transactions conditioned by a production engineering capability - that is, the first level of technological naturity.

It is followed by a project preparation and execution capability.

Second, we can see that there is some diversification with regard to the countries' relative position vis-à-vis capital goods and innovation capabilities. More developed economies, those of Mexico and Portugal seem to have the lead over less developed ones. However, even in the case of the latter some innovation capability has been detected.

Table 15. Characteristics of technological change in semiindustrialized countries-selected cases

Case/ country	Product/s/	Property	Source of technology	Nature of technical change	Reason for technical change	Market structure	Externalities and other beneficial effects	Diseconomies and other negative effects
1	2	3	4	5	6	7	8	9
Steel 1 /Argentina/	Steel billets and rolled products	Private national firm	Largely local	-Stretching capacity output -Changing product mix -Increase productivity	-Market demand -Market demand -Malfunctions and hazards	Oligopoly	-Trained engineers for enterprise and eventually industry and/or economy	-Expensive billet -Delayed replacement of equipment
Steel 2 /Brazil/	Steel flat rolled products	Public firm	Initially foreign	-Stretching capacity output -Changing raw materials and improving their productivity -Redesign of equipment and optimization to increase productivity	-Market demand -Market demand -Technical self	Oligopoly	-Technology sales to industry -Patents -Technology export	Not apparent
Steel 3 /Mexico/	Sponge-iron	Private national firm	Largely local	-New process for direct reduction	-Technical motivation in solving market demand problem	Oligopoly with product-differentiation	-Technology exports -Patents	Not apparent

/continued table 15./

1	2	3	4	5	6	7	8	9
Argentina 1	Rayon	Subsidiary of U.S. MNC	US plans local R D and engineering efforts	-New product varieties -Use of different raw materials -Quality improvements -Increased productivity	-Market demand -Market demand -Market demand -Market demand	1st period monopoly /late fifties/ 2nd period oligopoly	-Trained engineers for enterprise /other product plants/ -Developed suppliers of textile operations /dying finishing, and so on/	-Delayed substitution of rayon by polyester and nylon
Argentina 2	Clutches	Private national firm	U.S. and Europe	Adaptation to -New product varieties -Different materials -Smaller runs and more models -Standardization	-Market -Market -Market -Market	1st period oligopoly /spares/ 2st period monopoly /new equipment/	-Trained engineers and technicians for working activities eventually for industry and/or economy -Technology exports	Costly clutches similar metal
Argentina 3	Telephone equipment	Subsidiary of U.S. MNC	Europe and U.S.	-Adaptation to different raw materials -Increase productivity /process improvement/ -Increase productivity /laycut and process normalization/ -New recuperation process	-Market -Technical self motivation	1st period monopoly 2nd period duopoly	-Trained engineers and technicians for precision electromechanical production, eventually for economy -Developed suppliers of materials of equipment -Exports of equipment, tools and dies	Lower quality product

Source: S.Teitel - Creation of technology within Latin America, Annals of the American Association of Political and Social Science, November 1981 pp. 143-144.

When evaluating the aforementioned figures, however, we should bear in mind that identified components of technological competence constitute a set of interdependent variables and a sort of structural equilibrium is necessary for a proper technological performance. Thus, for example, even with the developed capital goods capability, but with no project preparation or execution capability, technology export capacity will be severely reduced.

TABLE 16

Industrial technology exports from selected developing countries according to the nature of technological capabilities required.
Number of contracts

	Pakistan 1974-1982 cumulative N = 36	Mexico 1977-1981 cumulative N = 160	Egypt (b) 1971-1982 cumulative N = 34	Portugal (a) 1978-1980 N = 154
1. Production engineering	44.4	36	-	55,2
2. Project preparation	33.3	-	88.2	-
3. Project execution	8.3	-	-	-
4. Capital goods	5.6	14	5.9	-
5. Innovation capability	8.3	22	5.9	10.4
T O T A L	100.0	100.0	100.0	100.0

Note: (a) excluding turn-key deliveries for which data were not available

(b) classification was done on the basis of contractual arrangements by the author

Source: J. Monkiewicz - Technology export ... op.cit. p.53; C.J. Dahlman, M. Cortes - Technology exports ... op.cit. p.45a; T. Sagafi-Nejad - Technology exports ... op.cit. p.28; P. O'Brien, J. Monkiewicz - Technology exports ... op.cit. p.54.

Third, it is interesting to note that the observed similarities in a structure of technological competence building in the countries concerned take place in spite of their different technological and industrialization policies which could mean that there is a certain degree of autonomy in the process involved. What was common, however, to all four cases was that local technological build up had received some protection at home either due to import substitution policy or measures related directly to technological policy. The same observation proves its validity with regard to India's example (62).

A highly important question is how to perform this protection and to what extent. This remains open however, and requires much more research efforts in order to specify some policy recommendations.

4.2 Implications for technology borrowers

In order to evaluate possible benefits for the technology receiving developing countries, we have to look closer at the type of technology which is being offered by developing country exporters. For this purpose, the classification offered by S. Lall seem to be the most convenient (63).

According to this classification there are three different types of technology provided by developing countries:

(1) Competitive technologies where developing countries are able to supply equivalents to the pieces offered by developed countries;

(2) Complementary technologies where developing countries are able to furnish simpler and more appropriate parts of technologies complementing more sophisticated basic core technologies from developed countries; and

(3) Non-overlapping technologies where developing countries offer some products and processes no longer in use in developed countries.

In the first category (which is obviously of minor significance in the totality of technologies being offered by developing countries), the main advantage for importers seems to lie in lower technology costs. As already pointed out earlier in this report, low technology costs were perceived as the main competitive advantage of the exporters from developing countries. Moreover, the emergence of new exporters may have some impact on the overall characteristics of technology suppliers' behaviour due to de-monopolization of the market.

In the latter two categories, major advantages arise from "appropriateness" of the technology. This appriateness should be seen in a threefold sense:

(1) in the sense of more appropriate products:
(2) in the sense of more appropriate process;
(3) in the sense of more appropriate scale.

Technologies coming from developed countries as a rule involve too large amounts of capital per worker in terms of the savings capacities of developing countries. Evidence from Indonesia on capital labour ratio indicates that they were almost twice as high for developed countries as compared to developing country investors. Data for Thailand indicate a similar phenomenon, i.e. capital labour ratio of LDC investor companies (64). The "OECD technologies" also as a rule require much more refined infrastructural support, often lacking in the countries concerned.

An important problem in technology transmission is the scale of productive units. In most cases the scale requirements of developing countries are far below the standards set up by designers in developed economies, which first of all reflect different purchasing powers of the markets concerned (see table 17).

TABLE 17

Manufacturing as a proportion of the U.K. market 1976

C O U N T R Y	Value added in manufacturing as percentage of U.K.
Malawi	0.1
Tunisia	0.7
Kenya	1.0
Ecuador	1.3
Singapore	2.0
Nigeria	3.2
Peru	4.1
Philippines	6.6
India	25.4
Brazil	28.2

Source: World Development Report 1980. World Bank Table 6

In such a situation imported plants frequently suffer from an excessive capacity and run into severe economic problems (65). The picture is however not as simple as one may be led to believe from the aforementioned examples. In a recent study on Zaire's technological development it was found out that both MNC's and Zairean owned companies were practically at par with regard to the inappropriateness of the technology utilized.

TABLE 18

Cases of inappropriate technologies in 1963

Manufacturing enterprises in Zaire, 1975

	Total no. of firms Analyzed	Number of firms in which important parts of the technology were considered inappropriate		
		Consumption goods	Intermediate goods	Total in percentage
MNCs	15	3	1	27
Other private (b)	24	2	1	13
old (a) foreign firms	7	1	-	14
new				
Expatriate-owned firms	10	1	2	30
Zairean-owned firms	4	-	1	25
Government-owned firms	3	-	-	-

Note: (a) established before independence (1960)
(b) purely financial affiliates

Source: E. Stigler - The mechanism, efficiency and costs of technology transfers in the industrial sector of Zaire, Development and change, Vol. 14, No. 1 1983, p.103.

Another important advantage of having supplies from developing countries is their better understanding of needs and problems of recipients. Having absorbed their technology in a comparable environment they can affect the transfer process much better than a supplier from a developed country.

Last but not least, "developing country exporters may provide the technology in a more unpackaged form since they do not enjoy monopoly power based on the combination of advanced technology, brand name, financial resources and managerial resources" (66).

Before concluding however, we have to say that the aforementioned observations are highly tentative since there are only few studies on technology receivers (67). Much more effort so far has been given to technology exporters. However, to arrive at a reasonable, comprehensive picture of the phenomenon the first issue must receive much more attention in future.

4.3. Some international implications

The importance of technology exports from developing countries, despite its relatively limited dimensions particularly in the upper grades of technology resources, does not only have purely national (givers - receivers) effects, but also brings some wider, international implications.

First, in certain segments of technology the proliferation of technology exports from developing countries may signify certain changes in the international market for know-how, characterized by high imperfections stemming from the mono - or oligopolistic position of the suppliers (68). Thus an injection of extra suppliers, which additionally have somewhat different features means certain improvements of the market in favour of receiving countries. Obviously, the extent and depth of changes depends largely on the extent and nature of the proliferation process.

Second, development of technology exports from developing countries constitute a certain challenge for OECD based multinational corporations. Of course, the challenge is not dangerous so far as these exports pertain as a rule to those technologies and industries which remain outside MNCs sphere of interests. However, assuming growing technological maturity of these exports a possible new conflict area arises. It may lead to some counteractions or preventory measures undertaken by MNCs if they feel endangered both in the short or longrun.

Third, proliferation of the "South-grown" technologies means a certain erosion of the technological monopoly of the North and thus creates an additional infrastructural element for both trade and technological co-operation among developing cuntries. The future outcome depends however on to what extent an indigenization of the technology in a regional sense occurs.

Fourth, emergence of technology export from developing countries, and particularly its DFJ version, is proof of a growing internationalization of firms based in developing countries. It is argued that in its growth process any company passes through different stages which may be classified as follows (69):

(a) domestic production stage;
(b) indirect export stage;
(c) direct export stage;
(d) non-direct investment production stage abroad;
(e) stage of manufcturing through direct investment abroad.

If this is the case we should expect a growing importance of foreign operations in developing countries, both at regional and global levels, with all the consequences that arise out of it.

Finally, as shown before, technology exports from developing countries are not widespread phenomena and they are confined largely to newly industrialized countries (NICs) and some of the "second tier" economies, whereas a vast majority of the others remain purely recipients of technology. Under these circumstances one could take this as another indicator of an intensified polarization process taking place within developing countries (70). This is a highly sensitive issue which undoubtedly creates new conflict areas among the countries concerned.

5. Conclusion and recommendations

There is no doubt that the phenomenon of technology exports from developing countries constitute a new and significant change in the traditional pattern of technology flows, not so much because of its present volume, but rather by the sheer opportunity of providing many developing countries with alternative sour es of technology, not necessarily coming from traditional TNCs sources of supply.

Its significance however is much broader than that for both theoretical and practical reasons. In the first case traditional views on the existence of technological progress in developing countries have to be substantially revised. In the second case we have to deal with some new structural developments on the international technology market and the changing nature of interrelationships both within the developing world itself and its outside contacts.

What can be ascertained at this moment is that exports of technical services seem to be the predominant form of disembodied technology exports from those countries and markets where these exports were normally placed, usually other developing countries.

Turnkey projects on the other hand seem to be the predominant form of hard technology export. Growing DFJ of some developing countries may add an additional important dimension to these phenomena.

It could be argued that expansion of consulting and engineering companies to foreign markets may play an important role in the stimulation of hard technology exports from developing countries in terms of industrial machinery and equipment. In the case of developing countries it is primarily the consultant who makes the selection and recommendation of the equipment and technology required. Any consultant is again basically associated with the national industry he knows best and therefore, given the presence of equivalent technologies at home and abroad, he would probably opt for the first one.

Most of the technology exported so far is of foreign, predominantly OECD, origin. However, there is already a small stream of home generated technology. The logic of the development process points out that this stream will increase in importance just as has happened many times before in the economic history of mankind. Of course, to rely on logic is not enough - relevant policy measures, both at international and national levels have to be taken in order to provide necessary support for the process already in progress.

A major comparative advantage of developing country technology exporters over their developed competitors is the cost factor. Cost factor however is a highly dynamic phenomenon which can easily disappear with rising incomes and wages, provision of more social security and the like. Hence we may expect a changing distribution of technology exporters among developing countries, who base their performance on the cost element. Therefore some old exporters will have to move up along the ladder of technological maturity or perish in markets invaded by low cost suppliers. As for the major comparative impediment of developing country technology exporters, the lack of proper infrastructural support on the part of their home countries seems to dominate.

The specific nature of the technology export market requires a good supply of relevant information, constant presence at the export market and an elasticity in funds generation. All these are difficult to ensure for small-scale developing country organizations which therefore frequently lose at the start, to the benefit of the well placed and well organized companies from developing countries.

In view of all what was said above, as well as taking into account the findings of the export group meeting on technology exports from developing countries held in Vienna, 19-21 December 1983, the following recommendations can be spelled out:

At the national level

(1) A predominant feature of most of the developing countries with regard to technological progress is a lack of an integrated technological policy. The policy which should on the one hand be equipped with proper institutional machinery and on the other hand with a set of suitable means and actions. The time has come to integrate three different segments of this policy: technology transfers from abroad, local technology generation and technological expansion abroad. So far there is a clear predominance of the first element at the expense of the last two. If however any meaningful results in the course of the technological growth of developing countries are to be achieved this attitude has to be substantially revised and indigenous technological abilities have to come to the fore. It means that export of technology should be seen in the context of the objective being the building up of an appropriate local technological development. Technology export could contribute to this process by enabling greater economies of scale, specialization and learning.

(2) The first step in this direction would be the granting of some protection for local "technological learning". This would essentially embrace four types of government intervention:

(a) support for the establishment of local manufacturing capacity, including - to the extent feasible - the creation of a capital goods sector;

(b) limitation of foreign capital penetration to those areas where local technological capability is not in a competitive position;

(c) incorporation into the rules on foreign technology acquisition a "local content principle" that should be enlarged with accumulated experience and skills and include local subcontracting, use of local materials, etc.;

(d) stimulation of local design, adaptation and innovative activity and promotion of locally generated technologies.

A major practical problem in this area is the attainment of a proper balance in the degree of protection provided. This balance could however be achieved only by iterative actions or a trial-and-error method.

(3) Technology belongs to the most critical assets of a company and a country. Therefore, its use should be viewed from the point of view of the targets to be achieved. This requires a proper understanding of the nature of the transactions involved, their implications for the operation of the given companies and the countries as a whole. So far the degree of understanding both among the businessmen and policy-makers seems to be rather low. As a result, much more attention is given to traditional commercial operations than for technological transactions. To increase its understanding and awareness of its potentials, training programmes should be developed, aimed both at the business community as well as government officers and development bankers.

(4) To get a stronger foothold on international technology market developing country exporters have to receive much more assistance from their respective governments. This could encompass utilization of the state trade representatives abroad for the collection of relevant market information, supply of low cost money, provision of the risk guarantee, promotion of joint sponsored undertakings and the like.

(5) In order to create a sound baris for government action in the aforementioned area, it seems necessary to start with the establishment of reliable statistics of technology export contracts concluded and subsequently a system for their monitoring. For these purposes, an extension of the field of activity of the existing national offices for technology transfer might be feasible.

(6) In view of the catalytic role played by consulting and engineering companies in technology exports, their greater association with local developers of technology could help in promoting technology exports through the transformation of available know-how into marketable technologies.

At the regional and international level

(1) Technology flows among developing countries should be viewed in the context of South-South co-operation and the collective self-reliance paradigm. Hence, the regional and international measures should aim at facilitating such flows by providing information and incentives on the one hand and reducing the obstacles and offering preferential treatment on the other.

(2) To achieve these targets work on the creation and strengthening of regional and international technology banks with UNIDO's INTIB system should be continued. This would supply prospective technology borrowers with additional information on the technological options available and constitute an important supportive mechanism. The aforementioned banks would be equally important for prospective suppliers of technology in their search for joint undertakings and various sorts of collaborators.

(3) Regional promotional measures for intensification of South-South technology flows should be encouraged. They might have taken a variety of forms - starting with an exchange of experience in this area, promotion of intra-regional industrial joint ventures, promotion of intra-regional joint projects for the development and utilization of technologies and promotion of the joint exports activity by regional associations, consortia, etc. In this context, the idea of establishing an International Technology Brokerage System suggested already in the late 1970's could be advocated. The system, based on regional centres, would essentially be responsible for collecting and disseminating relevant information and matching deman s with available offers of supply. It could encompass joint promotional measures with regard to technology supplies.

(4) Apart from the creation and better utilization of the existing information system, efforts such as solidarity meetings, investment promotion meetings, plant level co-operation programmes etc. should be better utilized in bridging the information gap.

(5) Generation of financial means is one of the major impediments to technology exports from developing cuntries. To reduce the financial constraints, existing financial infrastructure should be adjusted to enhance the technology transfer flows among developing countries.

(6) To increase the appropriate diffusion of technologies from developing countries by the reduction of bias against the emerging suppliers, international agreements should be reached on the appropriate joint promotional measures, which may include a combination of preferential terms, insurance and financial guarantees.

(7) An important part of the totality of the measures taken should be attributed to ensuring the preferential treatment of developing country technology exporters within the UN project financing schemes, the World Bank, UNDP etc. This preferential treatment could take a variety of forms such as extra charges for tendering organizations from developed countries, mandatory inclusion into project execution of the suppliers coming from developing countries, provision of preferential credit facilities, etc.

(8) Last but not least, it seems necessary to undertake a broad training programme with regard to a large spectrum of issues related to technology generation and its eventual exportation, innovation policies, technological policies etc. in order to provide necessary knowledge both for business and policy makers. A particular role in this respect should be played by UNIDO with its rich experience and available facilities. Accordingly, an enhancement of technology export issues within the framework of the existing UNIDO Technology Programme should be foreseen.

References

1. For example C.J.Dahlman and L.E.Westphal describe technology as "a collection of physical processes which transforms inputs into outputs, together with the social arrangements - that is, organisational modes and procedural methods", C.J.Dahlman, L.E.Westphal - The meaning of technological mastery in relation to transfer of technology, in: The Annals of the American Academy of Political and Social Science, November 1981, p.13.
2. F.Stewart goes even further in this direction describing technology as a set of products, machines/processes to make the products and software services necessary for the production, consumption of these products; F.Stewart - Arguments for the generation of technology by less-developed countries, in: The Annals of the American Academy of Political and Social Science, November 1981, p. 98.
3. See for example S.Teitel who defines technology as "information of a technical and organizational nature, required to manufacture industrial products", S.Teitel - Creation of technology within Latin America, in: The Annals of the American Academy of Political and Social Science, November 1981, p. 137. Similar views are shared by J.Ruszkiewicz in: The effectiveness of science-technology-production cycle, INES PW Research Papers No 7, 1977, p.6.
4. S.Lall - Exports of technology by India, Oxford University Institute of Economics and Statistics, February 1981, mineographed, p.2.

5. E.Olszewski - Podstawowe wiadomości o nauce i technice, OPT, Katowice 1971 p.5.
6. See inspiring paper of K. Sauvant - Transborder data flows: The basis of the emerging international information economy, 21 February 1983, mimeographed.
7. Business Week, 18 October 1982 p.38, quoted in K. Sauvant - Transborder data flows, The basis of the emerging international information economy, 21 February 1983, mimeographed pp. 6-7.
8. See S. Lall - Exports of technology by newly - industrializing countries: an overview, World Development, May 1984 forthcoming.
9. For a broader discussion of the issue see J.Maciejewicz. International technology transfer in the 80s, Warszawa 1983, mimeo pp. 20-27 in Polish
10. See C.J.Dahlman, L.E.Westphal - The meaning of technological mastery... op.cit. pp. 18-19.
11. Studies on restrictive business practices related to the provision of the set of multilaterally agreed equitable principles and rules, UNCTAD, TD/B/REF/13, 27 September 1983 pp. 5-6.
12. Data supplied by Ministry of Science and Technology, Republic of Korea
13. Studies on restrictive business... op.cit. p. 7.
14. First global study on the capital goods industry: strategies for development, UNIDO, ID/WG 342/3, 3 July 1981.

15. See P.O'Brien - The international projection of the industrial enterprises of the Third World: export of technology and direct foreign investment, paper presented at International Symposium on Industrial policies for the 80's; Madrid, May 5-9, 1980 p.6.
16. P.O'Brien - The international projection... op.cit. p.7.
17. P.O'Brien - The international projection... op.cit. p.7
18. Studies on restrictive business practices... op.cit.p.21.
19. Studies on restrictive business practices... op.cit.p.21.
20. See S.Lall - Indian technology exports and technological development. The Annals of the American Academy of Political and Social Science, p. 153, Nov. 1981, P.O'Brien, S.A.Hasnain, E.Lechuga - Jimenez - Direct foreign investment and technology exports among developing countries; An empirical analysis of the prospects for Third World cooperation, in: International flows of technology, UNIDO/LOD. 326 19 Dec. 1979 pp.171-175.
21. D.J. Lecraw - Technological activities of less-developed country-based multinationals, The Annals of the American Academy of Political and Social Science, November 1981, p. 164.
22. D.J.Lecraw - Technological activities of less-developed country-based multinationals... op.cit. p. 164.
23. For an extensive analysis see: D.J.Lecraw - Technological activities... op.cit. pp. 165-174.
24. P.O'Brien - The international projection... op.cit. p.4.
25. See The Challenge of Recycling Petrodollars, UBS Publications Vol 72, Zürich 1980 p.4.

26. Recent developments related to transnational corporations and international economic relations, UN Economic and Social Council, Commission on Transnational Corporations, Eight session, Manila, 30 August - 10 September 1982, E/C. 10/1982/2 16 July 1982 p. 15.

27. Recent development related to transnational corporations ... op.cit. p. 15.

28. The most comprehensive data on this issue are presented in S.Lall - Exports of technology by newly - industrializing countries... op.cit., table 1.

29. A.Zagórowski - Technology exports from developing countries The case of Yugoslavia, UNIDO/JS 353, 16 Nov. 1982 p.45

30. S.Lall - Developing countries as exporters of technology, The Macmillan Press Ltd 1982, p.34.

31. C.J.Dahlman, M.Cortes - Mexico, World Development, May 1984 forthcoming.

32. P.O'Brien, J.Monkiewicz - Technology exports from developing countries I : Argentine and Portugal, UNIDO, Development and Transfer of Technology Series, No 17, UN New York 1983

33. Tagi Sagafi-nejad - Technology exports from developing countries, The case of Egypt, UNIDO/JS 362, 14 Dec. 1982.

34. See J.Maciejewicz, J.Monkiewicz - Trends in technology exports from the socialist countries, Warsaw 1982, mimeo

35. Tagi Sagafi-nejad - Technology exports from developing countries. The case of Egypt, UNIDO/IS. 362, 14 December 1982 p.30. The observation is based on 66 conctracts identified.

36. S.Lall - Indian technology exports... op.cit. p.156
37. J.Monkiewicz - Technology export from developing countries. Case study of Pakistan, UNIDO, December 1982 mimeo p.55. The observation is based on 52 contracts identified.
38. Tagi Sagafi-nejad - Technology exports from developing countries, The case of Egypt, UNIDO/IS 362, 14 Dec. 1982
39. P.O'Brien, J.Monkiewicz - Technology exports... op.cit. p.24.
40. See Tagi Sagafi-nejad - Technology export from developing countries. The case of Egypt... op.cit. pp.72-200.
41. Tagi Sagafi-nejad - Technology export... op.cit.
42. P.O'Brien, J.Monkiewicz - Technology exports... op.cit. pp.27 and 59.
43. J.Monkiewicz - Technology export from developing countries. Case study of Pakistan, UNIDO, Vienna Dec. 1982 mimeo, pp. 58-60.
44. for a detailed discussion see C.J.Dahlman, M.Cortes - Mexico, World Development, May 1984 forthcoming
45. Tagi Sagafi-nejad - Technology export... op.cit. p.45.
46. Oral communications to author during his field surveys in Portugal and Pakistan.
47. P.O'Brien, J.Monkiewicz - Technology exports... op.cit. p.56.
48. T.Sagafi-nejad - Technology export... op.cit.
49. J.Monkiewicz - Technology export... op.cit.
50. See studies by S.Lall, C.J.Dahlman, M.Cortes, S.Teitel, F.C.Sercovich and L.E.Westphal.

51. P.O'Brien - Third world industrial enterprises. Export of technology and investment, Economic and Political Weekly, Vol XV Nos 41, 42, 43, 1980 p. 1837

52. P.O'Brien - Third world industrial enterprises... op.cit. 1837.

53. D.J.Lecraw - Technological activities... op.cit.p.169

54. International Herald Tribune, Supplement, September 1978 p.53.

55. P.O'Brien - Third world industrial enterprises... op.cit. p.1838.

56. See S.Teitel - Creation of technology within Latin America... op.cit. p.137.

57. S.Lall - Developing countries as exporters of technology... op.cit. pp. 60-61.

58. Industry 2000. New Perspectives, UNIDO, UN, New York 1979 pp. 190-193.

59. An excellent discussion of this problem is presented by D.Crane - Technological innovation in developing countries: Review of the literature, Research Policy, 6 /1977/ pp. 374-395

60. S.Lall - Developing countries as exporters of technology... op.cit. pp. 62-65.

61. This classification was taken from C.J. Dahlman and M.Cortes - Technology exports from Mexico as a starting point in the study of technological capability, draft The World Bank, February 1982 p.44.

62. S.Lall - Exports of technology by India... op.cit.p.160.

63. S.Lall - Developing countries as exporters... op.cit.p.70.

64 P.O'Brien - Third World industrial enterprises... op.cit. p.1840

65 S.F.Stewart - Arguments for the generation of technology ... op.cit. p.104.

66 S.Lall - Developing countries as exporters... op.cit. p.70.

67 An interesting study of recent origin is that of E. Stigler - The mechanisms, efficiency and cost of technology transfers in the industrial sector of Zaire. Development and Change Vol. 14 No 1 1983 pp. 83-114.

68 See J.Monkiewicz - International market for know-how during the 80's, Warsaw Technical University, Dec. 1981 mimeo; D.J.Teece - The market for know-how and the efficient international transfer of technology, The Annals of the American Association for Political and Social Science, November 1981 pp.81-95.

69 For an extensive discussion of this problem see: R.Luostarinen - Internationalization process of the form. Different research approaches, FIBO Working Paper no 1/1978, Helsinki, January 10, 1978, pp. 32.

70 For an excellent discussion of the problem see D.Ernst - Industrial redeployment and control over of technology: consequences for the Third World, Vierteljahresberichte, Probleme der Entwicklungsländer, Nr.83, März 1981, pp. 13-44.

Table 1. Portugal: Annual total value /1/ and number of contracts /2/ of technology exports /in $ US/

Specification		1973	1974	1975	1976	1977	1978	1979	1974-79 total xx/
1. Patent licence	/1/	.	78712	8611	-	-	-	-	87323
	/2/	.	1	1	-	-	-	-	2
2. Know-how licence	/1/	.	-	-	-	-	30000	.	30000
	/2/	.	2	-	1	-	1	2	6
3. Consultancy and Engineering services x/	/1/	.	37388	-	3505912	2283843	4925033	.	10752176
	/2/		1	-	7	10.	18	34	70
4. Technical assistance agreements	/1/	.	178763	-	-	2826610	1250519	.	4255892
	/2/	.	6	-	-	8	9	29	52
5. Composite agreements /1+2+4/	/1/	.	59034	2286666	1486666	1988312	3641808	.	9462486
	/2/	.	4	1	2	2	8	4	21
6. Turn-key plants	/1/	.	.	.	.	.	.	.	.
	/2/	.	.	.	.	.	.	.	.

Notes: x/ Including maintenance and repair as well as construction and civil engineering
xx/ In value terms excluding 1979

Source: P.O'Brien, J.Monkiewicz - Technology exports from developing countries /1/ Argentina and Portugal, UNIDO, UN, New York 1983

Table 2. Portugal: Annual total value /1/ and number of contracts /2/ of direct foreign investment in usd /10^3/

Specyfication		1973	1974	1975	1976	1977	1978	1979	1973/79
Direct foreign	/1/	59252,6	12590,8	4203,9	43016,2	80389,9	12860,6	39988,6	252302,6
Investment	/2/	53	42	20	27	40	39	57	278

Source: see table 1

Table 3. Portugal: Value of technology export according to institutional forms /in %/

Item	1974	1975	1976	1977	1978
1. Patent licence	22,2	0,3	-	-	-
2. Know-how licence	-	-	-	-	0,3
3. Consultancy and engineering services	10,5	-	70,2	32,2	50,0
4. Technical assisstance agreements	50,5	-	-	39,8	12,7
5. Composite agreements	16,8	99,7	29,8	28,0	37,0

Source: See table 1.

Table 4. Portugal: Number of technology export agreements according to institutional forms /1978-1980/

Item	1978 1/	1979	1980 2/
1. Assisstance to the companies	28	43	19
- Licences	8	6	2
- Technical assisstance	12	29	14
- Maintenance and repair	8	8	3
2. Consulting and engineering	10	18	10
3. Erection and construction	3	8	4
4. Hiring of Portuguese manpower	5	3	3

Notes: 1/ second half of 1978

2/ first half of 1980

Source: Estimations based on information of Bank of Portugal, see table 1.

Table 5. Portugal: Directions of technology exports in 1973-79 /number of contracts/ with exclusion of DFJ

Destination of export	1974-1976	1977-1978	1979	1980 1/	1974-80 total
USA/Canada	4	-	-	-	4
Western Europe	10	7	13	6	36
Socialist countries of Europe	-	-	-	-	-
Latin America	8	7	3	2	20
Africa	7	39	48	22	116
Middle East	1	2	7	5	15
Australia/Japan	1	-	-	-	1
Rest of Asia	1	1	1	-	3
Total	32	56	72	35	195

Notes: 1/ First half of 1980

Source: see table 1.

Table 6. Direction of Portuguese direct foreign investment in USD /10^3/

1973/79

Destination of export	1973	1974	1975	1976	1977	1978	1979	1973/79
USA/Canada	1466,3	123,7	1520,3	43,1	866,2	5117,2	2525,9	11665,7
Western Europe	19471,5	11186,3	1885,2	6905,7	40243,0	3050,2	7935,9	90677,8
Social countries of Europe	-	-	-	-	-	-	-	-
Latin America	36896,3	1254,3	439,7	3004,3	36172,0	3022,9	3886,7	114746,2
Africa	17,2	26,5	358,7	2990,1	3108,7	1670,3	1024,1	9195,6
Middle East	-	-	-	-	-	-	24607,3	24607,3
Australia/Japan	-	-	-	-	-	-	8,7	8,7
Rest of Asia	1401,3	-	-	-	-	-	-	1401,3
Total	59252,6	12590,8	4203,9	13010,2	80389,9	12860,6	39988,6	252302,6

Source: see table 1.

Table 7. Portugal: Nature of technology exporters according to the type of ownership /number of cases/

Item	1978[1/]	1979	1980[2/]
Majority owned foreign subsidiary	2	5	2
Minority foreign participation	5	9	1
State companies	11	20	9
Private companies	28	38	24
Total	46	72	36

Notes: 1/ Second half of 1978

2/ First half of 1980

Source: see table 1.

Table 8. Portugal: Volume of UFJ, by type of exporter ownership and country of destination /1973/79/, in USD /10^3/

	Majority owned foreign subsidiary	Majority owned domestic corporation	Public entity	Private entity	Total
USA/Canada	2,0	3078,6	8559,4	25,7	11665,7
Western Europe	126,9	11334,7	72007,3	7208,9	90677,8
Socialist countries of Europe	-	-	-	-	-
Latin America	-	20023,2	94516,4	206,6	114746,2
Africa	-	5639,8	3445,8	110,0	9195,6
Middle East	-	24607,3	-	-	24607,3
Australia/Japan	-	8,7	-	-	8,7
Rest of Asia	-	1,4	1399,9	-	1401,3

Source: see table 1

Table 9. Portugal: Nature of technology exporters according to their field of main activity
/number of cases/

Item	1978[1/]	1979	1980[2/]
Manufacturing companies	16	25	9
Consulting and engineering companies	21	34	17
Trading companies	1	3	1
R+D establishments	-	-	-
Others	9	10	9
Total	46	72	36

Notes: 1/ Second half of 1978
2/ First half of 1980

Source: see table 1.

Table 10. Argentina's exports of turnkey plants, 1973-1977

Year	Company	Type of plant	Thousands of dollars	Destination
1973	De Smet	Vegetable oil factory	5,525.0	Bolivia
	Nisalco	Cooked meat and extracts	200.0	Brazil
	Standard Elec.	Automatic central telephone station and external communications plant	573.0	Ecuador
	Sicom	Integral communications system	2,329.4	Chile
1974	SEL Engineering	Slaughter-house and cold storage plant	12,500.0	Cuba
	Phoenicia	Integral baking plant	2,900.0	Cuba
	Nisalco	Glycerine-producing plant	90.0	Mexico
	Emepa	15 sheds for port storage	6,775.0	Cuba
	Emepa	Structure sheds, metalic coverings and silos for fowl farms	15,940.5	Cuba
	Adabor	Metalic silos with integrated conveyors	2,329.1	Cuba
	Lix Klett	Air conditioning, ventilation and heating for a bank bulding	90.0	Paraguay
1975	Meitar	Processing of citrus fruit	6,200.0	Cuba
	Dosicentar	Two honey-making plants	1,490.0	Cuba
	Eximparg	Plants for extraction of vegetable oil from cotton seed	4,000.0	Bolivia
	Lito Conella	Supply, distribution and pumping terminals for liquefied gas	1,993.3	Ecuador
	Tachint	Oil pipeline and pumping station	120,000.0	Peru
	Bago Laboratory	Antibiotics-producing plant	220.0	Bolivia
	Benito Roggio	Airport	52,000.0	Paraguay

Table 10. /Contd/

Year	Company	Type of plant	Thousands of dollars	Destination
	Nisalco	Plant for processing of water for industrial use	47.3	Uruguay
1976	Meitar	Processing of citrus fruit, pineapple and manioc	8,310.0	Bolivia
	Gale Estab.	Plant for processing and bottling of spices	1,441.0	Cuba
	De Net	Plant for extraction of oil for solvent and for treatment of sunflower seeds and soyabean seeds	746.1	Uruguay
	Marial	Plant to produce lead oxide	146.8	Venezuela
	Marial	Plant for melting and recovery of lead	105.7	Venezuela
	Cemati	Ironworks for electric installations	146.5	Bolivia
	Phoenicia	Integral bread-making plant	115.0	Chile
	Caissutti	Slaughtering and processing of fowl	188.5	Paraguay
	Giuliani	Powered balanced food factory	239.2	Bolivia
	Industrial Gases	Plant for refining fats	235.2	Chile
	Iradi	Plant for processing and storing grain	483.2	Uruguay
	Bago Laboratory	Plant for the extraction of active elements	450.0	Honduras
1977	SEL Engineering	Plant to produce sodium casein, calcium and powdered milk serum	259.0	Uruguay
	Technimantonde	Pesticide-manufacturing plant	45,000.0	Bolivia
	Latinaconsult	Hospital	46,000.0	Ivory Coast
		TOTAL	340,742.1	

Source: International flows of technology, UNIDO/JOD. 326, 19 December 1979 p.51.

Table 11. Taiwan - turnkey plant exports in 1976

Type of Industry	No.of sets	Destination	Value US $ '000
Sugar Refining	1	Liberia	5,400
Cement	1	Hong Kong	1,250
Paper	7	Indonesia	3,081
	3	Malaysia	736
	1	Thailand	395
Wire and Chain	2	Indonesia	150
	3	Malaysia	350
	2	Thailand	300
Can Manufacture	1	Japan	213
	2	Indonesia	364
	3	Thailand	468
	1	Ivory Coast	151
Soap	2	Indonesia	221
Rolling Mill	1	Nigeria	820
Salt Refining	1	Thailand	110
	1	Indonesia	121
Plastic Injection Molding	3	Thailand	213
	3	Indonesia	146
	1	Philippines	113
	1	Malaysia	112
PE Woven Bag	1	Thailand	80
	1	Philippines	78
Water Treatment Plant	4	Indonesia	80
	3	Philippines	42
Non-Woven Fabric	1	Philippines	200
Dry Battery	1	Paraguay	87
	1	Philippines	63
Air-Pollution Control Equipment	1	Thailand	15
	1	Indonesia	14
Galvanized Sheet	1	Indonesia	167
Steel Pipe	1	Malaysia	209
	2	Philippines	451
TOTAL	58		16,257

Source: W.Rhee and L.Westphal, A Note on Exports of Technology from The Republic of China and Korea, mimeo, November 1978, table 2.

Table 12. Korea's turnkey plant exports as of the end of 1977

Exporting Company	Year of Completion	Industry, Product or Process Classification	Contract Value /$1,000/	Receiving Country	Type of Company Exporting
Sung-Lee Machinery	1973	Synthetic and silk textile weaving mill	1,000	Afghanistan	Leading textile machinery producer
Seoul Mi-waon	1973	Glutamine-soda factory	3,800	Indonesia	Leading food-processing company
Korea Engineering	1976	Synthetic resin plant	6,000	Saudi Arabia	Engineering consulting company
Eanil Cement	1976	Rolling mill	1,580	Indonesia	Leading cement manufacturer
Dae-Han Heavy Machinery	1977	Watergate of hydraulic power plant	1,200	Taiwan	Leading engineering company
Yoohan-Kimbery	1977	Paper plant	1,000	Colombia	Leading paper products manufacturer
	Total completed	6 plants	14,580		
Hankook-Inshuro	Construction in progress at end of 1977	Glass fibre plant	650	Saudi Arabia	Subsidiary of glass fibre company
Daewoo	"	Polypropylene plant	490	Kenya	Integrated trading company
Daewoo	"	Tire factory	60,000	Sudan	Integrated trading
Daewoo	"	Galvanised sheet plant	1,000	Sudan	Integrated trading company

Table 12. /Contd/

Exporting Company	Year of Completion	Industry, Product or Process Classification	Contract Value /$1,000/	Receiving Country	Type of Company Exporting
Hyun Dai	"	Cement	235,080	Saudi Arabia	Integrated trading company
Won-Hyo	"	Roofing nail plant	1,030	Nigeria	Engineering company
Sun-Kyung	"	Pipe fitting plant	450	Kenya	Integrated trading company
Whasin industrial	"	Zinc smeltery	72,000	Thailand	Leading engineering company
Kang-won industrial	"	Turbine plant	2,000	Sweden	Leading engineering company
Yoohan-Kimbery	"	Paper plant	1,500	El Salvador	Leading paper products manufacturer
	Total in progress	10 plants	374,040		
	AGGREGATE	16 plants	388,620		

Source: see table 11.

Table 19. Indian turnkey projects abroad by firm and industry /as of early 1979/

	Firm and industry	Nature of project	Destination	Status	Value
I	Traditional sectors				
	Lakshmi Textile Exporters	Textile mills	Malaysia	Completed	n.a.
			Sri Lanka	Completed	n.a.
			Tanzania	Completed	n.a.
	Walchandnagar Industries	Sugar mill	Tanzania	Completed	$3.4 m
	Hindustan Salts Limited	Salt refinery	Tanzania	Completed	$2 m
	Simon Carves	Animal feeds	Iraq	Completed	$1 m
	Consortium of Indian firms	Cotton spinning	Tanzania	Completed	$12 m
	National Small Scale Industries Corporation /Govt of India/	32 small-scale industries	Tanzania	n.a.	n.a.
	Larsen and Toubro	Dairy plant	Yemen	In hand	$1.4 m
II	Electrical				
	Bharat Heavy Electricals Limited /Govt of India/	Power generation /stations, boilers, transmission/	Malaysia	Several projects completed and in hand	$54 m
			Libya	In hand	$122 m
			Libya	Starting	$625 m
			New Zealand	Completed	$12 m
			Saudi Arabia	In hand	$150 m
			Jordan	In hand	n.a.
			Thailand	Starting	$3 m

Table 13. /Contd/

Firm and industry	Nature of project	Destination	Status	Value
	Lube blending plant	Abu Dhabi	n.a.	£2 m.
Sarabhai Chemicals	Multipurpose pharmaceutical plant	Cuba	n.a.	n.a.
Engineers India Ltd /EIL/ /Govt of India/	Subcontracted engineering construction commisioning /From Kellogg U.S./ for fertilizer plant	Sri Lanka	n.a.	n.a.
Vijay Tanks and Vessels	Sulphuric acid plant	Kenya	n.a.	n.a.
	Oil storage tanks	Kenya	n.a.	£40 m.
Asian Paints	Paint factory	Yemen and Saudi Arabia	Under negotiation	n.a.
De Smet	Solvent extraction	Sudan	n.a.	n.a.
/Subsidiary of De Smet	plant	Iran	n.a.	n.a.
International		Yugoslavia	n.a.	n.a.
		Malaysia	n.a.	n.a.
		Tanzania	n.a.	n.a.
		Philippines	n.a.	n.a.
		Indonesia	n.a.	n.a.
Polychem	Industrial Alcohol	Indonesia	Complete	n.a.
India Drugs and Pharamaceuticals Ltd /Govt of India/	Basic drugs and antibiotics	Algeria	Contract	£0.6 m.
		Sri Lanka	n.a.	n.a.
		Afghanistan	n.a.	n.a.
Rubber Reclaim Co.	Rubber factory	Tanzania	n.a.	n.a.
Shalimar Paints	Paint factory	Zanzibar	Complete	n.a.

Table 13. /Contd/

Firm and industry	Nature of project	Destination	Status	Value
Tata Exports	Transmission lines, substations, power distribution	Philippines	n.a.	n.a.
		Thailand	n.a.	n.a.
		Algeria	n.a.	$40 m
		Venezuela /with Kamanis/	n.a.	$200 m
		Egypt	n.a.	$14 m
Kamani Engineering Corporation	Cables and Transmission towers	Venezuela /with Tata/	n.a.	/see above/
		Iran /with Brown-Boveri/	Implemented	$40 m
		Libya	Implemented	$85 m
		Iran	Implemented	n.a.
Hind Galvanizing and Engng Co.	High voltage transmission	Malaysia	n.a.	$8.2 m
Voltas	Power generation and distribution	/Several countries details n.a./	n.a.	n.a.
Electrical Mfg Co.	Transmission lines	Dubai	Completed	n.a.
III Chemical				
Balmer Lauric /Govt of India	Oil refinery structures	Bahrain	n.a.	n.a.
	Oil storage tanks	Burma	n.a.	n.a.
	Fertilizer structures	Sri Lanka	n.a.	n.a.
	Oil terminal	Abu Dhabi	n.a.	n.a.

Table 13./Contd/

Firm and industry	Nature of project	Destination	Status	Value
		Iraq		
		Malaysia		
		Indonesia		
Triveni Structurals Ltd /Govt of India/	Hydraulic structures	Thailand	In hand	$0.3 m.
		Zambia, Tanzania	Complete	n.a.
Sayaji Engng Co.	Rock crushing plant	Afghanistan	Complete	n.a.
		Zambia	Complete	
Partap Steel Rolling Mills	Steel mill	Mauritius	Complete	n.a.
Consortium of firms	Steel mill	S.Arabia	In hand	
Heavy Engineering Corp. /Govt of India/	Electrolyser pots	Yugoslavia	Complete	n.a.
	Coke ovens	Egypt	Complete	n.a.
	Coke ovens /subcontracted from Russia/	Bulgaria	Complete	n.a.
	Coke ovens continous casting plant	Turkey	n.a.	n.a.
	Cranes	Cuba	n.a.	n.a.
Karnataka Implements and Machinery Co.	Farm implements plant	Tanzania	Complete	n.a.
Gammon India /Subsidiary of Gammon UK/	Desalination plant	Dubai	n.a.	$9 m.
Engineering Construction Corp.Ltd.	Natural gas liquification complex	Doha-Qatar	n.a.	n.a.
	Dairy plant	Yemen	n.a.	n.a.

Table 13./Contd/

	Firm and industry	Nature of project	Destination	Status	Value
	Engineering Construction Co-op.	Natural gas liquification plant	Doha-Qatar	n.a.	n.a.
IV	Telecommunication and electronic				
	Telecommunication Consultants Ltd	Laying coaxial cables	Libya	n.a.	n.a.
	Engineering Projects India Ltd /Govt of India/	Expansion TV, radio station /construction, testing, commissioning sub-contracted from Mitsubishi /Japan/	Iraq	In hand	$20 m.
	Instrumentation Ltd	Instrumentation and control equipment for power stations	Malaysia	n.a.	$10 m.
	Indian Telephone Industries /Govt of India	Two automatic telephone exchanges	Surinam	n.a.	$2 m.
		Tel.connections	Muscat/Aman	n.a.	$3 m.
		Switching equipment	Jordan	n.a.	$1 m.
		Cable laying	UAE	n.a.	$50 m.
		Railway control equipment	Nigeria	n.a.	n.a.
		UHF equipment	Sri Lanka	n.a.	n.a.
V	Steel, engineering				
	Hindustan Machine Tools /Govt of India/	Machine tool factories	Nigeria Algeria Kenya Philippines Sri Lanka Iran	Joint venture negotiated n.a.	~$12 m.

Table 13. /Contd/

Firm and industry	Nature of project	Destination	Status	Value
Western India Erectors Ltd	Boilers, turbines sugar, cement other plant erection /sub-cting from other firms/	Kuwait	n.a.	n.a.
		Iran	n.a.	n.a.
		Algeria	n.a.	n.a.
		Iraq	n.a.	n.a.
Tabarpur Colling Towers	Air conditioning equipment	Bali	n.a.	n.a.
		Malaysia	n.a.	n.a.
		Kuwait	n.a.	n.a.
Elecon Engineering Co.	Conveyors for sugar terminal	Mauritius	Completed	$3 m.
Wanson	Industrial boilers	Egypt	n.a.	n.a.
		Iran	n.a.	n.a.
		Sri Lanka	n.a.	n.a.
		Indonesia,	n.a.	n.a.
		Thailand	n.a.	n.a.
		Kenya	n.a.	n.a.
Engineering Projects India Ltd /Govt of India	Water Treatment plant			
	Part of petrochem. plant	Abu Dhabi	n.a.	n.a.

Table 13. /Contd/

Firm and industry	Nature of project	Destination	Status	Value
	Electrification	S.Arabia	n.a.	n.a.
	Silos, steel plant	Iraq	n.a.	n.a.
	Coke oven plant	Yugoslavia /with NEC/	n.a.	n.a.
	Fish canning plant	Maldives	n.a.	n.a.

Source: S.Lall - Developing countries as exporters of technology, The Macmillan Press Ltd, London 1982, table A.4.

Table 14. India: licensing of patents, designs and know-how abroad /as of early 1979/

Firm	Industry	Destination	Nature of agreement
Indian Drugs Pharmaceuticals Ltd /Govt of India/	Pharmaceuticals	Afghanistan	Process know-how
		Far East	Licensing
National Research Development Council /Govt.of India/	Leather	US	Patent
	Monochloroacetic acid	UK	Patent
	Spice oleoresins	Malaysia	Know-how
	Construction Materials	Philippines	Process know-how
	Menthol	Nepal	Process know-how
	Solar water still	Saudi Arabia	Process know-how
Amar Dye-Chemicals	Reactive dye mfre.	US	Process know-how
		Brazil	Process know-how
		Sri Lanka /negotiating/	Process know-how
		Algeria /neg./	Process know-how
		Tanzania /neg./	Process know-how
Unichem	Anti-inflammatory drug	n.a.	Patent
Godrej Soaps	Soap	Iran	Production licence
Atlas Cycles	Bicycles	Tanzania, Iran	Production know-how
		Zambia, Guyana, Sudan	Licence
		Bangladesh	

Table 14. /Contd/

Firm	Industry	Destination	Nature of agreement
Tata Engineering Locomotive Co.Ltd	Commercial vehicles	Indonesia, Egypt Guyana, UAE, Kenya /?/	Assembly under licence
Bajaj Auto, Ltd	Scooters	Taiwan Indonesia	Assembly under licence
Scooters India /Govt of India/	Scooters	Indonesia Colombia /?/	Assembly under licence
/Mr I.K. Bharati/	Steel	W.Germany	Process design
Bihar Alloy Steels	Continuous casting of alloy steel	W.Germany France	Know-how for adapting Domag /W.G./ equipment
Wanson Pvt.Ltd	Industrial boilers	Canada	Know-how for manufacture of steam boilers
Cooper Engineering	Diesel engines	Bangladesh	Licenced man.
Parle /Exports/ Ltd	Soft drinks	Muscat	Franchise
Computronics	Computer software	France	Conversion of programmes / 1 m/

Sources:see table 13.

Table 15. Indian engineering consultancy firms active abroad /as of early 1979/

Firm	Industry	Destination	Nature of service
National Industrial Dev. Corporation /NIDC/ /Govt of India/	Textile	Algeria	n.a.
	Paper	Guyana	Feasibility study
	Paper	Kenya	Feasibility study
	Fish processing	Maldives	Feasibility study
	Glass manufacture	Sri Lanka	Feasibility study
	Town planning	Tanzania	Planning
	Transport	Italy	n.a.
	n.a.	UK	Project report
	Machine tools, etc.	Iran	various
	Various sectors	Tanzania	various
	Mineral	Afghanistan	Survey work
	Textiles	Iraq	n.a.
	Steel, machine tools	Kuwait	n.a.
	Steel	Libya	n.a.
	Economic planning	Libya	5-Year Dev. Plan
	Starch, sugar, jute	Nepal	Various
	Industrial estate	Guyana	n.a.
Engineers India Ltd. /EIL/ /Govt of India/	Refineries	Iran	Subcontracted from Snam Progetti /Italy/
	Refineries	Syria	n.a.
	n.a.	Somalia	Subcontracted from Ingeco /Italy/

Table 15. /Contd/

Firm	Industry	Destination	Nature of service
	Water treatment refinery, petro-chemical.complex Various	Iraq Somalia, Sri Lanka Algeria, Bahrain, UAE	Various
Orient Paper Mills	Paper	Kenya	n.a.
	Paper	Nigeria	n.a.
Birla Textile Mills	Textiles	Sudan	n.a.
Development Consultants	Cement	Iraq	n.a.
	Cement	Libya	Management contract
Tata Consulting Engineers	Power, electrical	Iran	Training and management
	Power, electrical	Kuwait	Installation
	Power, electrical	W.Germany	Design services
	Power, electrical	Malaysia	Construction supervision
	Cotton spinning	Tanzania	Training
	n.a.	Algeria, Sri Lanka	
		Liberia, Iraq	n.a.
Water and Power Development Consultancy Services	Hydro and thermal power	Afghanistan Burma, Cambodia Indonesia, Iraq Laos, Malaysia,	Design, construction supervision

Table 15. /Contd/

Firm	Industry	Destination	Nature of service
		Mauritius, Nigeria Nigeria, Philippines, Singapore, Sri Lanka, Tanzania	
Engineering Projects India /EPI/ /Govt of India/	Rural electrification	Egypt	Studies
Rail India Technical and Engineering Services /RITES/ /Govt of India/	Railways: construc- and management	Jordan	Negotiating construction /jointly with two European Firms/
		Nigeria	Managing entire railw y system
		Syria, Iran, Zaire South Korea, South Arabia, Thailand, Libya Philippines, New Zealand	Technical assistance
Fertilizer Corporation of India /Govt of India/	Fertilizers	Burma	Marketing study
		Philippines	Marketing study
Polychem	Industrial alcohol	Kenya, Mauritius Philippines	Feasibility studies
Rubber Reclaim Co.	Rubber	Sri Lanka	Feasibility study

Table. 15 /Contd/

Firm	Industry	Destination	Nature of service
Central Machine Tools Inst. /Govt of India/	Machine tools	Iran	Study for research institute
INFIN Consult, Pvt.Ltd	Steel mill	Mauritius	Feasibility study
Karnataka Implements	Earthmoving and agricultural implements	Nigeria	n.a.
		Malaysia	n.a.
Hindustan Machine Tools /HMT/ /Govt of India/	Machine tools	Sri Lanka, Philippines, Tanzania, Indonesia, Iran Kuwait, Malaysia, Algeria	n.a.
Metallurgical and Engineer-	Steel and Aluminium	Nigeria	Plant design,
Consulting Organization /MECON/ /Govt of India/	Industry	Bangladesh, UAE Liberia, Mexico Hungary	Supervision Feasibility studies
Dasturco	Steel	26 Foreign countries	Various
Development Consultants	Sponge iron plants	South Korea, Egypt	n.a.
Pvt.Ltd	Materials handling	Egypt	n.a.

Table 15. /Contd/

Firm	Industry	Destination	Nature of service
Indian Drugs and Pharmaceuticals Ltd. /IDPL/ /Govt of India/	Pharmaceuticals	Various Arab countries	Technical assistance for ACDIMA
	Pharmaceuticals	Afghanistan	n.a.
	Pharmaceuticals	Sri Lanka	Feasibility study
Oil and Natural Gas Commission /ONGC/ /Govt of India/	Oil drilling and Exploration	Iraq	
		Tanzania	Exploration

Source: see table 13.

Table 16. Mexican technology exports

Firm Name		Nature of Exports	Recipient Countries
		I. Constructions firms	
A. Constructions firms			
Bufete Industrial Construcciones		Construction of paper plant	Dominican Republic
Construcciones, Conducciones y Pavimentos[X]	/CM/	Construction services for buildings, roads and sewage	Costa Rica, Panama
Construcciones Protexa[X]	/CM/	Construction of oil and gas pipes	Colombia, Ecuador, Peru, Panama
Estructuras y Cimentaciones[X]	/CM/	Construction of a convention center	Panama
Freissinet de Mexico[X]		Construction of grain warehouses	Guatemala, El Salvador
Iconsa-Cesa[X]	/CM/	Construction services for public works	Ecuador
Ingenieros Civiles Asociados[X]	/CM/	Construction services for water, hydroelectric, transporation, communication and civil construction projects	Brazil, Chile, Colombia, Ecuador, Costa Rica, Dominican Republic, Panama
Servicios Especiales para la Construccion[X]		Design and construction of roads, bridges and of tanks to store drinking water	Costa Rica, Panama
SECSA[X]		Construction services in association with design engineerig firms	Costa Rica, El Salvador, Guatemala
		II. Consulting and engineering firms	
B. Construction Services/Design Firms			
Cia Mexicana Aerofoto[X]		Technical services: photographic analysis of road sites	Honduras
Cortina y Asociados		Technology for a system of in-site pre-fabrication of buildings	Colombia, Saudi Arabia, Venezuela

Table 16. /Cont'd/

Firm Name		Nature of Exports	Recipient Countries
Dirac	/TM/	Consulting work in civil engineering and urban projects	Central America, Peru Venezuela
Euro Estudios[x]		Design and technical assistance for construction of civil and engineering works	Guatemala
Inarco	/TM/	Civil engineering architecture and construction services	Panama, Cuba
Innova	/TM/	Consulting services on methods and procedures related to heavy construction planning programs and cost control	Central America, Peru Venezuela
C. Industrial Engineering Firms			
Bufete Industrial Diseños y Proyectos[x]	/TM/	Plant design and project organization: paper plants, refinaries, thermo-electric plants	Argentina, France, Indonesia, Japan, Peru El Salvador, Dominican Republic, U.S.A., Venezuela
Ingeniería Panamericana[x]	/TM/	Design of a carbon black plant Design engineering for renovation of three paper plants.	Peru Cuba
Industrias, Diseños y Proyectos[x]		Technical assistance for an electric steel plant	Venezuela
Industriebau[x]		Equipment design for a thermo-electric plant	West Germany
Planeación y Consultoría de Programas y Proyectos[x]		Design services to revamp an industrial plant	Honduras
Poly-ingenieros		Design, engineering and installation of equipment for processing and packing of food products	Guatemala, Haiti, Jamaica, Nicaragua, Peru

Table 16. /Contd/

Firm Name		Nature of Exports	Recipient Countries
Procesos y Técnicas Industriales[x]		Technology for installation and operation of paper plant /Cusi technology/	Peru, Argentina
SIS S.A.		Technical assistance for operation and maintenance of steel plant. Design of PVC plant.	El Salvador
D. Management and Financial Consulting			
Bustamante Escobedo y Asociados[x]	/TM/	Assistance in management and financial systems	Colombia, Costa Rica, Ecuador, Panama, Dominican Republic, El Salvador, Nicaragua
Cia Mexicana de Consultores[x]	/TM/	Socio-economic studies for public works agencies	Guatemala, Panama
Ingenieria y Procesntiento Electronico[x]	/TM/	Data processing	Ecuador
Panamericana de Avalsos[x]		Consultancy services for industrial and commercial evaluation /8 projects/	Ecuador
E. Water Related Consulting and Engineering			
Control de Erosion[x]	/TM/	Technical assistance in erosion control	South America, Saudi Arabia, Egypt
CIETS S.A.[x]	/TM/	Technical assistance in irrigation and water purification project	Dominican Republic
Estudios y Proyectos[x]	/TM/	Technical assistance in drainage and environmental cohtrol	Costa Rica
ICATEX[x]	/TM/	Consultancy services for agricultural development in an irrigation project	Brazil

Table 16. /Contd/

Firm Name		Nature of Exports	Recipient Countries
		III. Government and private research institutes	
Instituto Mexicano de Investigaciones Electricas		Technical assistance to identify geothermic potential and to design geothermal plants	Costa Rica
Instituto Mexicano de Petroleo		/1/ Patents and licenses for refining and petrochemical technology	Spain, New Zealand, Colombia, U.S.A., Middle East
		/2/ Technical assistance in drilling exploration and distribution of oil	Ecuador, Spain Argentina, Costa Rica
		IV. Manufacturing firms	
F. Capital Goods for Agriculture/Food			
Ames-Tinsa[x]		License of product design and design of plant to produce water sprinklers	Venezuela
Remo		Turnkey cereal mills	Bolivia, Costa Rica, Nicaragua, Panama, Chile, Guatemala, Honduras
G. Chemicals and Petrochemicals			
DuPont de Mexico		Technology for downscaled plant of agricultural chemicals and explosives	Colombia
Fertimex	/K/	Joint venture to produce fertilizers	Central America
Furfurales y Derivados	/K/	Process to produce furfural	Brazil, Guatemala
Industrias Químicas de Mexico		Design and export of equipment for a carbon bisulfur plant	Peru
Ingasam		Tensoactive agents	Peru
Tom	/K/	Technology for producing polyurethane shoe soles	Costa Rica

Table 18. /Contd/

Firm Name		Nature of Exports	Recipient Countries
Productos Industriales del Plomo[x]		Design, installation and operation of a lead oxide plant	Holland
H. Glass and Plastics			
Cristales Mexicanos[x] /Vitro Group/		Technical assistance for glass production	Brazil, Guatemala, Benezuela
Protexa		Fiberglass technology	Argentina, Brazil, Venezuela, Italy
Vidriera Monterrey[x] /Vitro Group/	/K/	Plant design and technical assistance in glass production	Costa Rica, Guatemala
Vitro Fibras		/1/ Process technology for plastic/fiberglass molded parts	Several Latin American countries
		/2/ Construction of plant to produce modular houses	Argentina
I. Metal Products			
Comesa[x]	/K/	/1/ Technical assistance in setting up production of steel cable /joint venture in three projects/	Argentina, Chile, Peru, Venezuela, Ecuador
		/2/ Subsidiary to produceelectromechanical steel cable	U.S.A. /Houston/; Canada /Vancouver/
Conductores Monterrey	/K/	Personnel training in cable production technology. Possible joint venture	Colombia, Brazil
Industrias Monterrey	/K/	Technical services for installation and start-up of galvanizing plants	Argentina, Brazil, Venezuela
J. Metal Working and Capital Goods			
Avante Ingenieros		Fabrication of special process equipment for a nitric acid plant	Costa Rica

Table 16. /Contd/

Firm Name	Nature of Exports	Recipient Countries
Fabrica de Papel Loreto Y Pena Pobre[X]	/2/ License of a process to recover heat and alkaly from waste liquids /for small plants/	
M. Pharmaceuticals		
Laboratorios Zapata	Offers new biosinthesis to produce ampicillin	/India interested/
Quinona de Mexico	Offers technology to produce ampicillin	/Egypt interested/
Silanes	In talks to license an antiamebiatic molecule	France, Italy, Holland, Brazil
Syntex/Hormona	Technology for cortisone and sex hormones	U.S.A.
N. Steel		
Altos Hornos de Mexico	Detailed feasibility study for an integrated ministeel plant	Honduras
Grupo Alfa[X]	Technical assistance for operation and maintenance of steel works	Venezuela
Hylsa[X]	/1/ Process of direct reduction of iron.	Indonesia, Iran, Iraq, U.S.A., Venezuela, Zambia
	/2/ Technical assistance for use of sponge iron in electric arc furnaces	/Various countries in addition to HYL licensees/
Sicartsa	/1/ Technical service of civil engineers for the construction of a steel plant	Venezuela
	/2/ Technical services for project specification of steel plant expansion	Venezuela

Table 16. /Contd/

Firm Name		Nature of Exports	Recipient Countries
Aceros Tepeyac	/K/	Plant design, technology and technical assistance for establishment of foundry	Venezuela
Equipos Petroleros Nacionales	/K/	Joint venture to set up foundry /technical assistance provided by Fundidora Tepeyac/	Venezuela, Mexico
Fama /Vitro Group/		Technical assistance for the production of glass equipment	Colombia, Canada, U.K., South Africa, U.S.A.
Industrias del Hierro		Design of a metal working plant. Technical assistance in production and sales. Sugarmills.	Venezuela, U.S.A.
Swecomex[x]	/K/	Design services for production of condensers. Joint venture to produce heat exchangers	Venezuela, U.S.A.
C. Mining			
Azufrera Panamericana	/K/	Joint venture with Brazilian Petrominas to explore sulfur deposits	Brazil
Compania Minera Autlan	/K/	Has own process to extract mangnese. Direct investment abroad includes: Mineral Autlan Panama, Hornos Electricos de Venezuela, Sultan Metals, Sultan Manganese which includes Airco Alloys Inc.	Panama, Venezuela, U.S.A.
Industria Penoles	/K/	Has its own process for processing iron. Foreign investment	Brazil
Drill S.A.		Technical assistance to the area of oil drilling	U.S.A.
L. Paper		/1/ License of a process to control smell pollution	Canada, Colombia, Brazil, Bulgaria, U.S.A.

Table 16. /Contd/

Firm Name		Nature of Exports	Recipient Countries
O. Textiles and Fibers			
American Textile[x]		Production process for weaving dyeing, velveting and finishing of artificial fibers	U.S.A.
Celanese Mexicana		Technology for the production of acetaldehyde	India
Cordemex	/K/	Joint venture technical assistance for processing of hard fibers	Tanzania, El Salvador
Milyon[x]		Production process for non-woven textiles	Canada, Colombia, Ecuador, Spain, U.K.

Key: CM - belongs to Construmexico
TM - belongs to Technimexico
x - has received tax credits for technology exports /1977-81/
K - has involved direct foreign investment in some cases

Source: C.J.Dahlman, M.Cortes - Technology exports from Mexico as a starting point in the study of technological capabity, The World Bank, Februnry 1982, mimeo pp.2a-2c.

Table 17. Mexican technology exports, 1979-1981 /all values in thousands/

	1977	1978	1979	1980	1981	Total
I. Construction Firms						
Construmexico	3,153,954	3,977,436	2,704,438	2,182,457	2,228,309	14,246,594
Other			40,574	59,934	76,330	176,838
Total Pesos	3,153,954	3,977,436	2,745,012	2,242,391	2,304,639	14,423,342
U.S.$ Equivalent 1/	139,741	174,679	120,395	97,708	98,195	630,718
II. Consulting and Engineering Firms						
Tecnimexico	25,200	81,638	44,566	14,973	132,331	298,708
Other	1,176		10,842	14,678	14,314	41,010
Total Pesos	26,376	81,638	55,408	29,651	146,645	339,718
U.S.$ Equivalent 1/	1,169	3,585	2,430	1,292	6,248	14,724
III. Research Institutes						
Total Pesos	n.a.	n.a.	n.a.	n.a.	n.a.	131,000 2/
U.S.$ Equivalent	n.a.	n.a.	n.a.	n.a.	n.a.	6,437 3/
IV. Manufacturing Firms						
Pesos	16,591	81,940	75,634	165,174	354,636	693,975
U.S.$ Equivalent 1/	735	3,599	3,317	7,197	15,110	29,958
Average Exchange Rate Peso/U.S.$	22.57	22.77	22.80	22.95	23.47	

1/ Based on the average annual exchange rate series provided in International Monetary Fund, International Finance Yearbook

2/ No disaggregation by year could be obtained

3/ Converted at the average exchange rate for 1975-1981 of 20.35 pesos per dollar

Source: see table 16.

Table 18. Mexico summary of technology exports related to the industrial sector[x]

Exporting agents	Nature of export	Production engineering	Project Execution	Innovations	Based on Capital Goods	Total
Producers of Final/Intermediate Goods		45	8	29	1	83 /52%/ /26/
Engineering Firms		6	26	2	8	42 /26%/ /8/
K Goods Producers		4	2	1	14	21 /13%/ /6/
Research Institutes		2	9	3	-	14 /9%/ /9/
Total		57 /36%/ /22/	45 /28%/ /14/	35 /22%/ /9/	23 /14%/ /5/	160 /10%/ /42/

[x] Figures in parenthesis to the right indicate percentage distribution. Those below refer to the number of firms involved. The bottom row does not add up because individual firms with multiple transactions are sometimes involved in more than one type of export.

Source: see table 16.

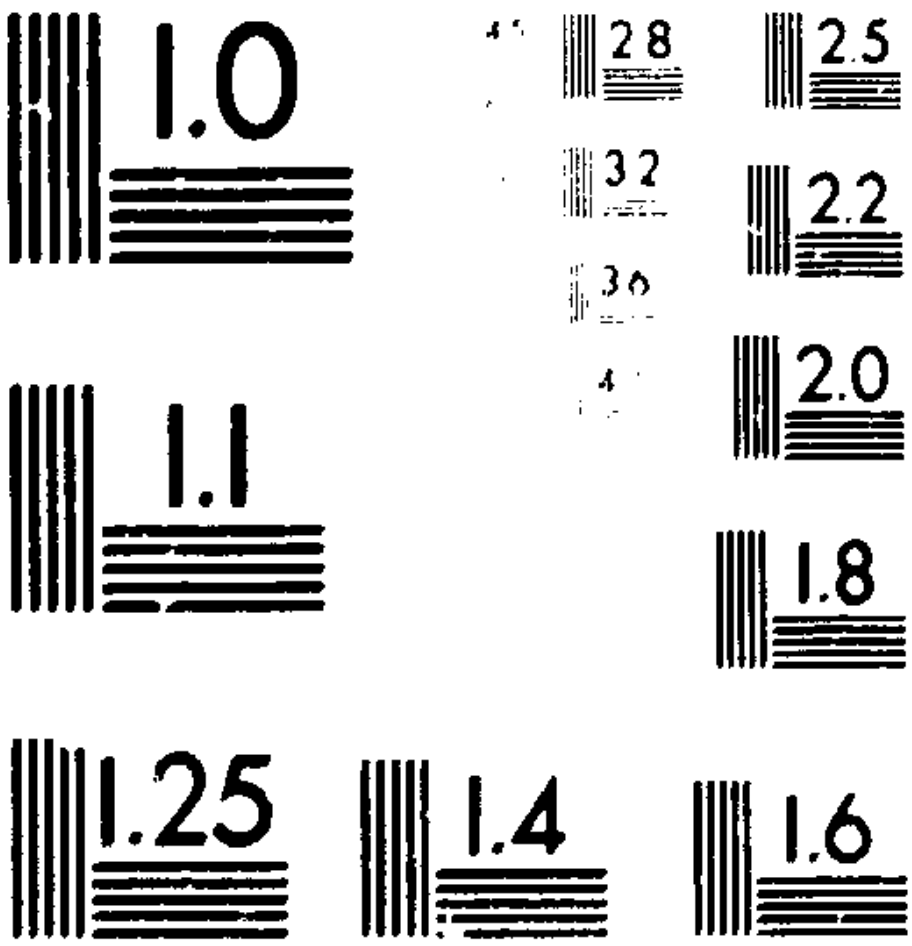

Table 19. Brazil: Technological Balance of Payments

/in US$ million/

	Receipts /a/	Payments /b/	Percentage /a/ /b/
1965	-	42	-
1966	5	46	10.9
1967	13	63	20.6
1968	9	70	12.9
1969	9	91	9.9
1970	44	104	42,3
1971	40	132	30.3
1972	53	154	34.4
1973	84	166	50.6
1974	109	212	51.4
1975	135	311	43.4
1976	133	362	36.7
1977	186	513	36.3
1978	222	591	37.6
1979[x]	264	782	33.8

[x] It excludes equipment rentals worth this year US$ 565 and 1.226 million for receipts and payments, respectively. To the extant that Brazilian /foreign/ manufactured equipment is used to carry out works abroad /in Brazil/ by Brazilian /foreign/ companies, these values are also associated to technology transfers both ways in the broad sense defined; ie., as including engineering and technical services. We do not know, however, how large that proportion is.

Source: F.C.Sercovich - Brazil as a technology exporter, JADB, April 1981, p.15.

Table 20. Brazil: Sectoral Breakdown of Technology Exports According to Date of Contract /in number of observations/

	Up to 1975	1976	1977	1978	1979	1980	1981[x]	Total
Manufacturing industry	10	9	5	14	26	20	4	88
Construction	8	6	8	22	10	5	.	59
Consulting	21	-	4	3	1	-	.	29
Total	39	15	17	39	37	25	4	176

[x] first two months

Source: see table 19 p.20.

Table 21. Brazil: Technology Exports by Destination /in number of observations/

	Latin America	Middle East	Africa	Europe	U.S.A.	Japan	Total
Manufacturing Industry	53	-	12	10	12	1	88
Construction	40	7	8	2	2	-	59
Consulting	25	4	-	-	-	-	29
Total	118	11	20	12	14	1	176

Source: see table 19

Table 22. Brazil: Regional Distribution of Technology Export Contract Value /in US$ million/

	Latin America	Middle East	Africa	Europe	Non-Identified	Total
Manufacturing Industry /12/[x]	98,0	-	0,3	-	12,6	110,9
Construction /36/[x]	1388,5	1422,0	227,0	1,5	-	3049,0
Consulting /10/[x]	3,0	5,4	-	-	-	8,4
Total /58/[x]	1489,5	1427,4	227,3	1,5	12,6	3168,3

[x] Number of observations

Source: see table 19 p.22.

Table 23. Brazil: Technology exports by the Construction Industry

Type of Work	Number of Observations	Relative Share /%/
- Hydroelectricity and Transmission Lines	17	28.8
- Highways /including tunnels, bridges and related works/	12	20.3
- Communications	6	10.2
- Ports	4	6,8
- Urban Construction	4	6.8
- Airports	3	5.1
- Water Systems	3	5.1
- Railways	1	1.7
- Others	9	15.5
T o t a l	59	100.0

Source: table 19

Table 24. Technology exporters from Egypt a/

Name of Company	Ownership	Main Activity	Year Established	Employees	Annual Turnover (U.S. $ mill.) 1979	1981	Total Exports 1979	1981	Main Technological Exports	Destination(s) of Technological Exports
1) Shawki & Co.	Private	Accounting and Mgt. Consulting Services	1940	130 (1981)		.65[1]	.26	.30	Mgt. consulting, accountants, training	Kuwait, rest of Third World
2) Engineering & Industrial Design Development Center (EIDDC)	Public	Training in industrial design and Engineering	1968	453 (1981)		.75[2]	--	--	In-plant training, prototype development	Syria, Iraq, Tanzania
3) Societe des Sucreries et de Distillerie d'Egypt	Public	Manufacturing of sugar, begasse pulp, alcohol, cosmetics, adhesives, machinery factory for foundry and steel construction	1855		156.0[3]		28.84[4]		Parents, know-how engineering, technical assistance, labor supply, feasibility technical & engineering studies	Europe, Sudan, Morrocco, Iraq, Oman, Other African and Third World Countries
4) Erection and Industrial Services Co. (Eriscom)	Public	Engineering services erection of mechanical and electrical projects	1974	28,000 (1981)	8.5	9.42	.89	1.55	Engineering services, technical assistance	Iraq
5) El Nasr Automotive Mfrg. Co.	Public	Automotive Assembly	1958	9,700 (1981)	148.7	153.0	0	0	Training for after-sale service	Iraq, Kuwait, Lybia, Algeria
6) Helwan Machine Tools Co.	Public	Machine tools, production, engineering, and technical services	1960						Technical assistance	Iraq
7) General Company for Paper Industry (NAKTA)	Public[5]	Pulp, paper, and board manufacture	1958	2,157 (1981)	26.80	30.79	0	0	Paper mills, chemical waste recovery	Iran, Iraq, Pakistan
8) El Nasr Salines Co.	Public	Salt mining and processing	1850		6.64				Consulting, engineering, technical assistance, turnkey plants	Iraq, Saudi Arabia, Yemen (North and South), Lybia, Cameroon, Sierra Leon, Nigeria

Table 24. /Contd./

Name of Company	Ownership	Main Activity	Year Established	Employees	Annual Turnover (U.S. $ mill.) 1979	1981	Total Exports 1979	1981	Main Technological Exports	Destination(s) of Technological Exports
9) Egyptian Iron and Steel Co.	Public	Steel products	1954	25,400 (1981)	170.88	235.59	.625	.820	Technical assistance, skilled labor	Saudi Arabia, Somalia, Kuwait, Qatar, Morocco, Syria
10) Misr Spinning and Weaving Co. (Mahalla)	Public	Textiles, spinning and weaving		20,000+ (1981)	212.2		59.61		Technical assistance, consulting, training, management services	Saudi Arabia, United Arab Emirates, Bahrain, Qatar, Jordan, Iraq, Sudan, Morocco
11) Kahira Pharmaceuticals Co.	Public	Pharmaceuticals							Technical assistance, turn-key plant	Iraq, Lybia
12) Business Services International	Private	Personnel recruitment and other services for int. firms	1980	NA	NA	NA	NA	NA	Recruiting skilled manpower, esp. medical staff	Saudi Arabia
13) General Organization for Gov't Printing Offices	Public	Printing and Publishing	1820	3,750 (1980) 3,500 (1981)	10	9.3	NA	NA	Training of foreign workers	Trainees from Saudi Arabia, Kuwait, Qatar, Jordan, Iraq, Sudan, and Lybia
14) e Egyptian echanical Precision Industries Co. (SAMI)	Public	Home, industrial, and corporation related material (zip fasteners, bathroom fixtures, hinges, locks, spark plugs . . .	1960	2,152 (2,090)[6] (1980) 2,127 (1981)	8.3	13.3	.243	.060	Training of foreign workers	Trainees (5 in all) from Holland, Jordan, Tunisia
15) The Egyptian International Center for Agriculture	Public	Agricultural training	1965	NA	NA	NA	NA	NA	Training	

Table 24. /Contd./

Name of Company	Ownership	Main Activity	Year Established	Employees	Annual Turnover (U.S. $ mill.) 1979	1981	Total Exports 1979	1981	Main Technological Exports	Destination(s) of Technological Exports
16) Delta Consulting, Ltd. Inc.	Private	Management consulting	1975	21 (1981)	--	0.25	0.1	--	Management Consult-Services	Saudi Arabia
17) Electrocable Egypt	Public	Manufacturing wires and cables	1956	3,000 (1981)	--	--	--	--	Technical skills, training	Libya, Saudi Arabia
18) The Arab Contractors (Osman Ahmed Osman & Co.)	Public	Construction, Agro-business, Industrial activities	1951	40,000 (1980) 44,000 (1981)	570	700	--	--	Consulting engineering, Management turn-key plants	Saudi Arabia, Kuwait, Iraq, Libya, Sudan, Jordan, Oman
19) Nasr Boiler Company	Public	Manufacturing boilers and Pressure Vessels	1962	--	--	--	--	--	--	--
20) Center for Planning and Architectural Studies	Private	Training, Architecture, Planning, Publishing	1980	20 (1980) 35 (1981)	0.05	0.15	--	--	Architectural Services, Training	Saudi Arabia
21) SEMAF	Public	Manufacture of railroad cars	1955	2,700 (1980) 3,017 (1981)	40	582	--	--	Engineering drawings, Training	Rumania, Sudan, Syria, Ghana, Pakistan
22) El Nasr Forging Co.	Public	Manufacture of forgings	1961	1,770 (1980) 1,843 (1981)	5.787	8.414 (1980)	--	--	Training of industrial workers, trained manpower	Western Europe, Saudi Arabia, Kuwait, Iraq, Bahrain, Qatar, UAE, Sudan, Nigeria, Somalia, Tanzania, Tunesia, Poland, Yugoslavia
23) National Research Center	Public	Research and Training	1956	2,475[7] (1980)	--	--	--	--	Training, Trained manpower	Saudi Arabia, Iraq, Libya, Algeria, Kuwait, Yemen, Oman, Qatar, UAE, Jordan, Sudan, Kenya, Pakistan, Africa

a/ As identified by field survey.
Source: Technology exports from developing countries: The case of Egypt, by Tagi Sagafi-nejad, UNIDO/IS.362, pp 21-23.

Table 25. Billings of the 200 top international consulting firms

by nationality and source of payments

Consulting firm nationality	Total foreign billings		From geographical region:							
			Middle East		Asia		Africa		Latin America	
	$ Mn.	%	$ Mn.	%	$ Mn.	%	$ Mn.	%	$ Mn.	%
United States of America	1,264.5	33.8	502.1	39.6	232.5	31.7	168.2	19.1	188.0	49.3
OECD Europe	1,798.0	48.1	563.3	44.5	344.5	47.0	547.1	62.2	130.3	34.1
of which:										
United Kingdom	514.1	19.8	194.0	15.3	154.5	21.1	134.7	15.3	13.0	3.4
France	326.8	8.7	65.5	5.2	21.1	2.9	155.3	17.6	39.0	10.2
Scandinavia[a/]	275.3	7.4	98.9	7.8	37.8	5.2	64.0	7.3	21.7	5.7
Fed. Rep. of Germany	226.4	6.1	91.6	7.2	32.7	4.5	70.8	8.0	18.4	4.8
Netherlands	168.3	4.5	29.0	2.3	64.7	8.8	48.6	5.5	10.1	2.6
Switzerland	139.3	3.7	36.8	2.9	25.0	3.4	19.8	2.3	16.1	4.2
Canada	282.9	7.8	52.1	4.1	42.6	5.8	60.2	6.8	39.9	10.5
Japan	112.9	3.0	26.1	2.1	69.3	9.5	13.7	1.6	2.9	0.8
Other	278.3	7.3	122.8	9.7	43.6	6.0	90.9	10.3	20.4	5.3
TOTAL	3,736.6	100.0	1,266.4	100.0	732.5	100.0	880.1	100.0	381.5	100.0

a/ Total of Denmark, Finland, Norway and Sweden.

Source: UNCTAD TD/B/RBP/12, p. 4

Table 26. The fifteen largest consulting firms from developing countries - 1982

Name and country of origin	Type of services provided[a/]	Range of earnings from abroad (1)	Share of (1) in total earnings	Foreign markets in 1982	
				Developing countries	Industrialized countries
Dar Al-Handasah Consultants (Shair & Partners) LEBANON	All	Over $50 mn.	99 %	Bahrain, Iraq, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, Syria, U.A.E., North Yemen, Algeria, Egypt, Morocco, Sudan Angola, Cameroon, Nigeria	
Daelim Engineering Co. Ltd. REP.OF KOREA	All	Between $10 mn. and $19.99 mn.	89 %	Iraq, Kuwait, Saudi Arabia, Indonesia, Malaysia, Egypt	
Hidroservice Engenharia de Projetos Ltda., BRAZIL	All	Between $20 mn. and $29.99 mn.	44 %	Argentina, Bolivia, Ecuador, Guatemala, Paraguay, Peru Uruguay, Guinea, Nigeria	Portugal
Khatib & Alami Consolidated Engineering Co. LEBANON	All	Between $20 mn. and $30 mn.	81 %	Bahrain, Jordan, Oman	
Associated Consulting Engineers (ACE) S.A.L. LEBANON	All	Between $20 mn. and $30 mn.	96 %	Bahrain, Iraq, Jordan, Kuwait, Saudi Arabia, Egypt, Nigeria	
Rail India Technical & Economic Services Ltd., INDIA	a,c,e,f, g,h,i.	Between $10 mn. and $19.99 mn.	78 %	Iraq, Jordan, Malaysia, Philippines, Algeria, Ghana, Mozambique, Nigeria, Tanzania, Zaire, Zambia, Zimbabwe	Japan
Geotecnica S.A. BRAZIL	All except b	Between $5 mn. and $10 mn.	25 %	Argentina, Peru, Iraq, Mozambique, Qatar, Saudi Arabia, U.A.E.	
Development Consultants Pvt. Ltd. INDIA	All except h & i	Between $5 mn. and $10 mn.	51 %	Venezuela, Iraq, Syria, U.A.E., Libyan Arab Jamahiriya, Kenya, Tanzania	
Cror Engineering Co. Ltd. Rep. of KOREA	All except h & i	Between $5 mn. and $10 mn.	92 %	Saudi Arabia, Indonesia, Singapore	
China Engineering Consultants Inc., CHINA b/	All	Between $5 mn. and $10 mn.	45 %	Jordan, Indonesia	
Promon Engenharia BRAZIL	All	Between $5 mn. and $10 mn.	7 %	Chile, Uruguay, Venezuela Algeria, Nigeria	
Sinotech Consultants CHINA b/	All	Between $5 and $10 mn.	26 %	Venezuela, Caribbean, Saudi Arabia, Indonesia	
Associated Consulting Engineers PAKISTAN	a,b,c, d,e,f.	Between $3 mn. and $5 mn.	63 %	Iran, Saudi Arabia, U.A.E., Indonesia, Malaysia, Libyan Arab Jamahiriya, Nigeria, Tunisia	
Hyundai Engineering Co. Ltd. Rep. of KOREA	All	Between $3 mn. and $5 mn.	14 %	Bahrain, Iraq, Saudi Arabia, Malaysia, Thailand, Papua New Guinea, Libyan Arab Jamahiriya, Kenya, Nigeria	
Sumra International MALTA	All except h & i	Between $3 mn. and $5 mn.	100 %	Libyan Arab Jamahiriya	

a/ (a) architectural, (b) mechanical, (c) environmental engineering, (d) civil engineering, (e) electrical engineering, (f) area planning, (g) construction management, (h) structural planning, (i) transport planning.
b/ In Taiwan Province of China.

Source: UNCTAD TD/B/REP/12, p.5

Table 27. : Contracts awarded to international contractors

by developing region markets in 1982 a/

Contractor nationality	Number of firms	Total Contracts Awarded		Geographical region:							
				Middle East		Asia		Africa		Latin America	
		$ Bn.	Share	$ Bn.	%	$ Bn.	%	$ Bn.	%	$ Bn.	%
United States of America	46	44.9	36.5	13.5	36.1	9.4	40.0	2.8	15.8	3.9	37.9
OECD Europe	96	45.2	36.7	14.8	28.9	5.4	23.0	9.8	55.4	5.8	56.3
of which:											
France	18	11.4	9.3	3.7	7.2	1.3	5.5	4.4	24.9	0.9	8.7
Fed.Rep.of Germany	15	9.5	7.7	2.4	4.7	1.8	7.6	1.3	7.3	0.6	5.8
Italy	15	7.8	6.3	2.8	5.5	0.2	0.9	1.5	8.5	3.1	30.1
United Kingdom	14	7.5	6.1	3.0	5.8	1.1	4.7	0.9	5.1	0.4	3.9
Republic of Korea	30	13.8	11.2	10.7	20.9	2.4	10.2	0.6	3.4	-	-
Japan	27	9.3	7.6	2.5	4.9	5.6	23.8	0.8	4.5	0.1	1.0
Yugoslavia	10	1.3	1.0	0.6	1.2	-	-	0.6	3.4	-	-
Turkey	9	2.7	2.2	1.9	3.7	-	-	0.8	4.5	-	-
Others	32	5.9	4.8	2.2	4.3	0.7	3.0	2.3	13.0	0.5	4.8
TOTAL	250	123.1	100.0	51.2	100.0	23.5	100.0	17.7	100.0	10.3	100.0

a/ Regions indicated are those of ENR/21 July 1983 and might not correspond exactly with United Nations classification of developing countries.

Source: UNCTAD TD/B/RBP/12, p.8