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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

**FIRST
CONSULTATION
ON THE
ELECTRONICS
INDUSTRY**

Valletta, Malta

6-10 November 1989

REPORT

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PREFACE

The Second General Conference of the United Nations Industrial Development Organization (UNIDO), held at Lima, Peru, in March 1975, recommended in paragraph 66 of the Lima Declaration and Plan of Action on Industrial Development and Co-operation 1/ that UNIDO should include among its activities a system of continuing consultations between developed and developing countries, with the object of raising the developing countries' share in world industrial output through increased international co-operation. The General Assembly, at its seventh special session in September 1975, endorsed the recommendation and requested UNIDO to implement it under the guidance of the Industrial Development Board.

At its fourteenth session, in May 1980, the Industrial Development Board decided to establish the System of Consultations on a permanent basis. 2/ At its sixteenth session, in May 1982, the Board adopted the rules of procedure 3/ according to which the System of Consultations was to operate, together with its principles, objectives and characteristics (ID/B/258, annex). Notably:

The System of Consultations shall be an instrument through which UNIDO is to serve as a forum for developed and developing countries in their contacts and consultations directed towards the industrialization of developing countries;

The System of Consultations would also permit negotiations among interested parties at their request, at the same time as or after consultations;

Participants of each member country should include representatives of Governments, industry, labour, consumer groups and others, as deemed appropriate by each Government;

Each Consultation meeting shall formulate a report, which shall include conclusions and recommendations agreed upon by consensus and also other significant views expressed during the discussions.

Thirty-seven Consultations have been convened since 1977, covering the following industries and topics: capital goods, agricultural machinery, iron and steel, fertilizers, petrochemicals, pharmaceuticals, leather and leather products, vegetable oils and fats, food-processing, industrial financing, training of industrial manpower, wood and wood products, building materials, fisheries, non-ferrous metals, sugar-cane and medium and small-scale enterprises.

1/ See Report of the Second General Conference of the United Nations Industrial Development Organization (ID/CONF.3/31), chap. IV.

2/ Report of the Industrial Development Board on its fourteenth session (Official Records of the General Assembly, Thirty-fifth Session, Supplement No. 16 (A/35/16)), vol. II, chap. XI, para. 153.

3/ Report of the Industrial Development Board on its sixteenth session (Official Records of the General Assembly, Thirty-seventh Session, Supplement No. 16 (A/37/16)), chap. IV, para. 46.

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INTRODUCTION

1. The First Consultation on the Electronics Industry was held at Valletta, Malta, from 6 to 10 November 1989. The Consultation was attended by 129 participants from 41 countries and 13 international and other organizations (see annex I).

Background to the First Consultation

2. The Industrial Development Board, at its second session in October 1986, decided to include the First Consultation on the Electronics Industry in the programme of consultation meetings for the biennium 1988-1989.

3. Since 1980 UNIDO has carried out several activities related to the promotion of electronics industries in developing countries. Those activities have taken the form of expert group meetings and workshops on a regional or subregional level, as well as a number of technical assistance projects. A review of those activities was undertaken as part of initial preparations for the Consultation and of efforts to design a plan for further action. On the basis of that review, the UNIDO Secretariat decided to carry out global studies on the electronics hardware and software industries in order:

(a) To appraise the technological, economic and market trends and their implications for the industrial development of developing countries;

(b) To determine the implications of the strategies of main actors and industrial policies of developed and developing countries;

(c) To identify entry barriers for newcomers and propose appropriate strategies for coherent development.

4. In addition to the global studies, the Secretariat carried out a number of country case-studies on the situation of and prospects for the electronics industry in selected developing countries and the global diffusion of flexible automation technologies.

5. A Global Preparatory Meeting for the First Consultation on the Electronics Industry was held at Grenoble, France, from 28 November to 2 December 1988, to discuss the issues that might be submitted to the First Consultation.

6. The Global Preparatory Meeting recommended that the issues described below be considered at the First Consultation.

Issue 1

7. The electronics industry is undergoing a process of world-wide restructuring which is having an impact on producers and users of electronic products in developing countries. New development strategies are therefore needed in those countries, strategies oriented mainly towards promoting more integrated development of their electronics industries, as well as towards a more coherent productive system at the subregional and regional levels. In establishing development strategies for the electronics industry, careful attention should be given to indigenous technological capabilities and market characteristics and to the policies required for the implementation of the selected strategies.

8. The first issue to be considered at the First Consultation was therefore defined as "Strategies for integrated development of the electronics industry including software".

Issue 2

9. New developments in micro-electronics are having a profound impact on practically all sectors of the economy. The transition to high technology in traditional industries such as textiles, iron and steel and non-ferrous metals is undermining the competitiveness of several developing countries. The incorporation of functions previously performed by mechanical or electro-mechanical systems into electronic components is causing an increase in the packaging of technology into "black boxes", making technology unpacking as a strategy for technology absorption and development more difficult.

10. It has thus become important to analyse the implications of the diffusion of micro-electronics technologies on the industrial productivity, competitiveness and employment of developing countries so as to formulate policies on the use of such technologies in ways that will promote their industrial development.

11. The second issue to be considered at the First Consultation was therefore defined as "Electronics technologies in the service of industrial development".

AGREED CONCLUSIONS AND RECOMMENDATIONS

Preamble

12. The First Consultation on the Electronics Industry recognized that the electronics industry has brought about fundamental changes in industrial restructuring, employment generation and manufacturing systems. It has also made a substantial contribution to the national product of many countries. Considering the world-wide movement towards increasing penetration by electronics in all sectors of the economy and the prospects offered by electronics as a means of contributing to and accelerating development, every effort must be made by the international community to support developing countries in promoting the application of electronics and industrial operations in the electronics field, and in achieving effective mastery of the various features of the technologies involved.

13. The wide-ranging impact of electronics on production mechanisms and consumption makes it imperative that every developing country, whatever its stage of industrialization, should actively participate in the ongoing evolution of electronics as users and, in certain circumstances later explained, as producers. National support measures and international co-operation must enable developing countries not only to make useful choices in full awareness of the priority areas of initiation, promotion and application of electronics and of the appropriate techniques for their needs and capabilities, but also to take account of the many factors which are decisive in the industrial promotion and use of electronics.

14. UNIDO should utilize all available modalities to promote the implementation of the recommendations of the meeting, including the organization of follow-up expert group meetings drawn mainly from enterprises in the electronics industry. In view of the pace of development of electronics and its crucial role in industrialization, the Industrial Development Board of UNIDO should consider the inclusion of the electronics industry in future Consultation programmes.

Issue 1: Strategies for integrated development
of the electronics industry including software

Conclusions

15. The Consultation concluded that:

(a) The electronics industry is a large and diversified industry with many strongly linked subsectors. Software has become essential for all electronic systems and should be considered together with hardware production. Despite this wide diversity, electronics must be considered as a unity;

(b) The electronics industry is one of the most internationalized industries with a wide range of markets and choice of production styles that offer opportunities of entry for most developing countries at different stages of development;

(c) The strategies of entry followed by many developing countries, whatever the subsector involved, must be weighed to ensure the integrated development of the industry;

(d) Several entry barriers must be carefully considered, notably the following:

(i) A high level of research and development is required to keep abreast of extremely rapid technological change in practically all subsectors of the electronics industry, such as components, data-processing equipment and consumer goods;

(ii) Substantial amounts of fixed investment are required in some subsectors because of the high level of technological sophistication and the large scale of production;

(iii) Moving into electronics requires, even more than in other fields of activity, the development of human resources. A certain threshold, involving many dimensions, needs to be crossed by the population, and special efforts must be made to increase public awareness, to motivate and to train qualified personnel, with the participation of all the sectors concerned, and of socio-professional associations in particular;

(iv) Highly skilled personnel must be employed in research and development, design and production, maintenance etc.;

(v) An adequate local market must be available;

(e) Most developing countries, in their industrial policies, have given insufficient attention to:

(i) Promotion of the electronics industry through fiscal measures and incentives;

(ii) Linkages between different subsectors of the whole electronics industry;

(iii) Necessary infrastructure and supportive industries and services;

(iv) Effective linkages between electronics production in export processing zones and the rest of the industrial sector;

(f) In subsectors where a sufficient degree of standardization has been achieved, entry possibilities have increased;

(g) The environmental impact of chemical exposure and waste disposal in the electronics industry has not been duly taken into account in the many electronics investment projects undertaken in both developed and developing countries;

(h) The prospects for co-operation between developing countries in the electronics industry depend on various factors, including the following:

(i) Production complementarities and enterprise-to-enterprise co-operation between developing countries at the regional level have not been sufficiently explored to permit coherent programmes of co-operation;

(ii) Considerable technological progress has taken place in many developing countries, opening up possibilities for the systematic and intensive exchange of experience and technology on an intraregional basis;

(i) The following benefits of co-operation between developing countries should be noted:

(i) International co-operation is of primary importance for technology transfer and information exchange, provision of training and meeting finance requirements;

(ii) Co-operation between enterprises in developing countries and those in developed countries is an important means of fostering complementarities and international subcontracting.

Recommendations

16. The Consultation made the following recommendations:

National measures

(a) As successful entry into the electronics industry depends on many factors, including the market, profitability, the availability of personnel, infrastructure and the fulfilment of other requirements, each country or group of countries should define its strategy in a realistic way, taking into account its specific situation, with due consideration being given to developing the applications of electronics in the various sectors of the economy;

(b) By means of regional and international co-operation, including direct co-operation between enterprises of developed and developing countries, efforts should be made to identify the fields in which entry into the electronics industry is most profitable for the economies of developing countries, to carry out a realistic analysis of requirements, to devise suitable strategies and to develop processes that can be adapted to evolving requirements and technologies;

(c) Because of the wide scope of the electronics industry, the choice of a point of entry into the sector should be made selectively. In most cases, the entry criteria should be based on prior analysis of global trends and technologies and the specific circumstances prevailing in the individual countries. Strategic planning should provide the necessary entry guidelines, such as the following:

- (i) The manufacture of telecommunications equipment, especially customer premises subscriber and switching equipment, including telephone sets and private automatic branch exchanges, could be considered by developing countries with a large domestic or regional market;
- (ii) The manufacture of semi-professional equipment, such as instruments and voltage stabilizers, is a viable option for most developing countries;
- (iii) Developing countries may consider the manufacture of professional equipment if the required technological capabilities are available. Where necessary, such capabilities could be strengthened through co-operation and technology transfer from developed countries;
- (iv) Consumer electronics are within the technical capabilities of many developing countries, offering new opportunities as markets previously under-exploited by large manufacturers are opened up or being created by domestic policies;
- (v) The production of components on the basis of limited batch operations using medium- or low-order technologies offers entry opportunities for almost all developing countries. However, the manufacture of active components, particularly integrated circuits, may be considered as an entry point, depending on the availability of sufficient investment and the required technological infrastructure;
- (vi) More specific or complex components should be carefully evaluated and special attention given to the design and development of application-specific integrated circuits, which are found in a growing number of products, and whose impact on information-intensive industries such as telecommunications and computing is expected to be considerable;
- (vii) Developing countries could use software development as a point of entry into the electronics industry. Such an approach could extend to system design and integration, involving high-value-added products and services. One area of immediate interest would be specifically oriented software and software modification;
- (viii) The introduction of enabling computer-based technology, such as computer-aided design and computer-aided manufacture (CAD/CAM) should be carefully considered in order to determine its potential benefits, particularly in small batch operation;

(d) In the development of the electronics industry, due attention should be paid to the needs of the environment. Appropriate standards should be incorporated into the design and construction of plants, and the necessary waste disposal infrastructure should be made available as required;

(e) Industrial policies and promotional measures should give high priority to the development of industrial electronics, in view of its interlinkages with and impact on other sectors of the economy, as determined by an analysis of and planning for the industry within the overall economic context. In particular, surveys of the electronics industry should be carried out prior to the establishment of plans, programmes and strategies for its development;

(f) The development of the electronics industry should be supported by appropriate promotional measures and incentives, such as tax concessions, soft loans, subsidized investment programmes and training schemes. The creation of a favourable investment climate, as well as the development of communication infrastructures and support industries, should be accorded high priority in government policies and programmes to create and promote investment and ensure profitability;

(g) Account should be taken of the role of government procurement policy as a means of promoting and encouraging investment in the national electronics industry;

(h) The assessment of needs has shown the particular importance, for educational and training systems, of paying due attention to the manpower requirements of the electronics industry at all levels. For this purpose, universities and training institutions should collaborate closely with industries, associations, workers' bodies and other related professional organizations, and should be encouraged to create or strengthen their programmes by using all the modern methods and electronic media available in fields of direct relevance to the electronics industry, such as design engineering, system analysis, software engineering, maintenance engineering, marketing management and business skills. Continuous education and training of technicians are areas of equal importance;

International measures

(i) Technology transfer agreements should provide for:

(i) Adequate, appropriate and clearly understandable technical documentation;

(ii) Adequate and appropriate training at all levels, which should be regarded as an essential element for the assimilation of imported technology;

(iii) Appropriate equipment which should ensure non-obsolescence over a reasonable period of time;

(j) All technology transfer documentation and training should cover, inter alia, operations, materials management and maintenance;

(k) Institutional links between training centres in developed and developing countries should be established or strengthened. Industries in developed countries should be encouraged to co-operate by providing fellowship programmes to developing countries;

(l) Production complementarities between developing countries on a regional and interregional basis should be exploited;

(m) Besides encouraging national centres, Governments should promote, in Africa, Asia and Latin America, regional centres for the promotion of new pro-

jects, training, technology transfer and exchange of experience in the electronics industry;

(n) All developing countries should participate in international efforts to promote standardization, to the extent that such efforts still need to be promoted, in the various subsectors of the electronics industry;

Recommendations addressed to international agencies, including UNIDO

(o) UNIDO, with the co-operation of other relevant international bodies, including those outside the United Nations family of organizations, should assist developing countries in the implementation of the recommendations of the Consultation. In this context, UNIDO should submit an operational follow-up plan for concrete technical assistance programmes in the electronics industry;

(p) UNIDO should assist developing countries on a regional basis in their efforts to identify and exploit complementarities in production, production strategies, research and development and markets;

(q) UNIDO should organize expert group meetings at regional and inter-regional level on specific issues pertaining to the electronics industry, such as the manufacture of telecommunications equipment, industrial equipment, components and software, taking into account the possibility of creating specific regional support centres on the basis of existing institutions, with a view to defining appropriate development strategies;

(r) UNIDO should develop and provide technical assistance programmes in the fields of repair and maintenance and training at all levels, particularly pilot programmes based on modern training methods. UNIDO could further assist in the establishment of metrology and standards laboratories for the electronics industry;

(s) UNIDO should reinforce and continue to disseminate technological information in the field of electronics.

Issue 2: Electronics technologies in the service of industrial development

Conclusions

17. The meeting concluded that:

(a) The development of the electronics industry world-wide is having an important but unequal impact on the productivity, international competitiveness and organizational structure of a wide range of industries in developing countries. However, the impact is fairly homogeneous in the telecommunications industry and its development activities;

(b) The impact of electronics on productivity and competitiveness in many developing countries depends not only on investment in equipment, but also on intangible assets such as software;

(c) The widely spreading use of electronics opens up new possibilities for industrial development in developing countries, which depend to a great extent on their scientific capabilities, manufacturing base and infrastructure development. Electronic technologies can make the industrial structure and

production organization of developing countries more flexible, thus enhancing their prospects for industrial development;

(d) Electronics has a multifaceted impact on the different industries in developing countries and on the various phases of production within each industry;

(e) To enable the electronics industry to generate gains in productivity and competitiveness, the introduction of electronics must be accompanied by wide-ranging changes in the organization of production, with the creation of conditions for an effective use of electronic technologies;

(f) Mastering the use of electronic technologies in many developing countries is hindered by insufficiencies in:

- (i) National policies, promotional measures and the institutional framework for selective and effective use of electronic technologies and products;
- (ii) Skilled personnel at all qualification levels;
- (iii) Maintenance conceived in a broad sense, taking into account, on the one hand, the rapid obsolescence of electronic equipment, and, on the other, the domestic production of spare parts, components and software;
- (iv) Effective transfer of the electronic technologies offered;
- (v) Co-operation at the regional, interregional and international levels, leading to the profitable exchange of experience in the utilization of electronic technologies in industry, training, repair and maintenance, and in processing technological information;
- (vi) Co-ordination among users and producers of electronic technologies and products at the national, regional and international levels.

Recommendations

18. The consultation adopted the following recommendations:

National measures

(a) Improving telecommunications services through the introduction of digital electronics should be considered by developing countries as an important means of increasing productivity in the different sectors of their economies;

(b) In selecting industries for the introduction of electronic technologies, Governments and enterprises in developing countries should take into account, *inter alia*, the following factors:

- (i) Exposure of the industries to international competition;
- (ii) Productivity advantages and the cost of additional management, training and repair and maintenance requirements;

(iii) Impact on employment, including new skill requirements and changes in the structure of employment;

(c) Developing countries should take advantage of the new opportunities for capital savings offered by several electronic technologies. CAD/CAM, programmable logic controllers and numerical-control machine tools could be used to establish flexible industrial structures to overcome, in some cases, the constraints of economies of scale imposed by mass production techniques, and to promote the development of small- and medium-scale enterprises;

(d) Electronics should be progressively applied in industry, with the aid of accompanying measures, to ensure its mastery by local users;

(e) Governments should adopt policies and promotional measures necessary to ensure that the introduction of electronic technologies at the national and enterprise levels has a positive and substantial impact. Such policies and measures should be oriented mainly towards bringing about a structure and organization of production that will be compatible with the new requirements of the electronic technologies;

(f) Developing countries should establish institutional frameworks designed to improve the mobilization and co-ordination of the efforts of major actors in the electronics field, such as policy-makers responsible for the industry, enterprises, users, centres of research and development, universities and manufacturing and professional associations;

(g) Developing countries should establish training programmes to facilitate the emergence of a new industrial culture compatible with the new modes of intellectual and material production being generated in a continuous and dynamic manner by electronic technologies. Such programmes should take due account of the new qualifications required by personnel at different levels, including management, designers, supervisors, operators and maintenance staff;

(h) In selecting electronic technologies, developing countries should consider the possibility of increasing the linkage of such technologies with other sectors of the economy, as well as their adaptation and improvement by research centres and universities;

International co-operation

(i) Firms in developed countries should assist enterprises in developing countries in the establishment of maintenance programmes that will not only guarantee the continuous operation of the equipment, which is constantly being affected by rapid world-wide technological change, but also contribute to the improvement of its productivity. In this context, when selecting electronic technologies, special consideration should be given to the evolving maintenance requirements and procedures;

(j) At the stage of negotiating technology transfer arrangements, the enterprises concerned should pay particular attention to the possibilities of continuous technological upgrading, in order to avoid the effects of rapid obsolescence;

(k) Developed and developing countries should strengthen their co-operation in such fields as transfer of technology, training at the different levels and maintenance;

Multilateral co-operation through international organizations

(1) UNIDO, with the co-operation of other relevant international bodies, including those outside the United Nations family of organizations, should assist developing countries in:

- (i) Assessing the impact of the introduction of electronic technologies on the upgrading of technological capabilities, employment, productivity and international competitiveness, in order to define the appropriate strategies;
- (ii) Promoting regional co-operation in the field of training, exchange of national experience in the use of electronics in the industrial sector, maintenance and the dissemination of technological information. For this purpose, UNIDO should assist developing countries in the establishment of regional centres for technological information, training and maintenance.

I. ORGANIZATION OF THE CONSULTATION

Opening of the Consultation

Statement by John Dalli, Parliamentary Secretary for Industry

19. The Parliamentary Secretary for Industry of the Government of Malta, in his opening speech, underlined the central role of technology in economic progress. He cited the tremendous economic growth of Japan and the Republic of Korea in recent decades, growth which was entirely attributable to the acquisition and absorption of new technologies. Electronics was a "pervasive" technology, and it was transforming, beyond the strict confines of the electronics industry, the whole organizational structure of business enterprises.

20. He then described the significance of the electronics industry for the Mediterranean region, which in ancient and medieval times had played a crucial role in scientific advancement.

21. Next he identified the two major constraints on the development of the electronics industry as inadequacies of access to markets and to technology. Acquiring satisfactory market outlets involved overcoming multiple constraints with regard to political controls, the specific skills needed, infrastructure, communication across national frontiers, geographical factors etc. Access to technology was even more complex, since those who possessed the technologies were not disposed in practice to transfer them. It was therefore clear that the key to fruitful participation in the electronics revolution was the educational infrastructure in the country concerned. In that context he drew the attention of the Consultation to the undeniable statistical correlation between the level of national expenditure on development-oriented research and the contribution of technology to the growth of the gross national product. He concluded by stating his conviction that, in the modern world, technological knowledge and strategic planning were unavoidably bound together. The task before the Consultation was therefore to gain a better understanding of the forces shaping the global electronics industry.

Statement by the Director-General of UNIDO

22. The Director-General of UNIDO, after expressing his gratitude to the Maltese authorities and people for serving as host to the Consultation, stated that Malta had traditionally acted as a bridge between North and South, East and West, and therefore constituted an ideal venue for such a meeting. Moreover, the country stood out as an example of successful entry into the electronics industry. Electronics would fundamentally influence production systems and consumption patterns. It had already been the fastest-growing industry during the past 10 years, and world production had surpassed the value of \$600 billion,* with international trade in electronics products accounting for some \$150 billion annually. Some developing countries had successfully entered this lucrative sector, although that group of countries as a whole retained merely a 7 per cent share in world production. However, electronics was being integrated into other sectors of the economy, affecting the productivity and competitiveness of such industries as the iron and steel, automotive, engineering and textile industries.

*References to dollars (\$) are to United States dollars, unless otherwise stated.

23. Developing countries should therefore exercise extreme care in the selection of electronics products for both use and manufacture, so as to achieve a more efficient, flexible and integrated structure of production.

24. In conclusion, he restated the objectives of the Consultation, namely the formulation of measures at the national level for the development of the sector and the evolution of new forms of co-operation at the international level for mastering the changing technology of electronics.

Statement by Edward Fenech-Adami, Prime Minister of Malta

25. The Prime Minister of Malta, in his opening address, said that the Consultation was especially significant both because of the central importance of the electronics industry in the present age - the "electronic age" - and because it was the outcome of co-operation between Malta and UNIDO.

26. He disclosed a major initiative taken by his Government in proposing, in collaboration with UNIDO, the establishment of a Mediterranean Regional Centre for Marine Technology as a follow-up to, and in fulfilment of, the Convention on the Law of the Sea. The obvious link with the theme of the Consultation was the major part that electronics played in marine technology, as indeed in industrial activity in general. The novel feature of the proposal was that it envisaged tripartite collaboration, whereby projects originating in private enterprise would be carried out with support from participating States and from international agencies. Thus, it recognized the need for client-originated demand as a first condition for Governments and international bodies to contribute to an industrially oriented research project. He believed that that represented a cardinal principle in any appropriate strategy for the insertion of science and technology in the planning of economic development. At the same time, State support for budding industries, and particularly the electronics industry, was a necessary condition for their success in both developed and developing countries.

Statement by the Director of the System of Consultations Division

27. The Director of the System of Consultations Division noted that the global electronics industry owed its current status largely to government promotional measures aimed at its development. However, in many developing countries the integration of the sector within the national economies had been hampered by inadequacies in policy instruments, in national research and development capabilities and in awareness of the sectoral impact of the electronics industry.

28. As a point of entry, he identified the development of programmable software as an integral part of the electronics industry presenting good opportunities for many developing countries, which could then tackle hardware development in an integrated and rational manner.

29. Manufacturing processes were undergoing unprecedented changes as a result of the impact of electronics technologies on productivity and profitability even in traditional industries such as textiles and mechanical engineering. The effects of this ongoing process of modernization needed to be closely monitored and appropriate measures taken by developing countries. The challenge posed to that group of countries stemmed from difficulties encountered in keeping abreast of technological change as well as in the selection of industrial activities in which electronics had the greatest impact. Those problems were further compounded by the stringent requirements to ensure proper maintenance of technologically sophisticated equipment. On the other hand,

flexible production techniques offered many new opportunities for offsetting the constraints traditionally imposed by economies of scale. He concluded by reiterating the objectives set for the Consultation, namely to identify necessary measures and formulate recommendations to promote an integrated development of the electronics industry by placing it at the service of development. To that effect the two issue papers submitted had outlined a number of points providing a framework for the deliberations of the working groups and facilitating the systematic examination of the questions at hand.

30. Finally, he requested the participants to avail themselves of the many opportunities offered by the Consultation to establish bilateral contacts with a view to initiating projects in technical assistance and investment promotion in the electronics industry.

Election of officers

31. The following officers were elected:

Chairman: Michael Soler (Malta), Chairman of the Malta Development Corporation

Vice-Chairmen: Mohammed Hakmi (Algeria), Ingénieur, Chargé d'études et de synthèse au Cabinet du Ministre, Ministère de l'industrie
Karol Horvath (Czechoslovakia), Deputy Minister, Federal Ministry of Metallurgy, Engineering and Electrotechnics
Prabir Kumar Sandell (India), Managing Director, NVL Group of Enterprises

Rapporteur: Antonio Orta (Cuba), Director de Relaciones Internacionales, Instituto Nacional de Sistemas Automatizados y Computación

Adoption of the agenda

32. The Consultation adopted the following agenda:

1. Opening of the Consultation
2. Election of Chairman, Vice-Chairmen and Rapporteur
3. Adoption of the agenda and organization of the work
4. Presentation of the issues by the Secretariat
5. Discussion of the issues:
 - Issue 1: Strategies for integrated development of the electronics industry including software
 - Issue 2: Electronics technologies in the service of industrial development
6. Conclusions and recommendations
7. Adoption of the report

Establishment of working groups

33. The Consultation established two working groups to discuss the issues and to propose conclusions and recommendations for consideration at the final plenary. Prabir Kumar Sandell (India) was selected to chair the working group on issue 1 - strategies for integrated development of the electronics industry including software - and Mohammed Hakmi (Algeria) to chair the working group on issue 2 - electronics technologies in the service of industrial development.

Documentation

34. The documents issued prior to the Consultation are listed in annex II.

Adoption of the report

35. The report of the First Consultation on the Electronics Industry was adopted by consensus at the final plenary on 10 November 1989.

II. REPORT OF THE PLENARY SESSIONS

Summary of discussions

36. There was general agreement on the crucial importance and the pervasiveness of electronics in all industrial activity and on the desirability for developing countries to promote the electronics industry, given its profound intersectoral impact. In view of its linkages with the overall organization of the production process, the electronics industry assumed a strategic position in the attainment of social and economic objectives.

37. The role of both North-South co-operation and co-operation among developing countries in the promotion of the electronics industry was fully recognized. Such an approach could effectively counteract the constraints imposed by limitations of market size and the difficulties often encountered in the acquisition of technology. In this context, however, it was pointed out that local absorption and indigenization of imported technology was imperative to reduce excessive technological dependence on external sources.

38. To attract foreign capital and know-how, the creation and maintenance of a favourable investment environment was advocated by some participants. The measures required varied widely and ranged from ensuring the availability of skilled manpower to providing for generous fiscal incentives. Participants pointed out that, in those developed countries where the electronics industry had recorded impressive growth rates, State support in its many manifestations was largely responsible for this performance. Participants generally agreed that, on a global level, the role of government and public policy in shaping the industry was crucial, to a greater extent than in any other industry.

39. In view of both the scarcity of resources and the costly experience gained through less than successful projects in recent years, it was suggested that proper, detailed feasibility studies should be undertaken for each project and financial and economic viability clearly established before investment funds were committed. In that connection, the crucial importance and relevance of market research was emphasized. The electronics industry was characterized as being predominantly market-driven rather than technology-driven, contrary to the generally held view.

40. Participants from developed and developing countries described their respective experiences in the electronics industry, which was exercising an ever-increasing impact on human life and activity, relating not solely to the development of information technology per se, but also to the role of electronics in the industrial production process as well as consumer products. In this context the idea was put forward not only that the commodity of information technology was freely transferable, but also that its consumption did not necessarily exclude others. A participant from the host country gave a brief account of the electronics industry in Malta, which now accounted for more than a quarter of the country's exports.

41. Emphasis was placed on the requirements of personnel training in the electronics industry. The capabilities of educational infrastructure and the linkages to research institutions and universities in most developing countries needed strengthening. Industrial maintenance of increasingly sophisticated equipment and machinery deployed in the industry made a high level of skills of operators and managers imperative. The ability to move towards higher-level electronic technologies would ultimately depend essentially on the creation and nurturing of a pool of skilled labour capable of attracting, absorbing and indigenizing that technology.

42. The participants concurred that, among the many challenges confronting developing countries in their efforts to establish or promote their electronics industry, the following three factors clearly stood out: first, the need for a diversified and tailor-made approach reflecting specific conditions; secondly, the imperatives of manpower training; and finally, the mastering of the technology.

43. Telecommunications technology was suggested as a priority sector in the promotion of the electronics industry in developing countries, given its potential for underpinning the formation and performance of local enterprises, thus strengthening the national industrial infrastructure. Various other entry points into the industry, such as software development or the manufacture of commodity-type products, were identified by individual participants. Their suitability and applicability would depend on a country's specific circumstances.

44. Many participants commended the Secretariat for the scope and quality of the documentation submitted to the Consultation, as well as the preparatory work carried out.

45. A representative of the United Nations Conference on Trade and Development (UNCTAD) stressed the implications of new and emerging technologies for the trade and development prospects of developing countries. Thus the rapid spread of electronics-based and other new technologies had affected the nature of competition in manufactured exports. Of growing concern to UNCTAD was the question of how that trend, combined with other developments, had affected the technology and trade policies of developed and developing countries. The work carried out so far suggested that the rising significance of the micro-electronics revolution in capital goods, consumer electronics, textiles and other industries offered great opportunities for economic growth and development. However, many problems, such as protectionism, voluntary export restraints and marketing arrangements, continued to persist, preventing the third world from fully participating in the benefits stemming from the global development of the electronics industry.

46. A representative of the United Nations Environment Programme (UNEP) stated that, while the electronics industry was sometimes thought of as a

clean industry, its negative impact on the environment had increased significantly and the clean-up cost of the damage caused had reached serious levels. This environmental impact stemmed largely from the increased use by the electronics industry of toxic chemicals and polluting agents in the manufacturing process and the release of contaminated effluents into the natural environment, and increasingly from the disposal after use of the consumer products of the industry. Those problems could be effectively counterbalanced by the adoption of cleaner production techniques and the substitution of safer and environmentally inert chemicals, and particularly through preventive management techniques. He then described the efforts made by his organization to encourage policy-makers and the industry to implement those necessary measures.

47. The representative of the International Institute for Applied Systems Analysis put the emergence of the electronic age into a historical perspective, heralding the third industrial revolution. Whereas the steam engine and the electric motor had left the industrial and communicational infrastructure relatively unchanged, the electronics revolution was having a profound effect on a global basis, influencing every walk of life in all countries. Nobody could therefore afford to be left out. He concluded by describing the recipes of success followed by such countries as Japan and the Republic of Korea.

III. REPORT OF THE WORKING GROUP ON ISSUE 1: STRATEGIES FOR INTEGRATED DEVELOPMENT OF THE ELECTRONICS INDUSTRY INCLUDING SOFTWARE

Summary of discussion

48. Participants stressed the importance of recognizing barriers to entry in the shape of capital cost, research and development resources and level of sophistication of existing industrial activities. The decreasing life cycle of electronic products made it necessary to increase the speed at which new products reached the market-place. A participant pointed out that the main barrier was often financial viability, so that initially suitable technologies should be purchased from outside. Furthermore, few national markets were large enough to absorb minimum economic production levels.

49. It was pointed out that the electronics industry could not outstrip industrial development in other sectors, but must be integrated so that it could be utilized in those sectors. Telecommunications equipment was mentioned as a suitable point of entry, since procurement was usually under government control. However, software suitable for large-scale systems must be secured. There was support for entry through professional electronics in view of the high value added and greater developmental impact. Consumer electronics posed the problem of rapid obsolescence.

50. It was argued that there was a need for human resource development in the electronics industry, not only at the technical levels, but also at the managerial and entrepreneurial levels. Training should likewise cover procurement, production control, materials management, after-sales service and maintenance, and skills must be refreshed at regular intervals. A participant pointed out that interactive training courses using personal computers were already available and could significantly curtail training times. UNIDO might consider training packages of this type adapted to the capabilities of developing countries. It was proposed that an inventory of vocational

training resources in developing countries be prepared in order to determine where these needed to be strengthened. A participant stressed the need to establish links between training centres in developing and developed countries. The desirability of including maintenance in training courses was highlighted, since imparting maintenance skills was an effective training measure.

51. Mention was made of the fact that chips could now be protected under intellectual property laws, and that the same protection might be applicable to all products containing a patented chip.

52. Participants stressed the importance of joint ventures with a buy-back arrangement as a means of overcoming limited national markets. UNIDO could contribute by identifying potential joint venture partners in developed countries.

53. The proposal was made to hold further meetings with a regional and subsectoral emphasis in view of the marked differences between developing countries and regions.

54. One participant summarized the ingredients of success in developing an electronics industry as follows: the Government should have planning capabilities, provide an adequate infrastructure, offer good vocational training opportunities and enjoy the confidence of the business community. Business must develop its entrepreneurship and be able to mobilize resources and confidence in themselves and their society.

55. It was suggested that software development might be a suitable option for developing countries because little investment (data input, software modification) was required. This should be done in partnership with a software company in a developed country in order to gain access to markets. One participant felt that, like books, software should be made available to developing countries at reduced rates.

56. A number of participants expressed support for the idea of regional electronics consulting centres which would help developing countries to select the correct option for development of their electronics industries and to overcome shortages of technical skills and training facilities. Other participants felt that there was no need, nor was it financially feasible to create new institutions, but that rather existing institutions should be strengthened, and better use made of the assistance and information already available from UNIDO. The view was expressed that such regional centres could only exist if the industry was prepared to provide them with financial support. It was therefore necessary first to determine the need for such centres. In Asia, for example, there was one which offered maintenance services on behalf of transnational corporations.

57. Another participant felt that regional electronics training centres should also provide assistance to ministries of industry in policy analysis and planning, with the aim of identifying the correct choices regarding entry. It was also felt that support was needed for specialized electronics industry federations so as to reduce the role of the State. The view was expressed that setting standards for electronic equipment was one area where the State must take the lead. However, such standards must be based on those adopted by the transnational corporations. A participant stated that national as well as regional centres should be supported. A regional umbrella programme should be prepared by UNIDO to channel assistance to such national centres.

58. Several participants endorsed the importance of granting fiscal incentives to encourage the implantation of electronics, given their importance for the development of industry as a whole. A participant warned that the value of incentives might not always match the cost of qualifying for them, for example through having to set up production in a region with poor infrastructure.

59. Participants pointed out that it was necessary actively to canvas trans-national electronic corporations to set up operations in developing countries. Once one had established a production facility, others were likely to follow suit. Several participants expressed the view that international business co-operation was essential, and that no country could afford to "go it alone". The importance of South-South as well as North-South co-operation was stressed, some developing countries such as the Republic of Korea, Singapore and India being major resources of the inputs needed by other developing countries for their electronics industries. A participant representing a major electronics firm in a developed country stressed the importance of the local partner's contributing to improving process technologies and products. A long-standing business relationship with a stable local partner capable of contributing to product development was essential.

60. One participant felt that because they so often embodied advanced technology, electronic components were particularly subject to export restrictions. That could inhibit relations with business partners in developed countries. One participant expressed the wish that UNIDO support developing countries in achieving a liberalization of trade practices in this area.

61. A representative of the International Labour Office said that educational and training policies in developing countries should make more provision for the needs of electronics industries. Bodies representing employers and workers should be involved in this process, since there was a need to update qualifications of electronics workers, and the proportion of workers using programmable equipment was increasing at a relatively modest pace; in one major industrialized country, it had increased from 5 per cent of the labour force in 1979 to 7 per cent in 1988. It was important that procurement policies for developing countries should give adequate support to national electronics industries.

62. A representative of the United Nations Educational, Scientific and Cultural Organizations said that studies had shown not only that developing countries were training far fewer engineers than developed countries, but that they were spending far less on each engineer trained. That problem was particularly acute in electronics. It was therefore essential to mobilize additional public funds for such training and to develop a long-term strategy to ensure that the necessary level of human skills was reached in developing countries.

63. A representative of UNEP said that when establishing electronics industries in developing countries more attention should be paid to reducing negative environmental impact and worker hazards. Moreover, developing countries might not have access to the expertise required to carry out environmental assessments and advise industry on treatment of hazardous waste. As a result, consideration of those aspects was often postponed until projects were operational, rather than being dealt with at design and planning stage. As a matter of principle, ministries of industry, rather than the environment ministries, should be responsible for handling the environmental

aspects of industrial projects, because they were better informed about the details of such projects.

IV. REPORT OF THE WORKING GROUP ON ISSUE 2: ELECTRONICS TECHNOLOGIES IN THE SERVICE OF INDUSTRIAL DEVELOPMENT

Summary of discussion

64. A member of the UNIDO Secretariat introduced issue 2 to the working group. He stated that the diffusion of electronics had not been confined to processes and products within the electronics industry. It had opened new possibilities in a wide range of industries, including processes of control in continuous process industries (iron and steel, non-ferrous metals), automation in automotive industries and flexible automation in the engineering industry.

65. The changes being introduced by electronics in those industries where developing countries enjoyed a favourable position (such as garments and the electronics industry itself) should be closely monitored.

66. The introduction of automated equipment should be carefully evaluated by developing countries, taking into account the following factors:

(a) The advantages of automation in terms of productivity and flexibility, and the implications in terms of maintenance and repair;

(b) The exposure of the industry in question to competition;

(c) The socio-economic adjustments which would be needed with the introduction of automation.

67. It should be borne in mind that the increase in competitiveness did not come from the use of new and sophisticated equipment alone, but required changes in the organization of production to create the necessary conditions for reaping the full benefits of the new technologies.

68. The working group agreed that the introduction of electronics techniques into industrial activities in general offered many substantial and wide-ranging advantages. Among the obvious benefits were an increase in reliability and consistency of production, new possibilities for product diversification, cheaper and more dependable equipment and machinery and a better control of the production process.

69. With respect to the often used terms "the electronic age" and "the third industrial revolution", it was pointed out that the scope and nature of electronics clearly had implications different from those stemming from the advent of both the steam engine and the electric motor. The electronics industry was based not on energy or material but on the processing and transmission of information. In view of its pervasiveness in the whole range of societal activity, the established perception of industry as composed of manufacturing entities was therefore bound to undergo a profound change.

70. Participants, particularly those from developing countries, concurred that in view of both the strategic importance of electronics and its capital and know-how intensiveness, Government and public policy assumed a critical role in its promotion. One participant identified the main ingredients for the successful operation of the electronics industry as simultaneous and concerted action on market development, personnel training, financing

packages, and finally industrial policies. He briefly described the transformation of the industry in his country, taking it from an underdeveloped stage to the league of world leaders within some 15 years as a result of implementation of the measures advocated.

71. The question of maintenance in its widest sense figured prominently in the discussion of the working group. Its crucial importance was widely recognized, particularly in the industrial context of developing countries. Many participants from this group identified lack of comprehensive and appropriate maintenance procedures as responsible for low utilization rates of industrial processes using electronic control and other devices. It was pointed out that for maintenance to be effective, a genuine transfer and absorption of technology must occur in the first place.

72. Participants from developing countries described their experiences and highlighted their difficulties in the application of electronics to industrial sectors. The problems of technological obsolescence, unavailability of spare parts, maintenance and lack of access to technological innovations were among the main constraints cited. In this context the same participants inquired about the scope and nature of technical assistance to remedy the above problems available from international agencies, and particularly from those within the United Nations system, such as UNIDO.

73. Within the electronics industry, telecommunications and the relevant electronic components were identified as a priority area most suited to rendering service in the process of economic development. However, it was pointed out that in the foreseeable future developing countries as a group, with few exceptions, were likely to remain largely users rather than producers of this technology - a condition they shared with many developed countries. Telecommunications, by providing information and intelligence, could make a substantial contribution to the productivity and competitiveness of industrial activity in developing countries. In telecommunications, in contrast to other segments of the electronics industry, the interests of developing countries were best served by selecting the most advanced technologies available in view of their many interfaces and link-ups with the global networks.

74. The need for the assimilation and indigenization of imported technologies in developing countries was emphasized, to enable them to utilize, operate and maintain the equipment efficiently. Reservations were expressed regarding the practice of some foreign suppliers who did not always provide comprehensive after-sale packages of technical support to purchasers in developing countries. This often led to severe operational deficiencies, breakdowns, technological obsolescence etc. As a result, the technological dependence of many developing countries in the electronics industry was in fact growing.

75. Judicious selection of electronics technology in full awareness of alternative technological options was considered an essential element for the successful integration of electronics techniques into the process of industrial production. Such an approach would also avoid costly expenditure on inappropriate and obsolescent equipment, which had on occasions occurred in recent years in some developing countries. Participants from that group, however, maintained that, given the dominance of a few corporate entities in the industry, in addition to financing and other constraints, countries were often left little choice in the selection of equipment.

76. In the context of international co-operation in the electronics industry, suggestions were made to the effect that regional centres for the exchange of technological and market information and industrial experience could make a

substantive and much-needed contribution to better resource utilization in the integration of electronics techniques in the national economies of developing countries. Some other participants from developing countries stated that the mandates of such regional centres could be extended to cover the all-important task of providing training in all aspects of the industry.

77. On the impact of electronics technology on the general level of employment in the economy, it was stated that fears of job losses resulting from the use of electronics were, in general, unjustified. On the contrary, in view of the increased productivity and competitiveness of enterprises making use of advanced production and management techniques, more and better employment opportunities were created.

78. The various aspects of the training issue were closely examined. It was noted that the scope and nature of the training offered in transfer of technology agreements was often left to the discretion of the technology supplier. This inevitably led to unsatisfactory assimilation and mastery of the technology by the purchaser, which in turn resulted in serious problems in operation and maintenance. One possible remedy consisted in stipulating detailed and extensive provisions for training and after-sale technical support in the contractual arrangements with the suppliers. In this context, attention should be paid to the specific training requirements of developing countries in general and individual clients in particular. The ultimate proof of successful absorption of imported technology was passage from mere use to the full integration of that technology within the productive process.

79. Participants from the least developed countries described their experience in the utilization of electronics techniques and products. It had, on the whole, been very discouraging, in as much as such basic services and amenities as radio, television and telephones, all incorporating advanced electronics, were more often in a state of disruption than in operation. The unavailability of skilled technicians locally and total technological dependence on external suppliers were among the prime reasons cited. Since scarce resources were often allocated to purchasing the necessary equipment, their unsatisfactory performance placed serious constraints on the economic advancement of this group of countries.

80. A participant stated that, in order to promote the role of electronic technology in the economies of developing countries, it was advisable to reconsider and reformulate existing regulations governing the transfer of electronic technology and informatics as a whole, in the light of the results of negotiations of the top representatives of the leading countries in this field.

Annex I

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United Nations Secretariat

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United Nations Conference on Trade and Development

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United Nations Environment Programme

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Specialized agencies and other organizations
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International Labour Organisation

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International Telecommunications Union

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International Trade Centre (UNCTAD/GATT)

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United Nations Educational, Scientific and Cultural Organization

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Other intergovernmental organizations

Arab Industrial Development Organization

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Commonwealth Secretariat

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Latin American Economic System

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Non-governmental organizations

International Co-operative Alliance

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International Council of Women

Catherine Galea, National Council of Women of Malta, Il Bejta, Antonio Bosio St., Lija, Malta

International Institute for Applied Systems Analysis

Robert Pry, Director, Laxenburg, Austria

Annex II

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| Telecommunication development in Africa | ID/WG.491/6(SPEC.) |
| Software industry. Development approach.
Background paper prepared for the
Global Preparatory Meeting for the First
Consultation on the Electronics Industry,
Grenoble, France, 28 November to 2 December 1988 | ID/WG.478/1(SPEC.) |
| Global study on world electronics.
Background paper prepared for the
Global Preparatory Meeting for the First
Consultation on the Electronics Industry,
Grenoble, France, 28 November to 2 December 1988 | ID/WG.478/2(SPEC.) |

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