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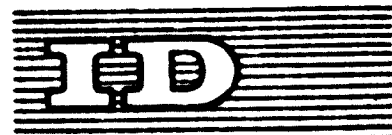
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Manufacture of Electronic Components in  
Developing Countries**

**San Francisco, California  
United States of America  
23 to 24 August 1971**

**SECTORIAL STUDY ON THE ELECTRONIC  
COMPONENTS INDUSTRY <sup>1/</sup>**

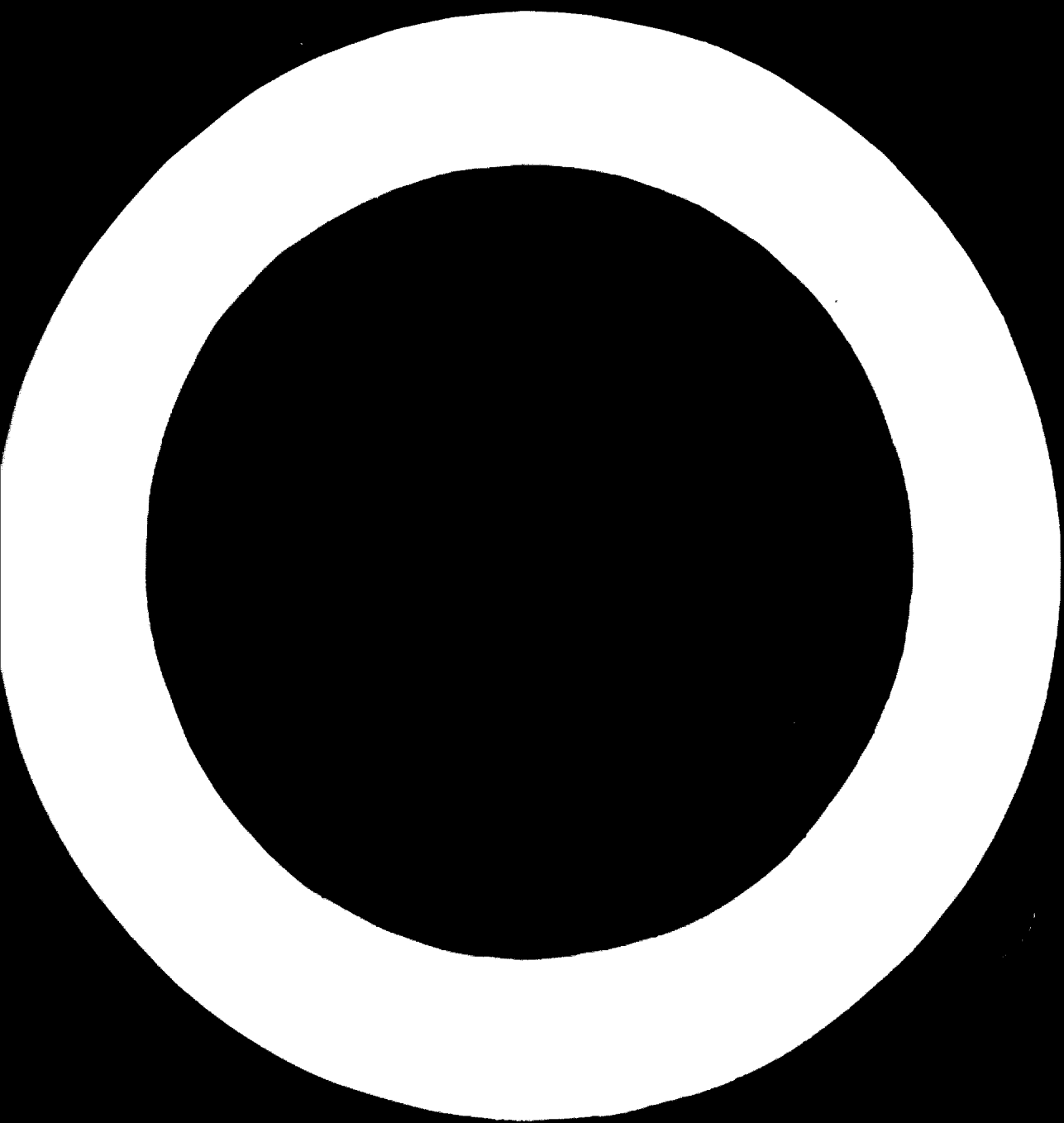
by

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## SUMMARY

The present paper attempts to analyse the various steps which need to be taken by the governments of the developing countries if they wish to launch electronic component industries.

In order to set off the discussion, the paper starts with a description of the industry's structure. Noting that the characteristics of companies depend on the types of markets from which they derive the bulk of their business, the structure of the industry is described in terms of four distinct component markets.

The domestic market is identified as the most influential factor on the basis of which the main strength of the industry can be built. The domestic market is seen as an environment likely to give rise to relatively large and self-contained companies which form the backbone of a national component industry.

The role of expatriate off-shore operations of large electronic world corporations played in the development of national component industries in the developing countries is examined next. This market can be considered a convenient regulator which the governments of the developing countries can use to boost the size of the domestic market in order to build up the size of the industry above the viability threshold. The different type of company this market attracts is noted. Finally it is observed that exports, apart from sales to the expatriate plants, are unlikely to materialise until the companies based on the domestic market reach commercial and technical maturity which allows them to survive the intensely competitive environment of international markets.

In reviewing the markets, the paper takes note of the sizes of component markets in the leading countries of the world and presents a brief quantitative analysis of the component market composition. A short discussion of five

groups of components from the point of view of their suitability for production in the developing countries is followed by outlines of approaches to estimates of sizes of the domestic, the expatriate and the export markets.

The review of markets is followed by a discussion of the main problems component industries of the developing countries have to face. Corrective measures are recommended where appropriate. Reasons for high prices and inefficient production are identified first to be followed by critical evaluation of business and production management practices. Lack of marketing drive is noted as well as the inherent problems of marketing of replacement components to technically immature users. Finally the possible impact of component world over production and the likely effects of semiconductor technology on the component business of the developing countries are considered.

The role the governments should play in establishment of electronic component industries in their respective countries is discussed in the concluding section. Apart from deciding that the presence of the electronic component industry in the country would be beneficial to its national economy, the governments role is seen in setting up measures to promote industry's size and quality. Suitable measures are classified under several headings and described.

The paper ends by recommending five steps of a promotion programme.

1. INTRODUCTION

This paper intends to discuss the problems of young electronic component industries which recently became established in some developing countries. It may offer encouragement to other countries to follow what is now beginning to emerge as an established pattern. When writing the paper it was found impossible to confine the considerations to the component sector alone. Much of what is said in the paper applies to the whole of the electronic industry in the developing countries in general, because many of the problems and difficulties encountered by the emerging component industries on their way towards the status of established industries are rather an outcome of the level of economic development in these countries than being particularly specific to the component industry.

## 2. STRUCTURE OF THE INDUSTRY

In the developing countries the electronic industry and its component sector depend on four identifiable markets. Taken in the order of importance they are the domestic market, the expatriate market, sub-contracts from foreign electronic companies and the export market. Each of these markets has its peculiarities which in turn affect the quality of the firms depending on it for their business.

To promote a well structured electronic industry in a country means to encourage the right number of companies to operate in each of the markets. Therefore, in order to analyse the structure of the component industries in the developing countries we shall discuss the relationship between the four types of markets and the types of companies making use of them. Later we shall discuss the qualitative and quantitative aspects of these markets which also must be well appreciated before sound promotion plans can be laid down.

### 2.1. Domestic Market

There is a tendency today among the developing countries to under estimate the importance of the domestic market. So much is being said and written about the export potential of electronic and component industries that the fact that no industry can become a reliable export earner without a strong commercial and technical base at home tends to be overlooked. It will be shown in the next sub-section that exports quickly achieved through sales to expatriate plants in fact mitigate against creation of the base from which technically and commercially sound companies are likely to grow and that export



companies of this kind remain small and weak. It helps to realise that all electronic world corporations have grown out of strength gained from trading at home. Although for many of them today the domestic market amounts to only a fraction of their consolidated trading results, the domestic market still remains the field where technical and commercial innovations are tried out before they are introduced to the export markets abroad.

The importance of the domestic market lies in its relative predictability. Like any other market, domestic market results from a demand and the domestic demand can always be better gauged than demand elsewhere. For one thing at home the entrepreneurs can judge the reliability of the source of their information. Another thing is that through their connections they can influence to some degree the course of future home events. Therefore, investments based on domestic demand are relatively safe. Since the size of investment is inversely proportional to the size of business risk, the domestic market is more likely than any other market to justify investment on a sufficient scale to allow development of an adequate technical and commercial base from which it is eventually possible to launch new products and to penetrate new markets. The domestic market, therefore, tends to give rise to large companies and to an indigenous know-how. The large companies then in turn generate secondary industries which grow out of demand for services created by these companies and out of the know-how they shed.

Of course, not every country may have a domestic market big enough to justify investments on a sufficient scale. This may be so even in the component sector where capital requirements are relatively low. In these cases it is then wise to concentrate on the expatriate market and to accept the prospect of perpetual dependence on foreign tutorage.

## 2.2. Expatriate Market

While the domestic market has an important role to play in the development of most industries the role of the expatriate market is limited to light industries. It is particularly applicable to the electronic industry and to its component sector.

The expatriate market came into existence in the late 1950's and early 1960's. It was created by the world corporations who in face of the growing Japanese competition and mounting production costs at home had to look for new means of maintaining their competitive position.

They found the solution in internationalisation of their production processes whereby off-shore plants were established in developing countries desiring to create employment for their growing populations. Special customs privileges were negotiated to allow the corporations to bring to their plants in the host countries all equipment and materials needed for the operation and to take out the manufactured goods for distribution in their world markets. The only indigenous resources used in the operation were the labour and the utilities of the host country. From the point of view of the host country's national economy the guest industry remained entirely expatriate contributing nothing but the value of wages and rent.

The 1960's have seen a rapid proliferation of expatriate operations. Expatriate plants of equipment manufacturers were followed by expatriate plants of manufacturers of sub-assemblies and these in turn were followed by expatriate plants of component manufacturers, each setting up off-shore operations in the neighbourhood of the off-shore plants of their traditional customers. A new kind of trading has thus developed inside the host countries but remained external to their national economies. Gradually, however, as the expatriate activities intensified and as the local businessmen started realising the new opportunities, the expatriate operations started giving rise to various local industries manufacturing simple parts at first and assembling or even manufacturing components and sub-assemblies today.

The expatriate market has now become an important stimulant of the growth of electronic and component industries in developing countries. In small countries not possessing a domestic market of an adequate size, successful electronic industries were built on this market alone.

A company operating in the expatriate market operates with greater risks than a company operating in the domestic market. For one thing, the market could disappear almost overnight if under unfavourable world trading conditions or mounting social pressures at home the foreign corporations decided to reduce or even to terminate their off-shore operations in a particular area of the world. Another thing is the higher degree of competition under which a company trading in this market operates.

The expatriate operator having access to world markets is always likely to abandon the supplier in the host country if he can buy more advantageously elsewhere. Therefore, a company dependent on this market will tend to be rather under capitalised, running at rock bottom costs and shy of investing in technical improvements. It will tend to remain small and technically dependent on licensors and even on its customers for technical backing.

The main virtue of the expatriate industries, particularly in the case of components, is the short time in which they can create a new demand in a developing country. This additional demand then boosts the component market created by the national industry oriented towards the domestic market and thus allows the local component industry to operate on a more economic scale.

There are other advantages too. For example, any business transacted between a national company and its expatriate customer is in fact an export order obtained without the costs and hazards of exporting to be faced in the more conventional forms of international trading. Further, whilst the domestic market is encountered in a passive way, that is to say, the demand develops as a result of a multitude of economic events governed by their own individual dynamism, the creation of an expatriate market is relatively easy to control through investment promotion policies. In fact, through skilful promotion it has been possible so far to create an expatriate market of almost any convenient size in the developing countries

which decided to make use of it. In those countries it is up to the authorities responsible for planning of the countries industrial development to determine the optimum size of this market so as to achieve the right balance between the quality of the industry built mainly on the companies operating in the domestic market and the size of the industry largely controlled by the flexibility of the expatriate market.

### 2.3. Foreign Sub-contracts

There are isolated cases when new local ventures are set up in a developing country on the strength of large sub-contracts obtained from foreign manufacturers prior to setting up a plant. It is usually a case of a large manufacturer wishing to offload its home facility into a production unit geographically better placed with respect to his foreign markets without having to invest own capital. Although such agreements are infrequent they are by no means unique. They usually occur on the strength of personal contacts between businessmen and through "someone being in the right place at the right time".

The production unit set up on this basis will operate within narrow technical limits and its commercial activities will probably concentrate on derivation of maximum benefits from the local industrial promotion programmes rather than on product <sup>quality and</sup> marketing. Its contribution to the national pool of know-how will probably be even less than that of the industries set up to cater for expatriate operations. On the other hand, such plants may be relatively large ones with most of their output going abroad. Therefore, such companies become early export earners even though in terms of value added they may contribute very little to the economy.

It is very difficult to make policy provisions to encourage growth of this market apart from providing facilities for systematic surveyance of foreign companies operations in order to advise local potential investors.

#### 2.4. Export Markets

The importance of exporting for any country is obvious. Although it is customary to measure the level of exports in obsolete monetary terms, such figures may be very misleading as to the value of such exports to the national economy. Frequently monetary value of products leaving a country may be high and yet the contribution of that particular export to the national economy may be almost negligible. Such is the case, for example, when no more than the value of the local labour is contributed to the value of the product. Therefore, when considering export earning power of the various types of companies just discussed, the amount of the value added in the country to the total value of the product should be taken into account, together with the export volume.

On this basis it will be found that export activities of companies discussed in connection with the domestic market outweighs the results likely to be achieved by companies operating in the expatriate market, or as sub-contractors to foreign companies and that exports by the domestic market oriented companies are by far the most valuable. Successful export business is the sign of a company's maturity. It shows that the company has technical capability to produce a product competitive in quality and in quantity and in price with products of other countries and that its marketing skills and financial

resources are such as to sustain international competition. Therefore, the key to successful export trading is to be found in the promotion of the quality of the home oriented companies who, though primarily concerned with the domestic market, are the true nucleus of the export oriented industry in the country.

### 3. REVIEW OF MARKETS

#### 3.1. Size

The component world market stood in 1970 at an estimated value of some U.S. \$15,000 million. The biggest producer was the U.S. with an output close to U.S. \$6,000. Japan easily took the second place with about half of that figure. In Europe, Germany lead the table producing about U.S. \$1,000 million worth of components with the U.K. occupying the second place close to the U.S. \$700 million mark. Elsewhere in the world, Hong Kong and Taiwan were the most notable countries the latter being more conspicuous by the rate of its output than by the volume which currently stands in the region of U.S. \$100 million.

Taiwan's rate of growth has been the largest in the world averaging in recent years over 50% annually. The Japanese component sector grew at 25% in the 1963-70 period. Due to the recent recession the U.S. component industry grew only 4% last year but it is expected to achieve 8% this year. The U.K. component production maintained a steady 11% growth. Hong Kong maintained its position as an important supplier of components in the world markets and Singapore's output is fast gaining significance.

In a developed country, component output will typically amount to between 20% and 30% of the total output of the national electronic industry. In the developing countries where wages and overheads are low this percentage will be considerably higher and will depend on the relative sizes of the domestic and expatriate markets.

Where the domestic market dominates the demand, the value of the component output may reach say 60% of the total national electronic market. The percentage will be even higher in countries where the electronic industry is primarily a service to expatriate operations.



### 3.2. Composition

Production statistics of developed countries classify electronic components in five categories, each category containing components of certain technological similarities:

- (i) Passive components can be broadly defined as conducting devices modifying the parameters of electronic signals passed through them. The group contains capacitors, coils, connectors, ferrite devices, loudspeakers, printed boards, resistors and transformers.
- (ii) Active components primarily perform conversion of electrical energy and cover power tubes, picture tubes, receiving tubes and all semiconductor devices.
- (iii) Electro-mechanical components are devices utilising mainly electro-magnetic energies to perform switching functions. Relays and switches are the main elements in this category.
- (iv) High technology components are, in fact, sub-assemblies performing sophisticated functions in complex electronic systems. The category comprises antennae, crystals, delay lines, filters and various signal recording media.
- (v) Wires and cables which do not need any further description

In a country possessing a fully developed electronic industry, the passive and active categories will be of about equal size each accounting for about 1/3 of the total component market. The remaining three categories share the last 1/3 of the market, the third and the fourth category being about equal and the last category about half of their size.

Not all categories can be equally recommended for the attention of developing countries. The decision on which category should be tackled will largely depend on the degree of development of production techniques and engineering skills and of course on the nature of demand.

Manufacture of wires and cables can be introduced quite early in the industrialisation process since the manufacture is largely automated and does not require elaborate measurements and techniques to control the quality of products. Of the passive components manufacture of coils, transformers and assembly of loudspeakers are least demanding. Fixed resistors and condensers are also suitable products for early stages of component manufacture in a country. Variable resistors and condensers are more demanding as far as manufacturing tolerances and final adjustments are concerned.

Assembly of semiconductor devices and manufacture receiving tubes though requiring higher degree of skills of operatives is well within the limits of "one the job" training. Setting up of a production line requires higher capital outlay because high precision tools are required. Manufacture of semiconductors is generally not recommended since apart from the high capital outlay, the process is technologically rather demanding. Assembly of semiconductor devices is labour intensive and as such is a suitable process for a developing country. However, the condition of the semiconductor world markets would impose an unacceptable risk on any new venture at present. Manufacture of picture tubes is a highly automated and therefore capital intensive process requiring only minimum labour. It is not very attractive to a developing country.

Manufacture of some electro mechanical components, particularly relays and switches, may successfully be introduced in the early stages of component manufacture in a country.

High technology components are not recommended mainly for the degree of skill needed to handle their production. They are also specialist items required only in small quantities.

### 3.3. Domestic Market

Domestic market for electronic components in a developing country is primarily created by manufacturers and/or assemblers of consumer equipment and to a much lesser degree by production of line communication equipment. Production of some classes of radio communication equipment can also contribute to the demand in a limited way in more or less isolated cases.

#### (1) Consumer Equipment

In the context of electronic industry consumer equipment describes broadcasting and TV receivers, all non professional recording and signal reproduction equipment and electronic musical instruments. In a developed country this market sector accounts from some 25% of the national electronic market. In a developing country it may account for well over 50% of the total demand and for 100% of national production. Manufacture and/or assembly of consumer equipment is, therefore, very important and frequently the only source of demand for components.

In order to anticipate the demand for components which this class of equipment is likely to generate it is necessary to estimate the likely future behaviour of the consumer equipment market itself. This can be calculated fairly accurately

from the expected annual demand for individual types of equipment and from the known numbers of components found in typical examples of these equipments.

Annual demand in terms of units of equipment can be conveniently calculated from  $\frac{1}{t}$

$$Q_t = Q_0 (1 + n) (1 + e_p r_p) (1 + e_y r_y)^t \quad (1)$$

Where  $Q_t$  - number of receivers in use in year  
 $Q_0$  - number of receivers in use in base year  
 $n$  - rate of growth of population  
 $r_p$  - rate of price decrease of the receivers  
 $e_p$  - price elasticity  
 $r_y$  - rate of growth of per-capita income  
 $e_y$  - income elasticity

To obtain value of  $Q_0$  some research may be needed since this information is seldom readily available from national statistics. Values of  $n$  &  $r_y$  should, however, be available there. Value of  $r_p$  can be taken at say minus 3.5% to anticipate effect of technological change and improvements in productivity and values of price and income elasticities can be calculated by regression analysis from statistical information on imports of equipment concerned.

In addition to quantities obtained from Equation (1) numbers of replacement units have to be considered. The assumption normally made in this respect is that 1/3 of units considered in a particular year will be obsolete four years later.

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1/ Dr. Varin Wonghanchae: Note on method of Estimating Market Demand for Radio and Television Receivers, UNIDA Report on Electronic Industry in Thailand by S. Skoumal.

Having established the numbers of equipment units, annual quantities of components can then be found from the known quantities of components needed for typical equipment.

These quantities can be easily obtained by inspection of typical circuit diagrams of appropriate equipments.

Typical quantities for broadcasting and TV receivers are shown in Table 1 below.

Table 1:

Quantities of Components in some Consumer Equipments			
Component	Broadcasting Receiver	Monochrome TV Set	(Units)
			Colour TV Set
Resistor fixed	24	92	300
variable	1	4	5
Capacitor fixed	27	115	350
variable	1	10	30
Coil	9	34	90
Transformer	2	3	10
Receiving valve	-	6.3	-
Transistor/Diode	13	12.6	70
CRT	-	1	1
Speaker	1	2	3
Printed board	0.014	0.060	0.120
(meter sq.)			

Note : One third of TV sets were considered to use receiving valves and two thirds transistors.

Another method of calculating anticipated demand for components is from projected equipment sales volume. It has been calculated that 45% of ex-factory prices of consumer equipment assembled in the developing countries is due to the value components. The estimated contributions by individual types of components are shown in Table 2.

Table 2:

Value of Components as % of . Ex-factory Prices of Consumer Equipment	
Resistors fixed	1.40
variable	0.38
Capacitors fixed	2.36
variable	3.87
Coils	4.65
Transformers	12.80
Speakers	3.81
Printed Boards	0.73
Receiving valves	1.05
Transistors and Diodes	6.20
CRT's	5.40
Miscellaneous	2.30
<b>Total</b>	<b>45%</b>

(ii) Line Communication Equipment.

This class of equipment comprises three main groups namely, telephone switching equipment, line transmission equipment with associated microwave terminals and subscriber telephone apparatus.

Since communications are an important part of the national infrastructure, investment plans will usually be available. The value of equipment to be purchased can be taken at about 30% of the value of the planned investment and the generated demand for components can then be calculated from the percentages shown in Table 3.

Table 3:

Value of Components as % of Customer Selling Prices of Telecommunication Equipment	
Resistors fixed	1.24
variable	0.44
Capacitors fixed	1.82
variable	1.25
Coils	2.68
Transformers	4.90
Printed boards	0.52
Receiving valves	0.15
Transistors and Diodes	2.76
Relays and Switches	24.00
<b>Total</b>	<b>40%</b>

Alternatively, if expansion plans exist in terms of quantities of new services to be installed, the hardware content of the planned investment can be calculated on the basis of useful "rule-of-thumb" figures of U.S. \$110 per subscriber line (inclusive of the subscriber set) and U.S. \$700 per the channel-end of transmission equipment. From the total hardware costs projected demand for components can then again be calculated using percentages from Table 3.

It is worth pointing out here that the opportunities which line communication equipment offers as a potential source of demand for components are frequently overlooked by developing countries. It is not always appreciated that radical expansion of the national telephone service will accompany the process of industrialisation and that sharply mounting expenditure will have to be incurred before the country's industrialisation plans can be realised. Equally unappreciated is the dynamism of the change which line communication facilities are undergoing at present due to the growing demands for new services such as facilities for mobile subscribers, data transmission and picture telephony to mention just a few. In these circumstances the time is not very far when the size of the line communication market becomes comparable with the consumer equipment market to offer equal opportunities as a generator of demand for components. It is suggested, therefore, that any future production plans take a greater account of this important but so far little appreciated potential boost of the component business.

**(iii) Radio Communication Equipment**

Estimates of component demand generated by radio communication and industrial equipment are more difficult to carry out because of the great diversity of equipment involved. However, manufacture of these classes of equipment is unlikely to take place in the developing countries on any appreciable scale for a long time and therefore its potential contribution to the demand for electronic components can be ignored.



### 3.4. Expatriate Market

To estimate the likely demand from expatriate off-shore plants for components made in the host country is considerably more difficult than to gauge the consumption of the domestic market. Such estimate essentially becomes an estimate of the country's own chances to attract patronage in the face of competing offers to the expatriates from other developing countries. Ultimately, the size of the expatriate market will depend on the size of the expatriate community which in turn will be in direct relationship to the rating which the developing country acquires as a host country and on the price/quality rating given by the expatriates to the locally produced components. Since neither of these parameters can be measured in any way until some expatriates actually operate in the country the initial estimates of the expatriate market can be only very tentative. Information of some reliability could be obtained only through direct enquiries among the world corporations likely to set up off-shore operations.

### 3.5. Export Market

The concept of export market is limited here to sales to customers outside the country.

If components manufactured in a developing country become acceptable to expatriate operators it is reasonable to assume that they will be acceptable to equipment manufacturers and assemblers in foreign countries too. The chances of a successful export trade are then directly related to the marketing skills and resources of the manufacturers concerned or to the skills and resources of a central marketing agency should such agency be set up as a part of an export promotion programme. Here again the initial estimates can be only very tentative and the only way to obtain information of some reliability is through market research enquiries with potential customers.

#### 4. INDUSTRY'S PROBLEMS

Apart from the expatriate off-shore operations of foreign companies, industries in developing countries are young industries and as such they suffer from their share of teething troubles. Some of the problems stem from the general economic climate characteristic for the developing countries, others are more specifically problems of the electronic component industry. In one way or another they all affect the industry's viability by causing:-

- high prices of products
- inefficient production
- poor business management
- poor quality of products
- marketing difficulties
- and
- uncertainties of long term business prospects

Below we shall examine some of the better known causes of these six major problems. Where appropriate possible remedies will be suggested.

##### 4.1. High Prices

It has been observed that the celebrated cheapness of labour in the developing countries does not always result in low prices of products manufactured there. In fact it would appear that it is only the expatriates who, through application of their standard management practices, and through concentration of large production volumes in their off-shore plants, are able to reflect the low cost of labour in the prices of their products made in the developing countries. By comparison, the prices of products made by the locally owned and managed companies are frequently found to be well above the world prices, sometimes by as much as 50%. Inefficient production and poor business management seem to be the twin causes.

#### 4.2. Inefficient Production

To analyse the problems affecting the efficiency of component manufacture in the developing countries would require a thesis in its own right. Within the scope of this paper it is possible to discuss only a few of the more striking causes.

- a) Short production runs cause low utilisation of the production equipment and excessive waste of time through frequent resetting of production lines.

A remedy should be sought in promotion measures designed to encourage the setting up of relatively large companies and limiting the number of firms making a particular component to a minimum. Also availability of training in efficient planning of production would be helpful.

- b) Excessive diversification of products reflects the marketing problems local component manufacturers face when selling their products, as replacements for imported components used in products currently assembled in the country. Since the average equipment assembler possesses only a very limited technical capability he is usually unable to carry out even limited circuit modifications to accommodate a locally made component which may differ in some minor detail from the imported one he has been using so far. The local component manufacturer who has to sell to a variety of assemblers, each producing equipment of a different foreign origin, is then forced to make an unnecessary number of variants of an otherwise identical product in order to retain his clientele.

An engineering centre equipped to advise the equipment assemblers on availability of locally made equivalent components, and capable of carrying out design modifications to accommodate the local equivalents in the currently assembled equipments, would improve the situation.

- e) Production methods used by the manufacturers are usually obtained under licence agreement from a large manufacturer.

The methods are frequently not suitable for short runs the manufacturer and does not possess sufficient engineering know-how to modify them.

An engineering centre equipped to carry out such modifications, and to advise intending investors prior to signing licensing agreements on the technical aspects of the intended purchase would go a long way to improve the situation.

- d) Stocks of raw materials and semi-finished products held by manufacturers in the developing countries need to be several times higher than in the developed countries. Unreliability of deliveries due to long supply routes is the primary cause but the local manufacturers tend to overstock even above the necessarily high levels mainly because of absence of knowledge of efficient stock management.

Encouragement of secondary industries to produce locally the required supplies, improvement of supply routes, and teaching of stock management practices is required here.

- e) Wasteful use of labour results from its cheapness. Up to 40% more labour may be used in a developing country to obtain the same output as in a developed country. Source of the waste is due to using cheap labour where capital would be used in the West to buy a machine. Also extra staff is needed for additional supervision. However, a considerable percentage of the extra labour is due to a wasteful use.

Managements should be made conscious of labour productivity. In countries with latent underemployment wasteful use of labour may be politically and socially desirable. Social services and competitive industry must be kept apart, however.

- f) High cost of money in the developing countries is not the least factor contributing to the high production costs.

A system of loan guarantees, availability of preferential interest rates and encouragement of the money market in the country, are the needed measures to bring about an improvement.

#### 4.3. Poor Management

As in the case of production problems causes of low quality of management are numerous and a separate study would be needed to carry out an exhaustive analysis. Only the most obvious can be discussed here.

- a) Managements of local component manufacturers frequently seem not to have out-grown the tradesman's approach to business operations. Commercial operations requiring organisational skills and long term commitment of plant and capital are avoided.
  
- b) Plant management frequently shows similar inadequacies. Middle management invariably does not exist and the management expertise of the manager/owner is inevitably limited to one or two management disciplines, the rest of the functions being left to drift. The companies are too small to offer opportunities for on-the-job management training and the autocratic executives offer even less encouragement.
  
- c) There is a complete technological dependence on the licensor in most cases. No engineering changes to take advantage of changed circumstances are possible and frequently the licensee is totally dependent on the licensor even for the supply of parts of components he assembles. Technical emancipation seems frequently far away.
  
- d) Poor marketing is frequently the greatest single weakness of the local manufacturers. Marketing is frequently down to almost selling over the counter to a customer who calls. Dynamic selling does not exist. Potential clients are not approached. Where expatriate and home industries exist side by side opportunities presented by the expatriate requirements are allowed to go by and expatriate component manufacturers are allowed to fill the void.

To remedy the general management standards, education programmes for practicing managers as well as management training facilities for more junior personnel can be set up and individual companies persuaded to take a liberal attitude towards granting releases to their employees to enable them to attend short courses, seminars etc.

The marketing situation could be effectively improved by setting up a marketing organisation to fulfil the role the middleman plays in the developed countries. Such organisation could be particularly effective as a marketing link between the local component manufacturers and the expatriates.

#### 4.4. Poor Quality

High prices of the locally made components tend to be accompanied by quality lower than it is customary to expect in products made in the developed countries. If the quality is found acceptable at one time it may not be maintained throughout the lifetime of the product.

Unreliability of deliveries tends to match the unreliability of the quality. While the problems of price can be relieved to some extent by manipulation of import duties there is not equally easy measure available to relieve the problems of quality and reliability. On the other hand, unlike some of the problems affecting prices, the problems of quality are all within the control of individual manufacturers who should be able to take remedial actions once they are made to realise the importance of such steps.

a) Inadequate control of quality on the production line is the most frequent cause of poor quality. The main reason, frequently overlooked, seems to be the lack of appreciation of the problems inherent in transplants of production processes from one country into another of a different economic and social background.

It is frequently not appreciated that in order to achieve comparable results in a new country, the controls of a transplanted process should be re-designed to suit local production conditions. These conditions are given by the quality of local labour and its mentality, the expected standards of maintenance of tools and measuring instruments, the quality of these instruments, the efficiency of management etc. They all affect the design of an effective quality control system and should be fully evaluated before a production line can be successfully transplanted into a new country. Of course at the time of the transplant none of the information needed for design of an appropriate control system is available in the new country. Therefore, even when the problems are appreciated the investor has little choice but to install a replica of a production line operating in some plant abroad. This, of course, will include a quality control system which is based on production conditions prevailing in a foreign environment and, therefore, will be bound to lead to sub-standard quality of the end products.



While this may be an inescapable situation at the start of a new production in a developing country, it should not be allowed to persist beyond the time necessary to accumulate enough statistical information on the quality of output of the new production line. An early re-design of the quality control system so as to meet more closely the local production conditions should be of high concern to the manufacturers concerned. Instead, the purchased production facilities tend to be regarded with an undue air of permanency and inferiority of products ignored because a rational approach to this problem which requires systematic recording over a considerable period of time and analytical evaluation of the recorded data is beyond the capabilities of most local managements.

- b) Inferior test equipment is frequently used by the manufacturers for production testing and product grading. If well maintained and periodically checked against suitable standards, cheap test equipment can be used in numerous situations. It has been observed, however, that use of cheap test equipment frequently coincides with lack of equipment maintenance facilities, a situation which seems to betray a misplaced interest in short term gains rather than a long term concern for quality of products.
- c) Poor maintenance of test equipment was already mentioned. Poor maintenance of production facilities is yet another factor. Because of the low grade labour in the developing countries, maintenance of the test and

production facilities should, if anything, be more frequent and thorough than in the more developed countries. This point tends to be overlooked in licensor's instructions and the licensee tends to neglect the minimum maintenance instructions he receives.

It was said earlier, that rectification of the causes for low quality of products are not beyond the powers of a developing country given time to do something about it. The first step in the right direction is to create a climate in which the importance of the problem is recognised. The second step should create incentive for the manufacturers to seek necessary remedies. A set of national standards specifying performance and methods of testing of various classes of components combined with effective publicity of the quality problem, should go a long way towards the creation of the needed climate. The incentives could come through the introduction of a concept of "Quality Label" whereby components certified by a professional body as meeting the national standards are allowed to carry the "Label" as part of their physical appearance. It was found in the developed countries that once the "Label" is recognised by the buyers as a guarantee of quality, the product gains a recognisable marketing advantage.

#### 4.5. Marketing

It must not be overlooked that at the time the local component manufacturer enters the market, all demand for components is covered by current arrangements, usually with foreign suppliers. Since change of components necessitates at the best changes in the part lists and may even necessitate modifications of equipment design, it is not an easy matter to sell a new component into an equipment in current production even to a manufacturer who is fully equipped to carry out such modifications. In a developing country few manufacturers have any capability in this respect, as pointed out earlier. (Normally new components will be sold to the equipment designer who incorporates it in the equipment right at the beginning of its life).

Furthermore, in the majority of cases the connection between the local manufacturer and his foreign supplier of components is more complicated than just a straight component supply link. The component supplier is often the licensor of the design made by the local manufacturer, or even a substantial partner in the local factory. Since in all these cases export of components to the country in question must obviously have played a role in the decision to make an investment in the country the difficulty of establishing markets for locally made components must not be underestimated.

The tendency towards higher prices and lower quality of the locally made component is not going to help in this respect; nor will the need for too great a diversification of products. Therefore, the early component manufacturers

in a developing country may need special incentives. For example, it could be made possible for them to offset trading losses of the first few years of their operations against taxable income in the later years. Help also could come from encouragement of the local equipment manufacturers, perhaps by tax incentives, to use locally made components. Also free technical service to the equipment manufacturers to help them to accommodate locally made components should prove effective in this respect.

Frequently the key to the establishment of the local component sector lies in rapid expansion of the equipment manufacturing sector. This should not be difficult because at the time component manufacture starts gaining momentum the developing country is usually meeting a substantial part of its equipment consumption by imports. The newly approved equipment manufacturers can then be forced to agree to use a stipulated percentage of locally made components in their equipment as a part of the bargain of obtaining protection privileges.

#### 4.6. Long Range Outlook

There are two latent dangers which may seriously effect the component business in the future. They are the potential danger of world wide overproduction if too many developing countries seek fortune in the component business and the possible disappearance of large scale use of discrete components as a result of progress of integrated circuit technology. It is by no means certain that either of these risks will materialize and if they do, it is impossible to forecast when this could happen without a good deal of research. Even then only tentative answers could be expected.

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With respect to the danger of world overproduction, it would seem at present that no serious danger will arise during the present decade though it may well happen that the expansion of expatriate activities will tail off and even that some of the off-shore plants may be closed thus affecting some local component suppliers.

As for the impact of integrated circuits, there is little doubt that they will be extensively used in capital equipment by the middle of the decade, and may well also be used in the high quality consumer equipment sold in the developed countries. It is doubtful, however, that they would penetrate the cheap end of the consumer equipment range before the end of the decade, if ever. Telecommunication equipment made in the developing countries may on the other hand be forced to revert again to foreign supplies of components after a brief period of self-sufficiency as a result of the progress of IC technology. Of course, the situation in the semiconductor world markets may be such by then that the developing countries may be able to make their own IC's or somehow participate in their manufacture - a move which cannot be recommended as yet.

## 5. RULE OF GOVERNMENT

Apart from the political function, the role of a modern government is management of the national economy. Because of the complexities of national economics and the long response time of the control measures, economic controls have to be conceived and performed within the framework of long range plans. The governments in their roles as managers of national economics have to concern themselves firstly with economic planning and secondly with formulation and administration of measures designed to achieve the planned results.

The decision to promote a certain kind of industry in the country is part of the planning process. Once the decision has been taken with respect to a certain industry, methods to control the new industry's size and quality are needed. Below we shall discuss such measures as are appropriate to the production of electronic component industries.

### 5.1. Promotion of Industry's Size

#### (i) Promotion of Markets

There would be little point in promoting electronic component industry unless there was an accessible market for its products. Such a market is primarily given by the presence of manufacturers/assemblers of electronic equipment in the country. Therefore, to encourage growth of a domestic component industry, policies have to be first adopted to encourage assembly of equipment.

In a developing country the consumer equipment sector will represent the major, and sometimes the only, demand for electronic equipment which can be met by local production. Therefore, promotion of the component industry must start with promotion of assembly, and if possible manufacture, of consumer equipment. The early promotion measures should be designed to appeal to foreign consumer equipment manufacturers who should feel encouraged by them to set up equipment assembly plants, preferably in partnership with local entrepreneurs, in the sponsoring country. Another important group of potential equipment manufacturers are the local importers of electronic equipment and the promotion measures should be aimed in their direction too. Starting from an established business manufacturing plants of importers have the best chance to grow into truly national enterprises. Plants started by foreign manufacturers will tend to remain under foreign domination.

Production of the expatriate market is equally important but here care must be taken of the contradictory situations which may arise. For example free entry of foreign components is an essential concession if expatriates are to be attracted, whilst barring of component imports encourages local manufacture. A solution to this kind of problem should be sought in constant re-appraisal of promotion measures and in flexibility of their applications.

Encouragement of local manufacture of telecommunication equipment offers yet another important opening.

Joint ventures between governments and private capital could frequently prove an effective way of promoting manufacturing facilities of electronic equipment where excessive market risks are involved, or if government agencies are to be the major customer.

(ii) **Financial Measures**

These measures are generally well known and are being practiced the world over whenever an industry is being encouraged in a country. They are not specific to the component industry.

Income and business tax concessions during the early years of operations of new companies are a well tried practice. In the light of the rather high business risk the component manufacturers have to face in their early years of operations their concessions may have to be extended over longer periods than normally granted to other industries.

Import duties must be flexible so as to encourage assembly of components from imported parts at first and full manufacture soon after. Imports of tools and manufacturing equipment should be free of duties. Duties on components competing with locally made ones should be such as to afford minimum protection in order to force local products to be as competitive as possible, though prohibition of competing imports can be justified in some cases for limited periods of time.



Short and long term loans at preferential rates can be made available from a government agency or at least government guarantees offered to private finance houses lending to the promoted manufacturers.

(iii) **Operating Conditions**

Effectiveness of industrial estates as a means of speeding up the industrialisation process has now been proved in many countries. Estates offering ready made accommodation to be rented are particularly effective in attracting electronic component industry. Although governments may prefer to set up corporations to operate the estates, government initiative is needed to get the estates established.

If industrial estates are situated away from large concentrations of populations hostels for single workers and houses for married employees have to be provided.

Access roads and even ports may have to be built to facilitate access to the country. Also cheap utilities and good telecommunication facilities must be laid on.

(iv) **Government Procurement Policies**

In all developed countries government orders significantly contribute to the degree of excellence achieved by their electronic industries and in turn by their component sectors. Government contracts ensure by their size continuity of business and in turn justify substantial investments which are necessary if efficiency of production and quality of design are to be achieved.

Opportunities for this kind of stimulation of the electronic industries of the developing countries lie chiefly in purchase of communication equipment. In a number of developing countries volumes of government purchases would justify local production if only governments were prepared to commit themselves to local purchasing. Instead, the governments frequently prefer short term advantages by buying the cheapest foreign equipment available and let the long term opportunities pass.

(v) **Facilities for Foreign Operators**

The role of expatriates as a means of relatively easy control of the size of the component industry was pointed out earlier. In order to attract their patronage bonded warehouses and full plant ownership together with free repatriation of profits and capital are essential privileges which must be offered.

Repatriation of profits is also an essential condition to be offered to foreigners entering into partnerships with local investors.

Other important assets looked for by foreign investors are ease of entry for personnel and goods, a business-like civil service, political stability and availability of supporting industries.

(vi) Promotion Office

A large number of policies have to be set in motion to develop the electronic component industry in a country. In order to co-ordinate the necessary effort, and in particular to bring the newly created opportunities to the notice of potential investors at home and abroad, a promotion agency must be appointed. Such an agency can be either set up within an appropriate government department or as an independent development corporation operating on a commercial basis.

The agency must fulfil three main tasks. In the first instance it must act as a dynamic public relations office whose job it is to create a favourable image of the investment climate in the country and to seek out potential investors through advertisements, direct mailing and personal approaches. In the second instance the agency must engage in speculative pre-investment studies in order to be able to advise the potential investors and to obtain information needed to direct its own activities. Finally, based on the information accumulated through its public relations activities, and gathered from its economic studies, the agency should act as a kind of marriage bureau arranging for capital and know-how to meet together the new opportunities.

## 5.2. Promotion of Industry's Quality

The main weaknesses of the component industries in the developing countries are lack of modern management concepts, excessive dependence on foreign technological know-how and absence of an organised coherence. The effects of these weaknesses were discussed in the previous sections. Below we shall limit ourselves to proposals of some remedies.

### (i) Management and Marketing Service

A company is only as good as its management. An industry is a collective of companies. Therefore, in order to improve the quality of an industry, it is necessary in the first instance to improve the quality of the management of individual companies.

It is suggested that the problem can be met by a marketing-cum-management consultancy organisation which by acting as a middleman between the component manufacturers and the customers should uncover the weaknesses of individual local manufacturers and subsequently advise them how to remedy the situation.

The basis of the service would be a market register compiling the known requirements for components in the markets accessible to the national industry. The market openings would be matched with the products of local manufacturers whose interests the organisation was supposed to look after. The handled products would be tested by the organisation for quality, and the manufacturing plants inspected for reliability of quality and deliveries. Any deficiencies found

during the inspection would be noted and the manufacturers advised how to bring about necessary improvements. When the product reached the quality required by the markets, the organisation would agree to handle it through its marketing facilities.

Besides directly affecting the quality of management of the local companies the organisation, being the focal point of commercial transactions between the local industry and a large number of customers, should be in a position to place large stock orders with individual manufacturers and to affect their specialisation. Thus the organisation would also act as a production planning agency for the smaller companies and by creating opportunities for larger production efficiency of the industry.

The organisation would also act as marketing consultants to its dependent manufacturers with respect to business transacted by the manufacturers independently of the organisation's marketing service.

(11) National Electronic Laboratory

If the weakness of business management is the most conspicuous limitation of the component manufacturers in the developing countries at present, the lack of technical capability will become the chief limitation as soon as the business practices improve. In fact, some of the early business problems are a direct consequence of excessive dependence on foreign technical know-how. Therefore, just as much as

fostering the development of the quality of the business practices of their component industries the governments need to pay attention to the development of the quality of technical know-how. It could be argued that it is up to the individual companies to protect their commercial interests through their own technical competence. However, the small manufacturers who predominate in the developing countries tend to have neither the foresight nor the financial resources to meet this necessity. When this situation is combined with the need for informed technical opinion needed to aid national economic planning and with the pressing need to improve the standards of quality for the industry's products, a case can be made for setting up a national electronic laboratory to serve the industry and the government. The Laboratory, a pool of the national electronic know-how would, of necessity, need to concern itself with problems broader than just those related to components. To meet its obligations the Laboratory would need to be ready to offer consulting services to, and to undertake technical assignments on behalf of clients.

To be of direct service, the Laboratory should be able to perform R & D functions for individual companies desiring its services. It should also be able to assist individual companies with their production difficulties and with the technical problems arising out of marketing of their products identified by the management and marketing organisation discussed under the previous heading.

The second important task for the Laboratory would be the administration of a programme designed to achieve internationally acceptable quality of the components made in the country. To this end, the Laboratory should become the agency responsible for establishment of national standards and for promotion of the "Quality Label" mentioned earlier. It would grant the "Label" after carrying out tests of components concerned and after satisfying itself with respect to the quality of the manufacturing plant.

Being initially the only technically qualified establishment in the country, the Laboratory should also concern itself with the technical future of the industry. It should study new production methods and eventually design new components and equipment based on their use. Some of this work would have to be sponsored within the Laboratory's own budget but it also should seek sponsorship from individual companies.

Lastly, the Laboratory should act as a professional advisor to the government departments and agencies concerned and with promotion of the electronic industry and its component sector. Therefore, it would have to keep itself well informed on the world trends in component design, the relevant technologies, and the marketing policies of the leading world corporations.

Although it would appear that the Laboratory should be established under direct or indirect sponsorship of the government, it should be so constituted as to ensure that business spirit is infused into its administration. It should be staffed by practical engineers with commercial orientation rather than by civil servants or academically oriented scientists.

(iii) Industrial Association

One of the general weaknesses of all industries in the developing countries is the lack of coherence which in the developed countries is provided by industrial associations. An association gives the industry a platform where individual companies can discuss matters of common interest and where the industry's point of view on important issues can emerge.

Through a representative association national industries can bargain with their governments to gain advantages or to oppose measures considered damaging to their interests. In a developing country such an association should be able to have a say in the formulation of various industrial privileges and in the control of industrial development. In the absence of an association, communications between governments and their industries are limited to isolated contacts with senior executives of individual companies who can and frequently prefer to inform governments only in the narrow context of the interests of their own companies rather than on



the broad issues concerning the whole of the industry.

In the case of electronic industries and their component sectors an industrial association would seem to have a particularly important role to play in the light of the industry's recent emergence in the developing countries and its fractionalised structure. Measures to encourage some form of association of electronic components, probably within a parameter of a broader industrial organisation should be considered, therefore, a part of any industrial promotion programme.

6. CONCLUSIONS

6.1. The message contained in this paper can be summed up by saying that in the present state of the world markets and the prevailing technology it should be possible for most developing countries to secure a share of the component market. How big this share can be will depend on the measure of success with which everyone of the five steps essential for the promotion of electronic component industries is carried out.

- (i) Before promotion of production of components can be started in a country production of equipment must be established. Therefore, promotion of the component sector must be preceded by promotion of equipment production.
- (ii) Promotion of patronage of expatriate equipment manufacturers may create a powerful secondary market for electronic components in a developing country. It should, therefore, precede or run in parallel with promotion of the component sector.
- (iii) Apart from promotion measures governments of countries promoting electronic components industries should pay attention to setting up facilities to strengthen business management of component manufacturers. Such facilities can either be run by the governments or as business ventures.

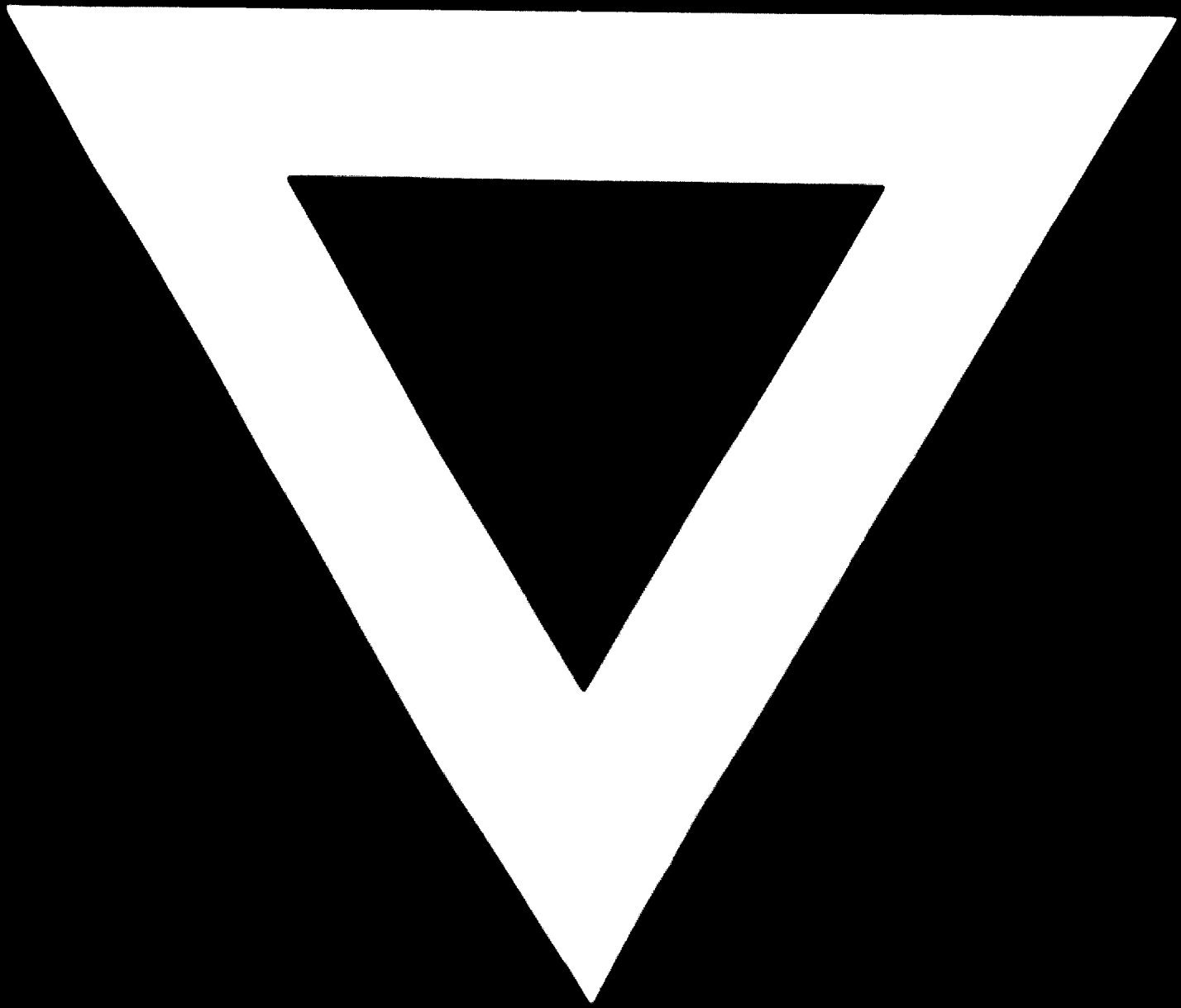
- (v) To achieve co-ordination of the promotion programme and its effective execution, all promotion and executive powers should be concentrated within a single organisation. Such an organisation could be a semi-government agency or a business venture.

6.2. There is a small but measurable risk that towards the end of the decade :

- (i) There may be overproduction of components due to too many developing countries seeking their fortune in the component business.
- (ii) Integrated circuit technology will render manufacture of discrete components obsolete.

It is, however, not advisable for the developing countries to indulge in production of semi-conductor devices at present even as a precautionary measure to ensure against this risk.





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