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DRAFT REPORT\*

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## INTRODUCTION

1. The meeting of the Second Consultative Group on Appropriate Industrial Technology was held in Vienna, Austria, from 26 to 29 June 1978. The list of participants is contained in annex I. The list of papers circulated at the meeting appears in annex II.
2. The objectives of the Consultative Group were principally to define a conceptual and policy framework for the selection and application of appropriate industrial technology in developing countries. In this context, the Consultative Group was required to:
  - (a) Review basic objectives of industrial strategies in developing countries and the relationship between reorientation in such strategies with the application and use of appropriate industrial technologies;
  - (b) Identify the principal features of selection, adoption and development of more appropriate techniques and processes, with particular reference to industrial sectors where such alternative technologies were most relevant and applicable;
  - (c) Discuss the interrelationships and sectoral linkages in the application and use of alternative appropriate technologies in certain sectors;
  - (d) Identify and discuss policy criteria and other issues which should be considered by developing countries in the selection and application of more appropriate production processes and techniques; and
  - (e) Highlight aspects of international co-operation in the application and development of more appropriate industrial technologies in particular sectors.
3. The meeting was opened by the Executive Director of UNIDO, Dr. Abd-El Rahman Khane. Dr. Khane pointed out that, following the Second General conference of UNIDO held at Lima, Peru, in March 1975, UNIDO had initiated various programmes for the promotion and application of appropriate industrial technology in developing countries. Appropriate technology, he said, should not be considered as an end in itself nor should it be isolated from general development objectives, particularly rapid and broad-based industrial growth which it was specifically intended to achieve. Apart from setting quantitative targets of industrial production in developing countries, the Lima Conference had also prescribed qualitative objectives, including the fulfilment of basic socio-economic needs, maximum development of human resources and greater social justice through more equitable income distribution. Consequently, it was imperative to review the basic structure and pattern of growth and the corresponding choice and application of technology in the developing countries. While there were sectors of industry

where advanced or improved technology was clearly necessary for the fulfilment of basic needs and the provision of basic products, an examination of the aims of industrial development revealed that there had to be a greater decentralization of industry and a reorientation of the structure of production. Such a decentralization called for technologies and policy measures which were often distinct from those designed to produce items for the different environment of the developed countries. Consequently, the formation of an industrial strategy required a dualistic approach integrating these two aspects. By taking the fulfilment of basic development needs as a starting point, a means of linking appropriate industrial technology to the overall development process might be found. Thus the concept of appropriate industrial technology could be placed in the mainstream of the industrial development effort.

4. The Executive Director said that the findings of the Consultative Group would constitute an important part of the conceptual and policy framework for introducing appropriate industrial technology in developing countries which would be the theme of the International Forum on Appropriate Industrial Technology to be held in India from 20 to 30 November 1978. The deliberations at the Forum, in turn, are likely to provide an important input to the United Nations Conference on Science and Technology for Development (UNCSTD) in 1979. The detailed statement of the Executive Director is contained in annex III.

5. The members of the Group designated Gangadhar S. Gouri, Deputy Director of the Industrial Operations Division, as Chairman of the meeting.

6. The Second Consultative Group used the Secretariat paper, "Reorientation of industrial strategy in developing countries and selection and application of appropriate industrial technology (ID/WG.279/4) as a basis for discussion. A number of other papers on appropriate technology, most of which had been prepared by the participants, were also taken into consideration.

## I. CONCEPT OF APPROPRIATE TECHNOLOGY

7. The term "appropriate technology", as discussed by the Consultative Group and used in this report, is broadly defined as technology that contributes the most to the economic, environmental and social objectives of development. In general, three sets of factors may be considered in determining whether a technology is appropriate, namely, development goals, resource endowments and conditions of application. Development goals would include growth of employment and output through more effective use of local resources; formation of skills; reduction in inequalities in income distribution; meeting the basic needs of the poor; improvement of the quality of life in general; and promotion of self-reliance. Resource endowments would include the availability and costs of local manpower, the level of skills and local management capabilities, availability and costs of water and energy and natural resources. Some of these are more or less fixed and others can be augmented by suitable action. The conditions of application would include a number of economic and non-economic factors, such as the level of infrastructure, climate, environment, the social structure of the population, traditions, cultural and educational background as well as the location of industry, the size and demand of the foreign and domestic markets and the foreign exchange situation.

8. The Group viewed appropriate industrial technology as a derivative of an industrial growth strategy encompassing the above sets of factors. It was recognized that the concept was dynamic and that appropriate industrial technology should not necessarily be conceived as labour-intensive or related only to small-scale production. Depending on conditions, it could well be capital-intensive and used for large-scale production. The determining factor was the appropriateness of particular production techniques and activities in a given set of circumstances.

## II. INDUSTRIAL GROWTH STRATEGY AND APPROPRIATE TECHNOLOGY

### Industrial growth strategy

9. The Second Consultative Group considered that a reappraisal of industrial strategy was necessary in a number of developing countries - particularly in countries where human resources and innovative capability had not been adequately mobilized in the industrialization process - in order to contribute to socio-economic growth and advancement.

10. The Group considered that, in many countries, the greatest untapped resource was that of manpower. As manpower was increasing rapidly as a result of population growth, it was necessary to activate such manpower resources through the application of industrial technology. In industrialized developed economies, the nature of technology used and evolved tended to be based on high savings ratios and slow population growth and usually required large capital resources beyond the means of the less affluent developing countries. In order to solve the problems of unemployment and underemployment in many of the developing countries, it was felt that special efforts were needed to develop industrial techniques and processes that would make maximum possible use of the available manpower resources. These problems were more acute in developing countries with lower per capita incomes and large manpower reserves, but they also applied in varying degrees to most other developing countries.

11. The Group was of the opinion that the fulfilment of basic socio-economic goals, such as greater employment opportunities, more equitable income distribution and greater dispersal of industrial activities, was fully consistent with the objectives of industrialization and that there was no basic conflict between social objectives and industrial growth. At the same time, such socio-economic goals needed to be adequately integrated into the framework of a comprehensive strategy for industrial and economic development.

12. It would obviously be necessary to acquire, apply and develop appropriate technology for the effective utilization of each country's factor resources. In certain industrial branches, such as mineral processing and metallurgy, production of fertilizers and petrochemicals - where the optimum capital investment was substantial - it might be necessary to utilize capital-intensive techniques and undertake large-scale production in metropolitan regions or areas of high industrial concentration. Even in "organized-urban"<sup>1/</sup> industrial branches, efforts should be made to economize on capital by:

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<sup>1/</sup> The term "organized-urban" sector was preferred by the Group to the term "modern" sector as used in the UNIDO Secretariat paper, ID/WG.279/4.



- (a) Using labour-intensive methods wherever practicable for subsidiary or ancillary operations;
- (b) Reviewing whether highly capital-intensive methods were really necessary and whether improvements on traditional technologies or adoption of alternative techniques would not be more consistent with better utilization of local factor resources;
- (c) Reviewing the nature of the manufactured product in several production phases to see whether certain modifications might not reduce the volume of capital investment required; and
- (d) Utilizing local sources for the supply of raw materials, and local facilities for manufacturing and servicing intermediate parts, as much as possible.

Such a review of the application of technology in the organized-urban sector might release funds for investment in dispersed industrial activities located away from centres of industrial concentration, thereby ensuring greater diffusion of employment and income.

#### Industrial dispersal

13. While the organized-urban sector should continue to receive the necessary impetus for rapid growth, the Consultative Group agreed that a wide range of goods and services could be increasingly produced by dispersed industries in semi-urban and rural areas. The dispersed industry sector could economically produce goods directly related to local micro-conditions and requirements of semi-urban and rural communities, such as production inputs for agricultural operations and consumption goods of various categories. These activities should be backed up by repair and maintenance facilities in rural workshops. In certain cases, the Group considered that it would be worthwhile providing these workshops with additional facilities for training local technicians and craftsmen.

14. Industrial dispersal would ensure greater participation of rural communities in particular, and hence mobilization of human resources in the industrialization process, thereby developing indigenous technological capability from the field level upwards. The growth of a dispersed or decentralized sector, therefore, should be an essential element of industrial strategy in most developing countries.

15. The potential for effective rural industrialization would obviously be different for each country and region and would depend on local factor endowments, infrastructure and other facilities, the growth of human skills, the extent of rural purchasing power and the extent to which an overall industrial policy package could be implemented.

16. The technological needs of dispersed industry could be significantly different from those of the organized-urban sector. For most industries,

dispersed industry would usually take the form of small-scale production units, employing, for instance, some 10-50 workers, though modern and large-scale production could also be undertaken, particularly if labour-intensive techniques were maximized. Technology appropriate for the dispersed sector would need to meet the following criteria:

- (a) The technology should be labour-intensive rather than capital-intensive;
- (b) Production should usually be undertaken in small-scale units, involving lower unit-investment outlays, though large-scale production using labour-intensive techniques would also be fully compatible;
- (c) Production should be geared to local resources, factor endowments and local skills;
- (d) Products should be related to local requirements and tastes and should match local purchasing power; and
- (e) Production units should be located principally in semi-urban and rural areas.

The above criteria might not always be applicable in selecting appropriate techniques for the dispersed sector. In many cases, even small-scale industry could use fairly capital-intensive technology, for example, in the production of precision goods. In other cases, production would still be dependent on the flow of basic industrial goods, including imported materials, over long distances. Thus, while the criteria for appropriate technology in the dispersed sector could be broadly defined as indicated above, technology selection and application would have to be related to the particular circumstances of the industrial branch or project concerned.

#### A technology programme

17. The Group emphasized that the technological needs of developing countries must be considered in comprehensive terms. The essential ingredients of a technology programme for each country should comprise:

- (a) The identification of technological needs and objectives;
- (b) The establishment of a comprehensive information system to assist national institutions and public and private enterprises by providing information on alternative, indigenous as well as foreign techniques and processes;
- (c) The growth of technological service capability at various levels of development, including engineering and design;
- (d) The creation of institutional mechanisms for screening the selection and acquisition of foreign technologies considered more suitable in certain conditions;
- (e) The establishment and development of institutional facilities for monitoring the impact, absorption and adaptation of foreign and indigenous technologies;

- (f) The growth of R&D activities in significant industrial sectors as well as the fostering of on-going development and testing at the shopfloor level;
- (g) The definition of policies and guidelines to encourage rapid indigenous technological development; and
- (h) The definition of those industries considered more suitable for large-scale production as well as those manufacturing branches which would lend themselves to a greater degree of industrial dispersal.

It was considered that only an integrated approach covering these aspects would ensure that the development of technological capabilities for the selection, acquisition, adaptation and absorption of technology could be effectively achieved in developing countries.

### III. SELECTION AND APPLICATION OF APPROPRIATE TECHNOLOGY

18. The Group observed that the application of industrial technology in developing countries, based on modern techniques and processes, had often not taken account of real socio-economic developmental needs in terms of maximization of employment opportunities, rapid development of technological capabilities and skills and a greater spread of industrial production activities to semi-urban and rural areas. These needs could be met principally through the selection and application of more appropriate techniques which would have to be identified in various production areas.

19. It was also observed that technology selection was part of the process of change which accompanied development. It might be useful initially to consider how technical change was related to technical capability, how this capability was accumulated and developed over a period of time, and to what extent technical capability should be a criteria for the choice of appropriate industrial techniques.

20. It was considered that if local communities could be motivated to apply their creative energies and their own experience to local needs, thereby developing their latent capabilities, new and appropriate technologies would begin to emerge. Appropriate selection and application of technology would be a judicious blend of varying proportions of indigenous and imported know-how.

21. It was recognized that there were always opportunities for introducing a more appropriate technology; not only at the planning stage but also in an already established industrial situation by minor incremental changes not necessarily directly concerned with the processing technology itself.

#### Technology inflow

22. It was noted that most developing countries continued to depend on the inflow of technology from abroad. Apart from foreign subsidiaries and affiliates in a number of sectors, national-owned enterprises in these countries also relied almost entirely on foreign techniques and processes. While inflow of foreign technology might be necessary in several production sectors, it was considered essential that institutions and enterprises in developing countries should ensure that the foreign technology acquired was appropriate to local conditions and in keeping with domestic technological development.<sup>2/</sup>

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<sup>2/</sup> A flowchart setting out various financial aspects of foreign investment was distributed by one of the participants.

23. It was recognized that the inflow of foreign technology and services in most developing countries covered various stages of project planning, implementation and management and that the size of the technology package thus acquired tended to be very large and aggregated. It was considered desirable that, with progressive industrial and technological development, the size of the foreign technology package should be gradually reduced and that domestic enterprises, consultancy and support services should assume a correspondingly larger share of responsibility for planning, implementation and management. Disaggregation of the technology package was considered necessary so that technology inflow would be mainly confined to processes and production know-how that were appropriate to local factor circumstances and which were not available from domestic sources.

24. The size of the technology package and the extent of disaggregation required would differ considerably in the organized-urban and in the dispersed sectors. In the former, the technology package would tend to be larger than in the latter where the scale and nature of production should, on the whole, ensure that the technology used would not require undue disaggregation. In several industrial branches, indigenous techniques would prove more suitable for the dispersed sector.

25. The Group noted that the technological trends in industrially-advanced countries were towards greater capital-intensity in most production sectors. These trends might often prove both too costly for developing countries and inconsistent with the objectives of providing more employment opportunities and scope for innovation. There was also a danger of developing countries continuing to be dependent on the supply of materials, components and spares from external sources, often with a substantial element of transfer pricing. In most production sectors, a varying degree of technological choice was possible and this needed to be exercised. Highly capital-intensive technologies and large-scale production might not necessarily be efficient in developing economies because of several constraints such as high initial capital outlay; inadequate availability of skills; the necessity to import components and spares; and the difficulty of maintaining sophisticated capital equipment.

26. It was noted that the selection of foreign technology in the organized-urban sector had received some attention in those developing countries that had national regulatory institutions to screen foreign technology proposals. Such screening, however, had been chiefly confined to the terms of technology contracts and comparatively little evaluation of alternative techniques as they related to national policy objectives, local factor resources etc. had been made. This was partly due to inadequate information on alternatives and partly due to a tendency

to opt for the technology considered most modern. Developing countries should be more selective in choosing the technology most appropriate to local circumstances and national objectives. The functions of regulatory institutions might have to be enlarged so as to include the provision of information and guidance to domestic industry. Criteria might have to be defined to assist entrepreneurs in choosing between technological alternatives but the final choice should continue to be the responsibility of the users.

#### Technology for the dispersed sector

27. It was observed that most developing countries had given very scant attention to the question of selecting appropriate technology for the dispersed sector. Little technological support had been provided, both at the artisan level in low-income rural communities, and at the village and rural industry levels. Consequently, village industries and artisan skills had deteriorated instead of providing the nucleus for a broad-based programme of rural industrialization. Concerted efforts were required to build up an adequate technological base in rural and semi-urban areas for dispersed industrial development which would foster both the traditional-handicraft and the small-scale mechanized sectors and integrate them within a programme of overall industrialization. This might necessitate upgrading artisan skills and creating incentives for cottage production.

28. The selection and application of technology for the dispersed sector would require:

- (a) A greater inflow of appropriate techniques and processes from medium- and small-scale enterprises in developed countries to enterprises in the dispersed sector in developing countries;
- (b) A greater flow of technology from enterprises in other developing countries where economic and manufacturing conditions were similar; and
- (c) A more effective adaptation and innovation of indigenous techniques and processes.

The search for technology, its selection and utilization, would need to cover all the above-mentioned sources.

29. The subject of dispersal should not be limited to industrial production carried out in factory establishments but also to families. This may mean further decentralization and disaggregation of the industrial production function with corresponding implications for technology choice. An examination of such decentralization to involve families to undertake industrial production activities to complement their traditional work in agriculture was considered essential.

### Productive efficiency

30. The Group considered that productive efficiency was a relevant issue in the context of technology choice. The use of particular techniques, whether in the organized-urban or dispersed sectors, should normally be consistent with efficiency in terms of production costs and product pricing. Productive efficiency was entirely scale-related if appropriate technology choice was exercised. Products of small-scale enterprises using labour-intensive techniques in the dispersed sector should also, with proper selection of technology, become competitive with similar items produced in large-scale units. It might be necessary, however, to provide special incentives and concessions and even protection from competition for a certain length of time to some industries in the interests of creating employment and dispersal of industry.

31. Efficiency should not only be understood in terms of competitive efficiency, but in terms of the extent to which an industrial activity effectively met the criteria set by a country's development goals. The danger of competitive efficiency was that, in certain instances, it left little room for innovation and the slow, but cumulative, process of learning by doing. It was noted that certain capital-intensive techniques, such as the use of mechanization for tillage in arid or semi-arid zones, might increase productivity for a short period of time but yet they had a long-term deleterious effect on the environment. Such techniques could not ultimately be regarded as efficient. It was recognized that the concept of efficiency was inseparably linked to that of appropriateness. Efficiency was also dependent on the availability of adequate maintenance and repair facilities.

### Selection and application of technology

32. The Group thought that a critical aspect of appropriate selection and application of technology was the dissemination of information on alternative techniques and processes. While knowledge even regarding technological alternatives for the organized-urban sector was inadequate in most developing countries, information on production activities suitable for the dispersed sector was lacking to a far greater extent. It was considered essential that an adequate information network should be set up in developing countries to:

- (a) Identify alternative sources of technology for those industries which met the needs of the dispersed sector;
- (b) Assist in the techno-economic evaluation of such alternatives under different conditions; and
- (c) Assist in the acquisition, implementation and absorption of such techniques.

While such appropriate techniques could be either indigenous or imported, they would have to be adapted to local conditions.

Research and development

22. In the opinion of the Group, there was a need for more effective R&D as well as engineering on adapting technology in various industries and in applying alternative production techniques. Such R,D&E activities, including extension services, should be worked out both at the institutional and private enterprise level, and also at the grass-roots level in rural communities. R,D&E should not be undertaken in isolation but carried out where it could be put into practice on the spot so that there would be less possibility of divergence between the aims of R&D institutes and the needs of the communities dependent on their assistance. Research and extension workers should have a genuine understanding of the problems of target areas which could only be acquired at first-hand. The Group felt that a reorientation of R&D was necessary and perhaps, even, a new image to emphasize the concern with local socio-economic realities. They also felt that a reallocation of resources, which were often misspent, might do much to promote the dissemination of information on existing technologies which would dispense with the necessity to re-invent "new" ones.



#### IV. SECTORAL LINKAGES AND INTERRELATIONSHIPS

34. The Consultative Group stressed that no line of demarcation could be drawn between the organized-urban and dispersed sectors and that the two should be considered as integral parts of a comprehensive programme of industrialization. It was felt by some participants that industries should be integrated into an industrial system at the pre-planning stage and not as an afterthought. Attention was drawn to the close interrelationships that should be maintained between large-scale and small-scale industries and between areas of industrial concentration and enterprises located in semi-urban and rural areas. Small-scale production activities should be integrated as feeder and ancillary plants to large-scale production units so that they could take part in that industrial process which was increasingly earning foreign exchange for developing countries. This would require not only closely-knit industrial operations but also effective financial and technological linkages.

35. It was felt by the Group that the trend towards a greater degree of vertical integration in developing countries needed to be modified and that closer and more effective inter-linkages should exist between large-scale and small-scale enterprises and production in urban and rural areas.

36. The Group emphasized the connexion between the growth of agricultural production and the development of the dispersed industrial sector. Without dynamic agricultural development, the growth pattern of the dispersed sector would be limited.

37. Close linkages should be maintained between the organized-urban sector and dispersed industry. This would mean examining the pattern of integration of domestic manufacture in various industries and the degree of horizontal integration that could be brought about by locating ancillary and service units away from the principal manufacturing enterprises. An important policy issue in this respect would be the structure of tax, particularly sales tax at various levels of production.

## V. POLICY ISSUES IN THE APPLICATION OF APPROPRIATE TECHNOLOGY

38. The Consultative Group considered well-defined policies for industrial and technological development essential for each country to achieve technological self-reliance and increased domestic technological capability. It was noted, on the other hand, that no policy pattern could be suggested to cover all or even most developing countries, in view of their wide diversity in resource endowments, levels of development and socio-economic circumstances.

39. A starting point for policy-making and policy appraisal would be for Governments to define their national development goals and how they intended to achieve them. The Group was fully aware of the difficulties of such a task. While the choice of technology was an essential part of meeting such broad development goals as industrialization, better employment and income growth, the Group realized that, by taking this course, Governments would have to make a number of hard choices on such issues as protection, differential wages and subsidization. Nevertheless, it was felt that if there could be a shift of emphasis from rate of growth to direction of growth, the long-term benefits of policies appropriate for technological development would outweigh the more easily-perceived short-term gains. What was needed was a "judgement-oriented" planning model to evaluate those combinations of policy and circumstance that fitted particular development goals.

40. In implementing development policies, planners might find it helpful to pinpoint those structural forces which were likely to make such policies less effective. In this context, some participants felt that a systems approach would be better than sectoral approach. They felt that the fact that industry tended to be compartmentalized into sectors obscured the view of the whole complex of interconnected production activities. It was often difficult to make improvements in certain existing industries if the structures of operation and production could not be seen as an integrated whole. It was often the nature of the production structure that determined how and which technology and materials were supplied rather than other socio-economic factors.

### General policies

41. It was emphasized that a number of policies and policy instruments influenced technological choice and development and that it was important to identify those which had the greatest impact in specific cases. Such policies included:

- (a) Policies defining the nature of foreign investment and extent of foreign ownership; and the role of the national private sector and state enterprises;
- (b) Policies defining the degree of centralized planning and the specific resource allocation between various industrial branches;
- (c) Policies identifying fields of production for large-scale industrial units or for small-scale enterprises;
- (d) Financial and credit policies, including incentives and concessions for industrial enterprises in different manufacturing branches;
- (e) Special incentives for small-scale and rural industries, including provision of infrastructure facilities, credit, and scarce materials; preferential purchase by governmental agencies; extension and common services; and the reservation of certain sectors solely for small-scale production;
- (f) Policies controlling imports;
- (g) Incentives for exports and for import substitution in particular sectors, whereby a clear policy framework would indicate when policies for import substitution should be replaced by those for export promotion; and
- (h) Policies controlling the prices of essential products, basic industrial materials, etc.

42. It was noted that some countries, in particular India, had reserved a number of items for production by the small-scale sector and selected them according to the amounts of capital investment and workers required. It was felt that other developing countries could study the experience of India so as to determine whether they too should introduce a similar policy for specific periods of time for particular items. The infant-industry argument could justifiably be applied to certain fields of small-scale production for varying lengths of time. It was, however, pointed out that such a policy should be carefully designed because some items could be equally well manufactured in both the organized-urban and dispersed sectors, depending on whether they were destined for local or export markets.

#### Fiscal incentives and disincentives

43. The identification of suitable products for large- or small-scale manufacture would necessitate examining the extent to which existing large-scale units in these fields should be restructured. Restructuring could be effected through policies of differential taxation and other disincentives for large-scale producers of those items considered more appropriate for small-scale manufacture.

44. Consequently, developing countries would have to define policies for ensuring that the dispersed sector had an adequate share in overall domestic production. Such policies could take the form of a suitable structure of

incentives or disincentives to ensure that production followed the pattern considered most appropriate; and varying degrees of regulatory control.

45. The Group was of the opinion that the present industrial pattern in most developing countries favoured organized-urban industry. Incentives such as tax holidays, tariff rebates, supply of scarce raw materials and credit facilities largely militated against small-scale enterprises in the dispersed sector. An effective extension of these advantages to that sector might but, it was stressed, not always result in significant restructuring of the pattern of industry as had been the case in some south-east Asian countries. At the same time, the Group also recognized that the provision of equal facilities and incentives to several industries in the small-scale sector would not be sufficient to guarantee competitive efficiency and several additional measures would be required. In some cases, it might be necessary to impose import restrictions on large-scale production units for a certain length of time.

46. It was felt that if fiscal incentives/disincentives were to be really effective, they might have to be applied at a very severe level in the form of differential taxes, excise duties and the like. In a large number of cases, regulatory control might be easier to implement in actual practice.

47. It was observed that in some developing countries, profits depended significantly on the ability to negotiate with the government tax concessions and granting of import licences. This might mean that entrepreneurs would be unwilling to move away from easy access to government departments and policies for dispersal should take this factor into account.

48. Incentives necessary for the effective growth of the dispersed sector and its small-scale enterprises and family units would include:

- (a) Greater resource allocation for non-urban infrastructure;
- (b) Manpower training facilities;
- (c) The establishment of comprehensive extension services including technological support and guidance and the development of basic managerial capabilities;
- (d) Adequate financial incentives and concessions and credit availability; and
- (e) Assistance in procurement, marketing and distribution.

49. Significant infrastructure facilities would comprise the provision of an adequate supply of energy, a transportation and communications network and common service facilities. Manpower training programmes should cover both the upgrading of artisan skills and the acquisition of technical skills to include a wide range of industrial production processes. Extension services should

provide technological assistance to various rural industries. Such services might have to be multidisciplinary, and they would require close linking to R&D institutions specialized in particular production branches. The concept of 'centres of excellence' would be especially important as would the close linkage between such centres and services in the field. Basic managerial expertise would need to be developed in the dispersed sector through consultancy and management extension services that provided guidance in entrepreneurial functions such as bookkeeping and labour costing. Managerial expertise could also be developed through field institutions or financial intermediaries such as rural development banks, which would be also instrumental in providing adequate credit facilities for initial investment and working capital requirements. It was recognized by the Group that the effective growth of the dispersed sector would be dependent on substantial financial support.

#### Policies for the dispersed sector

50. In the dispersed sector, it was noted that there had been little inflow of foreign technology and not much upgrading of indigenous techniques. If rural industrialization and indigenous technological capability at the grass-roots level were to be given adequate impetus, a comprehensive policy package had to be designed for:

- (a) The careful selection of suitable techniques for various production activities in the dispersed sector;
- (b) The dissemination of information regarding alternatives;
- (c) The establishment of technology extension services for assisting enterprises in semi-urban and rural areas; and
- (d) The provision of adequate facilities and incentives, particularly for small-scale enterprises in the dispersed sector.

51. It was noted that the flow of technology from medium and small enterprises in industrialized economies to those in developing countries had been minimal mainly because such enterprises were not aware of the possibilities that existed in developing countries. It was thought that more market information was needed. A policy of incentives, as well as widespread information on technological alternatives, should be offered by developed countries to remedy this short-coming. The flow of technology from other developing countries was also insufficient and a comprehensive policy package of norms and incentives should be devised to encourage such a flow. National institutions could play a critical role in promoting technological inflow among developing-country enterprises.

52. Developing countries should also introduce appropriate incentives for adapting and developing indigenous technological capability. Indigenous capability to design and set up similar projects should be fostered so that subsequent stages of growth in various industries would be consistent with local conditions and development objectives thereby ensuring that a fuller and permanent benefit would result from the initial transfer of technology.

53. In discussing the flow of technology, the Group considered that various other aspects of technological exchange, such as the disaggregation of the technology package, patents and trademark policies, the development of local repair and maintenance capability, consultancy and engineering facilities should also be taken into account.

54. It was recommended that consultants, particularly those engaged for large projects, invariably should be required to examine appropriate technology alternatives and take them into consideration. It was also thought advisable that institutional appraisal agencies should consider technological alternatives before projects are finally drawn up. It was noted that some developing countries had set up technology assessment groups and other countries might find it advantageous to establish similar groups.

55. The Group considered that an institutional mechanism for the dissemination of information on a wide range of technologies should be set up at the field level, which should be linked to regional and national information networks.

56. An important policy aspect was the growth of R, D & E capability to identify techniques suitable for the dispersed sector. Most R&D institutions in developing countries concentrated on the needs of the organized-urban sector and it was imperative that they focus more on the dispersed sector. It was also considered essential that R&D programmes for the dispersed sector in particular be effectively commercialized through a specific programme of governmental financial support. This would entail setting up pilot plants, prototype operations, quality control and testing facilities to assist commercial enterprises.

57. It was thought that adequate incentives should be given to private entrepreneurs also to carry out R&D. Those technological areas in which private entrepreneurs would be likely to contribute to innovational activity should be ascertained. Because information on conditions in industry was lacking, government-sponsored research was not effectively directed to competitive market structures. Another useful field of research might be to analyse why entrepreneurs adopted certain technologies, and what combinations of policies and less tangible factors led to the choice and successful introduction of a particular technology.

58. It was noted that many R&D institutes were too small to be effective. Good incentive policies were required so that both the private and public sectors would increase their R&D activities. It was suggested that targets might be set which would help policy-makers to structure their expenditure.

59. Mention was made of the fact that in one developed country, small-scale enterprises did not carry out their own research but relied on the services of a central research institute in their particular industrial field. Developing countries might consider setting up similar networks of R&D institutes to help affiliated enterprises. It was pointed out, however, that the affiliated enterprises often prevented the central institute from being effective by only allowing it to work on problems which would not affect the interests of members. This ruled out, for instance, guidance on the important issue of patents.

60. The Group considered it imperative to avoid a situation whereby developing countries would be again forced to purchase simple appropriate technological know-how from industrially-advanced countries merely because they did not have the research and testing facilities to develop and accumulate such know-how themselves.

## VI INTERNATIONAL TECHNOLOGICAL CO-OPERATION

61. The Consultative Group stressed that a significant degree of international co-operation was essential in evolving technologies for the socio-economic conditions and requirements of developing countries. Co-operation between public and private institutions and enterprises in both industrialized and developing economies was vital. The existing pattern of foreign technology inflow, especially, had to be suitably modified to meet the technological needs of developing countries more effectively.

62. The process of technological exchange would be accelerated if a comprehensive programme for international co-operation could be conceived and implemented. Such a programme should:

- (a) Facilitate technology flow to developing-country enterprises on suitable terms in sectors where foreign technology was considered necessary by the recipient country;
- (b) Facilitate the flow of information on technological alternatives, in particular on small-scale production techniques requiring less capital;
- (c) Evaluate alternative techniques through the exchange of information and experience on the suitability or unsuitability of such alternatives; and
- (d) Initiate an extensive programme of research and development not only through institutional enclaves but at the field level. This would include adapting existing processes and techniques, especially those suitable for small-scale production with a strong rural bias.

### Co-operation among developing countries

63. The Group considered that specific programmes should be undertaken for transferring technology and know-how from more industrialized developing countries to other developing countries. National institutions should specifically encourage enterprises in their respective countries to draw on the technological know-how of other developing countries because of the similarity in certain factor endowments, technological needs and experience in several developing countries.

64. It was noted that sufficient account had not been taken of the fact that such know-how could be effectively transferred to licensees in other developing economies. Most prospective developing-country licensees continued to seek know-how from trans-national corporations in developed economies even in respect of relatively simple production processes, for which a fairly wide range of technological choice was increasingly available in other developing countries. This was partly due to a



lack of knowledge of alternative production processes and partly due to a continuing preference for the more advanced production techniques used in industrialized countries and the better-known brand names marketed by large corporations. This bias could be overcome if developing countries shared their knowledge and experience. It was suggested that a possible way of dispensing with brand names would be to introduce standards to which certain products must conform. While not all products could be expected to meet certain uniform criteria, there were many product lines for which standards could be substituted for prestigious and, often, costly brand names.

65. The Group agreed that the commercial transfer of technology between enterprises in both developed and developing economies should be on terms that were equitable for recipient countries. It might be necessary to formulate norms to safeguard the interests of the developing countries in particular.

66. The Group thought that developing countries should use each other's technological service capability - a field in which several developing countries had gained considerable experience - particularly in consultancy and engineering for the dispersed sector and medium- and small-scale industries. It was recognized that developing countries required a solid base of technological capability ranging from vocational, scientific and engineering training to the growth of service capability such as design, engineering and management. Developing countries could co-operate with each other in developing these skills through joint training programmes and the exchange of information. Those industries in which training programmes could be jointly undertaken in developing-country enterprises should be identified.

#### Co-operation between developed and developing countries

67. Despite the scope for technological collaboration among developing countries themselves, the Group realized that, for the time being, enterprises and institutions in developed countries would probably continue to be the major suppliers of industrial technology. In this context, the Group considered the role of transnational corporations and their subsidiaries which continued to play a significant, often dominant, role in several industrial sectors in developing countries.

68. It was felt that transnational corporations inevitably concentrated their investment activities on those products and technologies already known to them. Foreign subsidiaries should generate and use techniques appropriate to the particular conditions of developing countries and develop a responsiveness to appropriate technologies in their own organizational structures. Use should be

lack of the information-dissemination capacity of transnational corporations who were often in the possession of useful technological know-how but unable to put it into practice because their organizational structures operated according to different criteria. Transnational corporations should be required to subcontract, as much as possible, certain goods and services from local decentralized enterprises in the host country instead of continuing to use suppliers further afield. At the same time, these companies should be required to train nationals of the host country so that they would become technologically self-reliant and eventually able to assume increased responsibility for subsidiary operations.

#### Bilateral and international aid agencies

68. The Group considered that the similarity in the technological development problems of the developing countries also necessitated greater co-operation both between developing countries and with bilateral and international aid agencies.

70. Attention was drawn to the fact that often a particular technology had been selected as part of bilateral assistance programmes even when socio-economic and cost-benefit analyses had clearly indicated that another type of technology would have been more suitable. It was recognized that a greater degree of consistency and sensitivity to the needs of a broader section of the population were required.

71. Some participants mentioned that it might be worthwhile to encourage more systematically contacts between small- and medium-scale enterprises in industrialized countries with existing or planned enterprises in developing countries.

72. The Group considered that an essential area of international technological co-operation was the compilation and dissemination of information and country- and industry-specific experience on alternative technologies. A system set up for this purpose would have to be a combination of various schemes, ranging from the simple to the sophisticated, and it should be dovetailed with the technological extension services of each country.

73. The information should encompass indigenous and foreign techniques and processes and indicate future technological trends which were likely to be of special interest. The parameters used for evaluating the information should be commercial rather than technical. It was also agreed that the information thus supplied should not relate to proprietary know-how, processes or products covered by industrial property rights.

74. It was important to ensure that pertinent information was reaching the people who needed it and for this reason manufacturing enterprises should be regularly asked to specify those information sources that had been of most use

to them. In this way the system could be adapted to meet the changing requirements of its clients.

75. It was noted that there was considerable scope for closer co-operation in joint research and development activities between R&D institutes in developing countries. Some areas of special attention might be those production branches which lent themselves to dispersal to non-urban areas and infrastructure, such as rural energy and transportation.

76. It was suggested that more research should be devoted to monitoring the use of technologies and to finding out why certain technologies had not been used, adapted or proved effective. Since the introduction of technology had a significant social impact, it was equally important to continue investigations in order to learn and understand the reasons why technologies which had seemed appropriate in theory were not so in practice.

77. The Group was told of courses one developed country conducted for senior government officials from developing countries who were associated with small-scale enterprises. The courses covered technology, finance, equipment, personnel training and the acquisition and use of information thus enabling planners to pass on their expertise to entrepreneurs in their home countries.

#### Role of UNIDO

78. The following suggestions were made:

- (a) UNIDO should offer more training programmes in technology choice. Training programmes on fiscal and managerial know-how were as important to entrepreneurs as technological know-how;
- (b) UNIDO could advise industries in the dispersed and medium-scale sectors on how they could improve their efficiency;
- (c) UNIDO should pay particular attention to agro-industries in its work as these tended to be more labour-intensive;
- (d) UNIDO should promote low-cost construction more intensively and, perhaps, distribute case studies and model designs; and
- (e) UNIDO's Senior Industrial Development Field Advisers should promote a greater awareness of appropriate technology in the field.

79. The Consultative Group took note of the recommendations of the Round-table Meeting of Ministers from Developing Countries, held in New Delhi, India, in January 1977, which identified significant areas of co-operation between developing countries. The Group also took note of the decisions and recommendations of the meetings of representatives of national offices of technology regulation in

several developing countries, held in Vienna in 1978.<sup>3/</sup> It was considered that all these recommendations, which included a programme for the exchange of information and experience on technology contracts between such offices, constituted an important first step towards technological co-operation between the participating countries.

#### International Forum on Appropriate Industrial Technology

80. The Group discussed the scope of the forthcoming International Forum on Appropriate Industrial Technology to be held in India in November 1978. Although the Group had concentrated on the conceptual approach to appropriate technology, in the context of the technological needs of developing countries, it stressed that the studies of the twelve industrial sectors indicated in the Aide-Mémoire for the Forum should be carefully prepared. While it was important to sensitize policy-makers in developing countries to the broader issues and implications of adopting appropriate technologies, it was important to highlight examples of successfully applied appropriate industrial technologies from a country- and industry-specific angle. The Secretariat documentation should pinpoint the policies and institutional structures that had contributed to the process.

81. It was suggested that the subject of information be treated as a separate item at the Forum because the confidentiality of certain aspects of commercial technology and standards was a difficult issue.

82. The Group was most concerned that the Forum should be an effective milestone along the road to introducing technologies appropriate to the stimulation of dispersed industrial activity. The Group hoped that the documentation would clearly bring out the complexity and urgency of the subject so that a solid base of understanding could be established for subsequent decision-making.

#### United Nations Conference on Science and Technology for Development

83. The subject of the United Nations Conference on Science and Technology for Development (UNCSTD), to be held in Vienna in August 1979, was touched on briefly. The Group was concerned that the recommendations of the Forum be brought to the attention of the Conference.

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<sup>3/</sup> Meeting of Senior Officials and Heads of National Technology Registries or Similar Offices in Selected Developing Countries, 6-10 March 1978, Vienna.

Meeting of Governmental Experts on Regulatory Functions in Transfer of Technology, 29 May - 2 June 1978, Vienna.

84. One of the members of the Group identified some issues which UNCSTD should discuss. These were:

- (a) That in the call for more scientific research and appropriate technology, attention should not be diverted from the economic, social and political obstacles to satisfying basic needs and providing meaningful employment for all;
- (b) That the Conference should not ignore the growing global expenditure on military R&D but propose ways of rectifying this maldistribution of scientific resources;
- (c) That the Conference should discuss the dominance of trans-national corporations in the international market for technology and how to curb their influence;
- (d) That the Conference should focus on the need of the Third World to have facilities of its own for collecting, evaluating and sharing economic and technological intelligence;
- (e) That the Conference consider why Third World science and technology councils and agencies have had limited impact as instruments for solving problems in developing countries;
- (f) That the Conference find ways to prevent the introduction of new technologies from increasing the gap, both in earnings and status, between men and women; and
- (g) That the Conference ensure that the proposals it makes are translated into meaningful action.

85. The Second Consultative Group agreed that the overall scope and dimension of technological co-operation must necessarily be considered against the need for rapid growth of technological capability in developing countries. This might require major new initiatives and additional programmes of co-operation, particularly between industrialized and developing economies and could take the form of:

- (a) The establishment of multi-disciplinary technology institutions in developing countries which could significantly adapt and innovate new technologies;
- (b) The development of technological capacity in new sectors of critical importance to developing countries, such as non-traditional sources of energy, the sea-bed;
- (c) The development of design and engineering capabilities in priority production sectors, such as steel, metallurgical industries, fertilizers and chemicals, agro-industries, capital goods manufacture; and
- (d) The growth of innovative capabilities for small-scale production and development of effective processes and techniques in various sectors.

Such a programme of international technological co-operation might necessitate the transfer of significant additional resources from industrialized to developing economies and require a basic reorientation in the structure of bilateral and multilateral financial transfers between the countries concerned.

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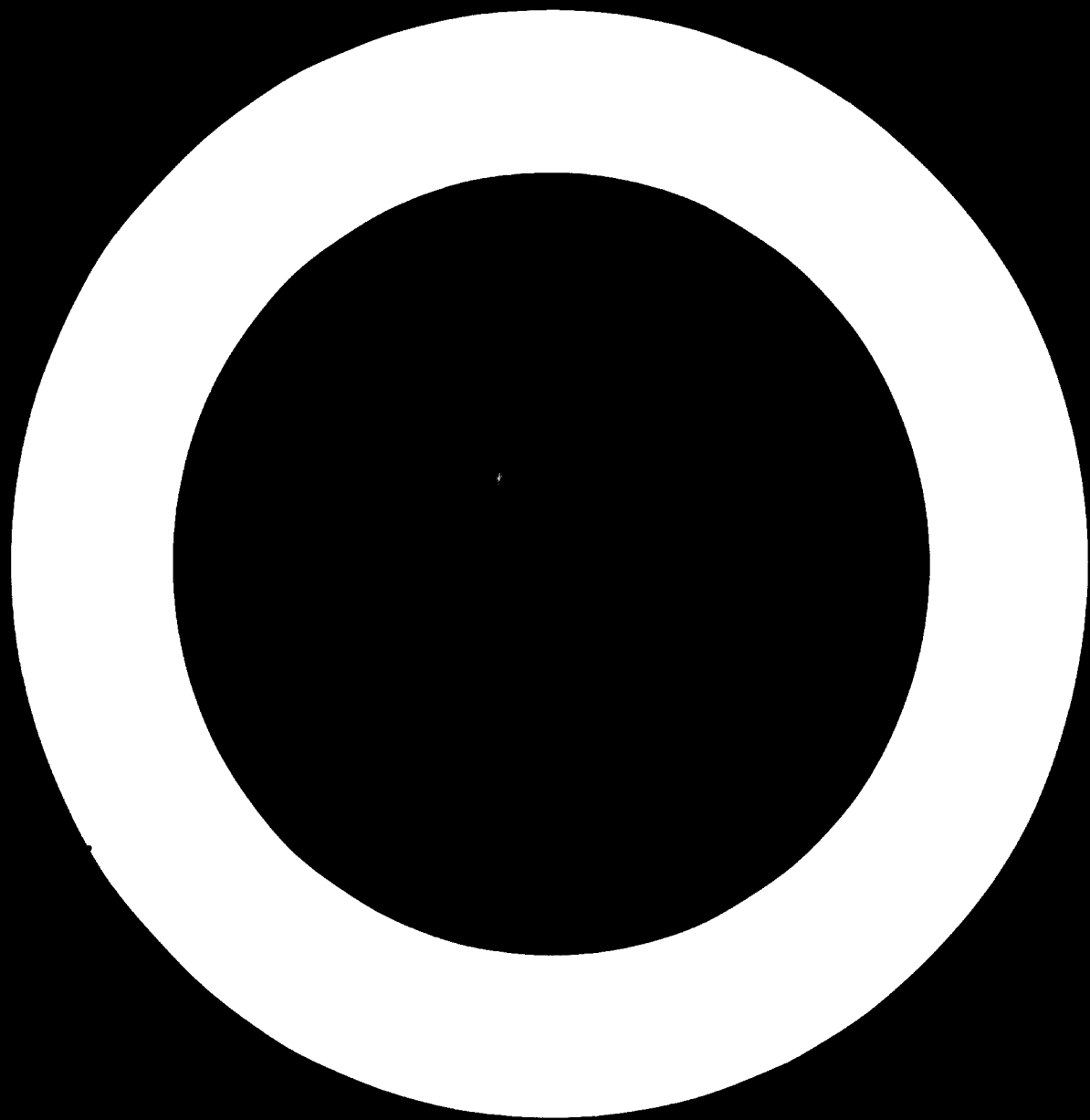
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ANNEX II

- ID/WG.279/1            Dualism, Sectoral Planning and Integration of the  
Modern Industrial and Dispersed Traditional Sectors  
by J.D. Peno
- ID/WG.279/2            Appropriate Technology in the Context of the  
Redirection of LDC Industrial Development Strategy:  
Concepts and Policies  
by G. Ranis
- ID/WG.279/3            Provisional Agenda
- ID/WG.279/4            Reorientation of Industrial Strategy in Developing  
Countries and Selection and Application of Appropriate  
Industrial Technology  
UNIDO Secretariat
- ID/WG.279/5            Appropriate Technology and the Activities to be  
Stimulated  
by J. Tinbergen
- ID/WG.279/6            Appropriate Industrial Technology:  
An Integrated Approach  
by D.H. Frost
- ID/WG.279/7/Rev.2      Final List of Participants
- ID/WG.279/8            On the Establishment of an Industrial Technology  
Development Policy, by K.H. Yap
- ID/WG.279/9            A Framework for Rethinking the Concept of  
Appropriate Technology for Development  
by P. Wignaraja
- ID/WG.279/10           List of Documents
- ID/WG.279/11           Some Reflections on the UNIDO Programme on  
Appropriate Industrial Technology, by B. van Bronckhorst



ANNEX III

Second Consultative Group on Appropriate  
Industrial Technology

26 - 30 June 1978, Vienna

STATEMENT DELIVERED BY THE EXECUTIVE DIRECTOR  
OF THE UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

Dr. Abd-El Rahman Khane

26 June 1978

Ladies and gentlemen,

I have great pleasure in extending to you a warm personal welcome to Vienna and I am particularly thankful to you for having responded to my invitation to attend this meeting. Your response has been most gratifying to me and to my colleagues, as it reflects both your interest in UNIDO's activities and in the subject of appropriate industrial technology. Your co-operation has made it possible to assemble here in UNIDO, a set of persons which have not only valuable experience in development problems but also a dedication and a commitment to the industrial development of the developing countries. Such co-operation is much appreciated indeed and encourages us to further develop the efforts that UNIDO has been undertaking in the field of development and transfer of technology.

As a matter of fact, UNIDO, since its inception, has been involved in problems of development and transfer of industrial technology, in general, as part of its effort to assist the rapid industrialization of the developing countries. The Second General Conference of UNIDO held in Lima in March 1975, however, gave UNIDO additional mandate to go into the field of appropriate industrial technology. Accordingly, we have thus initiated a concerted effort in this field in terms of a set of wide-ranging measures which could be adopted to promote the choice and application of appropriate technology in developing countries. One important measure of implementation of such a Programme of Action was the gathering of this high-level Consultative Group to advise me and the Industrial Development Board on policy and substantive matters.

Ladies and gentlemen, I should like to take this opportunity to make some observations as regards the subject of your meeting. Conceptually we believe that appropriate industrial technology should neither be an end by itself nor can it be isolated from the general development objectives, including rapid and broad-based industrial growth, which it is meant to help achieving. Our opinion is that in order to gain a practical and meaningful view of the concept of appropriate technology, and to work out equally practical and meaningful programmes of action, it is necessary to focus attention on the basic industrial development strategies and derive from them the appropriate technology path that has to be undertaken. If we refer to the Lima Target of industrial production by which developing countries are expected to reach a share of at least 25 per cent of the world's industrial production by the year 2000, the Lima Declaration made it clear that such a target, expressed in quantitative terms, has qualitative implications as well.

The qualitative aspects of Lima could actually be said to comprise three essential elements, namely, fulfilling the basic socio-economic needs, ensuring maximum development of human resources, and achieving greater social justice

through more equitable income distribution. When we pursue these aspects further, we find that the objective of rapid industrialization does not conflict with, but is rather a pre-requisite for the fulfilment of the basic needs aspirations. But by raising the question of the basic aims of development, we do raise correspondingly the issues of the basic structure of industrial growth and thereby the implied technology patterns.

Furthermore, it can be easily found that the structure of industrial growth that should be envisaged and the corresponding structure of technology flows, should be different from what they are today and call for a fresh approach. I hasten to add that, in saying this, I do not mean that the flow of technology to the modern sector and the application of advanced technologies is not necessary. On the contrary, it is basic to upgrade the technology base in general and it is also obvious that for the fulfilment of basic needs and the provision of basic products, there are sectors of industry where advanced or improved technology is clearly necessary. Not only that, but we cannot envisage a situation when the dynamic influence of modern technology is no longer available to industrial growth and development in general. Concurrently, however, the examination of basic aims of industrial development leads to the conclusion that there has to be a greater decentralization of industry and a reorientation of the production design and structure. Rather than being an ancillary pursuit, industrial decentralization is perceived as an integral element in the strategy for industrial growth.

Such a decentralized industry in the developing countries admittedly calls for technologies and other measures which have often to be different from those designed for the production of items for a different environment, i.e. of the developed countries. As a result, there is a two-fold approach, or dualistic approach, to an industrial strategy. Moreover, the two elements in such an industrial strategy need to be not only interrelated but integrated.

Ladies and gentlemen, I wanted at this stage to limit these observations to indicating that by approaching the problem of appropriate industrial technology starting from basic development needs, we should provide a mechanism by which we could link and integrate appropriate industrial technology to the overall development process. Through such a process the concept of appropriate industrial technology could be placed in the mainstream of the industrial development effort.

You have an interesting agenda and a set of very interesting papers before you. I am sure that your discussions will assist you in the definition of the basic conceptual and policy framework relating to the selection and application of appropriate industrial technology in developing countries. It is expected

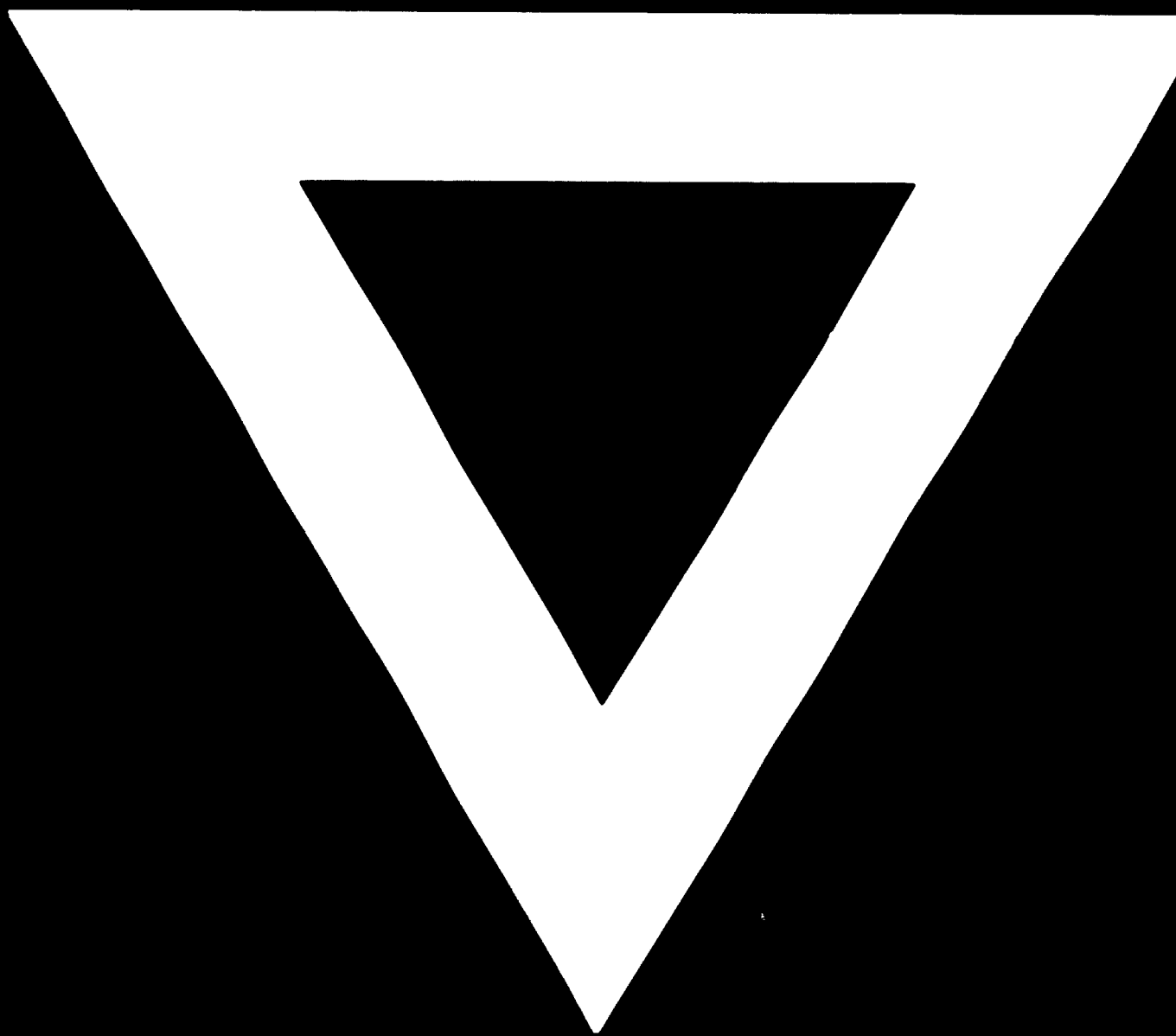
that the recommendations of this Group would provide a significant input for the deliberations of the International Forum on Appropriate Industrial Technology to be held in India, from 20 to 30 November 1978. The discussions and recommendations of the International Forum, in turn, are intended to provide a major contribution to the UN Conference on Science and Technology (1979) and to the Third General Conference of UNIDO (1980).

I should like, once again, to thank you for your participation and wish your meeting every success. Thank you.





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