Technological Movements on a World Scale

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Transnational Technology Transfers in the 80's: Myths and Realities
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The symposium 'Transnational Technology Transfers in the 80's; Myths and Realities' was held on occasion of the thirtieth anniversary of NUFFIC. The acronym NUFFIC stands for Netherlands Universities Foundation For International Co-operation, founded in 1952 by the Dutch universities to foster world-wide academic co-operation.

In retrospect, the record of concrete results is all but encouraging. The creation of NUFFIC has not yet amounted to something structurally different. A recent survey by NUFFIC-staff shows, that international development co-operation lives by incidental motivation and involvement of top executives and members of faculty. Sooner or later, anybody active in this field experiences, that such is not a sound basis.

Meanwhile the economic world crisis aggravates rapidly and does not leave the rich unaffected. But the response of the Western World is one of protectionism (as one can witness at the present UNCTAD-conference in Belgrade). In the 60's and 70's discussion-topics were: Unified Approach, Structural Change, Self-reliance, Basic Needs and New International Economic Order. In the 80's for most Third World countries the important topic will be that of survival.

Presently, a tendency towards commercialization of knowledge is undeniable. Main actors are the multinational enterprises, but also universities are encouraged to offer knowledge on commercial terms. Thus the free flow of knowledge is drying up.

Technology exports have consequences, not only for Delft University of Technology (DUT), but for the Third World as well. It is of utmost importance to investigate the transfer mechanism in a transnational perspective, and all speakers have tried to do so from various points of view.

In his opening speech Dr. Dieter Ernst (Projekt Technologietransfer, University of Hamburg) focused on recent trends in the international transfer of technologies. He discusses on what conditions, technologies for industrial production are transferred to developing countries and states that especially multinational corporations take a great part in the worldwide proliferation of industrial technologies. Attempts to extend the life cycle of technologies and the need to spread the excessive cost burden...
are major motives underlying this. For the '80's Dr. Ernst considers two developments of special interest: the increasing constraints to North-South transfer of technology and a growing resistance against the prevailing dominant technology systems.

After some introductory remarks on the debate of technology transfer in the period 1950-1983, Prof. Valpy FitzGerald (Institute of Social Studies, The Hague) shows that a more independent development is possible. Nicaragua serves as his case in point. The reduction of dependency does not mean autarky, but diversification towards new OECD power centres (EEC, Japan), Third World suppliers (the so-called NIC's) and to the Latin-American market, such as Brazil, Mexico and Venezuela. The lesson for a small country is not to say 'no' to all foreign investment, but rather to negotiate case by case within a specific technology policy. In this field people from universities can offer an enormous amount of help, because there is a total lack of information in countries such as Nicaragua.

Prof. Peter Odell (Erasmus University Rotterdam) has talked about the relationship between the international oil corporations and the countries of the Third World. Due to OPEC's success the international companies have been motivated to restrict their activities to politically 'safe' regions. Nationalization situates the responsibility for achieving appropriate technology with the state company which, unless very successful both operationally and politically, may have to give a low priority to new technology inputs. Prof. Odell concludes with some remarks on the role of international organizations.

In the process of technology transfer consultants play an important role. Mr. Pieter van der Sluis (NEDECO, The Hague), has characterized his profession as a brain intensive sector of the economy. He regards know-how as a commodity, to which he relates the product-life-cycle theory. In conclusion Mr. Van der Sluis gives his expectations about the future of engineering consultants, i.e., provided the free market economy game is conducted properly, there is a future in our world for all kinds of consultants.
In his contribution Dr. Gerard van der Horst (NUFFIC, The Hague) has dealt with the role of the Dutch university teaching and research activities in as much as they are relevant to the problems of the under-privileged. These activities are facing great pressure due to budget cuts and the new system of conditional financing of research. Although, according to Van der Horst, Delft University has not yet accomplished what it could in development co-operation. DUT also has many old links with Dutch industry, so Van der Horst suggests the creation of a new centre of (appropriate) industrial technology in co-operation with TNO ("Nederlandse Organisatie voor Toegepaste Natuurwetenschappelijk Onderzoek"), FMO ("Financierings Maatschappij voor Ontwikkelingslanden") and RVB ("Researchinstituut Voor Bedrijfswetenschappen"). This initiative fits very well in the ideas of the Lubbers administration.

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Two more persons should be praised here explicitly; they are:
— Dr. M.S.S. El-Namaki who ably chaired the symposium
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Paul Althuis
Art Vervuurt
International Transfer of Technology and the Restructuring of World Industry - Trends and Perspectives.
2.1. Introduction

The focus of my intervention will be on recent trends in the international transfer of industrial technologies. After giving a few comments on the existing myths of international transfer of technology, I will discuss somewhat more in detail some of the main mechanisms for transferring industrial technology to developing countries. I will underline the need to perceive transborder flows of technology as an essential element in the internationalization of industrial production. Third, I will identify some of the main actors involved in this game and their underlying motivations and strategies. Finally, I will add a few comments on the perspectives for the 1980's (1).

Since the end of the 1960's, international transfer of technology has ranked high on the agenda of international conferences geared to a reform of international economic and in particular to North-South relations. In fact, the rapid worldwide proliferation of technologies, particularly those related to industrial production and consumption, into even the remotest corners of the world market, has given rise to a new type of technological determinism, i.e. the myth of international transfer of technology. What this myth basically implies, is that first technology per se determines changes in the given patterns of international division of labour and that second prevailing modes of transborder flows of technology would decrease rather than increase the inequality of international economic and political relations. This perception of international transfer of technology has turned out to be remarkably influential. It certainly dominates mainstream thinking, not only in the major capitalist countries of the OECD-region, but also in the socialist countries of the COMECON and in a great majority of developing countries. According to this view, if international transfer of technology would only be accompanied by a few secondary reforms, relating mainly to costs and transfer modalities, it could become a powerful instrument for upgrading the development potential to Third World countries. In particular, according to this view, it would lead to a redeployment of industries to a growing number of developing countries in such a way, that these societies could build up viable and internationally competitive industrial structures.
In short, what the myth of international transfer of technology basically claims is that by means of importing 'modern' technology, developing countries could do away with some major structural constraints to development and could speed up their transformation into industrial societies.

In what follows, I will show that, in contrast to textbook wisdom and the phraseology of international conferences, international transfer of technology into developing countries is not the result of some kind of global welfare policy, which would aim at narrowing down international growth and development disparities by means of an improved worldwide distribution of access to technology. International transfer of technology instead should be perceived as an important element in the strategies of private firms, particularly multinational corporations, originating from the US, Western Europe and Japan, which are increasingly forced to internationalize their overall cycle of capital reproduction. The message I would like to get across to you is, that amidst a severe crisis of the world economy, access to key technologies and innovative capacities more than ever before has become an important instrument of domination. This applies both to power relations within a society and to international relations, particularly to North-South relations. What matters is that access to this type of knowledge is highly unequal and that it conveys tremendous power to those who control it.

2.2. International Transfer of Technology - An Essential Prerequisite for the Internationalization of Industrial Production.

International transfer of technology has become an increasingly important vehicle for structural change in the world economy and particularly for the internationalization of industrial production. During the last two decades major structural changes have in fact occurred in world industry. One of them is the proliferation of industrial activities to production sites outside the traditional growth poles of the OECD-region and the COMECON, i.e. the redeployment of industries to the Third World.
Until recently priority candidates for this type of industrial restructuring were those products and stages of production which basically require a cheap, docile and unskilled labour force (particularly garments, shoe and leather industries, consumer electronics and chip assembly). In addition, some basic industries, requiring a lot of energy or being heavy polluters and some first attempts to proceed with down-stream processing of raw materials have been involved, particularly in the field of petro-chemicals, pulp and paper and so on. What matters is that a huge part of the machinery and technical and organizational knowledge required for designing and constructing these factories in the Third World had to be imported. The same applies to the management of production and complementary support services such as inventory, maintenance, marketing, after sales services, finance and insurance. It is in this sense, that transborder flows of technology have turned out to be an essential prerequisite for the internationalization of industrial production.

How to determine precisely the volume and composition of these international flows of technology is still very much open to dispute (2). Suffice it to say here, that technologies for industrial production are transferred to developing countries mainly through the following mechanisms:

a. Through licensing and the supply of know-how, technical and commercial service;
b. As part of foreign direct investment.
c. Through the export of capital goods and integrated industrial projects, particularly turn-key projects.

ad.a. Licensing and the Supply of Know-How

Licensing and the supply of know-how usually takes place at a considerable cost and it is surrounded by a great variety of explicit and implicit restrictions to the utilization of this knowledge. Worse still, it is of a strictly selective nature - usually it is restricted to globally standardized operational and maintenance know-how, sometimes it includes knowledge needed for adaptative engineering. Access to systems knowledge, however, which a developing country would need in order to be able to reproduce and further develop the imported technology, is excluded for all practical purposes.
ad.b. Direct Foreign Investment

Transfer of technology embodied into direct foreign investment (DFI), of which a huge part consists of flows internal to large transnational conglomerates has been the privileged mechanism for an exclusive community of high-growth countries, such as Brazil and Mexico in Latin America, the ASEAN group in South East Asia, and most countries of the European periphery, particularly Spain and Ireland.

For the rest of the Third World, DFI expressed as a proportion of gross fixed capital formation has considerably declined during the 1970's and had to be increasingly substituted by commercial borrowing, controlled by transnational banking consortia.

Furthermore, patterns of DFI in the Third World differ considerably, depending on the sectors and regions to which investment is allocated. It can be shown for instance that during the 1970's, there have been significant regional differences with regard to capital intensity of investment and its productivity (3). On the one extreme, firms investing in South-East Asian run-away export platforms industries tended to deploy relatively low values of investment per worker. The values are in an intermediate position for the Mediterranean area and Latin America, and reach their highest values for OPEC and African countries. In the latter two groups of countries, investment is predominantly geared to infrastructure and some basic industries and related first-stage downstream activities.

These types of investment tend to be much more capital-intensive than world market-oriented investment. In the extreme case of sub-Saharan African countries, which are still dependent on one or two exportable natural resources, this means that countries with the least resources and the highest levels of misery have to pay most for their industrial capital formation.

Viewed from the perspective of transnational corporations, the rationale behind this "perverse" state of affairs is obvious - what counts for these firms is that access to energy, mineral and certain agricultural resources can be secured at lowest costs. Consequently, programmes to build up complementary infrastructure do not have to bother with
transferring skills and can rely on solutions transplanted from abroad which are expected to guarantee a rapid and cost-efficient finalization of the projects.

Viewed however from the perspective of the African countries "receiving" this type of investment, this pattern of transferring technology implies a massive waste of resources.

Output per unit of foreign direct investment follows the opposite pattern: locations in South East Asia showed the highest capital productivity whereas investment in Africa and OPEC/Middle East countries showed the lowest output per unit of investment with Latin America taking an intermediate position.

Thus, international transfer of technology embodied into DFI certainly has considerably increased the already very high disparities between a handful of industrial growth poles in a few NICs and OPEC countries, and the rest of the Third World.

ad.c. Capital Goods

Developing countries today are heavily dependent on imported capital goods. According to figures prepared by the OECD Secretariat (4), 58 units of imported capital goods are needed on an average in developing countries to produce 1,000 units of PDG. For capital formation in industry, this dependence on imported capital goods is considerably higher - even for the more successful NICs, the OECD study reports ratios of 500-700. It is important to note that by far the greatest share, i.e. more than 90 per cent of these imported capital goods are still originating from the OECD region.

Obviously there exists a hierarchy of dependence on capital goods imports. The most extreme case would be some OPEC countries in the Middle East like Saudi Arabia or the Gulf States, which depend practically in total on capital goods and where these imports are primarily geared to investments and infrastructure and basic industrial capacities (basic petrochemicals, iron and steel). On the other end, we would have countries like Brazil, Argentina, Spain, Mexico or India, where in aggregate statistical terms at least, local capital goods production contributes to a much higher degree to capital formation.
One should add however, that this type of aggregate statistics does not adequately reflect the degree of dependence on imports of capital goods and on the complementary knowledge needed to operate, maintain, reproduce, adapt and further develop them. In fact, even in the most positive cases, where the aggregate share of local capital goods production in industrial capital formation tends to be relatively high, capital formation will still continue to depend in a crucial manner on imports of capital goods and technology. This would be so for at least three reasons:

- the high degree of effective control exercised by foreign investment over "national" capital goods industries;
- the low share of strategic capital goods produced locally, for instance: NC machine tools and particularly CNC systems, automated equipment needed in raw materials processing plants, and information processing and telecommunications equipment;
- the subordination of prevailing capital goods industries to Western industrialization patterns which, due to their high economic and social costs and their inability to develop viable patterns of capital formation and socio-economic development, are rapidly becoming obsolete.

2.3. Actors involved and underlying motivation

Viewed from a Third World perspective, all of the afore-mentioned mechanisms of North-South technology transfer involve very high economic and social costs: imported technologies usually imply a waste of scarce local economic resources and tend to produce a variety of deformations in the existing productive and social structures. In fact, prevailing modes of transferring technology have increased rather than decreased international inequalities, and this is true in particular for access to strategic assets for industrialization (systems knowledge; innovative capacities; finance) and the geographic and sectorial hierarchization of world industry (5).

However as a result of centuries of externally geared underdevelopment most developing countries, including the most outspokenly socialist
ones, today need technology imports on a massive scale if they want to increase output, productivity and their long-term development potential, both in industry and in agriculture. They can thus hardly afford to renounce completely to any one of these mechanisms.

The lessons of history are quite obvious: from Chile to Mozambique, from Cuba to Vietnam (let alone the prospective future of a socialist Central America), it has always been the same sad story. After a political revolution, a developing country strives to get a strategy of transition off the ground towards a mode of economic and social development which stresses autonomy and the needs of the underprivileged. Sooner or later, the fact that science-based technology has to be imported on a significant scale, starts to have negative consequences on the scope for such 'alternative' strategies. Clearly, technological dependence per se would not be that critical. The real issue is rather the effects of technological dependence, most of them indirect and long term, on the overall economic, financial and political dependence and structural deformation of Third World societies.

The crucial problem then for the societies is to ensure that the process of importing foreign technology will not lead to such a qualitative intensification of dependence. This certainly implies, that the import of technology takes place in a strictly selective manner and that these technologies will be subordinated to the requirements of an increasingly self-reliant development. This is in fact the essence of what I have called elsewhere a 'strategy of selective technological delinking (6). A prerequisite for such a strategy would be to collect information on the actors involved in the international transfer of technology, their interests and the distribution of costs and benefits related to the international flows of industrial technology.

2.4. The Growing Reliance of Multinational Corporations on the Worldwide Proliferation of Industrial Technologies - The Underlying Rationale

In principle, exports of technology for industrial production in the developing countries could originate from three different sources:
from OECD countries;
- from COMECON countries;
- and from other developing countries, particularly NIC's.

Technology suppliers could be private or public firms, government institutions or supranational public organizations like the United Nations or the European Economic Community.

In reality, one particular type of technology supplier is clearly of primordial importance. In fact, private firms based in OECD countries are by far the major source of technology for industrial production in developing countries. This applies especially to firms originating from six countries - the United States, Japan, the Federal Republic of Germany, France, Italy and Great Britain. To a lesser degree, firms from Canada, Scandinavia, the Benelux countries and Austria are involved. It is within this dominant group of technology suppliers that the most important structural changes took place during the last 30 odd years. The increasing rivalry and competition between firms based in major OECD countries has been the name of the game of transborder flows of industrial technology. This is why we have to focus far and foremost on this type of actors when we talk about how unequal control over innovative capacities and international transfer of technology is going to influence the restructuring of world industry.

What then have been the motivations behind the growing engagement of multinational corporations in transborder flows of technology? Three of them deserve particular attention:

- attempts to extend the life cycle of technologies by means of global strategies of "planned obsolescence";
- the growing pressure to penetrate new and increasingly protected markets through export of technology;
- and the need to spread the excessive cost burden of R&D through corporate strategies of "burden sharing among unequals".
2.4.1. Attempts to Extend the Life Cycle of Technologies

Amidst a severe crisis of world economy, new forms of a global oligopolistic competition are emerging and rivalries both within and between major economic groupings are dramatically increasing. This applies in particular to conflicts between the United States, Western Europe and Japan.

Consequently, firms are forced to perceive the export of technology increasingly as an instrument for extending the life cycle of technologies which are either at a high state of "maturity" or are going to become obsolete in the very near future.

In this sense, the international transfer of technology performs the function of a substitute for innovation. In fact, a significant part of the transfer of technology to developing countries consists of mature or obsolete consumption technologies, which furthermore, are sold at excessive prices.

However, this technological conservatism, inherent in the export of technology, should not be overdone. Obviously, it is not only mature or obsolete consumption technologies which are transferred to developing countries, as the product life cycle theory seemed to imply. Modern or high technologies have recently been transferred to developing countries on an increasing scale, including for instance the transfer of new information technologies based on microelectronics. It is essential to understand that this transfer of "modern" technology is no less a part of a global strategy of "planned obsolescence" as is the transfer of mature and obsolete technologies. The near complete control, by a handful of private firms, of important product and process innovations is used by those firms as a major instrument of oligopolistic competition, i.e. by skillfully devising optimal time patterns for obsolescence.

2.4.2. The Growing Pressure to Penetrate New and Increasingly Protected Markets

The worldwide commercialization of technologies has turned out to be a very efficient instrument for the penetration of protected markets.
There is an obvious need for western capital to penetrate new markets: world trade whose volume, during the period 1963-1973, had an average annual growth rate of 9 per cent, since 1974 has grown by less than 4 per cent. Latest figures released by GATT (7) show that world trade in real value terms has been continuously declining since mid-1980 from a peak of $2,000 billion.

This tremendous crippling of export possibilities applies especially to intra-OECD trade and, even more dramatically, to trade within the European Economic Community. Given the stagnation of East-West trade, the disclosure of "new frontiers" will have to take place mainly in some developing countries, especially the OPEC countries and some NICs in Latin America and South-East Asia. There are three types of "growth markets" available in these countries: private luxury consumption, government procurement markets and world market factories. As each of these market segments is surrounded by a high level of effective protection, the export of technology might in fact be the only way to penetrate these markets. This point has been succinctly stated by Thomas A. Gallagher Jr., an American industrialist and influential consultant for the technology export policy of the U.S. government: "Markets closed to products are invariably open to technology. Even extremely close markets will open to western technology, providing the West gives them the credit to make the purchase! ----- as long as the United States is the predominant technological power in the world, closed product markets will always be open to American technology" (8).

2.4.3. The need to Spread the Excessive Cost Burden of Research and Development

The international transfer of technology has been increasingly perceived by corporate headquarters as a necessary and efficient instrument for shifting the enormous cost burden of research and development onto other shoulders, especially those of weaker bargaining partners. For this sake, a lot of very efficient instruments - most of them rather informal ones - have been devised by business intellectuals and management think-tanks: the great variety of transfer pricing practices and some new techniques of global cash management are just two cases in point.
Corporate strategies of "burden-sharing among unequals" have contributed considerably to the overall dependence and structural deformations of developing countries. In fact, they have helped to establish very efficient and flexible mechanisms for a significant and increasingly perverse transfer of financial means from developing to industrialized capitalist countries, through which developing countries are actively funding R&D activities in the United States, Western Europe and Japan.

It is important to note that technology-exporting firms do not have much room for compromise on this issue. In fact, "burden-sharing among unequals" is a fairly rational reaction to an objective dilemma. From corporate headquarters' point of view, this dilemma might be roughly described in the following way: How to finance that minimum of innovative activities, which is essential for securing worldwide oligopolistic market positions, given the following constraints:

- the strategic importance of R&D for capital accumulation;
- the excessive rates of inflation pertaining to R&D costs;
- the very high risks inherent in R&D?

It is thus safe to conclude that multinational corporations will have to rely increasingly on the export of technologies so that at least part of the growing R&D cost burden can be recuperated. As demand and investment keep stagnating, if not retrogressing, in practically all major OECD countries, and as an increasingly pervasive protectionism is surrounding these economies, a growing share of the multinational corporations' technology exports will have to go to the Third World and particularly to OPEC countries and NICs.

2.5. Perspectives for the 1980s

What then are the implications to be drawn from this rather depressing diagnosis and what are the perspectives for the 1980s?

Let me first refute one possible misinterpretation. By stressing the growing importance of technology for economic and social development
both within Third World societies and internationally, one should not fall into the trap of technological determinism. The motor of the system is not technology, but social and political change, i.e. basically class struggle, both within a society and on an international scale.

My presentation has been biased in the sense, that I have focused practically exclusively on one particular type of actor, i.e. huge, transnational conglomerates originating from the U.S.A., Western Europe and Japan. I have done so, because this allowed me to analyse the logic underlying the prevailing modes of the international transfer of technology.

Reality, however, is much more complex and there are in fact important countervailing social forces emerging, both in the Third World and in our own societies which are certainly going to play an increasingly important role in this game.

Two developments would seem to deserve particular attention:
- the increasing constraints to North-South transfer of technology;
- a growing resistance against the dominant technology systems.

2.5.1. Increasing Constraints to North - South Transfer of Technology

The constraints to a consensus among the main actors of international transfer of technology, both in industrialized and in developing countries, have been rapidly increasing amidst the present economic crisis.

Protectionism for instance threatens to become a problem of global proportions in the 1980s. Persistently high unemployment and slow economic growth in the United States and Europe have combined to intensify protectionist pressures and to weaken free-trade norms. Trade frictions have multiplied between nations and across sectors as the expansion of world trade has come to a halt. This outbreak of protectionism has taken a variety of new forms. In fact, the proliferation of so-called "voluntary export restraints" (VERs) and "orderly marketing agreements" (OMAs) has become so widespread that these barriers now rank equally with tariffs and quotas as the most widely used commercial policies.
Consequently, the "golden age" of international transfer of technology might soon give way to a series of new and basic contradictions which we are only just beginning to understand. This would apply in particular to the increasingly intense rivalry between United States, Japanese and Western European firms, and their respective governments, but also to the manifold new forms of conflict emerging between private firms and governments in newly industrializing countries and major oil exporting countries on the one hand, and their counterparts in the OECD region on the other.

Take for instance technology-exporting firms based in major OECD countries. For them, the balance of North-South transfer of technology was fairly positive throughout most of the 1960s and 1970s: trade increased; surplus petro-dollars were effectively recycled into demand for goods produced by OECD-based multinationals; off-shore investment in low-labour-cost countries allowed them to compress labour costs and to counter the decline of productivity growth in home locations; the capital goods sector was able to benefit considerably from technology transfers to developing countries; and, finally, the trade balances of the major OECD countries with non-OPEC developing countries improved.

Today, however, it turns out that the process of transferring and disseminating technology, once started, is increasingly eroding the capacity of these very firms, including the most powerful corporations, to control this technology, i.e. to remain in a position of technological dominance. The reasons are obvious - inspite of the extremely high social costs of transfer of technology for the so-called host countries, a learning process to receive and adapt technology imports is certainly underway in a number of growth regions in the Third World. Adaptation engineering skills are developing which would allow to lower the real cost of imported technologies and enable local firms to reap economies of scale that may facilitate entry to new domestic and foreign markets. There has also been improvement in the ability of local engineering firms to participate in more complex engineering tasks, particularly in resource-based industries. Potentially at least, this
could mean that for a growing number of technologies, the international diffusion of technology might accelerate and that former technological advantage of United States, West European and Japanese firms could be eroded away.

It is still very much open to debate how these new contradictions will influence patterns of international trade competition and investment allocation, and how this is going to be reflected in key sectors for future Third World industrialization. Two basic facts, however, can be taken for granted and could serve as starting points for future in-depth research on this crucial topic:

- **First**, the multipolarization of international trade competition for industrial products cannot be stopped anymore and firms from countries like Brazil, Mexico, Argentina, India, and South Korea, to name but a few, will increasingly be involved. This is indeed a considerable challenge for multinational corporations from the United States, Western Europe and Japan, if only because these new competitors cannot anymore be pushed around so easily as this was possible with the classical "export platform" countries.

- **Second**, as OECD countries are likely to fail in their endeavour of concerted action to regain technological dominance, this will put individual OECD countries under increasing pressure to search for individual and short-term gains. Rather than accepting to adapt to the forthcoming transformations of existing international economic and political relations, at least the major OECD countries will try to "fight it out on their own", if necessary by means of "fuite-en-avant" - strategies, and to take increasingly recourse to cutthroat technological competition and protectionism.

2.5.2. **Resistance Against the Dominant Technology Systems**

This brings me to a second and equally important point, which is going to influence the perspectives for North-South transfer of technology. During the 1970s, the consensus on the social utility of science and technology has started to break down, particularly in major capitalist countries. In fact, political movements which aim at establishing viable forms of social control over technology and to resist the dominant "Big Science - Big Technology Systems" have certainly gathered considerable momentum. These movements have taken different forms in different societies.
In western societies, for instance, anti-nuclear and disarmament movements have been an important catalyst, and new forms of resistance to the imposition of technology from above have also developed within trade unions and particularly on the shop floor. Recent developments in Poland indicate, that similar movements are under way in the societies of Eastern Europe. Finally the number of developing countries has increased where progressive or socialist governments have seized power and are willing to subordinate technology to the needs of the underprivileged and poor.

Today, the interaction of new technologies is still the practically exclusive prerogative of corporate management and government bureaucracies. However, uses of technology that violate the rights of workers and the basic needs of our societies, will increasingly provoke the emergence of new forms of resistance against the imposition of technology from above. But without understanding the driving forces behind the introduction of new technologies, and particularly their interaction with changing patterns of international division of labour, it is hard to achieve effective social control over choice of technology, and to ensure that machines will fit the need of the people rather than the other way round.

Notes


2) For details and a systematic evaluation see Ernst, D. (editor) - "The New International Division of Labour, Technology and Underdevelopment - Consequences for the Third World", 646 pages, Campus, Frankfurt am Main and New York, 1980.


Prof. dr. E.V.K. FitzGerald

Technology Transfer and the Restructuring of Peripheral Economies: some principles and an illustration from the Case of Nicaragua.
3.1. Introduction

It is very difficult to follow such a distinguished exposition by an international expert such as dr. Ernst. I am really more of a carpenter than an architect; someone who adapts the results of this technology transfer rather than designs it; in my work in recent years as an economic adviser to the governments of Mexico, Peru and most recently of Nicaragua, I have looked at the technology transfer process from the position of Third World governments. Among those in the First World who are trying to do something about the problems of underdevelopment, and clearly in the whole North-South debate on the relationship between poor countries and rich countries, the technology transfer problem has generated a lot of heat but not a great deal of light; the speech by dr. Ernst did clear up a lot of points however, and illustrates the wider view of world economic structure within which technology transfer is now being viewed. It seems to me that from the Third World point of view as well there has been an increasing maturity about and understanding of the nature of technology transfer process. That doesn't mean that the Third World countries are very happy about it, but at least now they understand the animal they are dealing with: I suppose the first stage in capturing a lion and trying to train it, is to understand what it looks like and what its habits are.

3.2. The Debate on Technology Transfer

If we just look back to the sixties and seventies in the great debates about economic development, we find that early on the way in which we looked at technology transfer was closely connected to what we call 'choice of technique'. That is: should industry or agriculture in developing countries be based on mechanized production, the use of tractors, fertilizers and so on, or should it be based on more labour-intensive methods of production; similarly there were debates on whether roads should be built on the basis of very large machines or with a lot of labour. I can see by looking around the excellent exhibition incidentally, out in the lobby, that Delft University is contributing innovative solutions to this problem in the form of appropriate technology. The debate about technology transfer in the
sixties particularly revolved around this point, about which choice of technique was appropriate to reduce poverty: there was a lot of criticism of the lack of employment generation by the technology transferred to the manufacturing sector; and the suggestion that this tended to build up industry at the expense of agriculture and so on. The debate in the sixties tended to concentrate on the effect of technology transfer on the internal structure of the economy and on income distribution. The reply from the defenders of such technology transfer, mainly associated with neo-classical economists, was that this was a problem of what is known as the factor-price problem: the relative price of labour and capital in particular. In other words, if the developing countries insist on projective labour legislation, or generous social security payments by employers, or forcing foreign companies to pay high wages, then naturally companies adopt capital-intensive technologies which save labour. The solution for the Third World countries would be to only adopt the most labour-intensive technologies to create as much employment as possible: they had only to keep their wage-rates low and then the multinational corporations and domestic firms would make sure that the right technology was chosen, applying their normal profit-maximising criteria. This approach was even adopted by the UN/ ILO. However, during the seventies the point of debate, shifted considerably, moving away from this discussion about the employment effect towards a discussion about bargaining. That is to say, the newly independent governments of Africa and the increasing nationalistic governments of Latin America and Asia began to press harder on the main actors in the technology transfer business, that is the multinational corporations, pressing for better terms. So the debate then came to revolve not around the impact of this technology, but around the price that the Third World countries were paying. Throughout the Third World government organizations were set up to monitor this technology transfer, to get more data on it; some countries began to get together (such as the case of the Andean pact in Latin America) to try and control the charges for technology, the royalties, the profit outflows, the transfer pricing and so on. The positive planning aspect of this wasn't the intermediate technology initiative, which had been an answer to some extent to the problems of the sixties (employment creation); the answer this time
was an attempt to set up a local capital goods production capacity to
generate indigenous technology, or at least adapt foreign technology to
local needs. The number of countries such as Mexico and Brazil embarked
on deliberate programmes stimulated by government investment, of setting
up their own capacity for producing capital goods.

Now, as we move in the eighties, things have changed to some extent.
First, the enormous amount of recent research on technology transfer,
which Dr. Ernst has so ably summarized for us, has enabled us to see
this process in a much wider context than the micro-economic ones of
'choice of technique' or 'technology bargaining'. It moved the debate
towards an analysis of the whole process of industrialization on a
world-scale and what place technology transfer plays in it. The very
interesting recent survey by the OECD on North-South technology transfer
published this year (1), for example stresses the historical context of
technology transfer, that throughout the process of industrialization
from the earliest days there has been massive technology transfer from
one part of the world towards the other. In fact, the major
 technological innovations in the Middle Ages enabled Europe to take off
(that is gunpowder and printing) were both technology transfer from
China to Europe; not the other way round. In my own country, England, in
the 15th and 16th century we were regarded as an inferior lot
technologically, and in fact we used to export wool to Holland and
Flanders to be processed and then buy it back: if anything we were
considered as a dependent country on the Low Lands. However we cleverly
developed our military capacity, established control over trading routes
and managed to build ourselves up as a major industrial power. Although
I don't think we should take that moral too far as industrialization in
the Third World is concerned; the example of Britain, and more recently
South Korea and Brazil is that dependency is not an immutable condition.
A key conclusion from recent research is this contradiction Dr. Ernst
was mentioning before, the desire to control technology by the countries
that have it, but also their need to sell and transfer it to the Third
World for marketing purposes, is something that has gone on
historically. We can see it in the major technological innovations of
the early part of the last century, such as shipbuilding, in coal mining,
railways for example. Britain dominated railway technology, but once you had railways all over the country, and indeed we had as many as two railways between London and Birmingham at one time, you have to export it and technology is then absorbed by your potential competitors.

The other new outlook, apart from looking at this global industrialization point, is that we were becoming more and more preoccupied about the product itself as opposed in which it is produced. For many products, particularly consumer goods, a major element of technology is the product choice itself, which means to a considerable degree the use of brand-names: the substitution of soap by detergents for example in Africa which has lead to a collapse in the indigenous soap-making industry. The replacement brought about no real improvement in the living standards of people using them, just a shift of profits from small local producers to large multinational producers. This is not just a question of the technology being used, it is not as if the traditional soap-making have been revolutionized by a new chemical process dominated by the multinationals; rather one product has been substituted for another. Other examples are the introduction of sliced bread made from wheat in the countries which traditionally had eaten maize and millet; again the introduction of motor-cars (made by multinationals) substituted for railways. In the technology transfer process you can see a process of the changing of the product as well as the method producing it. Once a specific product has been chosen (or you have been persuaded by advertising) than the number of ways producing it are very limited: it is no coincidence that the technology available from the multinationals is the best way to produce 'modern' goods. In other words, if you insist on having a certain sort of washing-machine, it is not very surprising that Westinghouse is the only company that can provide it. The question that one has to ask oneself is: is this the best way of washing clothes, not is this the best way of producing a certain style of washing machine. This second point is particularly associated with economists from the University of Sussex in England.

The Third point is that during the debate it has become clearer that the focusing of attention on technology alone is to mistake the effect for the cause. The source of the problem is the development strategies
adopted on a world scale: the way the world economy is evolving on
the one hand and the development strategies adopted by Third World
countries themselves on the other. It is the interaction of the
development strategy of the small poor country itself and its insertion
into the international division of labour which dr. Ernst was talking
about, which really brings about the technology problem.

This is the point I want to illustrate in a moment. In this stage, it is
enough to say (at the risk of over-simplification) that the nature of
the debate has shifted its ground considerably during the last three
decades, moving from a micro-economic choice of technique problem in the
sixties to a problem of bargaining in the seventies, and now towards a
more 'macro' or 'structural' debate in the eighties.

The last point I want to make is that the nature of the debate is highly
influenced by the world crisis going on at the moment. A central point
is that inflation, slow growth and unemployment in the First World and
its effects both from the side of those that resist technological
change, that is people who want a more humane technology, and those who
are arguing for a restructuring of the Dutch economy, who want an
acceleration of technological change. At the same time, in the Third
World the dominating theme is not technology transfer, but of course the
financial crisis itself. That is to say the problem of the balance of
payments (export prices, debt service) has become the dominant theme of
North-South relations at the moment. It is interesting to see that while
the First World has been the place for macro-economic demand management
and so on, while the Third World was preoccupied with technological
change; it's nowadays the First World which is more worried about
technology and the Third World is more worried about stabilization and
so on. Why that should be so is not entirely clear, but it may have to
do with the fact that the industrial restructuring of the First World
and financial pressure on the Third are not only part of the world
economic crisis but also the way of 'solving' it in a Darwinian way by
pushing the weakest to the wall. Needless to say, the First World has
no hesitation about giving financial advice to the Third World, through
institutions such as the International Monetary Fund and the World Bank.
But we should also notice that the sort of themes that the Third World
is used to facing (changing economic structure, balance between sectors, chronic balance of payments problems, fiscal crisis and so on) are things that we are just learning about: in fact there is quite a lot we could learn from the Third World about industrial planning. Now, given this changing nature of the debate and given the changing nature of the international industrial economy, which was outlined by Dr. Ernst and the vision of the international energy economy which Professor Odell is about to give us, I now want to discuss what can be done about it. Let us imagine ourselves in the position of a Third World government, trying to do something about poverty, trying to do something about its excessive external dependence and what it should actually do about it.

3.3. The case of Nicaragua

Now the case that I want to look at is that of Nicaragua; I have two motives for doing this. First, it is a case of a country which is attempting to design a truly national development model, one which is socialist in that is planned and geared to the needs of the poor, but based on the mixed economy. This mixed economy road means that Nicaragua will have a public sector and a private sector and also very importantly does not intend to simply shift from a dependence on the USA to a dependence on the USSR. In other words, they are looking for a middle road in the way that other countries such as Mozambique are doing. My second motive is that here in Delft and in so many other Dutch universities, there are groups of students, academics, technologists and so on who are doing a great deal for Nicaragua in supporting its effort to find a new road.

The problem for a small poverty stricken country like Nicaragua is different from the Newly Industrializing Countries (NIC's) such as Brazil, Mexico or Korea: They do have the possibility of gaining some direct control over the generation modern industrial technology. There is a possibility that they can follow the road of the 'late developers' (that is of Belgium, France, Japan and so on) within the next
generation. They are actually building up a heavy industry, developing an indigenous technological capacity and might becoming members of the first division, of the world economic football-league early in the twenty-first century. You may not know this, but the eighth, ninth and tenth largest capitalist industrial producers in the world are in fact Brazil, Mexico and Spain, closely followed by India and South Korea. In Latin America, Brazil and Mexico can adopt a realistic strategy to acquire the characteristics of a modernized heavy industrial economy. This possibility is not open, in the immediate future, to the vast majority of developing countries, where the real poor are. The objectives for the poorer economies in the Third World (I would argue the NIC's are no longer part of the Third World) must be framed within an existing technological framework; the best they can do is try and work out an option based on self-reliance and basic-needs. This is, to reduce their degree of dependence on foreign technology and increase the capacity of their economic systems to supply the basic health, education needs of their population. The strategy is not one of attempting to gain control over the generation of technology, nor is it merely the adoption of a tougher bargaining position; rather it is a questioning of adapting the economy to the achievement of popular objectives. Reducing dependency does not mean trying to build up your own heavy industry, which was the error of some of the poorer countries in the enthusiasm for import-substitution during the past two decades. What it means in practice is diversifying your links with First World suppliers of technology and not, as in the case of Nicaragua in the past relying entirely on the USA for their technological inputs. Nicaragua had built up, under the previous regime, an enormous dependence in its export agriculture on imported fertilizers, imported pesticides and imported transport equipment; it developed a reliance on imported health systems, imported educational systems, imported television systems, industrial systems and so on. What could Nicaragua do? It was necessary to move away from US, but to learn from the lessons of Cuba, so they are trying to build up technological links with Europe and Japan first, using the emerging competition within the OECD countries that we have already discussed.
It also means making use of the NIC's, that is to say Brazil and Mexico in the Nicaraguan case to obtain equipment and industrial supplies - from tractors to oil. And finally it is possible to relate to the less developed or non-central members of the socialist camp: you try and bargain with Bulgaria, Hungary or Yugoslavia rather than with Mother Russia herself. If we contrast this with the Cuban example, Cuba was forced by Washington to choose between the USA and the USSR, and there was no realistic way of diversifying their dependence towards Latin America in 1959 or even to Europe. Let us look at a few examples of this.

In mining, exploited in the past by US and Canadian companies, Nicaragua is moving its technical assistance to both Swedish and Bulgarian sources, deliberately trying to assign different mines of different areas to different sources. The Nicaraguan transport system is heavily dependent on oil (oil costs forty percent of all the imports of Nicaragua and one half of that goes for diesel and gasoline): so what do they do? They shift back from roads towards your existing railway system, which had been abandoned in the fifties and sixties. Where do they get aid to build up their railway system? They get it in France, which has an aggressive program of trying to make its railway equipment industry profitable by exporting railway technology to the Third World, and is prepared to finance such a transfer. Nicaragua has large forest resources, and wants to build up pulp and paper production with those. Where do they go for technology and support: to North America? No, they go to Mexico which has an adequate paper and pulp industry and a desperate shortage of trees, needs to import paper and pulp, and is prepared to build up on a co-financing basis Nicaraguan production under strict planning control to conserve the vital forest resources. In agriculture Nicaragua has a dependence on imported pesticides: a US company in Nicaragua is producing pesticides with a mercury base, that are forbidden in developed countries. They are not made and to be used in developed countries because they are toxic, but the mercury base pesticides are made by Pennwalt in Nicaragua for Central America. Nicaragua organizes its cotton-production to reduce very heavily the need for pesticides: both by reducing the number of sprayings and also by spraying, so to say, a cordon sanitaire round the cotton fields (you spray the entry points where the bugs come in, so as to kill them in
their way to the cotton bolls). This is technology transfer help from ecologists in the First World who are worried about the over-use of pesticides, who helped the Nicaraguans get in touch with people who knew about this sort of thing and to redesign their cotton-production. This not only has a positive ecological effect, but it also means that the dependency on imported pesticides is reduced enormously; but this is only possible with planned agriculture; it was not an objective or an option under the previous free-market system.

Another major foreign exchange cost and cultural dependence is packaging in the industrial sector. It is possible to reduce the amount of packaging enormously by reducing the amount of cellophane used, the amount of plastic bags used, the pervoricious tendency nowadays of producing every smallest thing you buy in a plastic 'blister' mounted on cardboard. If a country is interested, however, in implementing a basic needs program where planners are no longer interested in producing high technology, highly attractive consumer-goods, but rather or want to supply rice, cooking oil, bread, beans, and so on; than the packaging does not really matter that much. But if you are interested in selling perfumes, whisky, cars and instant cake mix the package does matter a lot. So by shifting the pattern of consumption away from luxury consumption towards basic needs consumption, the (foreign) technology content of industrial production can be cut down.

Returning to the industrial sector, Nicaragua is a country producing cotton and exporting it to nearby El Salvador, where it is than spun into yarn and sent back to Nicaragua for weaving to make the cloth. So here the transfer of relatively high technology into the spinning sector in order to balance production lines is a positive case of actually strengthening the industrial capacity of Nicaragua without engaging in any ambitious schemes of import substitution; similarly, instant coffee processing for export, alcohol from sugar and geothermal energy are 'high' technology which is also 'appropriate' to Nicaragua. However in the case of pharmaceuticals, Nicaragua like many Third World countries was dominated by an enormous import of pharmaceuticals of all kinds and descriptions. The children of better off families (and many families who could not afford it) being grossly overdruugged, using an enormous amount of very sophisticated drugs at immense costs for the economy and making people totally dependent on the doctor, on what the pharmacist has
to sell. In Nicaragua there are now two shifts in technological dependency. One is those to change the product, that is to say that instead of using drugs to treat diarrhoea, it is necessary to attack the root cause; that is, bad water supplies. If you can get cleaner water supplies, you reduce enormously infant mortality; so you teach mothers how to boil water and you also set up units for oral rehydration (that is for children who are dehydrated by diarrhoea), because all that the drugs do in fact is block the child up and they are very expensive; it is much cheaper and more effective to rehydrate (replace the salts and water in the child) and improve the water supply to get to the root of the problem. By changing the 'sort' of health (health technology itself) you reduce the need for imported drugs. Second for the imported drugs you must shift from brand-names to generic drugs (that is by their original name rather than its brand name) and you can then reduce enormously the cost; buy bulk from free-market competitors such as Hungary and Italy. In the case of the drugs-question you get a very good example which combines the changing nature of the products plus the reduction of the dependence on the brand-name. This is much less dramatic than talking about production-lines and process technology (such as robots in carmaking); but as far as the people of Nicaragua concerned, that is real technological policy. In health this approach also implies a shift from large hospitals to small clinics, so it is not a question of new technologies, but also of new methods of working of organizing production. The shift of education from large schools towards self-help literacy campaigns, is a technological shift, if you look at it in terms of education technology or a change in social organization. In housing, instead of government built flats such as you get in Cuba (large multistorey cement-built blocks) which are very expensive in terms of energy and labour time and don’t lead to much popular participation in building Nicaragua is concentrating on self-help housing. This can be seen as a technological shift, where the government puts in water and electricity and then the people get on with building their own houses out of wood, adobe, zinc sheets and so on; but it also involves a change in the social relations of production, and thus of society itself. Thus it is no longer a matter of 'supplying' basic needs to the poor, but of the poor 'producing' their own healths, housing and education.
Often, when we are talking about technology transfer the supply of capital goods for investment is seen as an 'import versus local production' problem, which for small economies mostly means imports. However very often the crucial question of maintenance is grossly neglected in these discussions. The maintenance of equipment is a boring and unexciting topic: no-one really likes talking about it and it seems much more exciting to discuss technology transfer itself (the machinery), if you are for or against it, or you believe it should be more 'intermediate'. In my own experience however, in a number of countries, is that maintenance is the most effective 'capital-goods sector'; the most effective heavy industry that a small country can build up rapidly may be maintenance workshops. The first reason is that an imported bus or truck will only last for three to five years if badly maintained (and this maintenance included not only the engine and carriage work, but also the roads upon which it runs); the same equipment will last for ten or even fifteen if looked after properly - all of which involves employment and not imports. An example quite near to home is Spain, which between 1935 and 1955 was actually cut off from equipment imports, but developed very high standards of maintenance. Of course, once more new cars, buses and trucks were available, maintenance standards declined again, and now like in Holland - nobody repairs anything, the garages just replace old parts with new ones. The second reason is that the teaching, the learning about technology, the domination of the technology comes through the repairs, the maintenance, and that then leads towards an innovative capacity, a capacity start changing machines and even building them in an innovative way. Nicaragua has found that the repair shops are a very useful source of starting on slow technical innovation and starting on producing useful solutions to problems where the supply of spare-parts is cut off; they are now producing simple agricultural equipment. Imports are cut even down to the most trivial level of paying small boys to go around scrap yards, collect sets of sparking-plugs of the same sort and clean them up with a bit of gasoline and then putting them in a box; suddenly there is source of second-hand usable sparking plugs. If the government tried to organize the recovery of spark-plugs you can imagine the result; but organize it with little boys who are paid a dollar per dozen sparkings
brought in clean and working, and you will have an excellent system.
In other words, the technological challenge is the articulation of the 'formal' and 'informal' sectors, not the subordination of the latter to the former.

Nonetheless, such a technology strategy which involves changing the product as well as the way of producing it, cannot eliminate the need for foreign investment. The lesson for a small country is not to say 'no' to all foreign investment, but rather to negotiate case by case within a specific technology policy of the sort which I have described. After working out this technology policy sector by sector, you can issue a foreign investment code which basically says that foreign investors will have to obey all the laws of the country and may have the same rights as any domestic firm, no more no less; and offer to negotiate one by one on the basis whether what they are offering is compatible with the technology policy. Then, and only then, you can have sensible and useful negotiations with foreign companies. It is also very useful to have advisors in the First World who will tell you about these companies. After all, when Western companies negotiate, they find out about their 'opponent' and what Nicaragua discovered, for example is that by employing a small New York banking firm to tell them about big American banks' position on the 'Somua Debt', it was possible to improve the negotiating terms enormously when renegotiating that debt. Again, when negotiating with the banana companies, sources of information inside the US, on the basis of ordinary commercial information about the balance sheets and the industrial strategy of these companies discovered that these companies, were going to pull out of Central America anyway, for financial reasons of their own; this meant that Nicaragua could press much harder than otherwise. In other words, although, it is true that the transfer of technology and the financial transfer of resources is dominated by large multinational corporations (obviously one can cry about it and say how awful it is and how evil the world is and so on, but the world is the world and if there is to be any reform of the practices of multinationals it seems it must be done in the centre, as in the case of Nestlé; the periphery can't do much about it), the most that a poor country can do is to learn as much
as they can about the adversary before negotiating. This is why the sort of work done by dr. Ernst and his colleagues at UNIDO, or professor Odell and his team at Rotterdam, is so important to developing countries.

So far, we have been talking about technology and development, and although the examples have been practical and actual, they are in some sense optional. However in the existing world crisis the problem for poor Third World countries is not even that of development, but rather that of survival. To survive at all they must produce food and energy. In fact in the last meeting of Society for International Development in Japan (2), talking about the North-South round table, they defined the 'hitherto neglected area of the food-energy' nexus as an absolute priority action and research area. In other words, if a poor country can manage its food and energy supply, it will more or less survive through the crisis and can than later perhaps think of industrialization, of more ambitious welfare schemes. In the Nicaraguan case, food therefore become a major agricultural priority, not only to feed its own population, but also as a major export-line, because the Caribbean is a seriously food-shortage region. The long term price trends for basic food products are also much more stable than what is expected for raw materials such as sugar and cotton. Food production, on the basis of peasant cooperatives, becomes a major strategic choice for Nicaragua and is the centre of the land reform programme. The other thing is to reduce energy dependence and Nicaragua is totally dependent on imported oil on the moment. The first step was to shift its oil sources away from the U.S.A. towards Mexico and Venezuela; it is still dependent on them, but it shifted its dependence from its previous 'colonial power' towards two progressive Latin American countries; and having two competing sources is useful, because either could replace the other. However, at the same time, Nicaragua is developing its own energy sources: hydro-electric energy is extremely expensive to put in and dam projects take a very long time, but longer-term investment in that has to be done. Meanwhile the Nicaraguans are developing their geo-thermal energy, using the volcanoes (drilling down, injecting water and generating energy from the steam generator thereby) with Italian and Japanese technology, to
develop a rapid source of domestic energy. In terms of survival, if Nicaragua can get its energy and food sources straight on the basis of 'appropriate' geothermal and small-farmer technologies, then it can keep going while moving forward in a technology transfer strategy geared to basic needs, or the 'logic of the majority' as they call it. Assuming that is, that the USA allows to get on with the job.

3.4. Conclusion

I would say that the picture of dr. Ernst gave of changes and the nature of world technology transfer system is substantially correct, but I fear that the Third World cannot do much to alter it at present: perhaps something could be done in the First World by applying appropriate social pressure but probably not in the Third World. There are, however, two strategies open: one strategy is that of the NIC's (Newly Industrializing Countries) such as Mexico, Brazil, South-Korea or India, which is to 'join the club' which gradually they are doing. The other way is for the other Third World countries, to withdraw just a little bit, not into autarky, but rather to turn inwards to some extent in order to design their own economic development models which would among other things, minimize the amount of foreign technology needed, and produce a clear 'shopping list' of what is necessary, allowing the country to bargain much more effectively. In this context we here in Holland and in Europe (particularly people in the universities) can do an enormous amount to help, because one of the great problems about alternatively technology strategies, as in all technology bargaining is a total lack of information. If we take the case which I have discussed, the Nicaragua one, the government is headed by a board (which is all 'junta' means) made up of a guerilla commander, a poet and a justice of a supreme court; those in charge of technology planning in industry or agrarian reform are experts on local conditions but don't know a lot about the alternatives explored in other countries. It is not a question of transferring Dutch technology (although some of it is very useful), it is rather one of using Holland as a clearing-house for transferring information from one part of the Third World (or from one part of the First World, say Spain or Italy) through institutions like Delft to other places in the Third World. 
Speaking from my 'carpentry' experience as an economic advisor, I can assure you that the lack of information about the world at large is one of the major development problems for a poor peripheral economy. One of the things that intermediate technology people or people interested in popular health in Holland can act as 'postmen', as transferres of technology. Going to Nicaragua, as they often do, they can say: 'look in Zambia we did this or that, in China they did this or that', collecting information and transferring it. In this field of popular welfare or basic needs, the transfer of technology function could be carried out by large First-World corporations; therefore, but they are called universities.

Footnotes

1) Organization for Economic Cooperation and Development North-South Technology Transfer the Way Ahead (Paris 1982)

2) Society for International Development North-south Round table the 'Osio Declaration' (Osio 1982)
Prof. dr. P. Odell

The International Oil Industry: a Case Study
4.1. **Introduction**

I do not claim any expert knowledge on the subject of technology transfers and thus what I have to say will be to put the most important of all industries, the international oil industry, in the context of technology transfer. This industry has indeed been an international technological transferrer of massive proportions. Thus in terms what was achieved by the oil industry and the problems to which that gave rise, and the conditions that now pertain as a result of recent fundamental changes in the structure of that system; all this perhaps has some relevance to the question of technological transfer in the broader context. In the programme I was billed as presenting a paper on the way in which oil production technology transfer flows from the United States to Western Europe.

This has been important, but it is not the aspect of the organization and the evolution of the international oil industry about which I wish mainly to talk. I want instead to talk about the relationship between the international oil corporations and the countries of the Third World.

It is true that the oil industry was and indeed still is, to a large degree, an American invention. Thus, with the exception of the work of two important Anglo-Dutch enterprises (Shell and BP), the bulk of the innovation in the world of oil, outside the communist world, has been initiated in North America. In the context of the quite recent growth in the importance of oil in Western Europe and other parts in the industrialized world, as contrasted with the much earlier importance of oil and gas in North America, Europe and Japan were way behind in oil and gastechnology and related petro-chemical developments, compared with the United States. Thus, one of the main flows of technology as well as one of the main flows in investment, in the immediate post World War II world was that of oil industry technology and oil industry financing from the U.S.A. to Western Europe, in the context of the Marshall-plan and in the light of the requirements in Western Europe for the rapid expansion of oil industry.

First of all, the extension of the European refining industry, then the expansion of petro-chemicals and most recently the expansion of upstream oil industry activities were all very much a function of the flow of
resources—technological, financial and human—across the North Atlantic. This enabled the oil industry in Western Europe quickly to come to dominate the energy sector of most Western European countries and perhaps, even more important than that it enabled Western Europe to take advantage of the increasing availability of decreasing real cost energy in the 1950's and the 1960's that the economies of the Western European countries were immensely stimulated by the process. I think it is true in a sense that the North-American oil industry came to full fruition in Western Europe where it was able to take advantage of the circumstances in a way in which it could not do so inside the U.S. because of legal, political and other restraints. The international oil industry came to full flower as it were in the 50's and 60's in Western Europe and in doing so provided one of the reasons for Western Europe's economic success in that period.

4.2. Technological Development and Technology Transfers by the International Oil Companies to Third World Oil Importing Countries.

On the basis of what happened in Western Europe, one could hypothesize the same kind of thing occurring in respect of the relationship of the transnational oil corporations, both Northern American and Western European, with the rest of the (non-communist) world: that the continuation, that is of that particular form of internationality through the structure of a set of large multinational corporations which saw their rôle as a worldwide one, and their responsibilities as lying in the development of the oil-markets throughout the world and not just the countries in which they happen to have been created, or into which they had moved by the 1950's. They saw their rôle in that global context and had there been no significant politico-economic objections to their way of working, then the process that happened in Western Europe would indeed have extended to large parts of Latin America and South-East Asia and into Africa. Indeed to some degree one can say that they did. The process of the expansion of the oil industry into many developing countries' economies, generally lowered the prices of energy in the local market-place and created the opportunities for quite a number of countries' which had already approached the point of economic take off,
to move on that stage of development. However the relationships of the transnational oil corporations with most Third World countries, became difficult and hindered the further development of that process. The one aspect of the process that was not hindered, however, was the degree to which the Third World countries became dependent upon oil as their primary source of energy. Throughout almost all of the Third World, the dominance of oil in the energy economy, became a virtual universal phenomenon. This ranged an almost absolute dependence upon from oil, to the exclusion of all else, in countries such as Nicaragua in Central-America, many countries of Middle-Africa and countries of other parts of Latin America and South-East Asia. Elsewhere in the Third World, there are no more than 4 or 5 countries in oil which has not become the most important source of energy.

There is, in that development a problem which arises because such dependence of oil was not, generally speaking the result of oil-production in the countries concerned. These were of course a number of countries, outside OPEC, which reduced their own oil resources, but by and large, the oil that came to dominate the energy economies of the Third World countries, was, as in the case of Western Europe and of Japan, oil from the major exporting regions of the Middle East, North Africa, Venezuela and elsewhere. There was a very simple and a very straightforward reason for this, viz. that it was cheaper to do that, than to produce energy at home. In the 1950's and the 60's and through until to 1973, when internationally traded oil became in real terms a steadily lower cost commodity. So throughout most of the world there was a propensity to depend on that oil rather than to invest in the local production of energy. It was so much cheaper and so much easier organizationally to depend upon, the apparently unlimited availability of oil from the main producing areas at prices which went down and down more or less steadily for the whole period between 1950 and 1970. This moreover was the period when so many of the Third World countries were seeking to develop in terms of industrialisation, the development of modern transportation systems, the process of urbanization. It was also the period when the processes at work enhanced the demand for energy to levels which necessitated very high rates of growth in its use. There were in many Third World countries ratio's of two to one between the rate of growth in energy-use on the hand and the rate of growth in gross
domestic product on the other. In that kind of context, the ease, the familiarity, the organizational excellence and the lower real price year by year of international traded oil, undermined the interest in, and ability of most Third World countries to do anything about encouraging local energy production. Indeed, in that period, with but the single exception of World Bank investment in hydro-electricity, there was virtually no flow of international capital to Third World energy-related projects. Even the World Bank specifically excluded the granting of project finance for the development of oil and gas resources on the grounds that those commodities were freely available through means of the multinational corporations.

Whatever investment was required locally to enable that crude oil to be refined and the oil products to be redistributed, was readily available from these entities. Why therefore spend the scarce resources of the World Bank and other international and bilateral aid giving organisations on the oil sector. The money could better be used — it was argued — in sectors for which such resources were not available. These international oil corporations, as I have already indicated, needed and wished to apply their technological successes to their operations wherever they were. They needed to do this, because they were always searching for additional markets during that period. The flow of oil from their highly successful producing operations was such that the extra barrel sold in some market or another in the world would provide a cash-flow to help in keeping the whole operation expanding. They saw no reasons why the technological developments that they were generating in North America, or in Western Europe should not be applied in other markets. Thus, in the expansion of the refining industry which was under way throughout the Third World over this period of time, the latest technology was automatically applied. I think it would be possible to argue, in the context of the conditions of the late 50's and 60's and through to the early seventies, that anything less than that would have been considered inappropriate.

What we had heard about Nicaragua and the need to relate the method of doing things there to the needs of the local situation — that is to orientate the technology to the circumstances of the country — is something that could not, and certainly did not, apply in respect of the oil industry perhaps because of the very nature of the commodity and the
products being treated and handled. One either refined petroleum in a way which is done in North America, or one did not do at all. There were no local skills in the Third World countries that could produce the gasoline needed for the same kind of motorcars that were used in the industrialized world and there was no locally producible alternative to the technologically advanced refinery that would produce the kind of final products required. The same was true of the other energy using, other oil using sectors of the economies. For these sectors high technology developments had to go on. In as far as there was change it was in the direction of the move towards smaller scale refineries. The post war development of the oil refining industry in Western Europe had been towards large scale operations -towards larger refineries, that is, of the kind that were developed in the port of Rotterdam and elsewhere around the continent during that period. It became the gradually accepted rule of the refining industry that any refinery, that could not produce two millions of tons of products a year was not worthwhile. That was the minimum size of operation that was thought appropriate and one went up from that level in respect of the appropriate size of refinery in Western Europe. However, during that period when Third World countries tried to secure their own refineries, in preference to importing products from the major export refineries of the producing countries, refineries of that size were inappropriate. In Central America for example, the total market for oil products at that time did not amount to two million tons per annum. Yet each country in Central America wanted to have a local refinery and, by one means or another, eventually secured one. From these needs of the Third World countries for smaller refining units there was a feed-back effect into the technological centres -where refining technology was being developed-, whereby economies were secured even with units of a smaller size than that to which the industry had been otherwise used. The first refinery on 'skids', for example- a kind of pre-fabricated unit of relatively small size- was, built in the U.S.A. and shipped out to Guatemala. That was in the early 1960's and in the few years thereafter each of those Central-American countries achieved at least one small refinery.
To some degree that development represented a technological adjustment to the needs of local economies and in that way one can see it as a response by the transnational corporations to the particular needs and conditions of that particular market. That is not to say, however, that the development was, in itself, economically appropriate for the country concerned. Indeed, the installation of those kind of refineries in those kind of economies almost always caused the cost of the production of the products to be above the costs that were involved in producing similar products in larger export refineries— in respect to Central America in the refineries on Curacao and Aruba. In going over to local refining, the countries of Central America put themselves in a position in which there was an inevitable upward pressure on the price which they had to pay for their products. More appropriate alternative policies at that time, in respect of the oil industry, might well have tried to bring down the high price of the oil products which were brought into the markets themselves, as a consequence of the limited competition in the region. There was certainly 'fat' to be squeezed out of the product-prices that were being charged locally compared with the costs of producing those products in Curacao etc. The idea for a local refinery seemed as though it would provide an answer but this simply increased the cost at which the operation was done. The prices which had to be charged for products thus had to remain the same or go down to some degree, oil companies' profit margins were squeezed, very little employment was created and once that local refinery was established, then the countries concerned were tied into the inevitably higher cost activities. That didn't matter too much whilst oil remained two to three dollars per barrel, but as it moved to ten and fifteen and up to thirty dollars a barrel, then of course the impact on those countries of dependence upon locally refined products became very severe.

Thus, in respect at least of such downstream oil industry operations the post-war history of the relationship between the oil multinationals and Third World countries is not necessarily one that produced the best possible results for the countries concerned. We must turn, however, to another aspect of these relationships.
4.3. The Impact of OPEC's Success on the Global Application of Developing Oil Technology.

The other main way in which we need to look at the evolution of the international oil system, is related to the impact in recent years of the successful change from a system controlled to a large degree by the multinational corporations, as it was in the 30's and through the post-war period. Although with an increasing degree of competition in many countries, it has changed to one in which control in the system has been taken over to a high degree by the major oil producing and exporting countries themselves. As far as these countries were concerned, the development of their oil resources, originally by the multinational corporations, was again at the levels of technology that had been developed by the multinational corporations elsewhere in the world. Whenever there were improved methods of seismic work, improved methods of drilling and improved methods of secondary recovery developed in North America and Western Europe, then the companies were also committed to their use in the major producing countries. This was not, of course for the sake of the producing countries, but because this was a means whereby the costs of their operations could be reduced, or a means whereby extra oil could be discovered and produced. In the highly competitive situation of the international oil market of the 1960's, then that was a 'must' as far as the multinational corporations were concerned. But there was not much by way of technological transfer or a transfer of know-how to or the development of managerial abilities and opportunities in the countries within which these oil producing activities took place.

However, by the early 1970's, with OPEC having a decade of experience under its belt, the scene was set for a transfer of control in the system. It looked at one stage in the early 70's as though the process of transfer of the ownership of the resources back to the countries and the transfer of control over the supply and the pricing of the commodity would perhaps take up a decade. This was what the companies were planning for. Indeed they thought they had secured agreements with the OPEC-countries whereby these changes would have occurred over a decade and during which period the companies had time to re-adjust their
operations so as to give less emphasis to those countries in which they had hitherto been so centrally involved. But within a year or two of the 1973 oil shock most of the producing countries had ignored the agreed schedule and nationalization of the industry became the order of the day. In other words, OPEC quickly achieved great success in achieving what it said it set out to achieve, viz. the control of its own resources. Then over the next few years it achieved control over the flow of these resources around the world and the price at which they were supplied.

The impact of OPEC success in achieving that goal, however, has been minimal in terms of technological transfer. As a consequence of the changes in ownership and control, the international companies were increasingly motivated to restrict their activities to the politically safe regions of North America, Australia, Western Europe and to one or two other limited parts of the world, where their technological development processes are thus now concentrated. If one looks through the investment plans of the international oil companies at a current time, then one finds that an overwhelming percentage of their investment is now concentrated in these kinds of areas. The rest of the non-communist world, is as a consequence becoming even more peripheral to the international oil industry.

4.4. National (State) Oil Companies' Responsibilities - and Dilemma

In the OPEC-countries themselves, the national state-owned oil companies that have taken over the responsibilities for the industry have been thrown into something of a dilemma. They have been given responsibility for achieving in some way the appropriate technology required for the further development of their oil and gas industries.

Unless they are successful --not only operationally, but also politically— then they may have been given a relatively low priority as far as funding and other resources for new technology are concerned. One entity that had been relatively successful since nationalization, is the state oil company of Venezuela (PetroVen). It had access to billions of dollars as a consequence of being allowed to retain its export earnings, but this has now been brought to an end and its foreign exchange earnings then have to be given to the government. As a result PetroVen
is now somewhat fearful that it will not be allowed access to sufficient funds to allow it to go ahead with technological developments of the oil industry that are still required in Venezuela. Indeed one might say that funds are increasingly required in Venezuela to enable PetroVen to continue to build its development of research, both of a conventional kind and, even more important the unconventional oil resources —those massive oil resources— of the Orinoco base. If its access to the funds that are required to do that expensive job are restricted, then the processes of technological development are likely to slow down.

Moreover in many of these countries that have taken over their oil exporting industries the lack of sufficient resources in terms of personnel and the lack of an access to the secret technologies of the multinational corporations means that managerial agreements with one or more of the international companies have almost become a necessity. Very often they are the same international companies which were previously responsible for developing the oil resources of the country concerned. They are developing them as a kind of a managerial—technological situation only, but with the organization as the responsibility of the state enterprise. The degree to which that kind of relationship can be allowed to persist and to develop, often becomes a highly political question in the countries concerned because there is some degree of opposition to what may happen to be a continuation of the mixture as before. A continuation that is of the old system of oil and gas exploitation by the multinational corporations as seen through many local political eyes. Quite clearly there is something of a dilemma here for the state corporations. There is a tight rope that has to be walked in political terms, that add to the organizational and financial problems of the state oil corporations that I have already mentioned.

4.5. New Centres for Technological Developments

I do not wish to imply that there is no technological development in oil as a result of the creation of state enterprises. There is; but it is of necessity a slow process. There is a lot of background work that has to be done and there are only one or two countries in the world in which any kind of separate centres of technological progress in the field of oil can currently be claimed.
Mexico is a clear example, but we must recall that Mexico nationalized its industry as long ago as 1938 and that it has had getting on for forty-five years of development as an independent entity. Even so its efforts on the upstream side were relatively unsuccessful up to a few years ago. Had it had access to the developing technical capabilities of the international oil industry at an earlier stage, then the great oil and gas resources of southern Mexico would have come on the world scene somewhat earlier and this might have changed the international energy and oil picture to a very considerable extent. Mexico has had time to achieve some successes, but even so in the context of the degree and the speed with which its industry is expanding it has had to secure access to all kinds of external financing arrangements to external availabilities of expertise and to the hiring of firms to undertake activities that even the transnational corporations themselves often put out to third parties. Apart from Mexico with its long experience it is only in Brazil and in India that the local state enterprises have created developments which appeared to be of international interest. In respect of these cases of some developments which two countries have made in offshore gas and oil exploitation.

4.6. The Role of International Organizations.

If we are to rely for the future development of oil production on as many of those Third World countries as possible; and if progress is to be made towards self-sufficiency in as many of those countries as possible with a view to assisting them economically in a very important way, then the slow process of the evolution of technological developments, quite separate from those which have already been achieved by the transnational corporations, means that development is going to be too slow for success to be achieved.

I don't think that the countries concerned have time enough available to enable that kind of independent development to take place. In other words, there still needs to be an institution or an organizational arrangement created at the international level whereby the expertise of which some 90 percent is still in the hands of the multinational corporations, can be effectively internationalized without the political
difficulties that I have already referred to: the fear of exploitation in a neocolonialist kind of relationship. This development is desperately needed in order to achieve higher degrees of oil production in those many countries of the world with the potential to produce more oil. The World Bank has defined some 60 countries currently dependent upon oil imports, which have a potential for oil production and development. Thus we must look to agencies such as the proposed Energy Affiliate of the World Bank, (so far a dead letter because of US opposition), or to the development of a UN Energy Agency (such as has proposed, but as yet not developed), or to the possibility of a joint OPEC-OECD investment organization (taking advantage of the attributes and the advantages of the two sets of countries which would be involved in such a development), in order to create by one means or another access to sufficient funds to meet the challenge of expanding oil industry activities worldwide.

Access to funds is not the only requirement in terms of the application of appropriate technology to new areas. There is also the need to organize the flow of skills and the application of new technology through managerial and other attributes. This also requires a cooperative effort with the international oil corporations. If their abilities and technical know-how, experience and successes could be geographically made more diffuse over the next ten years in some way whereby no political overturns are attached to their investment in an increasing number of countries in the Third World, then I think that over the decade of the 80's, we could just get a little nearer to an effective medium-term solution to the energy problems of the Third World countries. The exploration for and the exploitation of oil resources is encouraged by a supply price which is so much below the current international market price as to make almost all developments worthwhile given the context of a development which seeks to serve a local market. This development seems to me to require a diffusion of ability, a diffusion of technology, a diffusion of know-how (managerial and otherwise) through the medium of some new international agencies. By this means the advantages, the knowledge and the experience of the international oil companies can be made available on a much wider scale
than it has been in the past and to a much higher degree than it is being made available at the moment. Technology and other international transfer are the key to successful experience of the oil and gas industries in the modern world; and such successful development of oil and gas is the key to a ready availability of useful and low-cost energy in the world for at least the rest of the century.
P.M. van der Sluis

The View of Engineering Consultants
First of all I would like to mention that, although my voice carries some weight within our profession, I do not speak on behalf of this profession and therefore the views expressed today are my personal views.

Although I may touch upon some aspects of our domestic market for our services and in particular with the market in Third World countries.

We all know that we are living in a world in which changes are taking place rapidly and we all notice that the rate of change is also increasing unprecedented. This applies particularly to the so called "third sector of our economy": the service sector and our profession is part of this sector.

The American author Alvin Toffler, in his recent book, The Third Wave, has been studying these phenomena of change and rate of change in depth. In this view the First Wave is the civilization based on agriculture and the Second Wave civilization is based on industry.

We are now on the verge of entering the era of the Third Wave, which he calls "the information wave".

Depending on the level of its development, each country may find itself in either one of the three waves.

Some of the least developed countries are still in the agricultural wave. The Western world and some of the NIC's (newly industrialising countries) are in, or are entering the second wave era and only a very few countries have entered or are about to enter the third wave era.

Alvin Toffler also speculated how the distribution of this phenomena (1st, 2nd, 3rd wave) was or is over our globe.

But more interesting in this respect are the views expressed by Mr. S. Rajaratnam, deputy prime minister of the state of Singapore, in his address to the FIDIC annual meeting in Singapore in June this year.

He tried to analyse the reasons beyond the emergence and downfall of the various civilizations we have known, such as the Chinese, Indian, Babylonian, Egyptian, Greek, Roman and South American civilizations. Although one can think up a variety of reasons for such downfalls, Mr. Rajaratnam speculates that it has something to do with what he calls: "Hubris", a Greek approximation for "arrogance", which reflects the reluctance to accept, or maybe even better the opposition against, changes in society and/or economic order.
Once a civilization has reached a high level of development, all kinds of interest groups defend their established rights. And this is exactly what is happening in many parts of the Western world nowadays, where this hubris, based on attainments during the Second Wave, is an impediment for entering the Third Wave era. Does this mean that there is another change in the geographical distribution of civilizations forth coming?

Not at all unlikely says Mr. Rajaratnam. And he continues: Don't argue that this is against the present-day cast in the world; the Western world could only take the lead in the Second Wave because other civilizations, which were in a much better take-off position to do so than the Western World at that time were struggling vehemently with their hubris problems and therefore missed their chances. Because of the hubris problems in the Western world to-day, there may be hidden, but serious chances for Third World countries to take the lead or at least play an important role in the Third Wave era.

But, Mr. Ratjaratnam argues, these countries will have to believe in the rise of the information wave and behave accordingly. And of course, Mr. Ratjaratnam is convinced that Singapore will be one of those countries.

This brings me to the next part of my presentation. Is there anything we can learn from the youngest history of some of the Third World countries??

Mr. Witteveen, past president of IMF (International Monetary Fund) has studied the performance of a number of oil importing countries for the decade '70 - '80. He presented his findings in a lecture before the American Chamber of Commerce in Hong-Kong in March, 1982. His findings are summarized in the following table.
Countries with high growth rate | low growth rate

<table>
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<tr>
<th>overseas dev. ass</th>
<th>comparable as a % of G.N.P.</th>
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<tbody>
<tr>
<td>foreign exchange policy</td>
<td>realistic</td>
</tr>
<tr>
<td>import policy</td>
<td>no significant limitations</td>
</tr>
<tr>
<td>investment policy</td>
<td>promotive, particularly for investments from abroad</td>
</tr>
<tr>
<td>price policy</td>
<td>towards free market prices</td>
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</tbody>
</table>

This comparison does not give an indication on the income distribution in the various countries and this is a difficult topic to assess anyhow. The World Bank’s Development Report indicates, however, that, generally speaking, high growth-rate countries have a more favourable domestic income distribution than low growth-rate countries.

Looking back on my presentation so far, I hope I have given a picture of the large variety of factors that constitutes the environment in which we render our services.

I shall now try to characterize our profession and I will do that in a rather unusual way. Our profession is not a capital intensive, but a brain intensive sector of the economy. The capital in our organizations is the know-how embodied in our staff members and this is by definition men-bound. Jokingly: Our capital leaves our offices daily at say 5.00 o’clock in the afternoon and all you can do is hope that your capital will come back to the office the next morning.
Know how therefore is a kind of floating commodity and our profession is trading in this commodity. This means that we are:
- buying
- processing
- restructuring
- upgrading
- combining
- selling

our commodity: know how.
In order to be able to do this properly and profitably you have to manage this commodity. Therefore a successful consulting organization should trade and manage know how adequately.

May I now try to go somewhat deeper into the phenomenon: know how. I have already explained that you can consider know how as a commodity, be it a very peculiar commodity. Then, like all other products, know how should have a life-cycle.
My design for this know how life cycle is given in the annexed graph. Most of this graph is self-explanatory, but I would like to draw your attention to the following:
- the graph represents the development of a successful piece of know how. We all know that by far the majority of all innovation efforts are unsuccessful.
- Particularly in the innovation phase universities and research institutes can play a very important role. However I wonder whether society as a whole — and our profession is then part of this society — should not have somewhat more influence on what research subjects should be pursued. This would be a welcome opportunity for developing the interplay between Universities and our profession. And I think to the benefit of both.

I like to draw your special attention to the bottom line which shows that with time quality competition is gradually replaced by price competition.
I will revert to this later on.

I think we have now sufficient information available to look into the future, although to a large extent this will remain crystal ball gazing. For easier understanding, I will do this point by point.
KNOW HOW LIFE CYCLE

interest for our profession

innovation elaboration for practical application application diffusion of application common property

quality competition price competition
1 Changes in services to be rendered
We are going to be faced with enormous changes in the type of services our profession will be rendering in the future. Among all uncertainties, one thing will be sure: The services we shall be rendering say 10 years from now, will be completely different from our nowadays services. The "only" difficulty is that nobody knows what the changes will be. If Mr. Toffler is right then it is likely that it will develop towards the information era.

2 Left-hand side of the know-how curve
In developing their future package of services to be rendered, the consultants from the industrialized countries will try to stay on the left hand side of the know-how life cycle. The already existing trend: "including much more than pure engineering alone" will continue strongly, in other words: assignments will continue to become more complex and multidisciplinary. Society requires that our profession takes into account aspects of sociology, alternative energy (I mean clean energy), pollution and environment (for land and soil as well as for water and air) but also education, public health and sanitation and of course management of information (see Toffler above.) As a consulting organization you can either wait passively for the developments that will eventually take place or you can actively anticipate such developments. That means: accept the challenge, or even better: seek the challenge. I predict and the others will peter out.

3 Third World countries will join
In the endeavours as stated under 2 above, the consultants from the industrialized countries will be joined by consultants from some Third World countries, namely from those countries where the principles of free enterprise are adhered to, or at least favoured. I project a fierce quality competition between the two categories of consultants from different origin.

4 Management of know-how
Management of know-how seems to grow in importance. In quite a number of Third World countries management in general is rather weak and consequently the consultants from the industrialized countries may still have an advantage for some time.
5 Joint venturing
It is very likely that the already existing cooperation between consultants from the industrialized countries and Third World countries will continue to develop further. This may eventually lead to the ideal combination of cross-cultural awareness.

6 Mutual confidence relationship
I have stated that know-how is a peculiar commodity. You cannot measure or weigh or quantify know-how. Therefore know-how flourishes best in a seed bed of mutual confidence between client, consultants and in some cases financier. Unfortunately this confidence relationship is subjected to serious eroding forces and this is one of the things that worries me most about the future of our profession. Maybe this erosion could be somewhat offset by paying more attention to international meetings and congresses where people from different cultural background have the opportunity of meeting informally and by that learning to understand each other better.

7 Price and quality relationship
There is a distinct relation between quality and price of services rendered. It is impossible to obtain high quality services for a low price and it is my experience that this truism is often neglected. Ultimately both client and consultant will not escape unscratched.

8 Right-hand side of know how curve
The more we move to the right hand side of the know how life cycle, the more consultants from the industrialized countries and the ones who joined them will have to give way to domestic colleagues because of price competition. This is a sound development because it will offer those colleagues the opportunity to gradually upgrade their business.

Concluding my presentation I would like to express my opinion, that, provided the free market economy game is conducted properly, there is a future in our world for all kinds of consultants, no matter what their origin, as long as those consultants themselves also play their role properly.
Dr. G. van der Horst.

Rôle of the Universities.
6.1. Real causes of underdevelopment.

The real causes of underdevelopment lie in political, economic and social factors that, in turn, influence technical conditions in the developing countries. Social and political structures within the South and between the North and the South are key determinants of underdevelopment. It is entirely un-realistic to believe that technology alone can solve problems that essentially require a transformation in the status quo before a solution can ever be envisaged.

6.2. Technological dependence.

Technology is nevertheless an important instrument in a process of social change in the developing countries. But the developing countries (the NIC's not included) have a technological dependence with regard to the industrialised countries. What are the consequences of this technological dependence?

a) high costs in terms of direct payments for equipment and indirect payments for technical assistance, patents, copy-write fees, training programs and spare parts;
b) the loss of local control over decisions concerning technology;
c) the marginalisation and weakening of local science and technology capabilities;
d) the crippling of local initiative and local adaptive possibilities;
e) the capacity for innovation is transferred from the developing countries to industrialised countries;
f) the inappropriate and undesirable characteristics of imported technologies.

Imported technology can also have negative effects on social equality and political systems. For modernisation has consequences for social stratification. The introduction of new technology has strongly influenced the formation of new elites in the developing countries.

6.3. Effective control.

A strict definition of a transfer of technology assumes that the recipient country is given effective control over the imported technology. Effective control means not only that the developing country can make the technology
work, but that it can put the technology to work for the country, that it can master the technology for its own aims and goals. In this sense, effective control means:

- adapting the technology to the satisfaction of basic needs;
- making maximum use of local resources;
- having the means of accumulating knowledge and experience over the long term.

In terms of this definition, most of what has been called "transfer of technology" to the developing countries has in fact been a non-transfer. In many cases the developing country has never become the master of the imported technology in social and technical terms.

6.4. Transfer of technology.

The transfer of technology to the Third World takes place primarily through private industry. Universities train the necessary people but are not themselves a marketplace where technology is bought and sold. The transfer of technology is very firmly linked to the operations of international industry. The system of industrial ownership is essentially tied up in the multinationals.

Private firms of engineers and engineering consultants have become important links in the transfer of technology. They also play an important role in export promotion and in the selling of know-how.

The transfer of science and technology is firmly linked to the capital flow and foreign investments of multinationals into developing countries. It is the international flow of capital that is the driving force behind the penetration of western technology in the Third World.

A large portion of the international trade done by multinationals takes place within the organisation itself, between the mother company and its subsidiaries. Through the system of industrial ownership, technological knowledge can be kept in a closed circuit without the developing countries gaining the access to it.

Moreover, the developing countries fear that the restrictive conditions and business practices that accompany the transfer of technology by multinationals will only serve to strengthen the monopoly position of the multinationals. The contribution of the multinationals to the build-up of local technological capability has usually been limited.
6.5. The main problem.

The main problems in the whole area of science and technology for development lie in the developing countries limited capability and in their restricted access and range-of-choice with respect to technologies and knowledge from the rich countries and from international industry. The priority of developing local technical capabilities should have the highest priority in terms of resources, personnel, institutes, policy and management capacities in order for the South to be able to take maximum advantage of the new technologies and reduce the level of external dependence. This is the field where universities can play an important rôle, complementary to the activities of multinationals and engineering firms.

I want to launch some concrete suggestions on what Technical Universities especially in Holland and more in particular the Delft University could do. What is the rôle and function of the Dutch Universities in development related activities?

The rest of my story will fall apart in two sections. The first concerns the Programme of University Co-operation (PUO) and the second aims at a centre to provide information and advice on industrial development in the Third World.


Before coming to these points I want to make some remarks on the recent development in the Dutch Universities, especially in the sphere of the budget-cuts. The last year shows a period of a very severe cuts in the budget and no-one would have dreamt of that we are nowadays closing departments and "vakgroepen". Looking to this process of cutting the activities of the universities, I fear that development co-operation may suffer a lot. I'll take up two policy lines concerning the central planning of the Dutch Universities. The first is the existence of a central plan for each University, which has been presented to the Ministry of Education and Science. The NUFFIC, has made an analysis of all those documents, in order to assess quality and quantity of development related education, training and research activities.
Apparently in the central planning of the universities, development studies are out of focus. Development activities are decreasing with increasing budget restrictions.

The second point of concern is the new research policy in the Netherlands, the "voorwaardelijke financiering" (the conditional financing of the research), which urges all universities to concentrate themselves on top priorities in research.

What will be the position of development-related research within this new policy? I am afraid that much research which is being done by a small number of people will be classified as not important to the Dutch social needs.

Perhaps that other research-oriented educational activities, which are more socially relevant for our Dutch society, may gain at the cost of the development co-operation. Will education, training and research on development problems gradually decrease or even evaporate in Dutch Universities? Moreover, I'm not too optimistic with regard to the Delft University. What are the priorities for development co-operation set by the Council, the departments, individual staff members or students of this university. How stands this case in the University? Six years ago the DUT has committed itself, within the Board of the NUFFIC, to spend about 5 percent out the own pocket to development-related research. I hope really that DUT is not setting its priority too much on high technology innovation and that the activities on development co-operation will be pushed out. I hope that staff members in Delft also see their moral responsibility in this matter.

6.7. NUFFIC

Submitting some remarks with regard to the programme of university co-operation. I'll begin to say that the support to sister-organisations in countries of the Third World is really a historical task of the Dutch universities. The history covers only one decade from '69 up till now '82, but nevertheless the NUFFIC is an impressive programme built to support the universities in the Third World countries. The DUT has been participating from the beginning in this programme.

I assume that you are familiar enough with NUFFIC, so I do not have to spend too much time on that subject. The formula is the following: it involves
institutional cooperation on a long-term basis. The first evaluation of the programme, which was carried out under NUFFIC auspices, confirms the extreme importance of the concept of cooperation between institutions. This is not something on an ad hoc basis, but is truly a cooperative programme between departments and not just individuals. The conclusion of the evaluation also stressed the need for a long-term commitment, say for a period of ten years, because a real technological capacity cannot be developed in a short time. For university cooperation one must adopt a long-term perspective. The evaluation also shows that it is difficult to determine social needs accurately and then to design a scientific programme geared to them. The relationship between university cooperation and the poverty problem is not always clear. The evaluation did, however, confirm the necessity for long-term structural cooperation if the poverty issue is to be addressed even indirectly.

A weak point in Dutch cooperative links tends to be the limited involvement of the departmental staff of Dutch universities. In general, it appears that departments are too superficially committed to the cooperation. This last point is important because it is particularly true for the technical universities. If the technical universities do not want to accept the fact that the role of senior staff members is critical to a cooperative programme, then I fear for the quality and durability of the cooperation. It is understandable that in this time of shrinking budgets departments are less inclined to send any senior staff abroad. A person who leaves the country could be risking his place on the job market. On the other hand, recruiting fresh graduates for these posts can never lead to a genuine cooperation to which the department as a whole feels committed. I would urge that this point be given careful consideration. Otherwise there is a danger that the cooperation is carried on the shoulders of just a few individuals and no longer by the institution itself.

We also learned from the evaluation that in technical projects the nature of cooperation is strongly asymmetric. There is much more given than take. The cooperation between Delft and Surinam is perhaps an exception in this respect, but I believe that this cooperation was undertaken with a different goal in mind. In general I would say that institutional cooperation is not viable if the Dutch department is not professionally involved - if it does
not itself stand to gain anything. There is nothing wrong in also being able to learn something from development cooperation. I would also urge that more creativity be applied in making optimal use of the department's expertise and know-how in filling in the content of the cooperative programmes. Moreover, cooperative programmes must be differentiated; the cooperation with the University of Zambia will have a different content than that with the University in Bandung. More effort will have to be made to link the education and training abroad to research at home so that the Dutch department can also benefit. Only then there be will a strong stimulus for getting more deeply involved with the cooperation. Right now the programme consists too much of standardised lessons and laboratory tests, which cannot be relied upon to spark much interest in Delft. I hope that research can become a more integral part of the cooperation. I would also hope that this research could perhaps be included in proposals for conditional financing so that it is taken up in the Dutch funding scheme.

Finally, I would like to make a plea for more careful selection of the staff members who are to work in these programmes. In the past this was often given too little attention. The preparation of the persons to be sent abroad is an extremely important element of the programme. They must be equipped to face the difficult problems in developing countries, which are also often set in a totally different cultural context.

Another task for the technical universities is worth mentioning here. At the moment many technical projects are being carried out in the areas of education, training, research and consultancy. The experience that is gained in these projects, however, is seldom shared with others in the Netherlands. This means that there is little build-up of a pool of knowledge and experience. In November 1982 we held a small workshop with experts working in the field of technology and development. This informal gathering was important for exchanging experiences and for thinking together about new directions. A new initiative could be taken to issue invitations on a regular basis to project-leaders who are working in the frame of the various Dutch projects in Third World countries. The purpose of such meetings would be for them to learn from each others' experiences and also to be given supplementary training on recent innovations that are relevant to technology and development. Experts in the social sciences who are working abroad have
much more contact with each other than do the technical experts. I am convinced that the latter also could benefit from periodic upgrading of their knowledge. It is particularly true for technological fields that this would help them to accomplish their tasks better. Perhaps this could be a job for the technical universities.

6.8. Technology Advisory Centre.

My second point concerns the promotion of industrial development in the developing countries. I understand that the TH Delft traditionally has much stronger ties with Dutch industry than the other two universities of technology. My advice would be: make use of this experience to help foster industrialisation processes in the Third World as well. As I see it, the TH Delft has not yet accomplished what it could in development cooperation. It is my impression that the development cooperation has thus far remained too much within the walls of the universities abroad. In the projects with which I am familiar, I have seen only a few indications that industrial development is also being fostered outside the traditional university structures. Industry, after all, does not have to be a dirty word.

I know of two exceptions. The first is a recently completed project in Bandung. The Twente University of Technology carried out this small project under the name of 'assistance to the graduate programme in production and metallurgical engineering'. The first steps have been taken in building up a relationship with the local industry. Project goals included strengthening the local capability and promoting small-scale industry in the Bandung area.

Another example is a project of the TH Eindhoven to set up a small cutlery factory in Tanzania. This was classified as a micro-project. I think that these projects provide good examples of the possible link between industry and the university.

Let me now make a slight detour and cite the example of the Agricultural University at Wageningen. This university represents an interesting blend of three components. The first is the traditional task of education and research. The second component lies in the trial farms and fields where one can learn how and under what circumstances crops grow best. The third
component is the agricultural information and extension services. This combination of functions has made Wageningen an unique instrument for transferring and applying agricultural skills to the Third World. Not only is training given, but knowledge is also directly applied (at the level of the farmers). I wonder why such a formula could not work for the TH Delft as well, but then in the area of technology. Delft would be in an especially good position to serve as an important liaison with Dutch industry. Delft also seems to possess more knowledge in the industrial field than the other universities. Why could this knowledge not be better used to benefit the Third World? I propose that the TH Delft set up a special centre that can give information and advice about industrial development in the Third World, somewhat analogous to Wageningen's agricultural extension services. Such a centre perhaps would not suit the needs of the newly industrialising countries (NIC's), because I think that they already have sufficient basis for their industrial development. But for the vast majority of the non-NIC's it could be very useful indeed.

An important element of this service is the appropriate choice of technologies. Delft's existing Centre for Appropriate Technology (CAT) could probably be a part of this centre, but it must not become the dominant part. We are talking here not only about small-scale appropriate technology, but about truly industrial technologies that are needed on a larger scale. The need for industrial development is simply too big for the concept of village technologies. I am thus thinking in particular of information about the development of small-scale industries and the application of the concept of appropriate technologies to large-scale production processes. It would seem to me that Delft has all the knowledge at its fingertips that would be required to set up such a centre. This proposal is entirely in line with the suggestions just made by Professor FitzGerald. He also spoke of a pool of information and a clearing-house of knowledge. The point is not to ship off turnkey projects or ready-made blueprints to the developing countries, but really to advise them on how they can set up medium- and small-scale businesses.
This would perhaps also be the answer to building up national industrial capabilities that could then work as a countervailing force with respect to multinational industry in particular. The transfer of knowledge for the purpose of developing local small-scale industry gives the developing countries effective control over their technology and weakens their technological dependence. It also fosters local initiative, and this is especially important. I wonder why similar suggestions have not been made before in connection with the programmes of cooperation. We are of course familiar with the Technological Development Advisory Unit in Lusaka, but unfortunately this project cannot be called very successful.

The TH Delft could thus take the initiative for this appropriate industrial technology centre, but this does not mean that there would not have to be close cooperation with others. Consideration could be given, for example, to cooperation with TNO, RNO, UNIDO, with existing institutes in developing countries, and last but not least with RVB. In my opinion, management sciences will have to be an important element in this field, and a fund of experience is right at our doorstep.

Separate mention must be made of cooperation with consultancy bureaus. There is the risk that such a centre would be seen as unfair competition for the consultancy bureaus. A centre of the TH Delft would have great advantages, however, particularly because of the independent position of the TH staff members. As Mr. Van der Sluis commented, the commodity that a consultancy bureau is selling is know-how. But how often is the export of know-how not immediately followed by the export of products? It seems to me that the position of the TH Delft is very strong in this respect because it is not under pressure from any client. There is no criticism that can be made of consultancy bureaus in the area of the transfer of technology. In practice they are clearly the trendsetters for this transfer and also with respect to industrial application. But are they objective trend-setters? It is my feeling that a technical university could work with more objectivity. But this means that the university must have the expertise required in the area of technology for development if it is to speak with authority.

A few concluding observations. In talking about the choice of technology it is important to know in whose interests the technology is being development. Who gains and who loses from it? In addition, any choice must also be viewed
in its macro-economic and political context. This means that the technology choices must not be considered solely on their technological merits, but in terms of the important social and economic dimensions as well. As I have already mentioned, technology alone cannot solve development problems. The proposed centre will thus have to build up its own fund of social-economic experience, or have access to this expertise elsewhere.

In my opinion the time is ripe for such an initiative. The call from the development-cooperation ministry is becoming ever louder - to give more attention to industrial development in the countries of the Third World with the idea that it cannot hurt if Dutch industry also benefits. This Delft initiative could well be seen as a very appropriate response from the university community. There is no doubt that this point must be elaborated further and I would be more than willing to assist in the brain-storming.

Finally, it is also important to think about how such an initiative could fit into the two-phase structure and the conditional financing of the Dutch university system. One thing is certain, the establishment of a centre for appropriate industrial technology would be in the interest of many - and not in the least of the developing countries.
constitute a technology..." and he adds: "...technology = technique + structure. The technique constitutes the visible tip of the iceberg; the tools and the know-how (or, skills and knowledge). The structure is the social relations or "mode of production" within which the tools become operational, and the cognitive structure within the know-how become meaningful...".

The question arises: what constitutes the rest of the iceberg? Besides Galtung there are many more authors who have suggested the implication of existing nodes of production within which the techniques have been developed and transferred (e.g. Ernst in this booklet).

7.2.2. Knowing-how is it transferred?

"......In the fifteenth century European technology was not totally superior to that of other parts of the world. There were certain specific features which were highly advantageous to Europe, such as shipping and (to a lesser extent) guns. Europeans trading to Africa had to make use of Asian and African consumer goods, showing that their system of production was not absolutely superior. It is particularly striking that in the early centuries of trade, Europeans relied heavily on Indian cloths for resale in Africa, and they also purchased cloths on several parts of the West African coast for resale elsewhere." (2)

The above mentioned quotation makes clear that in the fifteenth century the situation differed completely from nowadays. Therefore, we should heed making over-simplifications. In particular, eternalizing the transfer process to a unilateral flow from technological vanguards-in-the-North to technological laggards-in-the-South.

The transfer process is a highly complex phenomenon, influenced by a whole range of actors participating in this process; to name a few: universities, multinational corporations, intergovernmental organizations, consulting engineering firms. Although the flow of technology may seem unilateral, the competition for benefits between actors certainly is not!!
Admittedly, the multinationals account for nearly 70 per cent of total world credit. Wionczek (3) elaborates a set of working hypotheses about the transfer of technology through transnational corporations for Latin America and amongst others it was interesting to note a Harvard survey, based on a sample of 187 United States-based TNC's, practically all those present in Western Europe at the end of the 1960's were also engaged in operating subsidiaries and affiliates in Latin Americ. This trend is strengthened by the existence of tax-havens and duty-free ports, through which taxes on profits are withheld from national governments.

Yet, a quite new phenomenon to the OECD-based multinational enterprises is that foreign investors from developing countries in recent years have been setting up shop in other developing countries and have established a South-South network of multinational enterprises. Peter O'Brien (4) summarizes these new branches on the existing network. He supposes, that existing data substantially underestimate the actual movements. On the one hand, you have direct foreign investment (DFI) and on the other technology exports. The latter subdivided into turnkey arrangements and the other forms of technology export: the provision of consultancy services, the sale or rent of patent licenses and technical training.

The question of knowing-how forces our attention to major points such as: to view the transfer of knowing-how as a dynamic system in which actors are not in equal bargaining positions. This inequality is reflected conspicuously where some actors impose the rules of the game. FitzGerald (5), although stressing the importance of the notion of the world-system, concludes that there is still room left for the weaker partners to change the rules gradually.

O'Brien argues that the most important factor for transfer is risk diversification and that the projection of industrial enterprises leads in some cases to a rapid expansion of international activities in service industries (banks, marketing enterprises and consulting firms) from developing countries.

Public discussion is under way a long time on the benefits of the transfer of technology from OECD-countries. O'Brien gives three advantages in the South-South transfer for the destination countries as compared to OECD-transfers: it is more 'appropriate' technology (in terms of sale production, installation of more adequate machinery etc.), in the field of the net foreign exchange impact over time of the totality of the operations (profit repatriation and royalty fees are much lower compared with OECD-transfers) and the products made are more appropriate.
Further research is necessary to obtain a more detailed overview: who is profiting most in the destination countries, transfer of technology from developing countries is actually competing the multinational corporations (for how long is this possible and how could this happen?), the countries with most Third World industrial transferrers are South-Korea, Taiwan, Hong Kong and a few Latin-American countries (all in the capitalist hemisphere and most of them crucial for US-interests), etc.

Junne (6) and Ernst give reasons why multinational corporations cannot be expected to transfer production to newly industrializing countries at the same pace as they did in the last twenty years. Amongst others: the decline of markets due to world-wide recession, the debt burden (Brazil and Mexico), the financial crisis of the state in the NIC's increased subsidies in industrial countries, new protectionism, etc. The abovementioned trends deserve further research.

7.2.3. Knowing-why is it transferred?

We cannot hope to understand the trends just mentioned if we do not take a close look into the question of why. Dieter Ernst went at great length exploding the myth of altruism as a motive for technology transfer. Instead, he mentions some major why's:

- attempts to extend the life cycle of technologies by means of global strategies of "planned obsolescence";
- the growing pressure to penetrate new and increasingly protected markets through export of technology;
- and the need to spread the excessive cost burden of R&D through corporate strategies of "burden sharing among unequals".

However a next step to be done, implied by O'Brien (7), is that new actors in this process have other interests. He gives 5 motives for enterprises exporting technology from developing countries:

a) domestic demand deficiency.
b) protection of export markets.
c) risk diversification.
d) to try and shore up market positions against the power of locally embedded TNC's.
e) search for raw materials
O'Brien lists three main considerations for developing countries for striking the best balance between initial inputs of technology from abroad and subsequent domestic development:

1) the nature of the foreign technology purchased.
2) the conditions under which it is purchased, particularly: the training of domestic staff provided under the import arrangement; the permitted scope for domestic adaptation of the technology and the size and type of incentives to do so; and, the opportunities to use and diffuse the adapted technology.
3) The linkage impacts of the technology import both across industries and with regard to the kinds of technological activities undertaken.

It would be no less than an 'ideal' situation, in which a government is capable of striking this balance. The actual situation is completely different; only a few developing countries are planning their development in this way and by doing so (e.g. Nicaragua) they are attacking 'the free-flow capitalist system' and thus -- according to Reaganomics -- are detrimental to its continuity. Those countries are subjected to severe pressures from IMF and World Bank.

An admittedly utopian picture would be the rise of a return-flow from South to North, because of changing views of life in the North.

7.3. A framework for international debate

"...The international rhetoric about 'science and technology for development' is so loose that we think it useful to suggest a conceptual framework in which the key words are used with some precision..." (8).

In the international debate, we have persisted much too long in attempts to arrive at satisfactory answers to either knowing-why questions or to knowing-how questions, without designing a model of the transfer process, which is at the same time realistic and transparent.

Deliberately glossing over all variants, refinements, sophistication etc. all of which we are well aware, we contend that discourse of technology transfers takes place in two distinct frameworks, hereinafter referred to as the 'established' paradigm and the 'contending' paradigm.
In the established paradigm, the world is composed, 
— on the one hand, of a few countries which have too-much-of-everything.
— on the other hand, vast regions where there is next-to-nothing.
"...Nowhere then is the disparity between the industrialized and the Third
World countries more marked than in the field of scientific research and
technological development...". A quotation like this is typical of countless
analyses, although it may appear in slightly different formulations. The
limitations of the established paradigm have been exposed by the connoisseurs
of the flaws of the "modern world-system" i.e. of "dependencia", of
"imperialism", of "unequal exchange" and "accumulation on a world scale"

Although we subscribe wholeheartedly to the dim prospects held out by the
contending paradigm for our "Interfutures", we should like to stress here,
that the fertility of the contending paradigm may be secured, only if it is
gearied to practical attempts of sumounting precisely those impediments,
that are not even debatable within the established paradigm. To say the same
thing somewhat differently, we recommend an integration of the approaches of
Ernst and FitzGerald, while taking into account contributions made by Odell,
Van der Sluis and Van der Horst.

What follows, is our attempt to lay some groundwork for an elegant framework
that neatly links both theoretical reflections and practical
recommendations. We propose to proceed step by step so as to avoid rushing
anybody of his or her feet.

Our point of departure lies in the assertion, that 'transfer of technology'
makes sense only if three prerequisites are met: (see fig. 1):
— a 'source' (So) overflowing with technology;
— a 'sink' (Si) in desperate need of technology;
— a 'link' (L) between source and sink.

As a second step imagine a situation (see fig. 2) in which there is '...just
more of the same...' i.e. where we have: several sources (So₂) and sinks
(Si₂) as well as manifold links (L₂).

It will not take long before the need (stage 3) arises to tap from a
combination of sources ('technology-mix') and, conversely, to feed into a
cluster of sinks ('technology-diffusion'). Thus, the hitherto separate links
evolve into 'linking-circuits' and soon a whole group of 'dormant
functionaries' become wide-awake, i.e. the class of 'mediators' (NA).
DECOMPOSITION AND ELABORATION OF THE TRANSFER-METAPHOR

Figure 1.

Figure 2.

Figure 3.
This class of mediators comprises:

- 'mediator-prospectors' (M-PRO's); they search all over the world for sources of technology; if the do not restrict themselves to identification only but also calculate (social) costs & benefits and/or even venture some daring predictions about the future impact on Humankind, then they deserve such intriguing names as 'technology-assessers' and/or 'technology-forecasters';

- 'mediator-storagers' (M-STO's); their responsibility —which is under-appreciated much too often— may be characterized as 'waste-prevention' of the output flowing from the sources; the modern library linked to an international network of computerized data-banks is a case in point but the traditional museum cannot be dismissed either;

- 'mediator-improvers' (M-IMPRO's); these restless people are never content with the output of the sources; their lifes are endless quests for purification of the output of the sources; so they engage in 'research and (experimental) development' (R&expD);

- 'mediator-tailors' (M-TAILL's); they are more down-to-earth persons in that their credo reads like this: purification is not an end in itself, but should comply with one of the sinks, which after all are the only down-stream ends of the linking-circuits; so '...the customer is always right...' and '...the only appropriate thing to do, is to adapt technology to basic human needs...';

- 'mediator-promoters' (M-PROMO's); sceptical if not cynical personalities, who argue '...that basic human needs remain hidden to the consciousness of the customer if we do not spread the promise of technology...'; the M-PROMO's recipe is well-known:

- 'mediator-distributors' (M-DO's); this esoteric group claims to be '...in closest contact with the customer...' by performing the art of 'permanent need-assessment'; thus, they can take care of the routing of various kinds of technology, e.g. 'high-tech' to the 'big-push' sectors and 'appropriate technology' to the 'informal sectors'.

In figure 3 we have depicted a 'sequentialized case'. Although this limiting case may never occur in Reality, it is still very convenient for educational purposes of which we can only demonstrate the most salient ones here. First and foremost, we are wakened up to the truth, that drawing up a list of actors, is necessary but in no way sufficient! The real challenge is to reveal and articulate the function(s) which they incorporate.
Furthermore, it is obvious, that we cannot close our eyes for the importance of 'structure'; that is to say: certain constellations of sources, sinks and mediators '...will never work...'.

Once one is able to recognize the 'structural-functionalist load' of the transfer-process, it becomes quite conceivable -if not undeniable- that a theory of technology transfers should be made part and parcel of a theory of (structural) social change.

Pending elaboration of the latter theme (9), let us return to our previous questions about 'knowing-what', knowing-how', knowing-why', and see what happens when we combine these with our transfer-model.

7.4. A research-agenda for the 80's.

On page 79 and 80 we have depicted a matrix of which
--- the 'columns' are: 'knowing-what is transferred', knowing-how is it transferred' and 'knowing-why is it transferred'
--- the 'rows' are: sources', 'sinks', 'mediators' and 'linking circuits'

In the 'cells' of the matrix we have situated a sample of issues recurring very often in discussions on technology-transfer (10). In this way one can arrive at a more coherent overview of the prevailing debate.

However, it is only a first illustration. Yet we are optimistic about the potentials of this matrix in capturing many more questions regarding the transfer of technology. Perhaps even more attractive is the possibility of arriving at a coherent set of research-themes via a process of successive reductions (9).
KNOWING WHAT IS TRANSFERRED

1. The future of the patent system.
2. Implications of innovations (bio-technology, micro-electronics, industrial robots).
3. Concept of appropriate technology.
4. What is the future of the consultants?

SOURCES

1. Designing and creation of alternative technology systems.
2. Try and work out an option based on self-reliance and basic needs framed within an existing technological framework.
4. Re-orientation of systems for science education and technology training; turning sinks into sources.
5. Strengthening national agencies for technological development.

SINKS

1. Using an annually increasing percentage of UN-administered development assistance for technological cooperation among developing countries.
2. Providing greater UNDP-support for projects which strengthen indigenous technological capabilities in developing countries.
3. Creation of an early warning system to alert developing countries to scientific and technological advances in industrialized countries with significant potential impact on developing countries economies.
4. Re-orientating the World-Bank to make it more responsive to the goals of technological autonomy and social equity.
5. Giving information about technology bargaining.

MEDIATORS

1. Possibilities of diversifying links; trying to get the same products from different sources.
2. Consequences of the growing militarization of the world economy.

LINKINGcircuits
KNOWING HOW IS TRANSFERRED

1. (Universities) to act as a clearing house for transferring information from one part of the Third World to other places in the T.W.
2. The role of consultants in this process.
3. The role of multinationals in the South-South transfer.
4. Extending the coverage of existing policies and regulations on restrictive and unethical business practices and environmentally damaging industrial activities, including the overseas operations of MNC's headquartered in the developed countries and their foreign subsidiaries.

KNOWING WHY IS IT TRANSFERRED

1. Research on the driving forces behind the introduction of new technologies.
2. Transfer of technology: production of development or reproduction of dependency?

1. Identification of technological requirements in all economic and social sectors.
2. Possibilities of technological autonomy and delinking/dissociation.
3. The use of periodically updated short- and long range technology plans as an integral part of its overall economic and social plans and reviewing and formulating the country's technology policies on a continuing basis.

1. How to attain and to assure 'objectivity' of consultants with respect to the interests of all parties involved in the transfer process??

1. The feasibilities of a New International Technological Order.

1. Establishment of an international association for Third World technological development.
2. Strengthening international mechanisms to further the development and dissemination of technologies most appropriate to meeting basic human needs.
3. Establishing new forms of international cooperation, esp. among developing countries.
Footnotes


