Development problems in the perspective of technology

van Bronckhorst, B.

Published: 01/01/1974

Document Version
Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

DEVELOPMENT PROBLEMS IN THE PERSPECTIVE OF TECHNOLOGY

B. VAN BRONCKHORST

DEVELOPMENT PROBLEMS IN THE PERSPECTIVE OF TECHNOLOGY

B. VAN BRONCKHORST

DEVELOPMENT PROBLEMS IN THE PERSPECTIVE OF TECHNOLOGY

Inaugural addres by
Ir. B. van Bronckhorst
lecturer in the Department of
Industrial Engineering of the
Eindhoven University of Technology,
The Netherlands
Friday, February 22, 1974

Ladies and Gentlemen,

Development problems have, in this University, been put forward as useful working-fields for engineers for quite some time now.
This idea existed already in the early years of the University. It was professor Dr.K. Posthumus who advocated the idea that the University should make an actual contribution towards developmentcooperation. His ideas were given substance by the acceptance – together with the two sisterinstitutions of Delft and Twente – of developmentprojects in the framework of the Program for University Development-cooperation.
Professor Posthumus was also the first chairman of the Eindhoven Committee for International Cooperation, denoted by the initials C.I.C.A.
That this work is at present progressing and has even led to the establishment of the Managing Committee for International Development C.I.C.A. by the Board of Governors and the University Council [1]), is certainly owing to Professor Posthumus' diligence in giving shape to the committee. But not only on the executive level of the University attention was paid to the problem of differences in existence in this world.
Many and various contribution were made by the Departments; by the (temporarily appointed) staff members, who assisted in setting up Departments of Universities of Technology abroad and appointed research fellows. In the Subdepartment of Philosophy and Social Sciences the name of Professor Oldendorff must be mentioned; together with his students he carried out research work in this field.
It was round about that time that the Department of Industrial Engineering began to take shape, and in view of the active interest Professor Oldendorff took in the setting up of the Department, it is not surprising that with the first views of Industrial Engineering concern for the problems of the third world was already present.
Professor de Beer, as head of the Department of Industrial Engineering (then still in its initial stages) and as member of the C.I.C.A. committee mentioned above, was the first to give three students the chance to graduate in Industrial Engineering in a developing country.
Naturally, this work could not be coached completely by the Department and as an addition to the expertise, contact was sought and found with the University of Tilburg, and particularly with the Institute for Development Problems. Apart from that, Tilburg had

already connections with Eindhoven because Professors Jansen and Bertholet, both from the Institute for Development Problems, were already giving lectures on 'An Introduction to Development Problems", which was added to the curriculum of the Eindhoven Subdepartment of Philosophy and Social Sciences. The graduation of the three a fore mentioned students must be considered by the Department of Industrial Engineering as a milestone in the elaboration of the interest for development problems. The assignments were devoted to the setting up and the execution of an industrial comparative research between two daughtercompanies of a certain firm, situated in the Netherlands and in India respectively [2]).
One of the three succeeded in proving the importance of taking further steps in the direction already taken.
This led to the drafting of a report entitled 'Industrial Engineering in a Development Perspective' [3]), which was presented to the Department, the Institute at Tilburg and the C.I.C.A. at Eindhoven.
This report contained the recommendation to conduct preliminary studies in order to arrive at a syllabus bearing the same title as the report: 'Industrial Engineering in a Development Perspective'.
In order to carry out the activities mentioned in the report and also as a preparation for the preliminary studies, a workinggroup was set up by the two Universities in the framework of the cooperative body Tilburg-Eindhoven. The workinggroup had to give shape to the wish of many in the developing countries as well as in our part of the world, namely the finding of general principles which could form the basis of planning, management and the dynamic adaptation of production-systems in developing communities.

Production systems generally contain social, economic and engineering components, which have to be balanced in various ways, depending on the context the system is part of. It should be noted that development is a problem of every society, that is, the posing of these problems must in principle not be restricted to the poorer or so called developing countries. That the attention is nevertheless focussed on this latter category is, because particular conditions prevail there which are widely different from those prevalent in the West, and because the need for good working systems is especially great when there is little room for expensive experiments. Thus the necessity for good methods for the design and the full performance of production systems is an established fact.

It is important to know that the name of the workinggroup, Adapted Production Systems, epitomizes the specific posing of problems of the research. The developing countries were and still are confronted with the choice between advanced western technologies and their own traditional working methods, which increased the need for a technology, adapted to their needs. It was often turned out to be a dearly bought experience before it was realised that the western production-systems did not work well or not at all under the local conditions; on the other hand it became apparent that their own methods were hardly suitable to fulfil the growing and changing needs of the population.
Between the two extremes 'Unpayable Western Technology' and 'Inadequate Native Workings Methods', one hope to strike the happy mean, an intermediate technology.
Marshden [4]) mentions some criteria which such a technology has to comply with:
– a stimulus for economic growth by making optimal use of the means available.
– supporting the social development by assuring that the great mass of the population will benefit from the developments.
– a basis for further technical developments for which the norms of judgement must be found in the country itself.
– advancement in dynamic development during which the qualities of the technology are continually adapted to the development of the society.

The term Intermediate Technology was introduced by Schumacher [5]) the founder of the Intermediate Technology Development Group established in London. This is a non-profit organization, in existence since 1965, which aims development and full performance of 'intermediate technology'. The idea of a possible intermediate technology has strongly appealed to the imagination of many who were directly involved in the problems of the developing countries.
To a number of them this meant the start of a facinating and new approach which promised multidisciplinary cooperation. This approach moreover aimed at development of the society, and could be instrumental in bridging the increasing gulf between the poor and the rich countries. Furthermore, in the developing countries themselves the foundation was laid for a levelling of the differences in development in rural areas and towns. Others, however, viewed the new plan with

suspicion, viz. as a means of masking the contrasts and an opportunity for the developed countries of getting rid of their responsibility towards the third world in a cheap way. Without a doubt part of this criticism is due to the vagueness of the concept and also to the existing prejudices as regards technology and development.

The workinggroup clearly noticed this when, in studying the literature, they came across many contradictions and various inextricable problems. On the one hand technological developments in general were criticized, criticisms that ran from 'technology is bad and objectionable' via the notion that 'technology is completely neutral' in any development, to the opinion that 'technical modernization is a requirement' for an existence worthy of men.
On the other hand the incompatibility of the models of the distinctive disciplines was put under discussion. It was necessary to take one's own stand and to arrive at a model by means of one's own experiences, and from there start working on the theory of adapted production-systems. For this reason the workinggroup has opted for action-research and has devoted itself to a number of projects on developmentcooperation. In this way the collecting of data and the forming of a theory happens simultaneously. At the moment, the research of the workinggroup can be divided into two interconnected parts [6]):
– A comparative research in quite a number of different industries in various countries.
– A depth research in certain companies which aims at the systematic improvement of their functioning.
In this research there are close ties with the University of Technology in Twente.
Professor Van Hasselt has the leadership of a project on inter-university cooperation between the three universities of technology in the Netherlands and the Institut Technologi Bandung in Indonesia.
The subject of this research is the question of how far are modern methods of management and production applicable in the Indonesian Metal Industry [7]). Owing to this project it clearly became apparent how necessary it is to give proper shape and substance to intermediate technology in order to get rid of the alternative character still associated with this term.
With the Institute in Bandung a centre for intermediate technology is associated [8]) and from the numerous discussions with the Indonesian staff it clearly appeared how much this concept stands in need of clarification.

In practice it became evident how difficult it is to work with a relatively vague notion, an obstacle which was felt by all. There was agreement upon one point only: intermediate technology means a different approach, a different way of arranging data, with the possibility of breaking away from a backward and stagnant situation. But with this the afore-mentioned alternative character is emphasized. In the first instance we are not dealing with a model, but with a pre-supposition about possible developments of the real situation. In that sense, the history of the concept 'intermediate technology' dates further back in developing countries and can be found, amongst others, in the theories of Gandhi, who looked for an economic and political re-organization of the rural areas, where methods would be applied based on the qualities of the population itself, their intellectual faculties, their skill and their inventiveness [9]).
We know now that the application of this theory on a large scale was a failure, also caused by the absence of concrete technical solutions which could be realised within the economic structure of the villages.

In my opinion intermediate technology cannot be built up without making use of the technical and scientific knowledge of the western world. It is, therefore, necessary to give further shape, and also a better foundation, to this essentially sound idea.

In our attempt to determine the concept 'intermediate technology' we must bear in mind that the meaning of both words has not been fixed exactly. To start with the concept 'technology'; this is often interpreted as an application of science, of rather the systematic application of scientific or other organized knowledge to practical tasks. With this interpretation technology is connected with the progressing education for tasks and processes into elementary parts, because only then there would be a possibility of arriving at scientifically founded pronouncements. Technological knowledge then aims at the perfection of the elementary parts without considering the entirety. Nor can the effects of that entirety on the surroundings be surveyed.
According to this interpretation an intermediate technology cannot exist, because it is just a question of choice, a selection from an ever growing collection of techniques mastered. The choice may be between more modern techniques and older solutions. Demands for intermediate technology will lead to answers from an out-of-date phase in technical development. Intermediate technology is then

synonymous to old-fashioned methods.
The advocates of intermediate technology on the other hand profess that it is not right to start from the existing situation. For them the main issue is the finding of alternatives for the development of modern technology. For this reason every discussion on intermediate technology is held in contrasting terms. Clarke [10]) gives a survey of nine delemmas which are put forward in the discussion:
pollution, capital-dependence, exhaustion of sources, dangers of misuse, compatibility with the existing culture, presence of a specialized elite, centralization, violation of traditions and alienation.
According to Clarke an intermediate technology is characterized by the way in which the practical tasks are formulated; modern knowledge should not rejected but other criteria should be used in judging the effects. New technological developments should fit into the frameworks indicated by these new criteria.

It we put modern technology and intermediate technology side by side as the two alternatives, then it appears to be difficult to come to a good comparison. This has a double cause. In the first place, we are dealing on the one hand with an ever growing collection of techniques which are applied in a vast area, while on the other hand, we are confronted with only a small number of unconnected and often primitive examples.
Secondly, in modern technology the attention lies with the efficiency of taskperformance while intermediate technology searches for normative pronouncements about the efficacy of the technological system in the surroundings. This means that emphasis is on effectivity. In short, the point of the one approach is producing technically the best system, and the other approach judges this system on the side-effects when it is being used.
In a certain sense two alternatives may be regarded as complementary; the one offers what is technically possible and the other asks for a technology that is socially desirable. The meanings of the words modern and intermediate refer to these different approaches, both stand for a different use of nevertheless the same accumulated body of knowledge, but they differ in the indication of the direction in which this body of knowledge must be widened.

Although they are complementary to a certain extent, one should not conclude that they are compatible. The difference is not restricted to

the accentuation of either the means or the end, but it becomes very strongly apparent in the lack of agreement as regards the desired further developments of technologies. Thus the two approaches cannot just be reducted to the same denominator. It is important for us to determine that we are dealing with a discussion on the question of how we are going to equip our existence. This discussion is not limited to some particular countries in the world, be they rich or poor, but is related to all. It fits in with the older definition of technology, viz. the discussion about techniques discipline that has technical operations for study-object [11]). In history it has been differently accentuated as a result from the tensions connected with the structural changes in human technical activities, the direct and indirect implications of this society and the range of these events.

Intermediate and modern technology are the indications of the two standpoints taken in the discussion, and this is the problem that has to be solved, because the participants are on different levels. Lay-men are talking with specialists; people who do not even have the disposal of at least part of the store of technical scientific knowledge are confronted with an overwhelming amount of factual material which undermines their proposals. Against the available and directly applicable knowledge there is only a relatively vague demand for 'something different'. In my opinion it is necessary to regard this demand seriously.

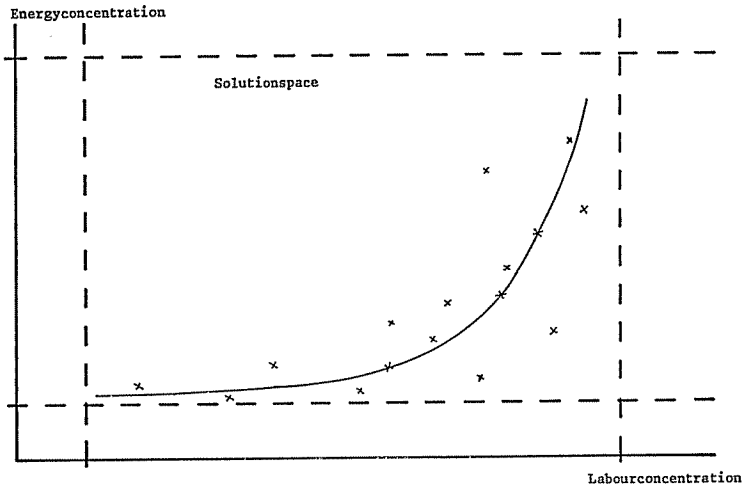
Ladies and Gentlemen,

The technological discussion is, as already mentioned, concerned with the question of how we are going to equip our existence. Let us therefore take stock of the results of this discussion. Such a research has taken place more than once and it is therefore sufficient to refer to the data collected by others [12]).
On the ground of that research, countries and nations can be ordered in a scale that runs from very primitive, poor nations to the rich nations that live in a complicated constitution of advanced technologies. It is remarkable that this classification shows only one dimension, that is to say, a higher degree of development implies that of everything there is more than in a lower degree Thus in the richer countries one finds more specialization, more machines, more consumption of

energy and materials, higher concentration of living and working areas. The fact that it is so easy to introduce this one-dimensional ordering has probably been a temptation to many to equate this ordering of ranks with a development in stages. It has been taken for granted that the historical process ran along one line only, in which some countries are the precursors and others got stuck at the beginning. Development was, without much trouble, equated with scale-enlargement, progressing specialization, and increasing concentration. Intermediate solutions could in this framework only be seen as falling back on earlier phases in development; as a sign of regression. And it is precisely this model of development that needs revising. For it is a model that starts from the principle that the western countries are in the lead and orders all other countries according to the extent in which characteristics of a western structure are present. This approach actually puts the west in a central position and form there measures the distances to the various other countries in the world. This line of development is indeed no more than a reflection of the approach in which the distances to other countries are adapted to a scale that represents the western countries in the highest degree of development. In observing this, we have brought to light one of the defficiencies of this developmentmodel.

There is another deficiency in this representation which could be regarded as much more serious, that is, the self-evident way in which the simultaneousness of nevertheless different characteristics is regarded as an indication that these characteristics belong together. If, for instance, there occurs a high energy-usage in the western countries and, moreover, a high degree of specialization, then we are inclined to regard these phenomena as the reverses of the same medal. The level of energy-usage and the degree of specialization are then inseparably connected. From a historical point of view, however, this is an untenable observation. In fact, it is true that mankind in increasing numbers was able to survive in relatively small areas, by making use of the natural resources and through specialization to make optimum use of these resources. In the first instance the development of the high cultures in history is coupled to increasing specialization.
Other solutions were not available, because the amount of energy that was available was limited. Only with the addition of a type of energy, different from what men and animals could supply, and different also

from what was supplied by water-power, wind and sun, and on the basis of the existing specialization, could a following phase of development occur. Let us take a look at this. In this existence, man was able to make use of raw materials, different forms of energy, and his own labour. We must look at these three as being inequal and not interchangeable. The point is in fact the converting of raw materials into forms more useful to man. With this conversion it is interesting to know in what way man combines his own labour with the use of energy. We can represent every developmentpattern on earth as a point in a diagram in which the axes are energyconcentration and labourconcentration. These concepts demand further elucidation. Energyconcentration is a function of the overall installed power, the amount of power used, the continuity of that usage and the efficiency of the conversion and the area in which the energy is used. Labourconcentration is a function of the number of workingmembers of a population, the workinghours per day, the various tasks per worker, the pace of taskperformance and the area in which labour is performed. For human life, on both axes a sub-borderline can be drawn; beneath a certain labourconcentration and energyconcentration no human life is possible. But there are also upperorderlines; for energy, a order of



magnitude of 1 % of the solar energy influx is given as a maximum. For labourconcentration such an upperborderline may also be drawn. It is evident that the precise value of the borderlines cannot be given, but preciseness is in this case less important than the fact that there actually are borderlines.
In the diagram it is indicated within which borderlines human life is possible. I would like to call this closed area of the diagram the solution-space for human existence. When we indicate in the diagram the known forms of existence, present or historical, a dotted cloud is formed, concentrated mainly in the righthand part of the solution-space. This cloud is bordered on the lefthand side by an enveloping curve on which the points lies that represents the countries and regions of this earth. The diagram shows that only a small part of the total solutionspace is occupied; in other words, mankind has only explored a small number of all the possibilities. The enveloping curve can be seen as the front of such a research, a front that shifts in time. This shifting front is indicative of the world's development.

For a long time the development took place in a direction that corresponded with increasing labourconcentration, but during the past 200 years emphasis was put more and more, at least in some countries, on the heightening of energyconcentration, next to an only slightly increasing labourconcentration. But where, at the beginning, solutions were looked for and found, which moved away from the subborderline, we are now confronted more and more frequently with approaching the upperborderline. From this it may be concluded in what direction developments must further be looked for. And these directions are not the same for the various countries. For the rich countries in the west it is necessary to aim at lower energy-concentration as well as at decreasing labourconcentration. For countries only half-way across the front a lowering of labourconcentration is desirable, but heightening of energyconcentration is necessary. For countries on the horizontal part of the front the point at issue is to increase the energyconcentration as well as the labour-concentration.

We have now arrived at a more adapted interpretation of intermediate technology. It is clear there is no question of a half-way stage or a going-back to an out-of-date past. The issue is to find new solutions starting from the situation in the country concerned and also from the

available knowledge in the world. The search for new ways is not restricted to the countries of the third world but certainly also involves the rich countries. It is essential to indicate case by case in what direction the solution must be looked for. And from there it must be indicated in what direction the body of knowledge must be widened, and with what research and experimental development have to engage themselves. This has to the discussion of techniques given a new shape, the issue is no longer the contrast between modern and alternative technology, but the necessary technological developments needed in each country.
Perhaps the use of the term intermediate might seem somewhat unjustifiable, or would the words 'appropriate' or 'adapted' be preferable? Personally I have a preference for intermediate, because in my opinion it clearly denotes the fact that we are dealing with a connecting link, a technology that makes it possible to change the present situation into a more desirable one.
Intermediate technology is not just a indication of a certain solution but is also the way in which that solution is to be found. Hence intermediate technology is the result of a developmentprocess.

It has already been mentioned that the discussion on technology runs a hard course for it is a discussion between lay-men and specialists. If intermediate technolgy is to be realised, it is necessary to bring the discussion to a more proper level, where the lay-men can have an insight into the technical possibilities without having to go through years of study. In western countries this could be seen already as a condition, but in the developing countries it must be seen as an absolute necessity. And to bring these matters into the open, the specialists have to take the initiative. The realization of this task is not simple. It is not just a question of responsible simplification, but one has also to be able to cross cultural boundaries. That means finding a presentation that appeals to and informs the parties concerned. Intermediate technology proposes the direct cooperation with those for whom all this was started.

Intermediate technology finally asks for an interdisciplinary approach, because the technical elements – i.e. the apparatus and working-methods – do play an important role in the whole, but they certainly must not take up an exclusive position. And what goes for the cooperation between lay-men and specialists is certainly true for the

communication between specialists, for each of them is doubly a lay-man in the other's field. Not only does he lack the knowledge, but, moreover, within his own discipline a number of assumptions is current concerning the particular spheres of knowledge of the others. Experience has indeed thaught us that it is more difficult to set up a discussion between the various specialists than between specialists and lay-men. Yet the mutual discussion must be seen as an essential condition for the cooperation in a group that engages itself with intermediate technology. It is, therefore, highly important to plan the formation of such a group carefully; so that neither the differences in opinion nor the different ways of approach by the workingpartners can be the cause of misunderstandings of failures.
All this is nothing new for it is about the application of rules that have been were set up much earlier. But these are rules that have often been sinned against, as appears in various developmentprojects. For even when cooperation is good in the own familiar surroundings, it does not necessarily follow, that under the special circumstances prevalent in the development country the good understanding is preserved. And working with people from totally different culture is no easy task.

Ladies and Gentlemen,

Let us now examine in how far it is possible to make use of the views mentioned above. An important aspect about how to make designs was given in the remarks. It is necessary to follow a separate course of study for this subject. Furthermore it is necessary to be able to handle workingschedules which enable all the persons involved to actually participate in the designingprocess. In as far as these schedules exist, but only implicitly, they must be made explicit, and in cases where there are not even any implicit schedules, new ones must be set up. In the development activities three problems play a part; Singer and Schiavo-Campo [13]) indicated them by:
– the development of appropriate technology;
– the adaptation of imported technology;
– the selection and transfer of technology.
The writers prefer the first-mentioned activity but they are aware that these items are easier to realize starting from the last-mentioned one. In practice only the last-mentioned of the list occurs indeed. Under the general denomination of Transfer of Technology we are coming upon

a special problem area where the issue may be the transfer of a range of techniques but also the setting up of a daughter-company of a western firm. If we assume that in a developing country a certain activity in the framework of the national planning is called for and that furthermore the apparatus and know-how to realize this activity is available in a developed country, then the question arises under what circumstances the transfer is to take place and what results may be expected. A brief research in this field, done in Indonesia, has taught us that the succes of the transfer is determined by the negotiationposition the developing country occupies with respect to the developed country [14]).

The research has furthermore proved that the outcome of the transfer-process was that the desired activity was indeed realized but that the country remained dependent on the developed country for the export of the activity. This was particularly the case with the supply of materials, machines and tools, management, and research and experimental development. All this boils down to the fact that only part of the technology can be transferred. So for the greater part no transfer is possible, for the structure of western technology is such that one cannot just transfer part of it.

Nearly every firm in the western countries exists in and by an extensive infra-structure. Setting up industries in a country where such infra-structures are not available is only possible when such a set-up has the permanent use of the infra-structure of the homecountry. For certain industries no other solution can be given, such as the petro-chemical industry or, in general, the large processing industries.

To build up a developing country's own infra-structure is certainly not possible at short notice. For this type of transfer a careful selection from the various possible types of industry is needed in any case, and attention must be paid to choosing those solutions that will cause the least discrepancy.

This demand is hard to meet, however, because the choice is not entirely free.

The various interests that influence the choice must be taken into account, which is often the reason why not the technically best solution is attained, but a compromise between politics, economy and technology. The case is somewhat different for those industries that are dependent on the existing infra-structure in the home country but that can, nevertheless, operate under the conditions of a developing country by adapting the product and the productionprocess.

Now we have come to the second problem: the adaptation of imported technology. There is not much experience in this field, although good attempts have been made. In general, this means that the product is manufactured with low capital investment, simpler machines and tools that demand little maintenance, local labour, a limited range of materials, low energy usage, and little need for specialist information.
In practice it means that the entire production organization must be drastically revised. The realisation of this is not an easy task, among other causes because of two hindering factors; first, there are usually not enough interesting alternatives available, because at the time when the production systems was set up, the best solution under western conditions was looked for, and secondly, it is not always possible to indicate what are the specific circumstances in the developing country under which the alternatives have to be tested.
In this connection moreover, the various desired developmentspheres have to be taken into account, and this often involves insuperable difficulties for the specialized experts.

Finally, we have come to the most complicated of the three problems; the development of an appropriate technology. In the first-mentioned case the point was to select the best solution, and in the following the revision was emphasized. In this last case the point is to make a completely new design. It is now not a matter of adaptation to an already existing infrastructure but to build up a technology on the basis of the locally available possibilities. Sometimes it is better to develop entirely new ones. But in both cases new potentialities must be opened up by the addition of technical knowledge.

If we view the possibilities and difficulties of each of the three problems in their entirety, it is notable that the institutions in the west and in the countries that have been developing ones so far, are the most suitable for realizing the transfer of the technology selected. These are pre-eminently the technologies that are connected with the urban development. Concerning the adaption of imported technology, neither the western nor the developing countries are adequately equiped, and for the development of an appropriate technology there are hardly any possibilities at all.
And the latter is the very type of solution which the developing countries with their large rural population want so badly. For the

demand for intermediate technology is particularly related to the development of the rural sector in these countries [15]).

It is therefore of importance to pay special attention to both those problems for which no adequate designmethods are available, and that, as regards a solution, are confronted with a shortage of channels of execution. In the problem of the transfer of selected technology the emphasis is on the negotiationposition of the developing country, and this is something on which little influence can be exerted, at least at short notice. Hence, the main problems are those of revision and design of appropriate technologies. Incidentally, both problems are not only of importance to the developing countries as I already mentioned before. Also in the western countries there is a demand for revisions, be it that this development is to based on lower energy and lower labourconcentration. Both problems clearly have aspects of industrial engineering, and in view of the importance to social development, they are moreover, problems that have a priority claim to consideration.

Two kinds of designassignments have come up, both with a specific contents, but demanding a similar approach. The area included in these assignments is very large. In order to fulfil such an assignment, many and various contributions are needed from specialists but also from lay-men, and from all that are involved in the -- broadly viewed -- designprocess. Cooperation is a necessary condition for the design and for the later realization of it. It is, therefore, necessary that the future industrial engineer, in addition to qualifying in the various disciplines, should qualify especially in working among and with groups that are involved in designing or in the full execution of a design. If we look at the syllabus of the industrial engineering in this light, it is notable that the curriculum of Eindhoven leaves much space for the development of these and other skills, which aimed at a practical application. Already in the first year of study projects are brought up, in addition to a number of theoretical subjects, that train small groups of students to work out designs. In this part of the curriculum the emphasis is on learning how to concretize an assignments which is deliberately kept vague, and subsequently to execute it according to an assignment of tasks. On the results a report is drawn up, which is also judged on its communicative value. Some of these projects aim at solving the lesser problems in the field of development,

such as the design of an oil-press, a brick-press or a survey of pumps. The reports on these projects are further assimilated by the sub-committee for microprojects of the C.I.C.A., which forwards the data to the fieldworkers.
Also the bachelor-degree part of the curriculum space is made for projects relating to industrial research. In the bachelor stage of the curriculum there is also an opportunity of attending lectures in optional subjects, and a number of students have availed themselves of this opportunity to attend the lectures on "An introduction to development problems". Finally, in the engineer-stage in addition to the other graduation possibilities, there also exists the syllabus 'Industrial Engineering in a Development Perspective', which is provided for by the inter-university workinggroup for 'Adapted Production Systems' mentioned before. Students of other departments of the University are also taking part in this syllabus.

The researches which I mentioned above are done in the framework of this syllabus. The students are actively participating in these researches. A great amount of independence in the choice of researches as well as in the workingmethods is possible in this syllabus, owing to the preparation for this manner of working in the pre-bachelor stage. I find this an advantageous situation, because I think it a major task of scientific education to further develop the student's intellectual capacities. The lecturer further has to contribute to this development and he must function as a catalyser.
In this function the lecturer must be a medium between the world-events and the student. Therefore he cannot be pre-selective, for not his specific ideas are at issue, but those that are developing in the world. The lecturer must be an expert, he may be a teacher, but foremost he must be a coach.

With this I have come to the final observations in my argumentation. I deem it an honour and a pleasure that I have been able in this department, where I was the first to graduate, to contribute for six years now to the further foundation of education and research. It is also a pleasure to see that those contributions are appreciated and that our mutual efforts have produced good results. Naturally, there remains much to be done yet and we must realize that the setting up of a department is an ever continuing process in which many crucial moments will occur. But all are prepared to work hard and that fills

us with confidence for the future. And this last remark is certainly true for the education and research in the field of intermediate technology. Together, students and staff, we are pleased to observe that our activities in the workinggroup have indeed procuded results. It is also a sign of confidence for me that, as chairman of the Committee for Development Cooperation C.I.C.A., I have been given the opportunity in this University of contributing to the elaboration of the policy; for development cooperation, which was set up by the University Council and the Board of Governors. I have good hopes that it will be possible to realize in this University what was put forward in the World Plan of Action for the Application of Science and Technology to Development [16]), the mobilizing of the community of scientists in the world in order to start the exchange of knowledge and information on a large scale, necessary for the realization of the objectives of the plan.
For I am firmly convinced of it that in the future the world will need a technological perspective even more. And I am grateful that, together with so many of you, I have been given the chance to elaborate such a perspective.

I thank you for your valued attention.

20

References

1) College van Bestuur en Hogeschoolraad van de Technische Hogeschool te Eindhoven
'Instellingsbesluit van de Beleidscommissie voor Ontwikkelingssamenwerking' Eindhoven, 1973.

2) Ven, A.D.M. van de, and Winkel, J.M.J. van de
'Vergelijkend onderzoek tussen een bedrijf in India en een bedrijf in Nederland'.
Afdeling der Bedrijfskunde, Technische Hogeschool Eindhoven.

3) Bertholet, Dr.Ch.J.L., and Bronckhorst, Ir. B.van
'Bedrijfskunde in Ontwikkelingsperspectief, Eindhoven-Tilburg' mei 1972.

4) Marshden, Keith
'Progressive Technologies'.
International Labour Review, 101 (1970) pp. 475–502.

5) Schumacher, Dr.E.F.
'Social and Economic Problems calling for the development of Intermediate Technology'.
London Observer, August 29th., 1965.

6) Wilde, ing. A.de
'Een afstudeerprogramma aan de Technische Hogeschool te Eindhoven: 'Bedrijfskunde in Ontwikkelingsperspectief'.
Afdeling der Bedrijfskunde, Technische Hogeschool Eindhoven, 1973.

7) Bruijn, Ir. E.J.de
'The Applicability of Modern Methods of Management and Production in the Indonesian Metal Industries'.
Technische Hogeschool Twente, 1972.

8) Harahap, Dr.Ir.Filino
'Teknologi Tepat bagi Pembangunan Industri'.
Prisma nr.5, August 1972, pp. 58..62.

9) Das, Amritananda.
'Implicit Socio-Economic Analysis in Gandhian thought'.
Quest, Jan./March 1966, pp. 20–29.

10) Clarke, Robin.
'The pressing need for Alternative Technology'
Impact of Science on Society, vol. XXIII, no.4, Oct.–Dec. 1973, pp. 257–272.

11) Guillerme, and Sebestik.
'Le commencement de la technologie'.
Thalés, tome 12 année 1966, pp.

12) Bertholet, Dr.Ch.J.L.
'Het ontwikkelingsprobleem in Sociaal Perspectief'. Universitaire Pers. Rotterdam, 1967.

13) Singer N.W. and Schiavo Campo, S.
'Perspectives of Economic Development'. Houghton Mifflin. Co. Boston, 1970.

14) Samadikun, Samaun, Harahap, Filino and Bronckhorst, B.van.
'A strategy to evaluate Transfer of Technology'.
Paper submitted at the International Seminar on Technology Transfer. New Delhi, 11–13 Dec. 1972.

15) Jackson, Sarah.
'Economically appropriate technologies for Developing Countries'.
A survey. Overseas Development Council, Accasional Paper no. 3, 1972.

16) Clarke, Robin.
'The Great Experiment, Science and Technology in the Second United Nations Development Decade'.
In: The Case for Development. UN. Centre for Economic and Social Information. Praeger Publishers, New York, London, 1973.