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UNIDO/IEEE Expert Group Meeting on the Manufacture of Electronic Components in Developing Countries

San Francisco, California, USA
23 - 24 August 1971

[redacted] V

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ACKNOWLEDGMENT

Thanks are expressed here to the UNIDO Manufacturing Technology Group for their co-operation in the preparation of the meeting and their generous hospitality offered to the conference and the participants. Special thanks are due to George E. Khol for his unflagging enthusiasm in the face of many adversities which had to be overcome in the course of preparation and for his hard work expended in making contacts with U.S. manufacturers on behalf of UNIDO staff. Also, Peter Goebel and Ed Hess should be thanked for the very able chairmanships they provided for two of the sessions.

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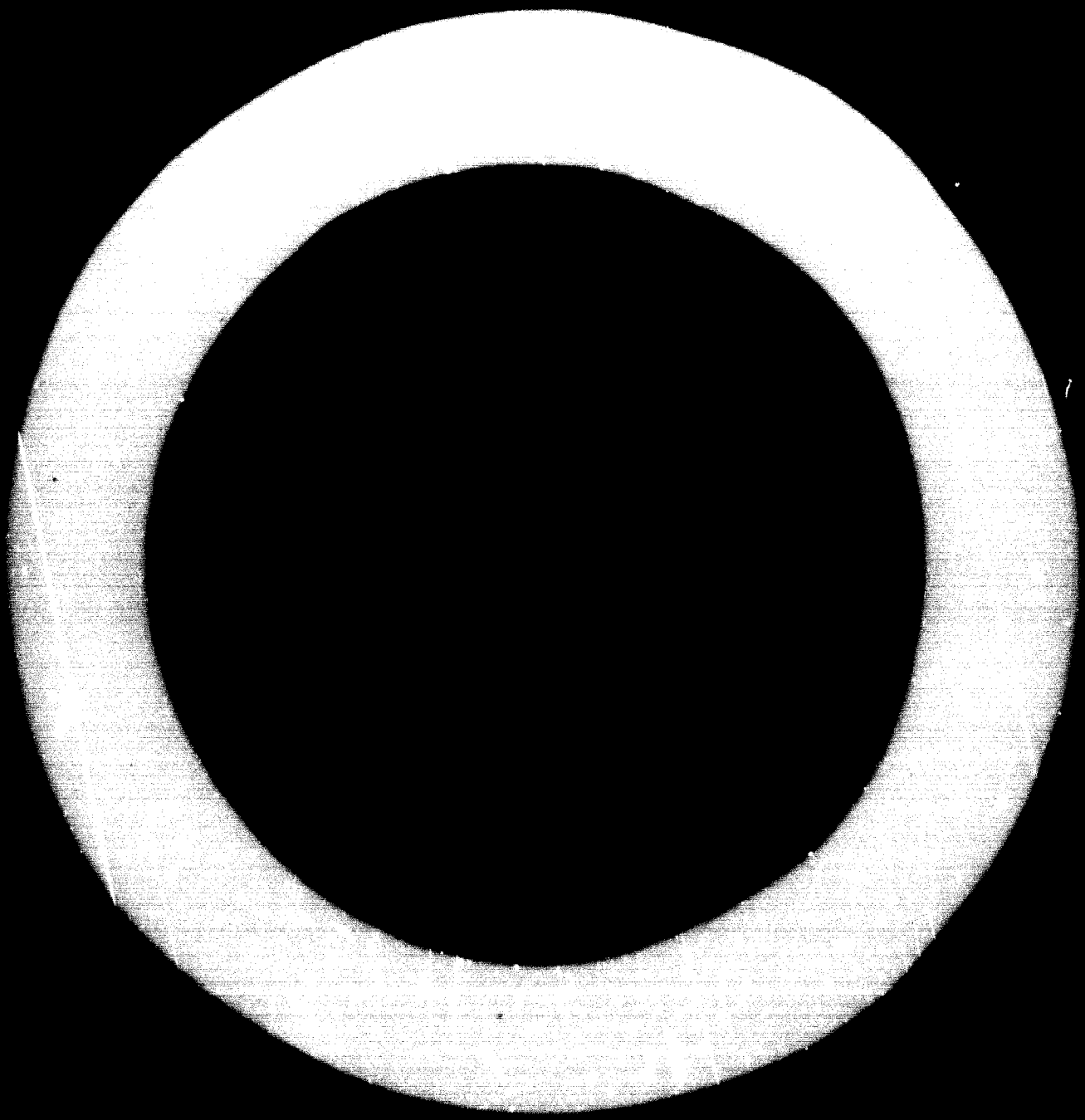


SUMMARY AND RECOMMENDATIONS

Summary

The present document gives the background which leads to the decision to call the meeting and summarizes the present papers in its descriptive part. There are separate summaries on UNIDO and IEEE sponsored papers apart from brief comments on each individual document.

The main body of the report is devoted to the problems which seemed to dominate the discussions. The problem of misleading export successes is discussed first. It is followed by arguments questioning the wisdom of indiscriminating acceptance of the hypothesis that electronic components are a suitable product to be made in the developing countries. The discussion pointed out that successful indigenous electronic industry based on imported components can be established. In the last part, the choice of technology is critically analysed pointing out that where components are to be made in a developing country, the choice of technology must be realistically related to the environment. There is a section listing the incentives technology 'donors' are seeking in the developing countries. Comments on individual items are also offered.

Recommendations

1. General:

(i) UNIDO should encourage governments of the developing countries to carry out feasibility studies designed to determine optimum approach to the establishment of electronic industries in their respective countries bearing in mind that:

(a) The establishment of an indigenous component sector is not an essential pre-condition for success of electronic industry in a developing country; equipment locally made from duty-free components is likely to be cheaper than equipment made from components manufactured in the country and may therefore lead to faster growth of the market and the industry, particularly the communications and professional equipment sectors. These sectors have a special significance for the development of the national economies of the developing countries;

(b) Where the component sector appears advantageous for the developing country's economy, investment in the manufacture of descrete components can be confidently made. The market is expected to retain its upward trend inspite of the development of integrated circuits;

(c) Bilateral agreements with other developing countries on manufacture of complementary ranges of discrete components should be sought to secure most economic volume of production;

(d) Local manufacture of high technology devices cannot be recommended. High investments involved, explosive nature of the state of the technology and low production volumes constitute disproportionate risk for the national economies of the developing countries;

(e) Hosting of off-shore operations of multi-national companies can be immediately beneficial to the national economy of the country and can make a significant long-term contribution to the technology transfer.

(ii) UNIDO should assist, upon request, in establishment of semiconductor technology monitoring services in the developing countries in order to facilitate training of local engineers in efficient use of components. Since world manufacturers of components might be interested in co-sponsoring such facilities UNIDO should make suitable approaches.

(iii) UNIDO should, upon request, assist governments of the developing countries in planning and co-ordinating of their R + D programmes with a view to identifying items suitable for commercialization.

(iv) UNIDO should assist in transfer of technology to the developing countries by:

(a) Compiling mailing lists of 'donor' companies:

- possessing suitable technology;
- likely to be commercially interested in developing countries;

(b) Compiling lists of obsolescent plants likely to be for sale cheaply;

(c) Publicising through the UNIDO Newsletter events concerning markets and the state of electronic industries in the developing countries. Particularly market and industry evaluations prepared by UNIDO experts should be publicised;

(d) Setting up a data bank as a part of the Industrial Promotion Service to hold relevant information on potential technology 'donors' and recipients in order to promote specific industrial projects;

(e) Providing upon request advice on licence agreements both with respect to suitability of the purchased technology for the purchaser and for the national economy of his country. Also advice on commercial terms should be available;

(f) Assisting upon request joint ventures negotiations.

(v) UNIDO should organize training in production techniques and management, in application engineering and in general business management for engineers, technicians and other personnel from the developing countries.

The following are points on which UNIDO assistance is recommended to the individual countries:

2. India

(i) Upon request to assist in a review programme of R + D establishments in order to:

(a) Identify items suitable for commercialization;

(b) For every identified item to define programme of work ensuring transfer of R + D know-how into a marketable product;

(c) Point out cases where R + D should be attached to factories;

(ii) To review policies and import practices concerning high quality components and raw materials with a view to:

(a) Stimulating production of professional equipment;

(b) Creating additional employment for qualified personnel;

(c) Identifying items whose manufacture in India would be of particular technological and economic importance.

3. Korea

Upon request to review programmes of R + D establishments in order to:

(a) Identify items suitable for commercialization;

(b) For every identified item to define programme of work ensuring transfer of know-how into a marketable product;

(c) Upon request, to examine exports of electronic goods in terms of value added and to recommend measures likely to improve the benefits to the national economy.

4. Malaysia

Upon request to carry out feasibility study in order to determine:

(a) Size and probable growth of the market for electronic equipment and components;

(b) Available human resources in the country in terms of requirements of an equipment oriented industry and a component oriented industry;

(c) Costs of local manufacture of components and the likel effects of their use on the growth of the industry;

(d) Types of components, manufacture of which should be promoted in the country;

(e) Effects of free imports of components (except those identified under Point (d)) on the development of the professional sector of the industry.

5. Romania

To secure facilities in the leading world corporations for Romanian engineers and technicians in order to receive training in

(a) Production techniques and management;

(b) Application engineering;

(c) General business management.

6. Singapore

As for Romania

7. Turkey

To carry out a feasibility study in order to determine:

(a) Size and probable growth of the market for electronic equipment and components with particular emphasis on the feasibility of manufacture of professional equipment on a commercial scale.

(b)

(c)

(d) as per Malaysia

(e)

1. INTRODUCTION

The meeting was convened to facilitate exchange of experience between the representatives from the developing countries and to provide a platform for their meeting with senior executives of some of the largest U.S. component producers. Such a meeting is of considerable value to all concerned since rapid technological change and problems of scale make the component sector somewhat hazardous for the developing countries and since the growing markets for components in the developing countries are increasingly of interest to manufacturers.

Accordingly the meeting was attended by delegations from six Asian and one European country all of whom recently established electronic industries and are rapidly expanding their activities. All delegates presented papers describing the state of the development of their respective industries and the problems encountered when venturing into manufacture of components and connected with planning of such ventures.

U.S. manufacturers were represented by delegates drawn from companies engaged in manufacture of discrete components, semiconductor devices, electronic equipment and by a delegate from a large firm of engineering consultants. Between them they contributed seven papers. Further U.S. manufacturers were

[illegible] representing the members of the ICSU Committee on Science and Technology in Developing Countries and the Heads of the Secretariat.

Observers representing other U.N. bodies and representatives of the press brought the attendance to about thirty persons inclusive of UNIDO staff. List of participants and the presented papers will be found in the Appendix.

This report gives a brief review of the papers and the comments on points which emerged out of the discussion. It concludes recommending UNIDO action on selected points.

2. REVIEW OF PAPERS

The choice of nations contributing papers was conspicuous by the width of industrial practices of the invited nations ranging from a centrally planned economy in Rumania to practically free port facilities in Singapore. Within these extremes, similarities of approach could be detected in the case of Rumania and India and equally in the case of Taiwan and Korea. Similarity also was found between situations in Turkey and Malaysia both standing on the threshold of their respective electronic eras. The following summarises the impressions gained from the papers of the electronic industries in the respective countries.

Characteristics of the Indian situation are the large potential domestic market and a planned approach to the electronic industry over the past twenty years. There is also a good balance between private and state enterpreneurship both being complementary to each other within a well protected national economy. Comparatively deep penetration of technology seems to be the main benefit of this planned approach. However, it seems to have produced relative isolation of the Indian electronic industry.

The situation of Rumanian state owned electronic industry seems somewhat similar to the Indian situation: planned progress within closely defined overall economic plan. Careful experimentation in the component field with ventures jointly owned with foreign investors seems to be a characteristic feature of the present situation.

similarity of the Korean and Taiwan situations appears to be very close. Electronic industries in both countries have recently been built in a short space of time through expatriate operations. There is no state ownership of industry in either of these countries though state agencies are actively promoting industry's expansion. In both countries expatriate and national industries operate in parallel but isolated from each other. The isolation appears more pronounced in Taiwan where the home market is perhaps more protected on account of its size than the home market of Korea. Taiwan industry seems to lean towards equipment technology while Koreans are showing greater interest in components with a greater involvement in research.

Singapore who lacks a home market of any appreciable size has mounted a vigorous campaign to attract expatriate operations of foreign electronic companies only three years ago offering virtually unlimited freedom of operations the campaign is meeting with remarkable success particularly as a base for assembly operations of semiconductor devices.

Turkey and Malaysia appear to be countries in search of a suitable policy towards their future electronic industries. Both countries have only token industries so far. On the

two countries [illegible] seems better poised for an early entry, however, Turkey seems better placed on account of its larger home market.

All papers give a full account of the historical background leading to the formulation of policies on which the respective national electronic industries are based. Also ample information is being offered on the present day achievements in terms of equipment and component output and in terms of imported volumes. Those figures would have been more useful if accompanied by corresponding volumes of imports of parts and raw materials, by value added information and by some management data. Furthermore, the quoted figures do not seem to differentiate between outputs attributable to the expatriate plants and to the plants which can be regarded as national plants. This shortfall is regrettable since comparison of real performance of indigenous companies in various countries would have been very informative and indeed stimulating for the participants. This, perhaps, might be remedied at future occasions. Information on productivity, comparison with world prices of products made by national industries, information on value added to exported items and on minimum economic volumes of production is useful. Remarks as to production and marketing problems experienced by the national manufacturers would equally add to the value of the delivered papers.

The IEEE contributions gave a well balanced account of the practical problems which have to be overcome when a component plant is being established. All papers were written with obvious understanding of the purpose of the meeting and have shown the breadth of the problem as well as giving useful information on essential points of practical importance. Theorising on plant requirements together with presentation of relevant budgetary figures is seen as a particularly useful way of imparting the feel of the problem. Between them the papers gave information on market and plant planning, pointed out practical means of technology transfer and its evaluation and discussed plant and R & D management problems. All in a concise and up to the point way.

The paper on Quality Control by W.C. Cooper deals with all important factors of effective control systems showing their functions and how they interact. The pictures of relevant test equipment form a very useful part of references and examples which are liberally given in the paper.

N.W. Ritter's paper on Plant Requirements is a comprehensive list of items which have to be attended to where a new plant is being set up. The paper not only enumerates the items but it also discusses the quality level at which the various requirements have to be met.

R.C. Foster enumerates in his paper all technologies falling in the category of Microelectronic Components. Current trends in all discussed technologies are pointed out as well as test equipment and personnel requirements.

Problems of setting up Integrated Circuit Facility are discussed by B. McDonald in his paper. The paper discusses step by step the IC manufacturing process describing the plant and equipment required at every stage. Budgetary prices of equipment for every stage form a very useful part of the offered information.

Commercial planning which should precede setting up a component plant is summarized in the paper on Technological Forecasting by K.G. Rudenberg. The paper describes available methods of forecasting of demand and leads on to methods of evaluation of collected data and their analysis.

Pictorial account of Manufacture of Hybrid Microcircuits is given by P. Schwartz in his paper. Apart from pictures, the paper contains explanatory notes on various stages of manufacture.

D.G. Wilson discusses problems of R + D in Electronic Components in his paper. Methods of organisation and financing are described with particular reference to small enterprises. Also relative merits of own R + D and buying of know-how are mentioned before concluding with a paragraph on planning of R + D activities.

3. ARE THE PRIORITIES RIGHT?

Use of statistical information on output and export performance as a measure of progress of electronic industries in the developing countries is meaningful only as long as it is not used divorced from other management information. In isolation statistical information can be very misleading. The UNIDO papers consistently failed to give any interpretative information alongside the statistics. It was observed in the past that other sources of information on performance of electronic industries in the developing countries fail likewise. Question, therefore, arises to what extent the developing countries are aware of the danger of having wrong investment priorities as a result of judging the performance of their electronic industries on insufficient evidence and to what extent they are likely to be misdirecting their resources. The following example should illustrate the point.

One of the UNIDO papers gave the following output figures and their breakdown into home consumption and exports to state the 1970 performance of the industry. (In U.S. $ million).

	Production	Home Consumption	Exports
Components manufactured	53	7	46
Equipment manufactured	51	42	9
			55

On the strength of this information the component business looks the more important sector of the country's electronic industry.

A closer study of the above table will reveal that in order to product $51 million of equipment, home consumption of components must have been some $23 million (about 45% of value of equipment made in developing countries is attributable to components). Therefore, allowing for $7 million of components shown in the table, $16 million worth of components must have been imported. Furthermore, value added to components manufactured in developing countries is known to vary between some 30% and 50%. Taking it for ease at 40%, we can then assume that $31 million worth of parts and raw materials must have been imported. The changed table below now shows that it is the equipment sector which is, in fact, the true export earner.

	Import	Production	Home Consumption	Export
Component parts and raw materials	31			
Components manufactured		53	7	46
Components imported	16			
Equipment manufactured		51	42	9
	47			55

Export of components is completely wiped out by imports of components and their parts. In fact, components make £1 million less.

It is interesting to speculate now at the possibility of eliminating production of components altogether and relying on the world markets for their supplies. We shall see then that for £47 million of imported components the country could produce £105 million worth of equipment thus achieving a total exportable value of £63 million and not export surplus of £16 million. The table below shows the situation.

	Import	Production	Home Consumption	Export
Components imported	47			
Equipment manufactured		105	42	63
	47			63

4. IS COMPONENT SECTOR ESSENTIAL?

The example in the previous section shows that summary figures can mask the real state of affairs preventing those concerned seeing better opportunities. They also may mislead those as yet uncommitted who are seeking guidance on their future electronic policies in examples of others. The lesson to be learned from the example is that while frequently the component sector forms an important part of the electronic industry in a developing country, it is by no means always an essential component of the development process. There are alternative ways.

Analysing the various ways electronic industry has developed in different countries, it is possible to identify three distinct patterns. In terms of the UNIDO papers presented at the meeting there is the Indian/Rumanian way, the Taiwan/Korean way and a third way approached to some degree by Singapore. Malaysia and Turkey might do well to study these developments.

The Indian/Rumanian approach is generally along the lines that the electronic industry has developed in the smaller countries of Western Europe. Partly or fully foreign owned plants started up to serve the consumer sector gradually acquire greater national character and as they grow they sponsor

the component sector to serve their own needs. Professional equipment sector develops in parallel largely due to government involvement who acts as a customer as well as an enterpreneur where either commercial risks are high or where long term technological advantages are at stake. The industry is adequately protected by tariffs and not unduly harassed to overreach itself with respect to exports. The progress is relatively slow but the rate allows the industry to divert time and money into building its own technological base starting with the component technology and moving towards equipment and system technologies in time.

Characteristics of this approach are the relatively long time needed to reach maturity, need for a well defined policy at the government level and readiness of the government to invest in the industry both by preferential buying and by equity involvement. Also home market of an adequate size must be available. The expected result is a well balanced industry strong enough to become nationally and internationally significant exporter.

The Taiwan/Korean way is characterised by rapid but relatively unco-ordinated growth occasioned by foreign investment laid down to cater for international interests of world corporations.

The industry is "export oriented" right from the beginning, the movement of goods in and out of a particular country being frequently confused with the traditional meaning of the export function. The component sector becomes a significant and even dominant part of the country's industry because of the internationalised nature of the component business. Little government control is exercised over the growth and there is no direct involvement by the government in the industry. Due to the preoccupation with exports and because of the lack of direct government involvement in the industry, penetration of technology remains relatively shallow. Consequently development of the professional equipment sector is lagging.

Galaxy of small manufacturing units indirectly spawned by the expatriate operations is too fragmented to give rise easily rise to a national technology base and the expatriate companies lack stimulus in that direction. The industries, therefore, are likely to remain dependent on outside technology longer than their rates of growth might suggest. The expatriate and the national industries remain separated by tariff barrier. The third approach is based on free access of components from the world markets in order to stimulate rapid development of the national equipment sector through availability of cheap components. The idea is to generate rapidly high turnover so as to create means which could be diverted towards an indigenous design and development base. Free access

to the local market by expatriate component manufacturers operating in the country could be part of this policy. Clearly defined development plans at the government level is required as in the first case and direct government involvement with the professional equipment sector may also be needed. Also international marketing may have to be state sponsored or aided. This approach should suit countries with a relatively plentiful manpower.

The main criticism of this approach is the fear of vulnerability. Let it be said, therefore, that reliance on component imports is no different to the reliance equipment manufacturing would ever place on their component suppliers - an essential partnership today if competitive equipment prices are to be achieved.

It would seem, therefore, that unless there is an over riding reason, the developing countries finding themselves on the point of defining policies towards their future electronic industry should ask themselves whether or not component industry should be included in their plans. The points listed below may help to clarify the issue.

(i) Components made in the country are likely to be more expensive and less reliable than components available from the world markets.

(ii) Between 30% and 50% of the final value of equipment is due to components. Expensive components, therefore, affect prices of equipment appreciably.

(iii) Cheap equipment will create greater demand and thus more employment.

(iv) Manufacture of consumer and some telecommunication equipment is more labour intensive and less capital demanding than manufacture of components.

(v) Free availability of imported cheap components will stimulate development of indigenous capital equipment base.

(vi) Equipment technology is more brain intensive and less capital demanding than components technology.

(vii) Local manufacture of capital equipment, particularly telecommunication equipment will stimulate economic growth of the country more directly than any other activity of the country's electronic industry.

(viii) Import substitutions and exports of equipment can usually be made to pay for imports of components without undue difficulties.

The table presented below and compiled from U.S. manufacturers data might also be of interest in this connection.

	Minimum Economic Annual Output (U.S.$ million)	Minimum Capital (U.S.$000)	Sales to Capital Ratio	Labour Intensiveness
Radio receivers (assembly)	0.3	50	7	Very high
Discrete components (manufacture)	0.5	250	2	High
TV receivers, colour (assembly)	2.0	400	5	High
Semiconductor devices (manufacture)	2.5	1.600	1.5	Low

It is accepted that much smaller units than those given in the above table exist in the developing countries. The above figures are minima ensuring world prices of products. Prices of products made in the developing countries are always higher.

2. CHOICE OF TECHNOLOGY

Pre-occupation with semiconductor technology, particularly with integrated circuits runs through all papers of the invited countries. Quite understandably it also was dominating the deliberations of the meeting. It seems worthwhile to examine how high technology devices are likely to affect component and equipment business of the developing countries over the next five to ten years and to see if any conclusions can be reached.

To start with the component business let it be said that integrated circuits as independently manufactured and marketed do not appear to be a suitable product for the developing countries. Justifications for the statement are not difficult to find.

The high level of investment, higher than in any other sector of the electronic industry, is the first deterrent. Coupled with the high investment is the low usage of labour as compared with discrete components and particularly with production of equipment. All semiconductor plants are high risk ventures because of the explosive nature of the semiconductor technology and the subsequent difficulty of balancing costs of plant obsolescence against expected market pressures in calculations of product prices. Only huge quantities of identical devices justify setting up a production line and only massive number of catalogue items can finance the enormous marketing costs which even large world corporations can seldom afford. It is

worth noting that in England, G.E.C. with a turnover of around US$600 million in electronics is currently closing down their I.C. business for lack of profitability.

Of course it can be argued that I.C's must be available to the local equipment manufacturers if their products are to reach technical maturity and if they are to become potential export articles. On this ground alone, it can be argued, it should be possible to justify local production.

Those arguing this point are, of course, overlooking two vital points. Firstly, it should be realized that integrated circuits are not going to have all that great an impact on equipment likely to be manufactured in the developing countries over the next five to eight years. Furthermore, since electronic industry in the developing countries needs to be protected by tariffs in any case, the effects of changes in the design practices outside a developing country can be comfortably cushioned off. As for the export prospects of "old fashioned" equipment, let it be said that most exporting of electronic equipment from developing countries had so far been done on the basis of bilateral agreements and that this practice is likely to continue. In international trading of this kind, capability of the product to give satisfactory service and its low price are the only factors which count.

The second point in the present argument is, of course, the inescapable effect of quantities. High technology components made for local consumption could be only made in such

quantities so as to be disproportionately expensive as would, as such, appreciably affect prices of equipment using them.

In these circumstances, therefore, high technology components can be realistically used only in professional equipment. The small quantities so required should then be imported - duty free.

Seen in this light the problem of catching up seems then to be reduced to the problem of bringing into a developing country semiconductor expertise at a level sufficient to enable local engineers to use semiconductor devices effectively in their designs and to be able to shop around in the world markets as successfully as their counterparts in advanced countries. No production knowledge of semiconductor devices is necessary for this purpose.

The situation could probably be best met through establishing in a country an applied research unit attached to some government funded research institute and charged with the task of keeping abreast with the semiconductor technology developments and with training of local engineers in the use of devices. If suitably constituted it might even be possible to obtain co-sponsorship or some other form of support from the leading world manufacturers who should be able to see opening of new markets for their devices at the end of the line.

The foregoing discussion relates to integrated business operations in the high technology areas. It leaves open sub-contracted assembly work of complex devices and even integrated manufacture and marketing of simple devices with relatively arrested technologies such as germanium transistors, rectifiers and diodes. Handling of these could probably be profitably undertaken by the developing countries wishing to venture in the semiconductor field. Market research and careful feasability study should precede any investment however. Import substitution rather than hopes for export should form the basis for the planned venture unless, of course, firm and long term export arrangements are in hand.

Growth of discrete components business is postulated in the preceeding paragraphs and more explicitly treated in the companion document on the "Attitudes of U.S. and European Companies towards Ventures in Developing Countries".

b. VALUE OF INCENTIVES

The value of joint ventures and expatriate plants to the receiving country were discussed in the previous section. In order to attract technology donors certain facilities must be offered by the developing countries. It was not possible to take a census of opinion on the importance of facilities the 'donors' are looking for when considering the pros and cons of setting up a plant in a developing country. A large number of factors come into a consideration and their relative importance seems to very with individual companies and with changing circumstances. Below the reader will find a list of those mentioned by the contacts during the interviews. The order of listing does not necessarily signify their relative importance.

(i) **Ease of Trade**

For a company interested in an expatriate operation this means availability of bonded facilities. When a joint venture is being considered the size of the local market and the rate of its growth together with the prospects for tariff protection will probably receive maximum attention under this heading. The government's record of interference or non-interference with trade will also be carefully looked at in both cases.

(ii) **Security of Investment**

Fears of nationalization of foreign assets play an important part. The risk equation consists of balancing the estimated political stability of a country against the probability of recovering the investment before any foreseeable instability may occur.

(iii) **Low Production Costs**

Low wages alone are no longer a decisive factor. Cost of services ease of access of materials and personnel, ease of communications, cost of money, availability of raw materials and of supporting industries, competence of civil services, debt collection practices, are only some of the factors which affect production costs.

(iv) Single Contact Facilities

A number of developing countries have streamlined their administrative procedures with regard to establishment of foreign enterprises in their countries. [illegible] will deal with the potential 'donors' [illegible]

[illegible] over the [illegible] 'donor' willing to deal [illegible].

(v) [illegible]

Availability of industrial estates with laid on public services, communications and all administrative facilities is expected to by most potential 'donors'. Some of them prefer to 'try it' on an estate before committing themselves deeper by building a factory.

(vi) **Fiscal Incentives**

Tax allowances are expected as a matter a fact but become frequently illusory because during considerable part of the tax free period the new plant is unlikely to show taxable profit. Governments could therefore gain relative advantages by a new and imaginative approach on this point.

(vii) **Local Capital and Credit**

High cost of money and scarcity of local capital were the most frequently mentioned difficulty when joint ventures were discussed during the interviews.

(viii) **Ease of Access**

Efficient and sufficient ports (air and/or sea), and flexible procedures are an important asset. Simple immigration regulations must make the ease of movement of people.

(ix) **Minimum Red Tape**

Red Tape in the developing countries is universally feared. A country with efficient administrative proceduresWill always enjoy preference.

(x) **Supporting Industries**

Services of supporting industries would be welcome by expatriates and non-expatriates alike. In the countries where they exist unreliability of quality and deliveries make frequently reliance on these services impractical. Initiative on the part of governments of the developing countries to secure co-operation of the 'donor' already involved in a particular country would not go unheeded.

APPENDIX A

List of Participants and Papers

A.1. UNIDO Sponsored

India

STATUS OF THE INDIAN ELECTRONIC COMPONENT INDUSTRY

by U. VENKATESWARLU
Technical Manager
Electronics Corporation of India Ltd.
Industrial Development Area Cherlapalli
Hyderabad-40

Korea

ELECTRONIC COMPONENTS INDUSTRY IN KOREA

by SEI JIL KIM
Technical Director
Tae Taihan Electric Wire Co. Ltd.
2001 Ka Choongmu Ro,
Chung-Gu,
Seoul.

Malaysia

ELECTRONIC COMPONENTS INDUSTRY IN MALAYSIA

by YEE MENG FOH
Director
Federal Industrial Development Authority
Kuala Lumpur.

Romania

ELECTRONIC COMPONENTS INDUSTRY IN ROMANIA

by ION CONSTANTIN
Chief of Laboratory
L'Entreprise des Composants Electroniques
Ipris-Baneasa
Bucharest.

Singapore

STATUS OF THE ELECTRONIC COMPONENTS INDUSTRY IN SINGAPORE

by CHRISTOPHER LIA
Director of U.S. Operations
Singapore Economic Development Board
44 Montgomery Street
San Francisco, Calif. 94104

Taiwan

ELECTRONIC COMPONENTS INDUSTRY IN TAIWAN

by TSAO YAN YUNG
Manager
Leco Electronics Ltd.
65 Nanking East Rd., Section 3
Taipei

Turkey

THE STATE OF THE ELECTRONIC INDUSTRIES IN TURKEY

by DR. TUGAY ZAMEN
Assistant Director
Electronic Research Unit
Marmara Scientific and Industrial Research Institute
Bayindir Sokak 33
Ankara

A.2. **IEEE Sponsored**

TOTAL QUALITY CONTROL - THE KEY TO EQUIPMENT RELIABILITY

by WILLIAM G COOPER
General Radio Company
Concord, Mass.

PLANT FACILITIES AND FABRICATION TECHNIQUES FOR PASSIVE COMPONENTS

by N. DAVID MEYER
P.R.Mallory & Co., Inc.
Indianapolis, Indiana.

TRENDS IN MICROELECTRONICS COMPONENTS

by [illegible] C. [illegible]STEN
Xerox Corp.,
Rochester, New York.

SETTING UP AN INTEGRATED CIRCUIT FACILITY

by BRUCE McDONALD
International Data Systems
Acton, Mass.

TECHNIQUES OF TECHNOLOGICAL FORECASTING IN ELECTRONIC COMPONENT FIELD

by H. GUNTHER RUDAMELRG
Arthur D. Little
Cambridge, Mass

WORLD MICROCIRCUIT MANUFACTURING

by PAUL SCHWARTZ
General Instrument Corp.
Hicksville, New York.

R & D IN THE DESIGN AND PRODUCTION OF ELECTRONIC COMPONENTS

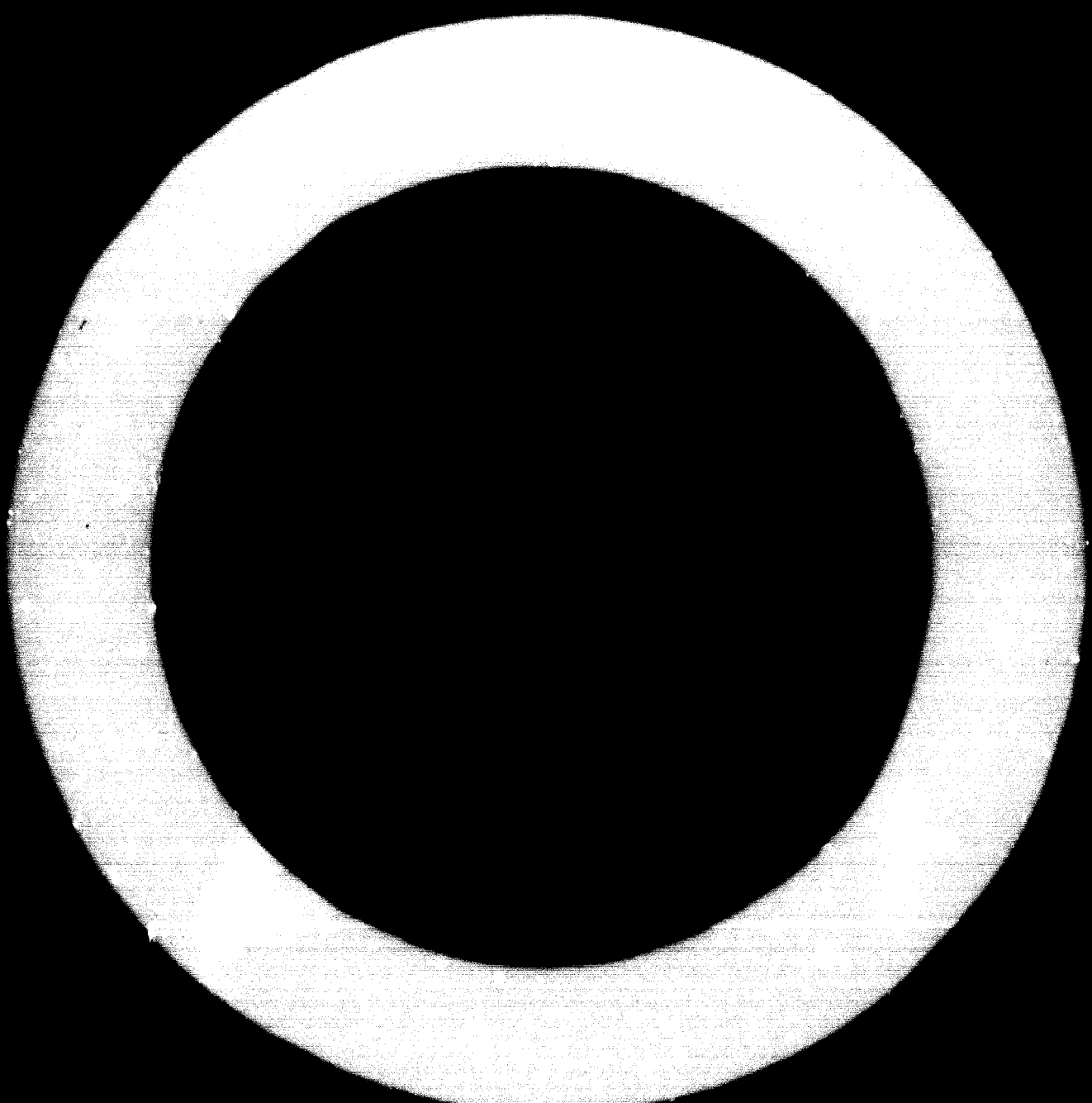
by DONALD R. WILSON
P.R. Mallory & Co. Inc.
Indianapolis, Indiana

A.I. UNIDO SECRETARIAT

N. BERNOVICK, Senior Industrial Development Officer, New York, USA.

S. APANASIEV, Industrial Development Officer, Vienna, Austria.

S. SKOURAS, Industrial Consultant, Colchester, England.



APPENDIX B

The meeting was followed by two days of visits to plants in the San Francisco area. The plants visited on August 25 were AERTECH INDUSTRIES at Sunnyvale, and AMERICAN MICROSYSTEMS INC. at Santa Clara. FAIRCHILD at Mountainview was visited on 26 August. The last day was devoted to attendance of WESCON Sessions 18 and 25, on Automation of Manufacture and on Hybrid Manufacturing.

All three visits followed similar pattern. On arrival the delegates were welcomed by the staff of the host company and were given a broad description of the manufacturing process to be shown. Explanations to the underlaying technologies were also given. The two morning visits were followed by luncheons served by the hosts. The delegates as well as all the attending UNIDO staff were guests at the WESCON Lunch on 23 August at the IEEE invitation.

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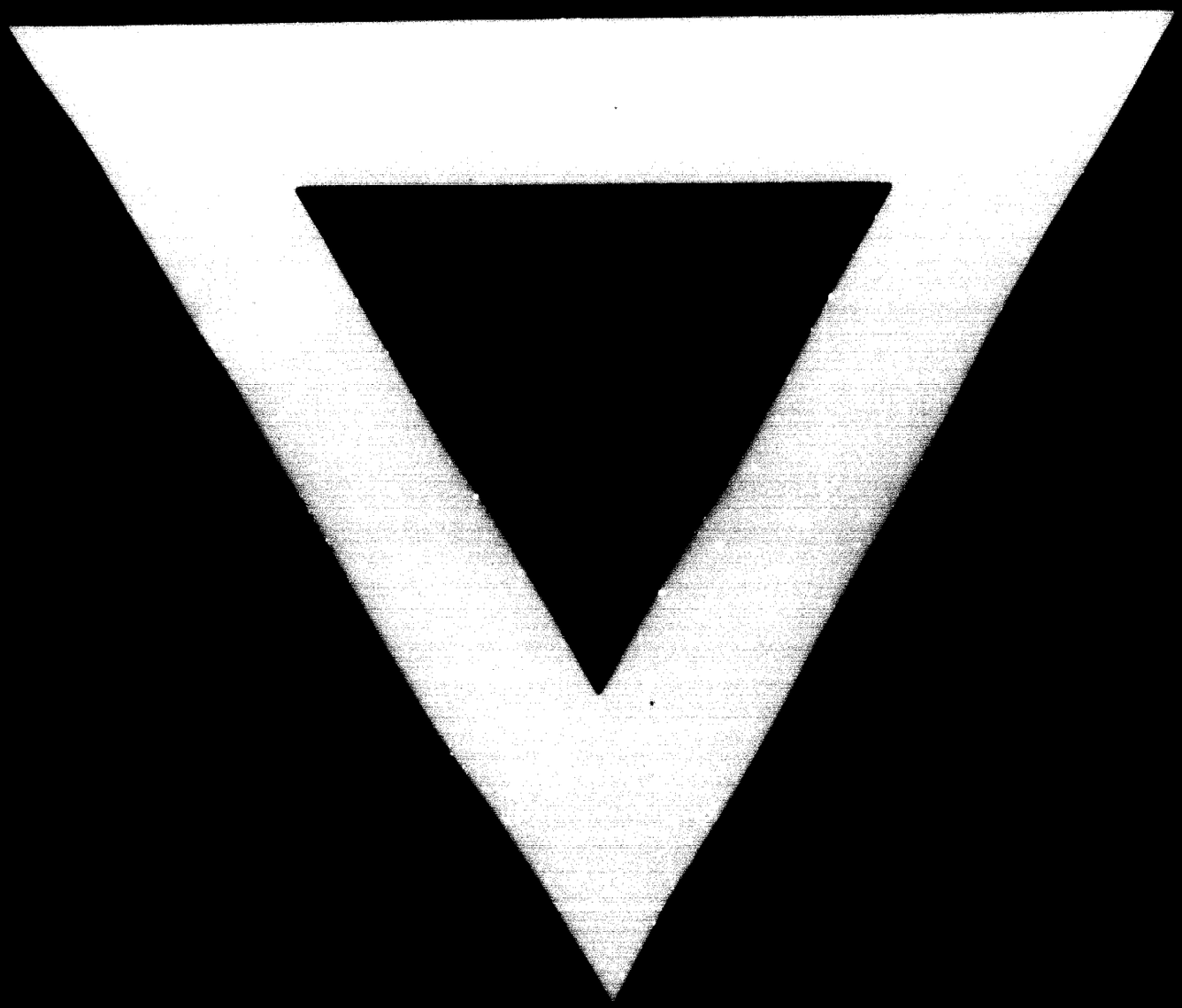

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