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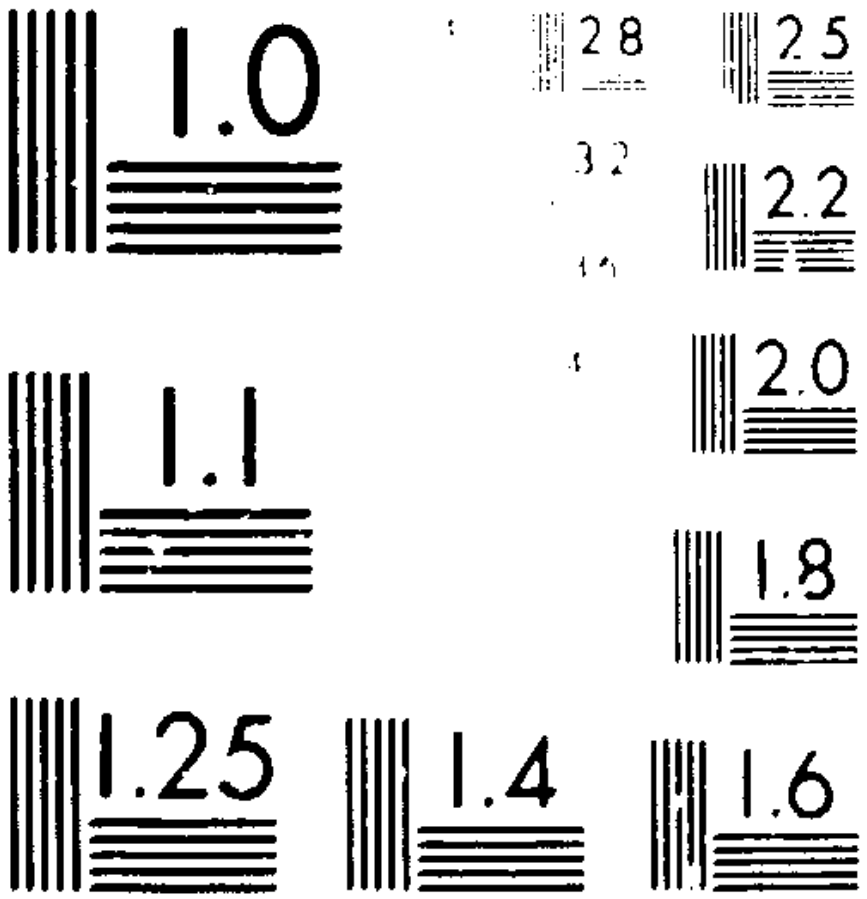
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United Nations Industrial Development Organization

Workshop on Selection of Technology for
Assembly of Electronic and Electrical
Products in Developing Countries

Utrecht, The Netherlands, 4-8 May 1981

REPORT (Technology, electronic products).

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CONTENTS

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INTRODUCTION

The Industry Council for Development (ICD) brought to the attention of the United Nations Development Programme (UNDP) the work carried out by N.V. Philips Gloeilampenfabrieken on the adaptation of electronic assembly operations to enable plants to be built in various developing countries with relatively low capital investment and with a higher proportion of labour inputs; the quality and reliability of the electronic products produced matched the standards obtained in large-scale plants using current highly automated technology and were competitive in local markets.

UNDP considered the experience to be of potential interest to the developing countries and it decided to finance a workshop on the subject, designating the United Nations Industrial Development Organization (UNIDO) as the executing agency. A small executive committee was set up towards the end of 1980 to organize the Workshop and also to advise on follow-up promotional activities. It was composed as follows: A. Chavez J. (UNDP); W. Simons (ICD); J. C. Ramaer (Philips' Gloeilampenfabrieken, Eindhoven); P. H. Pijs (Philips' Pilot Plant, Utrecht); F. R. Bradbury (University of Stirling) (ex officio); N. K. Rao (Massachusetts Institute of Technology) (ex officio); B. Crowston (UNIDO) (Workshop Co-ordinator).

CONCLUSIONS AND RECOMMENDATIONS

The participants in the Workshop agreed that the list of issues formulated at the final plenary meeting (see annex IV below) was important and should provide the basis for a set of guide-lines to facilitate the choice of technology in electronic and electrical assembly industries suited to conditions in developing countries.

The participants also agreed that the choice of technology called for dynamic interaction among investors/entrepreneurs, suppliers, Governments and international organizations.

On that basis they made the following recommendations:

1. The guide-lines should be designed chiefly to serve the needs of the investor/entrepreneur and the supplier; they should also facilitate the Government's role, if any, in the selection process and should promote greater understanding between all parties involved in that process.

2. The guide-lines should incorporate the issues identified during the workshop and should reflect the dynamic interaction experienced by participants in dealing with those issues.

3. The structure of the guide-lines is important and requires considerable thought. The issues identified should be presented in a way that will reflect the dynamic context of decision-making. It is suggested that UNIDO consider several approaches to structuring the guide-lines, particularly the one outlined in the report of Working Group I (reproduced in figure I below), taking into account any further written contributions from participants.

4. The final distribution of the guide-lines will be confirmed by the Workshop's Executive Committee (representing the sponsoring organizations), taking into account the normal distribution practices of UNIDO and the recommendations made by the participants regarding priority audiences in the developing countries.

I. ORGANIZATION OF THE WORKSHOP

A. Date and place of the Workshop

The Workshop on Selection of Technology for Assembly of Electronic and Electrical Products, organized jointly by UNIDO, UNDP and ICD, was convened at the Philips Pilot Plant, Utrecht, from 4 to 8 May 1981.

In addition to the representatives of UNIDO, UNDP, ICD and Philips, the following 15 participants from developing countries, acting in their individual capacities, attended the Workshop at the invitation of UNIDO:

H. Ali, Manufacturing Manager, Texas Instruments Malaysia

J.K. Asare, Acting Managing Director, Ghana Industrial Holding Corporation

R.G. Chase, General Manager, Barbados Industrial Development Corporation

M.L. Choy, President, Korean Microsystems Inc., Republic of Korea

A.C. Hamdi, Head of Sector for Communications and Instrumentation, Egyptian Iron and Steel Co.

B. Hilia, Ministry of Industry, Morocco

W.K. Kiiru, Project Engineer, Ministry of Industry, Kenya

P. Luo, Vice-Chairman, Science and Technology Committee of the Fourth Ministry of Machine Building, China

P.A. Maganya, Industrial [illegible]nics Engineer, Ministry of Industry, United Republic of Tanzania

W.G. Michael, Head, Planning and Projects Department, Ministry of Industry, Ethiopia

B. Nasiruddin, Bangladesh

A.D. Vianna, President, Microlab S.A., Brazil

G. Villela-Pardo, Capital Goods Industrial Promoter, Nacional Financiera, S.A., Mexico

S. Wajnberg, Executive Secretary, Interministerial Executive Group for Components and Raw Materials, Ministry of Communication, Brazil

T.Z. Zeren, Systems Group Chief Engineer, PTT Electronic Communication Equipment Factory and Laboratories, Turkey

B. Opening of the Workshop

The Workshop was opened by Dr. J.C. Ramaer, Vice-Chairman of ICD and Director of the Bureau for International Economic Relations, N.V. Philips Gloeilampenfabrieken. He said that ICD had been founded in 1979 to provide a dialogue between the leaders of industry, Governments and international organizations, particularly the United Nations system. ICD made the skills

and experience of its members available, where practical, to support the industrialization of the developing countries.

He went on to describe the specific experience of Philips in developing productive capacity outside the Netherlands, involving the transfer and adaptation of technology. By 1980, Philips had established 50 factories outside the Netherlands, of which 25 were in developing countries. They were supported in turn by two pilot factories, one at Utrecht for the more labour-intensive processes and the other at Eindhoven for advanced technology.

The representative of UNDP said that UNDP had been interested for some time in finding ways of helping the developing countries to create new industries that would be competitive in the markets that were to be served. UNDP therefore attached considerable importance to the Workshop; it had approved a project financing the inputs required for the participation of experts from developing countries and had invited UNIDO to become the executing agency. UNDP would follow the deliberations of the Workshop with a great deal of interest, since it recognized that the meeting was experimental both in terms of the methodology for drawing on the know-how of private industry, as well as researching and trying to provide guidance to other developing countries on the basis of the discussions on choice of technology. The Workshop therefore represented a unique opportunity to break new ground in that area of development activities.

C. Election of the Chairman

F.R. Bradbury was requested to chair the Workshop.

D. Documentation

A list of documents prepared for and presented at the meeting together with a list of the reference material used for the Workshop, is contained in annex II below.

E. Summary of presentations

The Head of the Development and Transfer of Technology Branch of UNIDO presented a paper on the experience of UNIDO in the transfer of technology (ID/WG/339/9). His paper outlined the mandate of UNIDO in the field of

transfer of technology and referred particularly to the United Nations Conference on Science and Technology for Development, held at Vienna in 1979, and the Vienna Programme of Action on Science and Technology for Development,[1/] which had been adopted at that Conference. He then outlined the factors that affected the transfer of technology and explained the significance to the developing countries of the so-called "breakthrough" technologies, which included genetic engineering, micro-electronics and microprocessors and new energy technologies. Finally, he referred to the robotization of assembly equipment and the significance of that development on the industrialization process in the developing countries.

Background papers were presented by three participants.

Mr. Villela-Pardo (Mexico) described the Mexican experience in the electronic industry (ID/WG/339/10). He noted that some 6,000 persons were currently employed in that sector and that it was principally an assembly industry, dependent upon foreign firms for the design and technology of its products and parts. The development of the local industry had been hindered by the lack of an ample research and development base, by the scarcity of local components of adequate quality and by a shortage of trained personnel.

Mr. Nasiruddin (Bangladesh) presented a paper taking a critical look at the assembly of television receivers in Bangladesh (WG/ID/339/11). In it, he reviewed some of the major problems related to the assembly of television receivers in his country and proposed some possible solutions. In considering the possibility of local television assembly, Mr. Nasiruddin made a critical appraisal of possible benefits, including the creation of employment, the transfer of technology, foreign exchange savings, and the overall cost-benefit to the consumer. Those considerations were dealt with at length in the paper, which was particularly relevant to small-scale television assembly operations of up to 50,000 receivers per year.

1/ Report of the United Nations Conference on Science and Technology for Development, Vienna, 20-31 August 1979 (United Nations publication, Sales No. E.79.I.21 and corrigenda), chap. VII.

Mr. Wajnberg (Brazil) presented a paper on the electronics sector in Brazil (ID/WG/339/12), which dealt with the manufacture and assembly of television receivers in a developing country with a large internal market. Mr. Wajnberg explained that, as an initial stage, a country should import components and assemble receivers and at the same time organize and train its human resources. As a second stage he advocated the gradual substitution of locally produced for externally supplied components and the initiation of local product design. He went on to make a quantitative assessment of the growth of the Brazilian electronics industry and included a section on electronic sub-contracting activities in the tax-free zone of Manaus.

Two other background papers submitted to the Workshop (ID/WG.339/3 and ID/WG.339/4) summarized the supplier's technical proposal for the establishment of a television assembly plant. The design of the Workshop reflected the dynamic interrelations of the main parties involved in the consideration of a major investment in an electronic assembly industry and the required choice of technology. Within that framework, the key document that provided the basis for discussions in the "game-playing" process was the supplier's technical proposal. The proposal was not designed to provide a solution, on the contrary, it was introduced in order to allow participants to analyse the effects of different variables and then negotiate improvements to suit the investment objectives, while also taking into account the government policies of the three anonymous countries used in the "game" process. The supplier's technical proposal was tabled at the meeting and reviewed for the participants by Mr. P.H. Pijs, Plant Manager of the Philips Pilot Plant at Utrecht.

The proposal showed the alternative technologies that could be selected for the establishment of a televison assembly plant over a range of production capacity of up to 200,000 small-screen television receivers per year. The proposal included the supply of the necessary plant and equipment and kit components, as well as technical assistance, including the training of the required personnel. Two alternative approaches were embodied in the proposal, namely, the current automated technology and the adapted form for lower capital investment and increased manual work content. The investment expenditure contained in the proposal and the production costs for the two approaches at the various levels of capacity up to 200,000 receivers per annum were

calculated on the basis of one particular location. In order to enable the participants to relate the proposal to different locational factors and other conditions, UNIDO had prepared data sheets for three anonymous countries. The data sheets were essentially industrial investment profiles, giving information on the Government's economic policy, the regulations governing private and public foreign investment and the comparative advantages of the manufacturing sector. They applied to:

(a) A country with a small internal market;

(b) A country with a large internal market;

(c) An exporting country with a large-volume market.

II. METHODOLOGY OF THE WORKSHOP

The Workshop was centred around a dynamic process of role-playing by four types of functional groups, namely the "supplier" group, the "working" group, the "boss" group and the "advisory" group. There were three working groups based upon market orientation. Each working group was composed of participants from developing countries, who were playing the role of receivers of technology. The sessions were divided between private discussions of the supplier's proposal and meetings with the other three groups - "supplier", "advisory" and "boss", as described below.

A. Inputs

The supplier's technical proposal for the establishment of a television assembly plant gave the basic information used at all the group sessions. The proposal contained a full description of two variants of the technology that would be appropriate for the television assembly sector, together with their capital investment and operating costs for various levels of production. An outline of the proposal was included in the documentation (ID/WG.339/3). In addition, industrial investment profiles of three anonymous developing countries were provided (one for each working group), to permit the choice of appropriate technology to be considered in the context of the actual economic/fiscal conditions prevailing in the selected developing countries.

B. Procedure

The way in which the groups interacted with each other is set out below.

Session	Working group I	Working group II	Working group III
1	Boss	Supplier	Advisory
2	Free	Boss	Supplier
3	Advisory	Free	Boss
4	Supplier	Advisory	Free
5	Free	Supplier	Advisory
6	Advisory	Boss	Supplier
7	Supplier	Free	Boss
8	Boss	Advisory	Free

The timetable allowed each working group two one-hour sessions with the supplier group, the advisory group and the "boss" group. The sessions with the advisory group were scheduled immediately before, or after, the free sessions, so as to allow flexibility in the time allotted to the two activities. It should also be recorded that before the sessions each working group was given time to discuss the proposal and to formulate and agree negotiating strategies.

The supplier group was composed of three industrial executives (with commercial, legal, and engineering/plant management expertise) and was briefed to be generally representative of the suppliers of such technology rather than of any particular firm. The group was able to offer various points of view on the adaptation and selection of technology.

The participants from developing countries were assigned to the three working groups. Each group, as far as numbers permitted, included entrepreneurs, technologists, legal advisers and government officials; each had a designated chairman and a rapporteur. The membership of each of the three working groups was chosen to be representative of a recipient developing country with different market orientation - small domestic, large domestic, large export - and the industrial development profiles were allocated accordingly. Each group negotiated with the supplier group the best way to formulate from the proposal a choice of technology and equipment to make the required products with optimum benefits, given industrial development profile conditions prevailing in the developing country concerned.

The "boss" group played the executive decision-making role, interacting with each working group and reviewing the emerging ideas as they developed from sessions with the supplier group. The participants in the group comprised representatives of UNDP, UNIDO and ICD and the UNDP consultant, who acted as chairman.

The advisory group had the task of ensuring that full consideration was given to the public sector issues involved in the establishment of new industries in the developing country. In particular, government measures and requirements were elaborated for the working groups' consideration. The advisory group was composed primarily of representatives of United Nations organizations. Their main concern during the sessions was to ensure that the wider implications relevant not only to government policy but also to any regional or interregional policies were considered as part of the selection process.

C. Outputs

Each working group was asked to produce an in-depth analysis of the process of technology selection, with particular reference to its choice of production facilities required for the conditions prevailing in the developing country's industrial investment profile. Each group presented a report, through its rapporteur, to a plenary meeting of the Workshop. At the same plenary meeting, the supplier group and the advisory group also presented their reports and comments.

After the presentation of the group's reports, the participants in the Workshop, in plenary meeting, under the guidance of the Chairman, identified and discussed the various issues affecting the choice of investment in the electronics assembly sector of industry, for the various conditions prevailing in the three developing countries. The issues identified and their discussion are reported in chapter IV below.

The Workshop considered at the closing plenary meeting the relevance of the issues to be formulated into guide-lines on the choice of technology for investment within the selected industrial sector. The consensus reached by the participants is set out above in the conclusions and recommendations. Furthermore, the participants provided guidance on the preparation and format of the guide-lines and made suggestions on the distribution and use of the Workshop's report and guide-lines.

III. WORKSHOP'S ANALYSIS OF THE SUPPLIER'S TECHNICAL PROPOSAL

A. Inputs

The participants in the Workshop were provided with the comprehensive supplier's technical proposal for the establishment of a television assembly plant. In addition, support facilities were provided, including free access to the staff and equipment in the adjacent pilot plant and the use of a small computer to vary the inputs to the costs, profits and cash-flow calculations contained in the proposal. A description of the computer installation and an example of a computer print-out are given in annex III below.

UNIDO considered a survey of the development of the electronics industry in the developing countries carried out by consultants for UNESCO, which showed that the countries that had developed the sector fell into three main groups, namely, small countries with a small internal market, large countries with a large internal market, and countries that had developed the electronics industry for export. The industrial development profiles of these developing countries provided for the Workshop by UNIDO were therefore formulated accordingly.

The three papers gave details of the "typical" countries, their general economic profiles, comparative manufacturing advantages, foreign investment policies, government economic policies and regulations governing public and private investments, as well as the comparative advantages of the manufacturing sector. They were annexed to the reports of the relevant working groups.

In order to illustrate the many aspects of technological choice included in the proposal, a film was produced by Philips specifically for the Workshop, showing both the "simplified" and the current technologies. The technologies were described and costed separately in the various sections of the proposal, covering, for example, assembly-line stages and flow chart, investments, staffing, quality control, maintenance and engineering, materials management, cost calculations, cash-flow and planning.

B. Procedure

The participants in the Workshop (listed in chap. I, sect. A, above) were divided into the three working groups described above. The working groups were the first step in a process which analysed the selection of technology

according to market orientation. A general discussion followed, involving all participants in a series of plenary meetings and leading to the identification of the priority issues for the selection of electronic technology.

The working groups discussed with the various other groups the proposal for the establishment of a plant to produce a portable black-and-white television receiver with a 12-inch quick-start picture tube, in seven one-hour sessions, as described in chapter II above. To facilitate a practical and in-depth analysis, each working group was given access to the facilities in the pilot plant at Utrecht in which the "simplified" technology had been developed. Arrangements were also made to visit the Pilot Factory for Advanced Technology at Eindhoven, in which the "current" technology was being developed. The working groups were also given access to and assisted in making calculations on the computer (described in annex III below) to vary the parameters suggested either by the supplier, "boss" or advisory group, or by the working group itself.

C. Outputs

After a detailed examination of the proposal, and following interaction with the other groups, the three working groups presented reports to the plenary session of the Workshop on the type of enterprise they would recommend for establishment in their particular type of developing country. The full text of the reports is given in documents ID/WG/339/13 (large internal market), ID/WG/339/14 (small internal market) and ID/WG/339/15 (large-volume exporting country). A summary of the main findings is given below.

1. Working group I

As a first exercise, working group I, representing the large internal market, defined the issues and made a flow chart for the selection and transfer of appropriate technology. The approach was subsequently accepted by the Workshop as useful. The chart is referred to, as such, in the recommendations of the Workshop, is reproduced as figure I. The group considered that the maximum volume quoted in the proposal, 200,000 receivers per year, was inadequate for their type of country. They estimated the local demand from the data included in the investment profile of the large developing country as being some 300,000 receivers. The formula used and other factors considered in coming to that estimate are detailed in document ID/WG/339/13.

The supply of materials required for such a plant was given careful consideration and the group estimated that some 46 per cent of them could be obtained locally, thus complying with national policy and favourably affecting unit cost. That, however, would involve the addition of an extra quality and testing group in the plant.

The group recommended "simplified" technology to be selected for the first three years. In its view, during that period the learning curve, that is, the period during which the local operators, technicians and management personnel would become proficient, would be much shorter with the "simplified" technology. In addition, the group referred to other advantages, such as lower capital costs, greater flexibility for product changes, and easier care and maintenance. However, the group considered that the latest current technology should be introduced at an early date, when staff skills had been improved and the capital had been accumulated out of retained profits. All the initial know-how required to establish the operation would need to be imported. The group considered, however, that the trained work-force could identify and introduce current technology and equipment progressively after the first three years of plant operation.

2. Working group II

Working group II, representing the small internal market, selected from the proposal the case for the production of 25,000 black-and-white television receivers and analysed the profitability of such a plant, assuming it would cost $US 1.5 million (excluding working cpaital), with a selling price for the sets of $US 170. (Government protection would be required to keep the price that high.) The group estimated a return on capital employment (that is, excluding borrowing) of some 50 per cent. They also showed that there would be a small net loss of foreign exchange of $1.00 per set. The way in which these figures are arrived were set out in the group's findings (see ID/WG/339/14).

The group made an interesting analysis of the technology, current and future, which would need to be considered if such a venture were started. After agreeing with the suppliers that a second generation of televsion receivers was imminent (in the next three years or so) they proceeded to discuss the assembly plant for the new generation of sets. The sets would be designed around integrated circuits, the only major discrete components being the deflection circuit tuner and the picture tube.

The group considered the question of overall benefits to the country and recognized that television assembly yielded technology transfer benefits in the form of improved industrial skills. However, the total investment involved was some $US 2.0 million, and, as pointed out above, the new generation of assembly plants employing current technology would require the assembly of only three major components. Given the small internal market, there might well be other demands on such capital for ventures giving more foreign exchange savings, which would also offer more opportunities for improving industrial skills, making the proposed investment in television assembly line technology of debatable value from the viewpoint of national policy.

3. Working group III

Working group III, representing the large-volume exporting country, considered the establishment of a viable facility to assemble television receivers in a small-to-medium-sized developing country for the local and neighbouring market, but also mainly for export. The group found it necessary to negotiate the delivery of components, product technology and assembly technology, as well as the required technical assistance for local personnel to operate and manage the facility. Like the other groups, working group III paid particular attention to the overall cost of materials and components, which involved an annual working capital at least five times greater than that required for the plant's capital investment. Moreover, the group stressed the importance of including material and component management know-how in the loans under the overall agreement, a point also stressed by the other groups.

The plant envisaged by the group would initially provide black-and-white television receivers to the local and neighbouring markets and subsequently move into the higher-volume export market. Having assessed the "current" technology as more cost-efficient at high volumes and providing a high quality standardized product and having, on the other hand, noted the flexibility and lower investment cost of the "simplified" technology, the group decided to use a hybrid of the two systems as their choice of assembly technology.

The findings of working group III (see ID/WG/339/15) showed that the members were very much aware of their dependence upon any supplier for product design technology and the provision of almost all the required components. They therefore stressed the need to negotiate a joint venture agreement with the supplier, with the objective of then holding approximately half of the equity of the company. The demands made on the supplier were:

(a) To share the benefits of his research and development of product design on a continuing basis but, concurrently and more importantly, to assist in building up as soon as practicable within the new company a local research and development capability;

(b) To provide technical/managerial assistance beyond the start-up period on a continuing basis at direct cost;

(c) To provide marketing know-how;

(d) To defer any royalty payments until the new company was profitable or, even better, not to require any;

(e) To permit the purchase of components elsewhere if they cost less than those available from the supplier;

(f) To provide technologies and new innovations to improve the company's competitive position.

On the other hand, the group offered the supplier, in addition to relatively low cost and abundant labour, the following concessions:

(a) Freedom from corporation tax for 10 years;

(b) Duty-free importation of machinery and components;

(c) Development loans for 15 years at 12 per cent;

(d) A factory building on long-term rental at a subsidized rate.

Finally, and bearing in mind the needs of both parties, the group advocated that the joint venture should be completed on fair terms and in good faith.

IV. GENERAL DISCUSSION

The presentation of reports by each of the three working groups completed the "game-playing" part of the Workshop and led to a general plenary discussion. In the discussion, the participants were no longer acting within the framework of the assigned working groups representing three different market orientations; instead, each one participated in an individual capacity, addressing himself to the objectives set out by the Chairman.

The general discussion had two fundamental objects. The first was to determine whether or not there were significant issues common to all market orientations, which could be identified as a result of the mock negotiations held during the meetings of the working groups and further consideration of the factors that were of significant importance in making decisions on the choice of technology. The second object was to consider, on the basis of the major issues identified, whether there was sufficient justification to recommend that guide-lines be written as a means of advising potential decision-makers on the process involved in choosing the appropriate technology. Such guide-lines would be written after the completion of the Workshop and would follow the advice of the Workshop on structure and content.

The general discussion explored the insights that participants had gained from their role-playing exercise, as well as the review of the reports of the three working groups in the plenary meeting. The general discussion also laid the groundwork for establishing a consensus that a common basis existed for identifying major issues in the process of selecting the right technology, regardless of market orientation.

The focus of the discussion was on technological choices for the electronics assembly industry. It was soon determined, however, that the technological choices could not be separated from the overall process for the consideration of investments in the subsector.

Decision-making was found to be a dynamic process, requiring not only the direct involvement of entrepreneurs vis-à-vis the supplier but also the participation of pertinent advisory bodies, as well as taking into account the interest of the Government in such a venture. The choice of technology was an integral part of a complex process of decision-making, which took place within the framework of parameters provided by different parties involved in the overall process.

Technology was understood to be the way that people made and delivered things. Choice of technology, as discussed in the plenary meetings, was an integral part of the total investment decision. Therefore, the choice had to be considered by a team of individuals acting together and focusing on the legal, financial, marketing and technical aspects in a co-ordinated and complementary manner, as well as taking into account governmental policy orientations, which would have a bearing on the team's choice.

Consequently, it was recognized that the choice of technology within the above schema needed to be considered with the benefit of governmental guidance. Such guidance could emanate either from governmental objectives designed to assist the industrial development process of a country or, alternatively, from the Government's responsibility for regulating industrial investments and industrial operations.

The general discussion was based on the participant's experience in recognizing what would be important issues in the overall process leading up to investment. Therefore, the goal was to extract the critical elements of that experience in order to provide advice to others who might be faced with similar responsibilities.

The participants gave priority consideration to the matter of who would receive the advice, since the different parties involved would be approaching the question of technological choice from different points of view. In other words, the main objectives of the entrepreneur might be different from those of the supplier, which in turn could be different from those of the Government.

In view of these differences, it was decided that the issues would be identified and guide-lines possibly written for whichever party seemed most appropriate within the framework of the decision-making process, focusing particularly on possible weaknesses in bringing about a common understanding of the actions that would be needed to tackle specific fundamental issues related to the choice of technology.

While maintaing a broad approach, the participants recognized that the principal aim of any advice to be given would be centred on the entrepreneur or investors vis-à-vis their negotiations with the potential supplier of technology. At the same time, however, it was also important to provide advice within the context of the national interest, as articulated by the Government's policies for the healthy promotion of industrial development in the country concerned.

Since decision-making was a dynamic process, responding to ever-changing situations, longer-term implications of decisions made at any one time were always an important consideration. Therefore, the entrepreneurs' strategy must be built around goals that took into account the particular factors operating in the sector, the possible rate and direction of technical and economic change, and the inevitable interdependency of the Government, industry and the supplier.

Participants highlighted certain features of technological choice that were so vital to the sector under review as to overshadow other major issues normally considered in an investment situation.

For example, television assembly was a rapidly changing technology. Current technology would soon become obsolete as a result of the drastic changes brought about by the introduction of silicon chips. By making it possible to encompass a great deal more electric circuitry in less space, silicon chips eliminated the need for the current practice of assembling components from kits. Thus, choice of technology in that subsector of the electronics industry must be made with a thorough knowledge of the state of the art and of changes that might be expected to take place in the next two or three years. Current technology might become outdated by that time. The systems for the assembly of black-and-white television sets, which currently involved some 750 parts, or of colour television sets, which required about 3.000 parts, would be considerably simplified and the necessary circuitry could be drastically reduced to perhaps a dozen component parts. Such a change in technology would revolutionize the assembly of such products.

Another important factor brought out by the Workshop in terms of investment costs was the fact that the working capital required for components could be from five to ten times more than the investment capital for plant and equipment. Therefore, it was of priority importance in the investment decision to consider all those elements associated with the purchasing, storage, utilization and assembly of such a large stock of components and the cost of the financing required to underwrite the operations.

In the light of the above significant features of the electronics assembly industry, it became apparent that any choice of technology needed to be highly flexible so that equipment for the assembly and the process lines could easily be modified to accomodate different types of products or changed drastically for use in some completely different business.

In that regard, the possibility of establishing a long-term association with the supplier of the technology was considered an important factor which would have a significant influence on the decision-making process. Such an association would also provide a sufficient degree of confidence in the long-term prospects for the investment if the supplier's obligation to provide appropriate technological support services included the responsibility for keeping production facilities technologically up-to-date. The greatest assistance a Government could provide local entrepreneurs would be to maintain economic stability, thereby facilitating sound future planning.

In the context of the above broad but significant features of electronic assembly work, it was apparent that one strategy applicable to any country or entrepreneur entering the business would be to acquire a hybrid of a simplified and current technology. Such a move would permit the entrepreneur and his staff to learn the business as quickly as possible, so that within three or four years the enterprise might be ready to acquire the current technology that had become current by then. Such an approach would obviously also facilitate changes in the product line.

Within that strategy, the entrepreneur ought to begin developing a research and development function. More important still would be the development of a process development capability, so that improvements could be made in the production lines and the plant would not be dependent upon the supplier of the technology.

It was agreed that the strength of the enterprise would be closely related to its ability to become technologically independent. That, in turn would depend on the willingness of the entrepreneur to undertake process development activities in order to innovate products for his markets.

Therefore, in assisting entrepreneurs to enter the electronic assembly industry, Governments should give priority emphasis to the development of engineering and management skills, ensuring that the physical infrastructure of the plant was flexible enough to adapt to new product lines, to different product ranges, and ultimately to new technologies.

It was on the basis of those considerations that the meeting addressed itself to the identification of important issues that would have a significant bearing on the decision-making regarding choice of technology.

V. ISSUES

A paper outlining the issues to be considered by the Workshop (ID/WG/339/5) was circulated to participants before the meeting. The paper provided a supporting framework for the Workshop and listed a range of areas and topics that participants were invited to use as the starting point for their deliberations.

The scope of the issues to be considered when making a choice of technology was portrayed in diagrammatical form at the meeting (see figure II below). It will be seen that the central circle is the starting point for most approaches to the problem, representing the techno-economic outlook of the enterprise or entrepreneur. It encompasses the total range of inputs and outputs of the enterprise, as indicated in figure III below, which shows that there are a number of issues related to the techno-economic functioning of the enterprise that must be taken into account.

The outlook of the enterprise, of course, is only one of the factors determining the choice of technology. The national policy issues, depicted in figure II as the circle surrounding the enterprise, are equally important. There is a two-way connection here. The enterprise is dependent upon national policy and its instruments, for example, import regulations and use of foreign exchange, whilst the national economy, for its part, will look at the new technology introduced through the enterprise as part of its techno-economic development.

Beyond the national outlook are the wider-range factors depicted in figure II as the outer circle, to include world technology, trade and politics.

Any decision process must take account of all these interests and the wedge cutting across the three circles labelled as "strategies and goals" is meant to indicate the scope of the decision process and its relation to the demands of all three domains shown in the figure. There is a further very important element in the decision process leading to technology choice, and that is the way in which the situations change with time and that too is illustrated conceptually in figure II.

In presenting the issues, it is convenient to do as the Workshop did and take them in two major groups, first those of concerning the enterprise or entrepreneur, and secondly, those concerning the nation. The issues that were identified in the Workshop fell mainly into those two groups. There was frequent

reference, of course, to the wider international issues, particularly with regard to electronic product technology, which is in a state of very rapid development. One of the issues discussed frequently was the relation of any particular technological acquisition to the state of the art world-wide.

A third grouping was identified as "strategy and goals" or "implementation", but many of the points made here were inescapably and properly taken account of in the issues facing the enterprise or the nation. Under the heading of strategy and goals, however, some important topics were considered, notably the implementation of technology and the conduct of negotiations with suppliers.

The emphasis that was sought in both the issues and guide-lines was the interaction along the axis joining the supplier and enterprise, Government and international agencies showing a strong interacting role.

The issues that were emphasized during the working groups' study of the supplier's technical proposal and in the subsequent plenary meetings are summarized in annex IV below. The nature and significance of the issues are expanded upon briefly in the following sections.

A. The enterprise: techno-economic factors

1. Markets

Clearly the important issue is the estimation of demand for the products of selected technology: market segments, total size, expected market share. The range of products to be manufactured and their specification in relation to user needs should also be assessed.

The probable future expansion and diversification of demand for products of the technology and the relation of market growth to expanding production capacity should be taken into consideration as far as possible.

The nature of the competition and the degree to which the domestic market will be protected by import duties on competitive products should be taken into account. The probable impact of the eventual reduction or elimination of such protective barriers on the success of the enterprise will need to be projected.

Export market opportunities should be assessed. The attractions of increasing sales substantially by exporting to regional neighbours have to be set against the uncertainties inherent in export business, which is not only highly competitive but also runs the risk of being short-lived if neighbouring countries adopt local manufacture protected by import licences.

The degree to which business risk will be accepted by receivers of technology and the degree to which it may be possible (or desirable) to offset this by joint venture arrangements with the technology supplier should be taken into account.

Pricing policy and expected demand elasticity in the domestic market are also factors to be considered. Who are the price-setters and how does this affect export possibilities and hence the investment appraisal?

Market development and the associated problems of marketing are important for assessing the pattern of demand and the achievement of targets. There is a range of issues here, less emphasized perhaps in the Workshop because the proposal assumed that product sales and distribution to final users were not the responsibilities of the entrepreneur, whose problems ended at the end of the production line.

2. Technology

The dominant issue in the choice of technology concerning technology per se is the expected high rate of change of both product and process technology and the degree to which the acquired technology would be flexible enough to accomodate any changes.

A related question is the degree to which assembly-line technology should be dedicated in its equipment and plant to a specific product. The acquisition of a flexible and adaptable technology, as against a product, is an important issue in the choice of technology.

The timing of entry into electronic assembly line technology is another related issue. Is it already too late for simple assembly technology and should the acquisition of highly automated plant be preferred? This question is related to that posed in the previous paragraph, in so far as the highly automated line may be less adaptable than a more manual version.

In choosing technology, the strategy and goals of the entrepreneur as regards growth, expansion and diversification is a decisive factor and the issue is how will the acquired technology lend itself to expansion and to the manufacture of products other than the one it has been designed for?

An early step towards diversification may be taken by "integrating", that is, by taking over for local manufacture some of the components comprising the "kit" provided by the suppliers of the technology. One issue in the choice of

technology is the identification of such components and the provision of resources (equipment, materials, skills) for their local manufacture.

The local supply of materials and certain components ("sourcing") may come from outside the firm acquiring the technology but within the country in which it is located. It is possible, for example, that one manufacturer of components may supply many assemblers in a region and seek to achieve in this way some of the economies of scale that large-volume production brings. Government encouragement of this approach is likely.

Like components, materials may be from local sources and again Governments are likely to encourage this approach in order to assist national economic development. The quality of materials so "sourced" is an important issue because of the dependency of the performance of the product on the quality of materials used in its manufacture.

There is an issue of standards and specification that all enterprises taking on new technology must face, in developing and developed countries alike. Cross-border trade and commerce is inhibited by disparate standards and an issue for enterprises on a regional and eventually world basis is to secure compatability. A similar consideration applies to compatibility of equipment and parts: entrepreneurs, as buyers, are benefited by such compatibility in so far as it permits multiple sourcing and, hence, competitive tendering.

The infrastructure of the receiving country is a major issue to be considered in choosing technology. Infrastructure is a term embracing the total business and technical context or environment in which the acquired technology must operate. Any inadequacies in the infrastructure, be they in transportation, communication, utility supplies (for example, power and water), maintenance and repair services, engineering services, toolmaking, sources of information on business and techno-scientific matters or research institutes and associations, will seriously limit the effective operation of the technology. This issue may be outside the competence of any individual entrepreneur to resolve and/or overcome but in deciding on the choice of technology there has to be a recognition of the constraints that may be imposed by infrastructural deficiencies and the degree to which the technology chosen remains effective even under difficult operating conditions.

The entrepreneur acquiring technology that is new to him may need to continue dealing with the technology supplier or other source in order to ensure a progressive updating of his products and processes. This is an issue the selectors of technology will wish to raise with their suppliers when discussing the inclusion in the contract of a continued updating of the technology acquired.

The issue of continuous linkage with an external source of technology is invariably related to the overall critical issue of what degree of technological and marketing independence the entrepreneur seeks. In planning his strategy, he must carefully evaluate the "point of entry" (that is, simplified or current technology or a "hybrid") the rate of staff training he can afford, the possibilities for establishing an in-house research and development capability etc. He may reduce his involvement in such activities to a minimum and accept a high degree of dependency on the foreign technology supplier. Alternatively, he may maximize his involvement and improve his bargaining position with the supplier. He may even create a sufficient research/technology base to create his own product technology.

3. People

Receivers of technology that is new to them must be clear on what skills and abilities are necessary for its successful establishment and operation. Sources of these important factors of production must be identified. A related issue is the provision of training facilities - by the supplier, by the receiver or in local colleges or other training establishments. This involves decisions of who is to do the training, where it is to be done, how, at what cost, and how people should be selected.

Engineering and management are functions of particular importance. The availability of suitable persons and the training arrangements for them are important issues because there is often a scarcity of such capabilities in newly developing countries.

Related to management is the issue of business administration competence in such basic subjects as how to place an order, how to control stock levels, how to plan the flow of work in progress on the assembly line from station to station and other skills needed for effective plant operation. In the television assembly industry as many as 750 components may be involved in a simple black-and-white set and as many as 3,000 in a colour set. In such an assembly-line technology,

the task of materials management is of critical importance for smooth uninterrupted production and thereby for the cost effectiveness of the whole operation.

Quality control is at least as much a "people" issue as a methodological one. The technology chosen must include quality control and quality assurance procedures and appropriate testing devices, as well as training programmes for quality control personnel.

In the process of acquiring technology as well as in the normal conduct of business it is important that entrepreneurs and their employees should possess negotiating skills. This in turn demands that they be well informed. When negotiating a contract for supply of technology it is to be expected that the suppliers will be powerful advocates of their position and the receiver should be equally well prepared.

Availability of qualified personnel within the enterprise is one matter; the quality of individuals in the support service organizations and infrastructure is another, no less important, although outside the control of the entrepreneur. It is, however, an issue of which one should be aware if only to recognize it as a constraint. In this category come people in academic and government research establishments: if there is a lack here of ability to communicate effectively with industry, their usefulness to the entrepreneur and his technological/scientific problems will be greatly impaired.

4. Finance

Acquiring technology is a major investment for the receiver and thorough investment appraisal involving sales, prices, costs, investment, interest, taxation, profits, and cash flow should be undertaken at the start of negotiations and be updated rapidly as the project moves forward from feasibility phase to implementation.

In the area of finance the following issues were regarded by the Workshop as of outstanding importance:

(a) Sources of finance - shareholders, banks and finance houses, Government, technology supplier (in joint ventures) - and its cost;

(b) The equity/loan structure and the relation of this to the nature of the business and the acceptance of risk;

(c) The financial management function in the business and the importance of exchange rates in negotiations leading to a recommendation to conduct these in one specified currency;

(d) The sources of funds from the Government or banks for new ventures;

(e) Financial incentives in the tax system for the establishment of new technologies.

5. Forms or structures of the transfer of technology

The variety of organizational forms for the transfer of technology is an important consideration. These range from licensing (with or without know-how) through turnkey projects to joint ventures with shared ownership, direct foreign investment, or acquisition of a company. The choice depends on many factors but especially on the receiver's technical and business experience in the technology being acquired. In a situation of rapid technical change and high competition, a joint venture, to share risks and technological developments, has attractions but there may be reluctance on the part of suppliers to enter small undertakings on this basis. There is also the issue of independence to be set against shared ownership. (See below.)

The choice of turnkey versus "unbundled" technological projects was regarded in the Workshop as an important issue. Those responsible for selecting technology have to compare the convenience of turnkey projects with the loss of freedom in choice of equipment and plant suppliers and, perhaps more seriously, the loss of the opportunity to learn during the construction, start-up and initial management of a new technological project.

Because of the importance of the management function to the success of an enterprise, consideration may be given to a management agreement as part of the technology acquisition contract, but such arrangements are likely to be of limited duration, to cover the early stages of operation of the production line. However, continued reliance on such assistance is not recommended.

B. National policies

1. Economic considerations

Governments should approach technological choice processes from an appreciation of the relation of the technology in question to national industrial and technological development policies and strategies, and should make judgements based on the established priorities and time perspectives of such strategies.

The instruments of such policies include legal supportive measures, such as pioneer industry law, export industry development law, export promotion law, and appropriate financial and fiscal measures such as tax incentives, loans,

guarantees, foreign investment law and regulations and the promotion of research and development (including promotion of the commercialization of its results).

National policies and regulations also impinge upon the availability of foreign exchange for purchases and the control of imports through licensing.

Payments of royalties and payments for technical services by the supplier and, in the case of joint ventures, the transfer pricing of supplies and products are also subject to government scrutiny and regulations in many developing countries.

The policies and instruments of Governments constitute an interlocking pattern, which may influence the decision process with respect to technological choices. The issue here is the need to acquire and adapt technology which both conforms to and takes advantage of its national economic and fiscal environment.

Governments in receiving countries may have policies which affect the prices manufacturers can charge for their products, the instrument here often being a tax on the products if they are non-essential goods. Such charges will be an important element in the investment appraisal of the entrepreneur, having a substantial effect on the cash flow of the venture.

The government measures for the protection of the products of domestic industry, referred to at the beginning of this section, are crucially important for product pricing by the entrepreneur acquiring assembly-line or any other technology. Some Governments, however, see dangers in the overprotection of domestic industries and their policies may tend towards the eventual liberalization of trade, with the object of exposing their industrial concerns to the stimulus of foreign competition. A careful probing of government strategy on these matters is evidently an issue of great consequence in technology choice and investment appraisal.

Another economic aspect of choice of technology at the governmental level is the role of external financing to facilitate payment for technological supplies. This issue is one which receivers may explore with potential suppliers of the technology they seek.

2. Technological considerations

In addition to economic development policies, Governments of receiver countries are likely to have technological policies and strategies, to which the chosen technology will be expected to conform.

One of the central features of technological policy for Governments of developing countries is likely to be the reduction of technological dependence. Figure II shows that no country, developed or developing, can be totally independent of world-wide technological growth and development, but a realistic aim is to raise local levels of technological capability so that the initial dependence on foreign sources of technology can become an inter-dependency, with a two-way flow. Therefore, Governments of developing countries will regard as an important issue the contribution an acquired technology may be expected to make to the country's overall technological capability. Are the administration and technical skills of managing the enterprise transferable? What are the linkages: do the products provide a base for technological expansion? What are the demands on the technology for quality control and quality assurance processes and procedures? Can the acquired technology serve as a vehicle for the subsequent development of technologies emerging from government institutes or universities?

The Workshop identified infrastructure as an important issue for both the Government (as the main provider) and the entrepreneur (as the user). Physical infrastructure (communications, road, rail, ship and air transport, public utilities (energy and water supplies)), and technical infrastructure (training facilities, schools, universities, colleges, research institutes, service organizations, information services): all are important aspects of technology choice.

Any technology is completely dependent upon its infrastructure for effective functioning. The demands made by the technology on the infrastructure elements (both physical and technical) referred to above must be carefully assessed and discussed with the Government as well as with the suppliers of the technology.

Although capable people are of critical importance to an effective infrastructure, they are not the only prerequisite; the infrastructure must also include the appropriate organizations and administration to be useful: good scientists, engineers and technologists cannot become effective without them.

The entrepreneur cannot create his own infrastructure, this being a task for the Government: it is likely, however, that the new technology may itself contribute to the national infrastructure: television sets may be seen by Governments to offer an important channel of communication between the Government and the populace.

One issue that Governments and international organizations must deal with is that of agreement on standards and specifications to facilitate trans-border trade in components and equipment.

Collaboration between the public and private sectors can be advantageous: to private business by providing a market for its products and to the public sector by raising national technological competence and independence.

3. Social implications

A major issue affecting a nation's choice of technology is its effect on employment. In the case of electronic assembly-line technology, the more labour-intensive variant of the technology may be favoured by Governments, since it employs more people than the more automated forms. The issue is not straightforward, however, since the numbers employed in either variant are small and automation can improve working conditions by eliminating heavy lifting and uninteresting repetitive work. Television sets may also be cheaper when made in large numbers by automatic techniques.

Whilst availability of skills and knowledge are important to the entrepreneur, the Government may look to new technology to raise the general level of skills in the country. Governments may be called upon to provide training and education programmes to meet the manpower inputs required by the developing national technological competence. A serious issue for the enterpreneur in this respect is to be assured that the requirements of the technology for skills and management can be met in the new location to which the technology is to be transferred.

A national social issue, illustrated by the television set assembly-line technology, is the question of what contribution the product makes to community life. Often, imported foreign-made sets can be cheaper for the consumer. Imported sets may, however, involve an economic cost (foreign exchange) and a social cost (lack of employment). Governments must hence consider the various trade-offs in terms of national objectives. The Governments must be prepared to offset cost against the technological policy issues listed in the previous section. The educational and political value of television sets may be an important factor in the Government's cost-benefit calculations for the proposed acquisition of technology.

C. Strategy and goals

1. Enterprise

Entrepreneurs who have to make a decision on the choice of technology for electronic products should have a strategy, even if it is not explicitly stated. They should have objectives, both long-term and short-term; they should have a realistic understanding of their strengths and weaknesses. They should also be aware of competition, foreign exchange constraints, competing claims on government resources, lack of management and technical skills, and the rapid pace of technological change. The issue faced by the entrepreneur, therefore, is how to shape his strategy to enable him to reach his goals with the resouces at his disposal, taking into account the various constraints as well as national goals and priorities.

All of these issues are dynamic in character and influence the fluctuating business and technological environment (see figure II below) in which the entrepreneur operates.

To make successful decisions under such difficult conditions there are two essential conditions:

(a) Thorough preparation, including early discussions with government and financial organizations;

(b) A negotiating strategy with technology suppliers which provides opportunities for successive renegotiation, as shown in figure IV below.

At the tactical rather than the strategic level, the entrepreneur should prepare carefully for his negotiation with suppliers by obtaining the guidance of relevant parties (notably the Government) and by recognizing the strengths and weaknesses of the suppliers with whom he bargins.

As one Workshop participant warned, the price quoted for the supply of know-how, if itemized, may be a poor criterion for selection, since the total investment will greatly overshadow the cost. Another important factor is the reputation and reliability of the supplier, particularly in regard to after-sales obligations.

2. Government

The Government of the receiving country, as well as the entrepreneur, should consider the choice of technology in dynamic strategic terms. For the Government, however, the acquisition of an individual assembly-line technology may be a small item in a much larger strategy.

The likelihood of decisions and technological growth being effective will be enhanced if the Government's overall strategy is both widely known and stable.

Figure I. Flow chart for the selection and transfer of appropriate technology

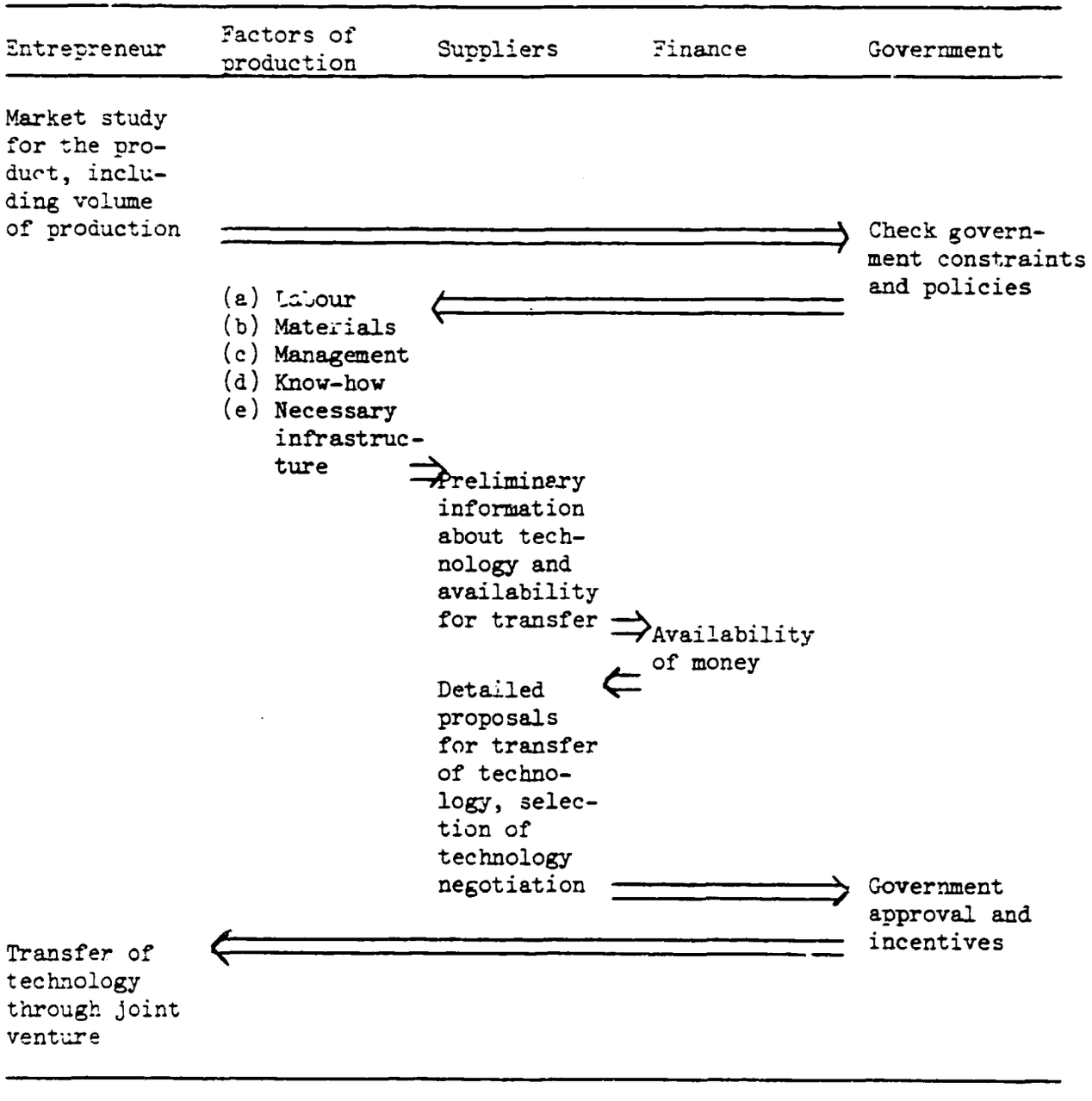


Figure II. Dimensions of the choice of technology

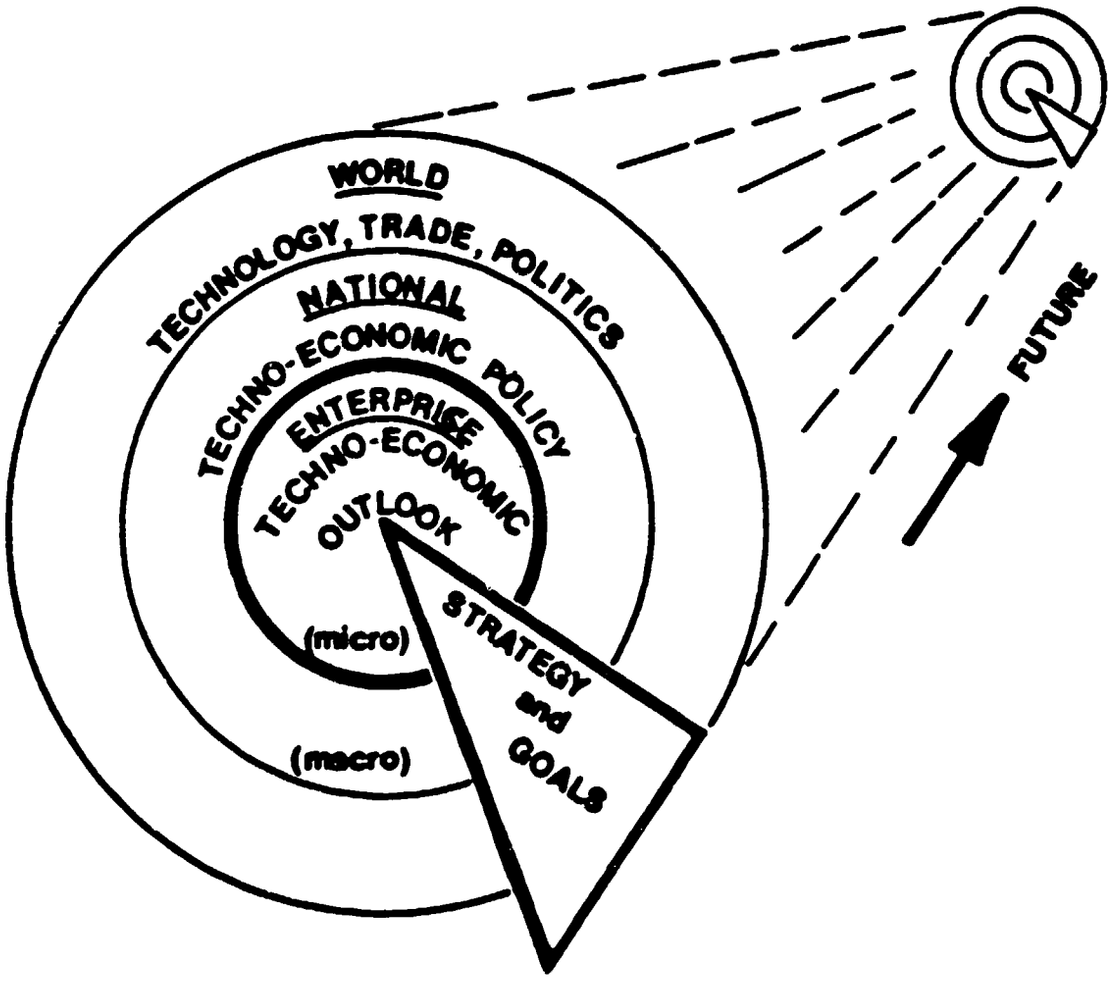


Figure III. Technological inputs and outputs

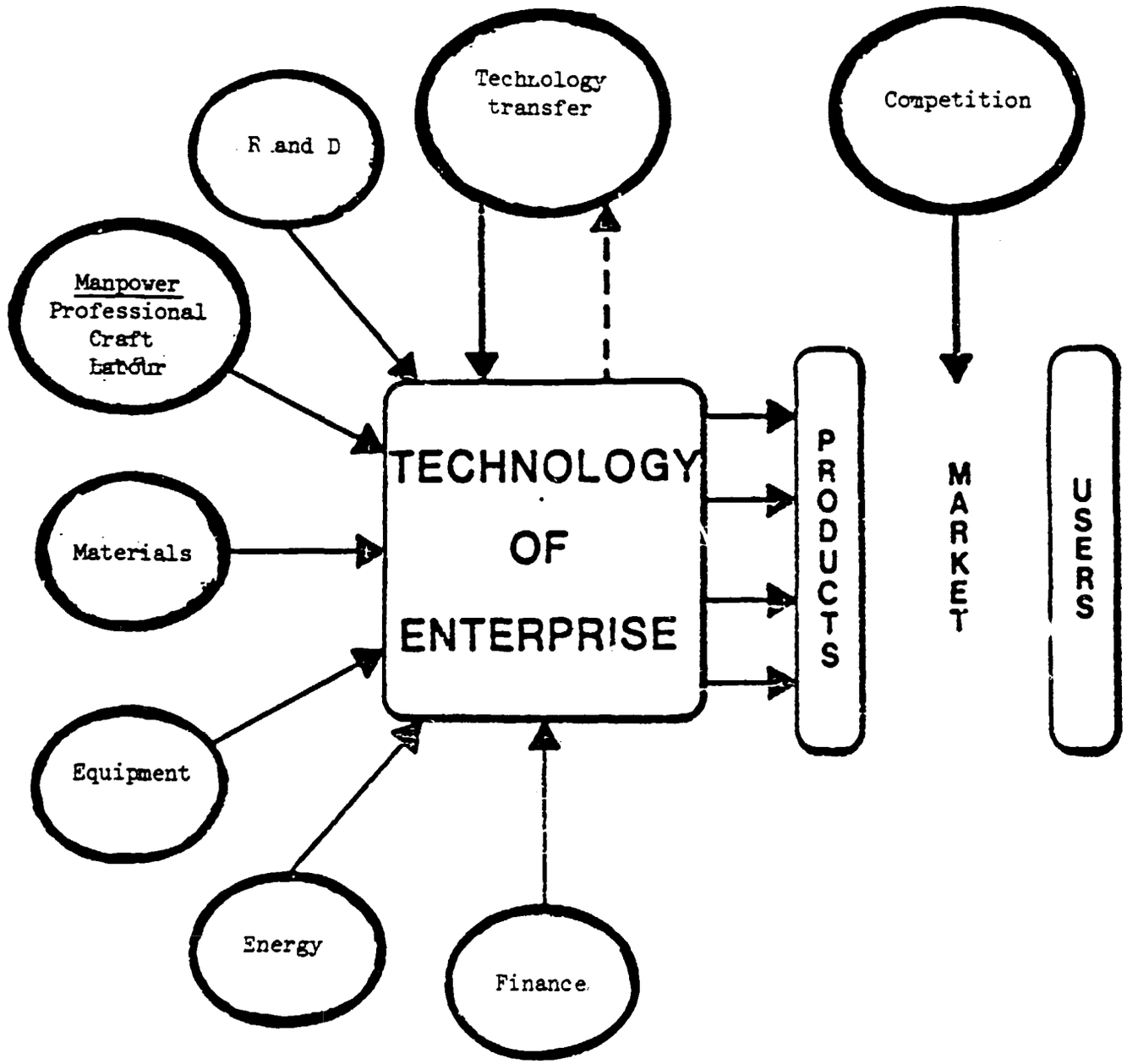
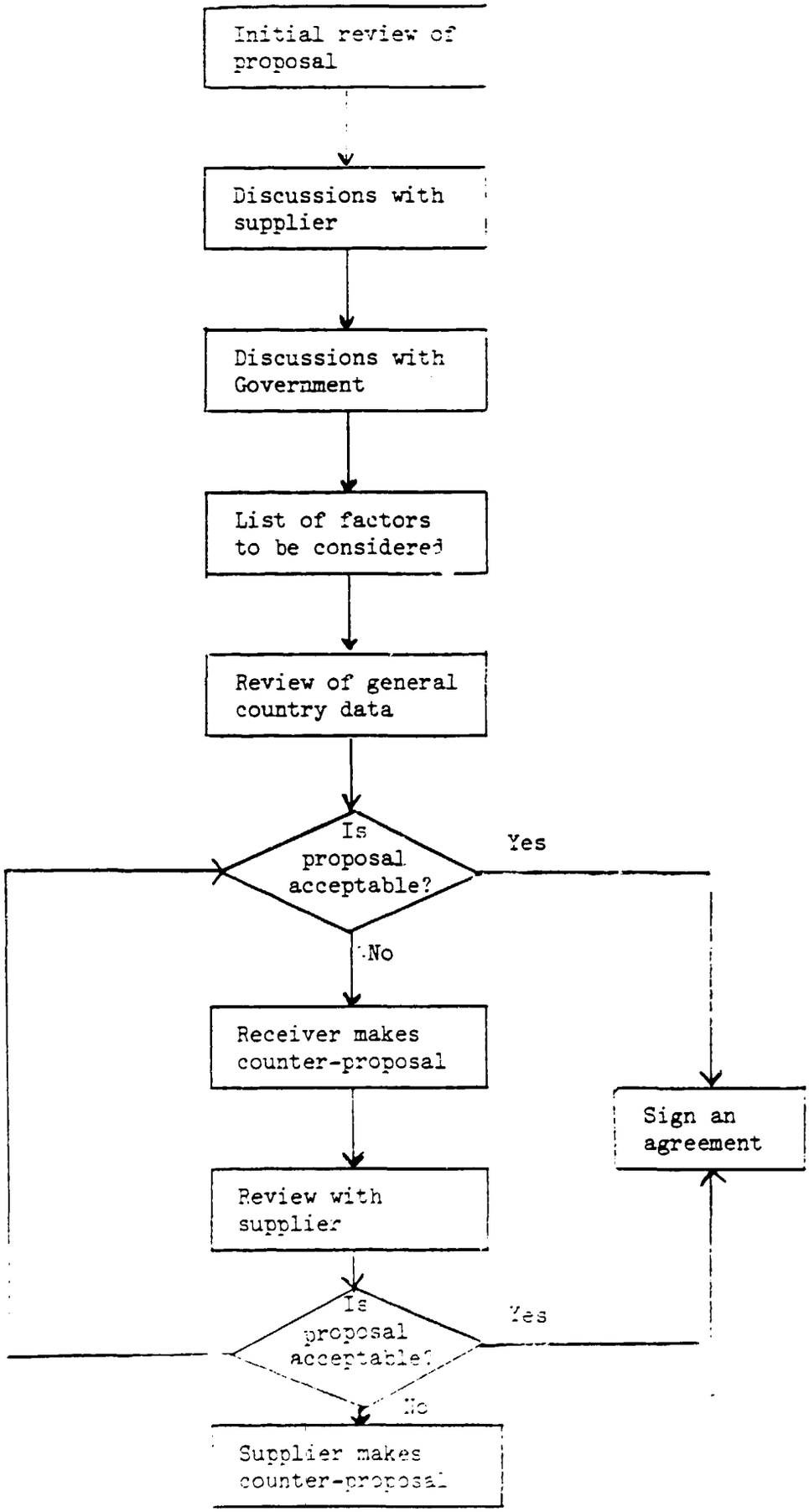


Figure IV. Flow chart of the decision process



Annex I

PROGRAMME

4 May 1981:	Opening statements
	Explanation of the Workshop concept by UNIDO
	UNIDO presentation on its experience in the transfer of technology
	Philips introduction to the Pilot Factory and case history
	Presentation of the supplier's technical proposal
	Tour of the Pilot Factory and explanation of facilities
	Presentation by participants from three developing countries on national experience in the electronic assembly industry
5 May 1981:	Sessions 1-6 of the three working groups
6 May 1981:	Introduction to Philips with audio-visual presentation Tour of Philips Pilot Factory for Advanced Technology, Endhoven Sessions 7 and 8 of the three working groups
7 May 1981:	Presentation of the reports of the working groups
8 May 1981:	Formulation of the conclusions reached by the Workshop
	Identification of priority issues for the selection of technology leasing to draft recommendations
	Adoption of the conclusions and recommendations
	Concluding activities

Annex II

LIST OF DOCUMENTATION BEFORE THE WORKSHOP AND SELECTED REFERENCE MATERIAL

UNIDO documents

Symbol	
ID/WG/339/1	Agenda for the Workshop
ID/WG/339/2	List of participants
ID/WG/339/3	Outline of case study
ID/WG/339/4	Workshop methodology and outline of case study
ID/WG/339/5	Issues for consideration
ID/WG/339/6	Adapting technology - an example from the electronics industry
ID/WG/339/7	Technology transfer in Malaysia
ID/WG/339/8	Caribbean electronics industry
ID/WG/339/9	UNIDO's experience in the transfer of technology
ID/WG/339/10	The Mexican experience in the electronic industry
ID/WG/339/11	A critical look into the assembly of television receivers in Bangladesh
ID/WG/339/12	The electronic industry sector in Brazil
ID/WG/339/13	Findings of Working Group I
ID/WG/339/14	Findings of Working Group II
ID/WG/339/15	Findings of Working Group III
ID/WG/339/16	Report of the Workshop on Selection of Technology for Assembly of Electronic and Electrical Products in Developing Countries

Restricted document supplied by Philips*

Supplier's technical proposal for the establishment of a television assembly plant

Selected reference material

Industry Council for Development, Industrial Statesmanship for an Independent World: Proceedings of the Second ICD Development Symposium, Convened at Geneva, 2 July 1980 (New York, Industry Council for Development, n.d.).

A. Kuilman, "Transfer of industries to developing countries" (summary of a statement made at the Seminar on Transfer of Technology and International Division of Labour, organized by the Centre for Applied Studies in International Negotiations at Geneva in November 1980).

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*Available from Philips Pilot Factory, Utrecht, Netherlands, subject to the approval of Philips. A charge may be made to cover production and mailing costs.

Philips, SFH: A New Video Pilot Plant in Eindhoven (in Dutch, with English summary).

Philips, "The influence of technology on the employment situation", translation of an article in Philips Koerier, issued by the Philips Concern Press Department, Eindhoven, Summer 1978.

Philips, The Philips Pilot Plant, n.d.

World Intellectual Property Organization, Licensing Guide for Developing Countries (Geneva, 1977).

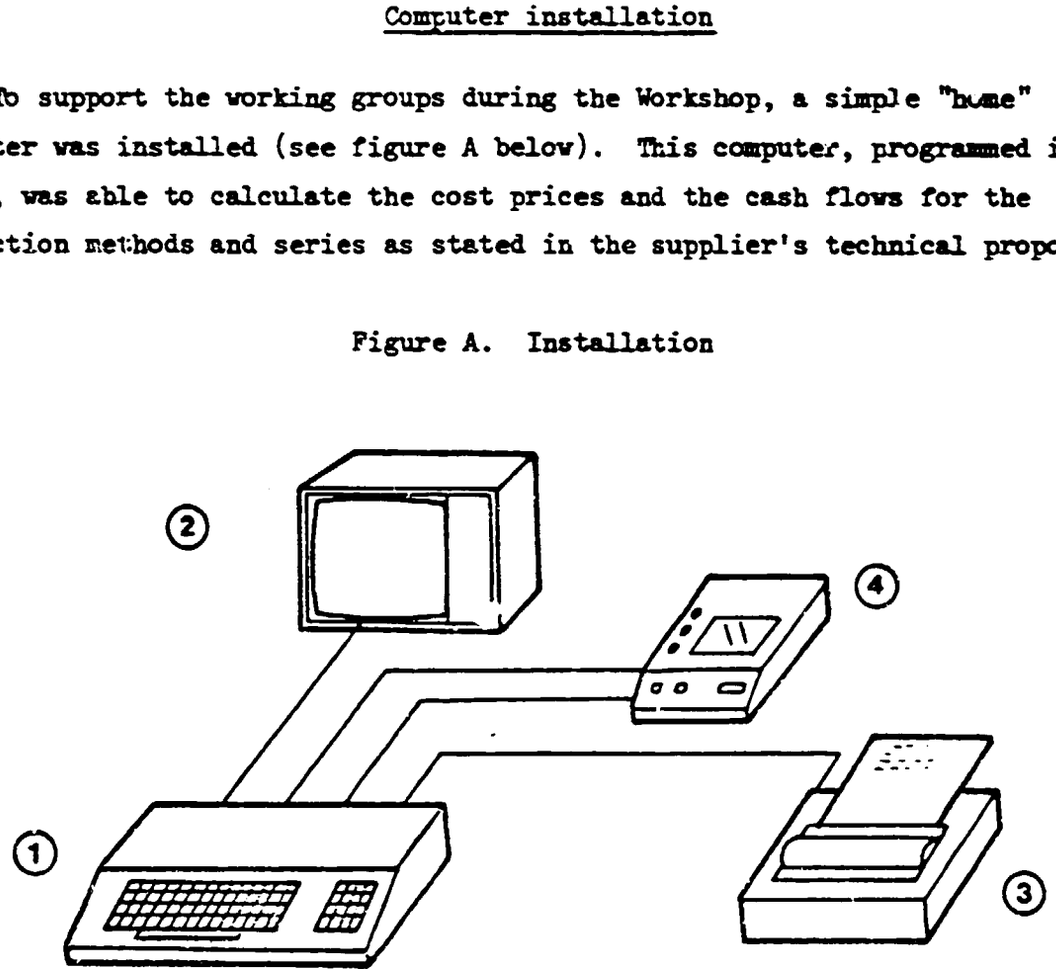
Annex III

COMPUTER INSTALLATION AND OUTPUT

Computer installation

To support the working groups during the Workshop, a simple "home" computer was installed (see figure A below). This computer, programmed in BASIC, was able to calculate the cost prices and the cash flows for the production methods and series as stated in the supplier's technical proposal.

Figure A. Installation



Source: NV Philips Gloeilampenfabrieken, Eindhoven.

Key:
1 Computer — EXIDY - SORCERER, 48 k memory capacity
2 Monitor — TX 12" television set (black/white)
3 Printer — EPSON - MX 15
4 Cassette-recorder

Computer output

For an example, see figure B below.

The basic data could easily be changed at the request of the participants in the Workshop.

Figure B. Computer output

COSTPRICE CALCULATION * TX *

BASIC DATA			** VARIABLES	
DIRECT WASES PER HOUR	=	2.5 US $	** 10BH	= 2.5
MAXIMUM INDIRECT WAGES	=	3 TIMES DIRECT WAGES	** 22F1	= 3
MANAGER SALARY	=	6 TIMES DIRECT WAGES	** 31F2	= 6
INTEREST	=	15 %	** 61IT	= 15
DEPRECIATION(EQUIPM.)	=	6 YEARS	** 41DE	= 6
DEPRECIATION (BUILD.)	=	30 YEARS	** 51DY	= 30
BUILDING PRICE	=	250 US $ /sq.METER	** 47MP	= 250
LAND PRICE	=	2.6 US $ /sq.METER	** 71MM	= 2.6
IMPORT DUTY (EQUIPM.)	=	5 %	** 43ED	= 5
IMPORT DUTY (MATERIAL)	=	20 %	** 95DM	= 20
HANDL. CLEAR. TRANSP.	=	9.5 %	** 75HC	= 9.5
INSTALLATIONCOSTS	=	2.5 %	** 79IN	= 2.5
FREIGHT and INSUR.	=	12 %	** 97FI	= 12
KIT- I for 25K	=	78 US $	** 99M25	= 78
I for 50K	=	78 US $	** 100M50	= 78
PRICE I for 100K	=	74 US $	** 102M100	= 74
I for 150K	=	74 US $	** 105M150	= 74
FOB. I for 200K	=	72 US $	** 107M200	= 72
DESIRED RESULT	=	5 % of COSTPRICE	** 35E2	= 5
EXCISE DUTY	=	5 % of TRANSFERPRICE	** 33E1	= 5
CASHFLOW CALC. FACTOR	=	15 %	** 93C0	= 15
TRANSFER I 1st YEAR	=	143.7 US $	** 81F5	= 143.7
I 2nd YEAR	=	143.7 US $	** 82F7	= 143.7
PRICE I 3rd YEAR	=	136.3 US $	** 83F9	= 136.3
I 4th YEAR	=	136.3 US $	** 84F3	= 136.3
COMMERCIALI 5th YEAR	=	132.6 US $	** 85F4	= 132.6

** If BASIC DATA have to be changed type C?

COMPUTER OUTPUT

ANNUAL COSTS ** All amounts in US. Dollars (1981) **

	25 K		50 K		100K		150K		200K	
	S	C	S	C	S	C	S	C	S	C
SAL	313	308	460	424	807	672	1103	903	1416	1108
DEP	75	356	86	365	117	449	159	589	183	653
INT	229	355	361	486	548	697	733	927	812	1024
SUB	618	1021	908	1276	1473	1819	1996	2419	2412	2786
VAR	62	102	91	128	147	182	200	242	241	279
ANC	680	1123	999	1404	1620	2001	2196	2662	2653	3065

COSTS PER PRODUCT

PPR	27.2	44.9	20	28.1	16.2	20	14.6	17.7	13.3	15.3
MAT	113	113	113	113	107	107	107	107	104	104
ISV	6.5	6.5	6.5	6.5	6.5	6.5	4.4	4.4	3.3	3.3
CPR	147	164	140	148	130	134	126	129	121	123

SAL = TOTAL SALARIES
DEP = TOTAL DEPRECIATIONS
INT = TOTAL INTERESTS

SUB = SAL. + DEP + INT
VAR = VARIOUS COSTS (10% of SUB)

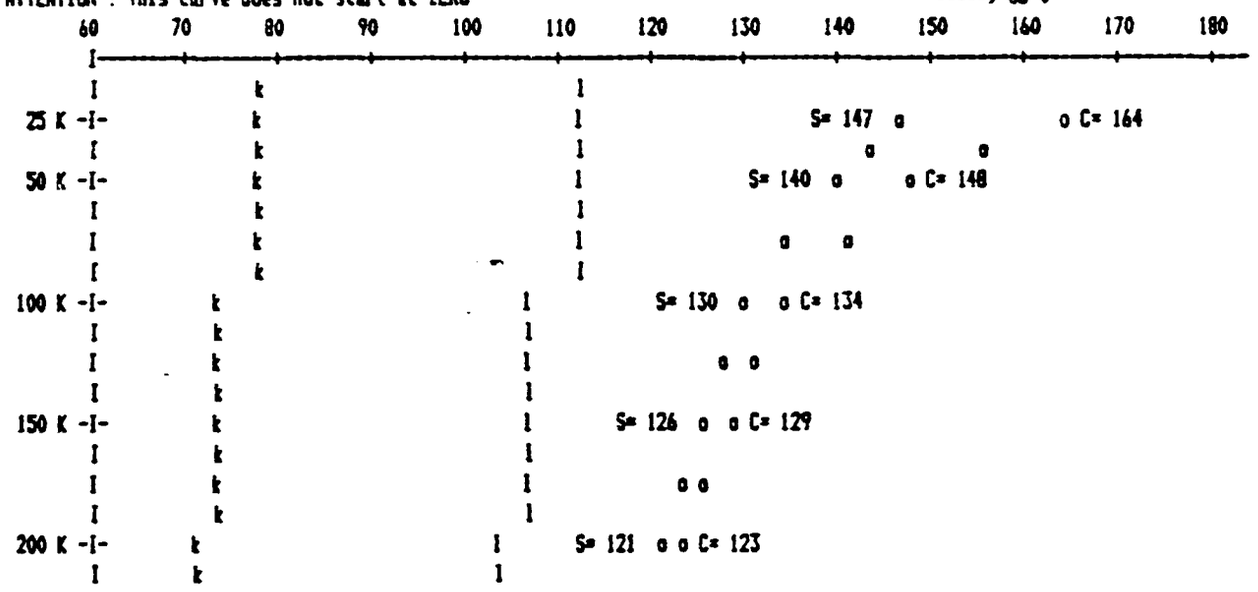
ANC = ANNUAL COSTS

PPR = COST PER PRODUCT
MAT = MATERIAL
ISV = INDUSTRIAL SERVICE

CPR = COSTPRICE

COMPUTER OUTPUT

ATTENTION ! This curve does not start at ZERO ——> US $



** CASH FLOW CALCULATION **

YEARS --->	0 START		1st		2nd		3rd		4th		5th	
ANNUALSERIES-->	0		25 K		50 K		100 K		150 K		200 K	
CASH OUTFLOW	S	C	S	C	S	C	S	C	S	C	S	C
LAND	39	39										
BUILDING	825	825					425	425				
EQUIPMENT	285	1973	66	51	184	503	171	758	141	384		
STOCK	941	941	848	848	1153	1153	936	936	455	455		
SALARIES IND.	98	104	196	210	235	253	367	362	464	448	548	514
SALARIES DIR.			117	99	225	171	441	310	639	454	868	594
VARIOUS COSTS	31	51	62	102	91	128	147	182	200	242	241	279
MATERIAL			2825	2825	5650	5650	10700	10700	16050	16050	16467	16467
INDUSTR.SERV.			163	163	325	325	650	650	660	660	660	660
TOTAL CASH OUTFLOW	2218	3934	4276	4297	7862	8182	13837	14322	18608	18692	18784	18513
CASH INFLOW												
SALES REVENUE			3592	3592	7185	7185	13630	13630	20445	20445	26520	26520
RESIDUAL LAND											39	39
RESIDUAL BUILD.											1084	1084
RESIDUAL EQUIP.											393	1422
NETT CASHFLOW SURPLUS/DEFICIT	-2218	-3934	-684	-705	-677	-997	-207	-692	1837	1753	7736	8007	1516	2545
PRESENT VALUE at 15 %	-1929	-3421	-518	-534	-446	-656	-119	-396	913	871	3344	3461	655	1100

Nett present value ** SIMPLIFIED: 1903 ** CURRENT : 428

Source: NV Philips Gloeilampenfabrieken, Eindhoven.

Annex V

SUMMARY OF ISSUES: FACTORS THAT HAVE A SIGNIFICANT INFLUENCE ON THE DECISION-MAKING PROCESS

The following list presents in condensed form the issues identified as important by the Workshop. Those that were considered to be of particular significance are indicated by an asterisk.

A. Enterprise (techno-economic outlook)

1. Market

Size
Share
Segment*
Range of products
Future
Local and/or export constraints
Acceptance of risks (by whom?)
Competition
Market development
Pricing

2. Technology

Timing of entry
Rate of change*
Flexibility (conversion of simplified/current/hybrid technology)
Acquisition, updating (buying the technology, not the product)
Integration
Local content
Local capacity
Expansion/growth/diversification
Sourcing of materials
Dependency
Sources of information
Service/maintenance/repair
Local tools
Compatibility of standards
Trade-offs (cost complexity)
Infrastructure constraints*
Pricing protection;* liberalization
Sequential acquisition

3. People

Availability at all levels
Training - who, how, where; cost; selection
Labour rates

Process and engineering development (research and development)
Quality control
Knowledge of business systems; materials management
Negotiating skills and information
Quality of people in support service organizations
Relations with academics

4. Finance

Sources; cost
Equity/loan structure
Financing of new products
Profit
Financial management; currency risk

5. Forms and structures

Joint venture; control (finance/industry)
Licence
Direct foreign investment
Choice of supplier; negotiating with several suppliers; total effective value
Subcontracting
Management agreement
Turnkey or "unbundled" projects*

B. National (macro outlook)

1. Economic

Compatibility with national development plan/priorities; stability of policies
Controls on foreign investment; payments; technical service royalties
Transfer pricing
Price policy; effect on choice of technology
Protection; liberalization; frequent review*
Foreign exchange
Incentives: financial/services/special institutions
New wealth
Rationalization; sectoral planning

2. Technology

Dependency; interdependency; scientific and technological policy
Strengthening of capability; linkages
Infrastructure: physical/technical; training
International organizations; standards; local competence; knowledge of export market standards
Technological bank; development standards*
Co-operation between the public and private sectors

3. Social

Absorptive capacity; skills and knowledge: relating them to choice of technology* (subsidy incentives)
Employment; communication
Consumer satisfaction
Quality of life; worker motivation
Public understanding

4. Implementation

Trust
Time
Negotiation