UNITED NATIONS
ECONOMIC
AND
SOCIAL COUNCIL

49828

Distr.
LIMITED

E/CN.14/INR/89
PART I
30 September 1965

Original: ENGLISH

ECONOMIC COMMISSION FOR AFRICA
Conference on the Harmonization of Industrial
Development Programmes in East Africa
Lusaka, 26 October - 6 November 1965

ELECTROTECHNICAL ENGINEERING INDUSTRIES IN THE EAST AFRICAN SUB-REGION

(in two parts)

PART I

CONTENTS

M65-100

CHAPTER I

INTRODUCTORY NOTE

1. The object of this study is to investigate the possibility of establishing national, multinational (two or three countries) and sub-regional plants for the production of electrical engineering goods in East Africa.

The countries covered by the study are:

1. Ethiopia	2. French Somaliland
3. Somali Republic	4. Kenya
5. Uganda	6. Tanzania
7. Burundi	8. Rwanda
9. Malawi	10. Zambia
11. Rhodesia	12. Malagasy Republic
13. Mauritius	14. Reunion

2. Statistical data on which the analysis is based were obtained from the Economic Commission for Europe, replies to questionnaires sent to the countries, and from published statistical publications of the various countries of the sub-region. Maps, graphs, and tables, referred to in this paper are in Part II of the study (E/CN.14/INR/89).

CHAPTER II

The available data

3. This section covers all the data which it has been possible to obtain within the limited time available relative to demand and local production in the countries of the East African Sub-region.

Data provided by the Economic Commission for Europe

The data provided by the ECE is as follows:-

(i) The f.o.b. value of exports of electrical machinery, apparatus and appliances to the various countries of the Sub-region in the years 1957, 1958, 1959, 1960 from the USA, Japan, the United Kingdom, Western Germany, France, Italy, Sweden, Switzerland, Canada, and the Netherlands, as being the major exporting countries of the West, figures of exports from the Eastern European countries and China not being available. This data was given in detail for Ethiopia, the former East Africa (comprising Kenya, Uganda and Tanganyika), the Rhodesias and Nyasaland (Malawi, Zambia and Rhodesia) and Madagascar (Malagasy), and in totals only for all electrical machinery, apparatus and appliances for Somalia, Mauritius and Reunion. No figures were given for French Somaliland or for Burundi and Rwanda as the statistics of these two countries were previously incorporated with those of Congo (Leo.).

(ii) The ECE also gave the values of imports of electrical machinery apparatus and appliances in each of these four years as indicated by the countries themselves. These values are given c.i.f. except for the Rhodesias and Nyasaland, in which case they are given f.o.b. Only partial detail is given in some instances and the total value of the items not detailed is considerable in relation to the total value of imports.

4. In some instances the total imports into a given country in a given year as reported in the National Statistics are less than the exports from the 10 major exporting countries of the West for which figures have been given by the ECE. This may be due to differences in the timing of the statistical year, differences in statistical classification or inaccuracy. In the case of the Rhodesias and Nyasaland the imports as given by the Statistics of the previous Federation are very much higher than the exports from the ten major exporters of the West, due to the fact that considerable imports are obtained from South Africa.

5. Table II.1 (1) summarizes the data obtained from the ECE information. Starting with the countries for which full details are given for the exports from the Major exporting countries of the West, columns A give such exports in value and as percentages. Columns B give the imports as indicated by the National Statistics or the "A" value plus 12 per cent (to cover freight and insurance) whichever is the greater, with the sub-divisions made in the proportions of the percentages in column A. In the case of the Rhodesias and Nyasaland the value of imports as indicated by the countries f.o.b. is also increased by 12 per cent to give the value c.i.f. Sub-total 1 gives the totals for Ethiopia, East Africa, The Rhodesias and Nyasaland and Madagascar.

6. The totals given for Somalia, Mauritius and Reunion are sub-divided in the proportions of the percentages of the "B" value under sub-total 1 and a sub-total 2 is obtained by the addition of the imports into these countries to sub-total 1.

7. For French Somaliland, Burundi and Rwanda, for which no figures have been given, the total value of imports is estimated at 2.4 million US dollars. Within the approximation adopted in the last column for the total imports into the Sub-region, this figure can vary from 1.9 to 2.8 million US dollars. This total (B4) is sub-divided in the proportions of the percentages of the "B" value under sub-total 1.

Information available on imports in recent years

8. Table II.2 (1) gives the latest information available on imports of electrical machinery, apparatus and appliances in the countries of

the East African Sub-region as obtained from the replies received from these countries up to the middle of August 1965 to a questionnaire circulated to them in this respect by the ECA in April 1965. No data were obtained from French Somaliland, Malawi or Reunion, but imports into these three countries have relatively little weight in the over-all picture of the Sub-region.

9. The countries of the Sub-region were requested to give data for the last three years for which information is available, and to indicate whether the years for which data is given represent normal years. Some countries have given three year averages as indicated in the Table. Others have given figures for 1 year only and have not indicated any abnormality in these figures. In the case of Zambia and Rhodesia the figures are given for the year 1964 only since the statistics for the years 1954 - 1963 were combined together for the Federation of the Rhodesias and Nyasaland.

Information available on local production in recent years

10. The questionnaire referred to above also requested the countries to give information on local production of engineering products in recent years divided into four divisions as follows:-

(i) Electrical machinery, apparatus and appliances
(ii) Structural engineering and metal products
(iii) Machinery other than electrical
(iv) Transport equipment

Each of these main divisions was sub-divided into commodity groups for which information was requested.

11. Ethiopia, Kenya, Uganda, Tanganyika, Burundi, Zambia, Malagasy and Mauritius gave production figures for the year 1963 while Rhodesia gave production figures for the year 1964. No production figures were obtained from Somalia, Rwanda and Malawi.

12. Table II.3 (1) gives the values of local production of electrical machinery, apparatus and appliances in the countries of the East African Sub-region as given in the replies to the questionnaire, while Tables II.3 (2), Table II.3 (3), and Table II.3 (4) give the production figures

for the other three divisions. Table II.3 (5) gives the total value of local production of each of the main divisions referred to above in each of the countries of the sub-region for which information is available as well as the value of the per capita local production.

Imports of electrical machinery, apparatus and appliances into the countries of the Sub-region for the period 1956 - 1963

13. In order to attempt a projection of demand for electrical machinery, apparatus and appliances in the countries of the Sub-region an effort has been made to obtain consumption figures from the year 1950 up to date so as to have a long enough period on which to base the projections. However, the following factors have seriously affected the collection of data.

(i) Most countries of the Sub-region have recently attained their independence. They are still building up their statistical administrations and organizing their statistical work.

(ii) Little information is available prior to 1956 and the period for which it has been possible to obtain a reasonable amount of data is limited to the period 1956 - 1963.

(iii) The data available in the various countries are not put in standardized form and are not given in sufficient detail to enable assessment of demand except for major commodity groups (radios - batteries and accumulators - and bulbs and lamps excepted for some countries).

(iv) During the period of the Federation of the Rhodesias and Nyasaland, the data for the three countries were grouped together and information for the individual countries starts from 1964. Similarly data available for Kenya, Uganda and Tanganyika were grouped together under "East Africa" up till recently. It has, therefore, been found necessary to confine the collection of data to major commodity groups and to radio receivers - batteries and accumulators - and bulbs and lamps, and to confine the period of observation to the years 1956 - 1963.

14. Referring to Table II.3 (1) it will be seen that only Rhodesia has a sizable local production of electrical machinery, apparatus and appliances (amounting to about 18 million US dollars annually, of which about 9 million are for radio receivers, 5 million for switchgear and transformers, and 2 million for batteries and accumulators. The only other countries which have any local production to speak of are Malagasy, (1,2 million US dollars practically all for radio receivers) and Kenya (0.8 million US dollars mostly for repair work). Accordingly import figures can be taken as indicative of demand, Rhodesia excepted. Tables II.4 (1) to II.4 (10) give the import data obtained from foreign trade statistics for the purpose of projection of demand.

Annual consumption of engineering products in recent years in the countries of the Sub-region

15. As mentioned in Chpater I (Introduction) the electrical engineering industries are basically mechanical, the production of an electrical commodity being in essence a mechanical operation. Accordingly no study of electrical engineering industries can be complete without an overall picture of the various engineering products in the country. With this in mind the average annual consumptions of the various engineering products in the countries of the Sub-region for the period 1961 to 1963 have been obtained and are given in Table II (5).

Information obtained from visits to some countries of the Sub-region

16. In addition to the data given in the previous sections of this chapter, the author has been able to obtain some information from visits paid to five countries of the Sub-region, namely, Kenya, Uganda, Tanzania, Zambia and Rhodesia. These five countries between them cover 53 per cent of the area of the Sub-region and account for 45 per cent of its population and about 57 per cent of its total Gross Domestic Product. They are also the countries which are likely to take a leading role in the industrialization of the Sub-region in the next decade.

Kenya

17. As mentioned above Kenya, Uganda and Tanganyika formed, until recently, what was termed East Africa and treated as one area, having a Common

Market and common service facilities run by a Common Services Organization. Kenya is more industrially developed than the other two countries. The three countries still keep the Common Market and the Common Services Organization, but each country is working out its industrial development on a national basis, keeping in mind the necessity of an area approach.

18. In spite of the relatively advanced industrial development of Kenya, the country has no electrotechnical engineering industries, the figure of US$780,000 given in Table II.3 (1) as the turnover for these industries in 1963 being mostly for repair work, and a few minor industries. However, an electric bulb factory and a plant for electric wire drawing and insulating to produce domestic wiring and underground armoured cables are in the process of being implemented.

19. As mentioned in Table I.1, the installed power station capacity in Kenya was about 90 MW in 1963, and the country takes some electric energy from Uganda. However, the projected Seven Forks Hydro-Electric Scheme will give Kenya, in its final stage, 250 MW of hydro-electric energy and make the country independent of electricity from outside sources.

Uganda

20. Although Uganda produces about 20,000 tons per annum of copper, this is blister copper and it is not economically justifiable to establish a refinery to produce electrolytic copper.

The country has no electrotechnical engineering industries, and the only projected industry in this field that has come to the author's knowledge is the manufacture of dry cells to cover the requirements of Kenya, Uganda and Tanzania.

Tanzania

21. Tanzania has no local electrotechnical engineering industries. According to the Kampala Agreement, it is proposed to establish a radio assembly plant in the country to cover the requirements of the Common Market of Kenya, Uganda and Tanzania.

Zambia

22. Zambia's economy is dependent on copper mining and refining operations, its present production being about 650,000 tons per annum (the third in the world), and yet Zambia has no electrotechnical engineering industries in the general sense[1/]. The copper industry is run by two major concerns, the Rhodesian Anglo-American Ltd. and Rhodesian Selection Trust Ltd. The first company is much the larger of the two and has diversified activities, but it finds the Zambian market too small for most industrial projects.

The copper mining industry consumes large quantities of electric energy and these are mostly obtained from Rhodesia and the Congo (Leo.). It is, however, proposed to construct a second stage of the Kariba Dam Hydro-Electric Scheme on the Zambia side of the dam to reduce the country's dependence on outside sources of electric energy. The Zambia Government also has plans for rural electrification.

It is proposed to construct a radio assembly plant in Zambia, which is now past the drawing board stage. The cost is estimated at US$1,000,000.

23. Rhodesia

(i) Rhodesia has the highest industrial production in the Sub-region (more than 50 per cent of the total), and its local production of electrical commodities in 1964 amounted to about US$18,000,000. And yet the country depends mainly on agriculture, whose products constituted about 45 per cent of export in 1964, tobacco being the main export product.

(ii) The main electrotechnical engineering industries in the country are:

(a) Domestic radio receivers, for which the country has three plants. One of these plants produces transistor radios, radiograms and pickups. The products of the

1/ In the course of preparing this study the General Electric Workshop Ltd. in Lusaka, manufacturing lead acid accumulators was visited, the output of this plant is only 600 batteries per month. The country probably has other minor electrotechnical engineering industries.

plant are of a high standard comparable to European standards. Its investment is about US$3,000,000 and it makes its own electrical and mechanical designs as well as its industrial designs. Production of television sets has been discontinued on account of market limitations. Rhodesia's production of radios is mostly for export, mainly to South Africa, but also to European markets.

(b) Manufacture of transformers and assembly of switchgear (except for small switch and fuse units which are manufactured, the fuses being imported). The value of production in 1964 was over US$5,000,000.

(c) Electric batteries and accumulators, for which the country has five plants. The value of production in 1964 was over US$2,000,000. Dry cells are not produced, as market requirements are too small.

(d) Domestic refrigerators, the cooling units being imported. The value of production in 1964 was about US$800,000.

(e) Electric bulbs and lamps (assembly), the value of production in 1964 being about US$400,000.

(f) Insulated wires and cables, for which the country has one factory which was put into operation in 1954. Electrolytic copper is obtained from Zambia at producer's price. The company makes plastic insulated cables up to 3.3 k.V., but the voltage can be increased to 6.6 k.V. The factory has been established to cover the requirements of the Rhodesias and Nyasaland as well as Angola and Mozambique, and now has considerable spare capacity.

(iii) A study was made of possible industrial opportunities in the Rhodesias and Nyasaland in 1962 and published in 1963, the last year of Federation. The following industries were put forward as having reasonable possibilities:

(a) New industries

Electric lamp and torch bulbs
Welding machines
Telephone hand-sets
Electric motors
Electronic resistors, capacitors, filters, etc.
Electric warehouse trolleys, fork trucks
Electric small guage shunting units
Electronic equipment, including computers

(b) Expansion of existing industries

Domestic refrigerators
Other domestic electrical appliances
Switchgear
Electric wires and cables
Radio (and television) sets

CHPATER III

DEMAND FOR ELECTRICAL MACHINERY, APPARATUS AND APPLIANCES IN THE EAST AFRICAN SUB-REGION

Estimation and projection of demand

24. As mentioned in Chpater II imports of electrical machinery, apparatus and appliances into the countries of the Sub-region can be taken as indicative of demand for all countries except Rhodesia which has a sizable local production.

25. The insufficiency of data available and the discrepancies apparent in this data affect the accuracy of assessment of demand and of projection, and consequently only an order of magnitude is likely to be obtained.

26. In the case of Malawi, Zambia and Rhodesia for which data had been grouped together under the Federation of the Rhodesias and Nyasaland, the years 1956 to 1960 witnessed the execution of the Kariba Hydro-Electric Project, which cost about US$200 million. It has not been possible to separate the effect of the implementation of this project from demand figures for electrical commodities, which were seriously swollen by its execution. This did not only affect the items directly connected with the project such as generators, electric motors, switchgear and transformers but also commodities indirectly affected such as refrigerators, air-conditioners and other domestic appliances imported.

27. No information has been obtained regarding other non-recurrent projects such as power stations or sizable extensions of distribution network that may have been executed in the Sub-region within the period 1956-1963.

28. The changing pattern of the economy after independence referred to previously will considerably affect future demand for electrical machinery, apparatus and appliances. However, the quantitative effect is difficult to assess, for it is dependent on the development plans of the various countries, and these in many cases, have not been worked out.

29. In view of the foregoing considerations any assessment of the value of the available data and of projections based on such data is exceedingly problematic. However, with these limitations and reservations in mind, an attempt is made to use the available information for estimating the order of magnitude of demand in the years 1970 and 1975.

Trend Projections

30. Tables II.4 (1) to II.4 (7) give the available data on imports of electrical machinery, apparatus and appliances into the countries of the East African Sub-region by major groups of commodities for the years 1956 to 1963. Tables II.4 (8) to II.4 (10) give the available data on imports in these 8 years of Radio Receivers - Batteries and Accumulators - and Electric Bulbs and Lamps.

31. Referring to Table II.4 (1), the effect of the execution of the Kariba Hydro-Electric Project over imports into Malawi, Zambia and Rhodesia during the years 1957 to 1961 can be clearly seen. These three countries have, therefore, been separated from the other countries of the Sub-region for the purpose of projection of demand.

32. For the assessment of demand it is necessary to add local production to imports and to subtract exports. However, since Rhodesia is the only country that has a relatively large local production, imports for internal use have been taken as representing demand for the other countries of the Sub-region.

33. The use of a curve for projection of demand, logarithmic or otherwise, requires definite indications to this effect from the available data, and this does not show itself from the plotting of consumption shown in Tables II.4 (1) to II.4 (10) in the Graphs given in Figure 1 and Figure 1 (1) (pages 2 and 3 of PART II). Moreover even where long range projection is best met by a curve the first part of such a curve can be approximated to by a straight line, and it is likely to be the first part of any such curve that would be applicable to countries on the threshold of industrial development, other considerations apart. Accordingly a linear trend projection has been adopted.

Linear Trend Projection of Demand

34. The least square method has been adopted in making the linear trend calculations of future demand as can be seen from the following example:-

35. From Table II.4 (1) giving imports of electrical machinery, apparatus and appliances into the various countries of the Sub-region imports for the countries other than Malawi, Zambia and Rhodesia over the years 1956 to 1963 are as shown in the following table:-

Serial No.	Year	Relative Year	Imports		xy	x^2
			Value	Per cent		
		x	000 $	y		
1	1956	-4	25,250	100	-400	16
2	1957	-3	27,533	109	-327	9
3	1958	-2	23,502	93	-186	4
4	1959	-1	25,353	100	-100	1
5	1960	0	29,284	116	0	0
6	1961	1	30,338	120	120	1
7	1962	2	34,362	136	272	4
8	1963	3	40,326	160	480	9
TOTAL	-	-4	-	934	-141	44

36. To facilitate calculations the year 1960 has in all cases been taken as datum year, to which other years are related, and the import values are given as percentages of the value in the first year for which data are available.

The formula adopted is as follows:-

$y = a + bx$

Where:

x is the year in question

y is the value of imports expressed as a percentage of imports in the first year for which data are available,

a and b are the factors to be calculated

37. Based on the previous formula, a and b can be obtained from the following two formulae:-

$$\sum y = na + b \sum x$$
$$\sum xy = a \sum x + b \sum x^2$$

Where n is the number of years for which data are available.

Solving the previous formulae we obtain:

$$b = \frac{\sum y - na}{\sum x} = \frac{\sum xy - a \sum x}{\sum x^2}$$
$$= \frac{934 - 8a}{-4} = \frac{-141 + 4a}{44}$$

From this we obtain the formula:-

$$y = 121 + 8x$$

From which we derive the following projection formula:

Imports in 000 $ = 30,600 + 2,020 x.

38. Projections for the major commodity groups and the commodities covered in Table II.4 (2) to II.4 (10) have been worked out in a similar manner and the results drawn in Figures 1 and 1 (1).

39. It will be noted that for the two major groups "electric power machinery - (SITC 722)" and "equipment for distributing electricity - (SITC 723)" the projections show a downward trend. This indicates that the earlier years of the observation period witnessed the execution of projects which needed imports of these two major groups which were not repeated during later years. Future demand will naturally depend on similar projects which may be implemented. With the industrial development drive taking place in the recently independent countries, consumption of these two groups is bound to take an upward trend.

40. A downward trend is also seen in the case of imports of apparatus for medical purposes. These depend on social development plans, which were evidently slowed down during the transition period to independence and have not picked up sufficiently yet.

41. For the other four major groups, the following projection formulae are obtained for the imports into the countries of the East African Subregion except Malawi, Zambia and Rhodesia:

SITC 72 - Electrical Machinery, Apparatus and Appliances
Imports in 000 US$ = 30,600 + 2,020x

SITC 724 - Telecommunication Apparatus
Imports in 000 US$ = 8,430 + 1,025 x

SITC 725 - Domestic Electrical Equipment
Imports in 000 US$ = 2,055 + 198 x

SITC 729 - Other Electrical Machinery
Imports in 000 US$ = 10,550 + 1,078 x

42. For the commodities covered by Tables II.4 (8) to II.4 (10) and figure 1 (1) the following projection formulae are obtained for the imports into Kenya, Uganda, Tanzania, Malagasy and Mauritius:

SITC 724.2 Radio Receivers
Imports in 000 US$ = 3,680 + 513x

SITC 729.1 Batteries and Accumulators
Imports in 000 US$ = 3,000 + 344x

SITC 729.2 Electric bulbs and lamps
Imports in 000 US$ = 523 + 22x

43. Assuming that the growth rates represented by the above formulae can be applied to the individual countries of the Sub-region and applying these growth rates to the demand indicated by the countries in their replies to the questionnaire we obtain the projections of demand in 1970 and 1975 given in Table III.1. No projections have been made for SITC 729 (other electrical machinery) as it will not serve a useful purpose.

Projections based on the relationship between per capita GDP and per capita Consumption

44. Another approach to projection of demand has been made, based on possible correlation between per capita GDP and per capita consumption.

45. Table III.2 gives the Per Capita GDP and per capita consumption in the countries of the East African Sub-region of some electrical commodities which have shown reasonable correlation. Consumptions of switchgear and transformers and of rotating machinery have not shown any correlation, and this is understandable.

46. The data given in Table III.2 has been plotted in graphs in figures 2 to 7. The following remarks are to be taken in consideration in using these graphs:

Figure 2 - Insulated Cables:
Figure 6 - Electric Batteries and Accumulators:
Figure 7 - Electric Bulbs and Lamps:

In all these cases Rhodesia shows a much higher consumption than indicated by the graphs, due to its advanced industrial development.

Figure 3 - Domestic Radio Receivers:

47. Mauritius shows a much higher consumption than indicated by the graph. It is a small island with a relatively small population, whose wealth (from sugar) probably gives many of its inhabitants the means to procure radio receivers. Zambia and Rhodesia show signs of earlier fulfilment of much of the demand.

48. Table II.3 gives the projections of population and of Gross Domestic Product for the countries of the East African Sub-region for the years 1970, 1975 and 1980. These are plotted in graphs in Figure 8.

49. From these data projections of demand based on Per Capita GDP and Per Capita Consumption have been worked out and are given in Table III.4.

Estimation of demand

50. Estimates of demand calculated for the years 1970 and 1975 based on linear trend projections (Table III.1) and those based on per capita GDP and per capita consumption (Table III.4) have been entered in Tables III.5 and III.6 for 1970 and 1975 respectively.

51. In comparing the projected figures of demand for the commodities for which projections have been made on both bases the following should be noted:-

(i) That in the case of linear trend projections for radio receivers - batteries and accumulators - and bulbs and lamps the consumption in Kenya, Uganda, Tanzania, Malagasy and Mauritius in 1956 to 1963 was taken as basis. Application of the growth rates so obtained to other countries of the Sub-region is a rough approximation.

(ii) For telecommunication apparatus other than radio receivers linear trend projections have been made on the basis of consumption of the five countries mentioned in 1 above plus Ethiopia, Somalia, Burundi and Rwanda. The application of the growth rate so obtained to Zambia and Rhodesia is again a rough approximation. (This also applies to linear trend projections for Electrical Machinery apparatus and appliances as well as those for Domestic Electric Equipment).

(iii) From Figures 2, 3, 6 and 7, utilized for projections based on per capita GDP and per capita consumption, it can be seen that the points representing consumption in a number of countries of the Sub-region fall far from the curve utilized for projections. It will also be noted that the upper part of each curve, shown dotted, can only be a very rough guide of a possible per capita GDP and per capita consumption relationship. Further the data utilized for drawing these curves relate to the years 1961 - 1964 and these years, as mentioned earlier in the paper, are not likely to be truly representative of annual consumption in the various countries of the Sub-region.

52. These observations explain in part the differences between projections based on linear trend and those based on per capita GDP and per capita consumption. The estimated figures in tables III.5 and III.6 based on the two projections can only be intelligent guesses giving a very rough order of magnitude of consumption. Equally acceptable 'Guessestimates' can probably be obtained by multiplying the average annual consumption over the period 1957 to 1960 shown in Table II.1 (1) (The Rhodesias and Nyasaland excepted) by say 1.5 for the items for which the demand is not likely to increase steeply and 2.2 for the remaining items in order to obtain orders of magnitudes of demand in 1970, and by 2.0 and 3 to get orders of magnitude of demand in 1975.

53. In the questionnaire circulated to the various countries of the Sub-region, they were requested to give estimates of consumption in 1970 and 1975. Only Rhodesia and Mauritius gave such estimates. Rhodesia also gave the basis of projection as a growth rate of 5 per cent per annum, which appears quite feasible. Mauritius gave estimates of consumption generally showing a much lower growth rate.

CHAPTER IV

DATA RELATIVE TO ELECTROTECHNICAL ENGINEERING INDUSTRIES

Data relative to production of electrical machinery in the United Kingdom

54. Table IV.1 gives an analysis by size of enterprise of the production of electrical machinery in the United Kingdom in 1958 for firms employing 25 or more persons as obtained from the U.K. Board of Trade Report on the Census of Production for 1958, part 56. The table shows that the net output per person employed varies with the size of enterprise, showing three peak values for three sizes of Enterprise:-

(i) Employing 100 - 199 persons
(ii) Employing 1,000 - 1,499 persons
(iii) Employing 7,500 persons and over

This is indicative of the fact that there is more than one economic size of plant for an industrial enterprise.

Table IV.2 gives similar information for the case of insulated wires and cables (obtained from part 57 of the report referred to above) and shows even more pronounced optimum sizes of enterprise for the two cases:-

(i) Employing 50 - 99 persons
(ii) Employing 500 - 749 persons

In all the cases of optimum sizes of plants, the output per person employed increases with the increase of the size of enterprise.

Data relative to manufacturing operations in Europe

55. Table IV.3 (1) gives basic information regarding minimum economic size of plants for various branches of electrotechnical engineering industries, fixed capital requirements, labour force, floor area and electric energy consumption based on European conditions in 1965.

56. Column 3 of the table gives the minimum economic size of plant based on modern engineering practice in industrialized countries. For

the countries of Africa, plants of lower capacities are likely to be viable, depending on the particular branch of industry, transport conditions and the nature of the market. In the case of domestic refrigerators and domestic washing machines (serial numbers 7 and 8 in the table) the minimum economic size of 20,000 to 25,000 pieces per annum is intended to meet the severe competition within the European market.

57. Column 4 gives the maximum weight of piece to be lifted and helps with the design of buildings and lifting gear. Columns 5 and 6 give the fixed capital investment needed per unit of production per annum and the percentage of this investment which goes into buildings.

58. Columns 7 and 8 give the total working hours per ton of production and the percentage of this total which goes into machinery hours. Columns 9 and 10 give the output in tons per annum per production workman and the output per annum in tons per square metre of production area on the basis of 2 shift operation. Column 11 gives the total floor area needed for the shops and shop offices (apart from other buildings for offices, stores, etc.) related to the total labour force. Column 12 gives the production workmen as a percentage of total labour force while column 13 gives the production workmen as a percentage of the total number of employees. The last column, 14, gives the electrical energy consumption per ton of production.

59. The fixed capital investment is given for European conditions in 1965. For African conditions addition of transport costs and custom duties and increased erection costs result in capital requirements being about 50 per cent higher than for European conditions.

Data relative to electrotechnical engineering industries with possibilities for developing countries

USA Conditions, 1959/1960

60. Table IV.4 (1) gives data relative to some electrotechnical engineering industries with possibilities for developing countries. The data are based on USA small industry situation in 1959/1960 (as given in the Industry Fact Sheets published by the Department of State, Agency for

International Development, Washington) and should be adapted realistically to suit individual countries particularly as regards labour requirements, costs and inventories of raw materials and spares to be carried. They are relatively small in their size by USA standards, but may be considered medium scale in some developing countries. The plants offer possibilities for local investment even where the capital market is still in the early stages of development, for building up needed technical skills, creation of channels of distribution, saving of foreign exchange and gaining experience in management essential to broad-based economic growth.

61. Referring to the table, column 1 gives the SIC number of the Branch Industry given under column 2, for reference purposes. Column 3 gives the annual production capacity of the plant relative to which the data is given, on a one shift basis. After a period of operation on such a basis it may be found advisable to run two shifts per day if the market can absorb the increased output, in order to reduce costs.

62. Columns 4 to 8 give the capital requirements. Column 4, fixed capital, covers the cost of land, buildings and equipment, furniture and fixtures. Column 5 gives the working capital, which represents the initial payment that must be made before receipts from sales start to come in, for direct materials, direct labour, manufacturing overheads (supplies, fuel, water, truck operating costs if any, and indirect labour), administrative costs (interest, insurance, legal charges and audit charges), contingencies, sales costs (sales commissions, freight out, travel and advertisement) and labour training.

63. In most cases the allowance for direct materials, direct labour and manufacturing overhead is fixed at 60 days on the assumption that 30 days will be needed to build up an inventory of finished products and another 30 days will be allowed for collection of accounts. Deviations occur, depending on the time required to get delivery of materials and other factors. The allowance for administrative costs, contingencies and sales costs is based on 30 days in general, since most of these will not begin until sales have started, and time is usually allowed before

payment becomes due. For training costs an estimate is made of the amount of labour time that will be nonproductive or only partially productive, wastage of materials and non-productive use of items coming under manufacturing overhead. Variations in the allowances under this heading arise from variations in the training time needed. In some cases the work is of such a character that no allowance for training costs is needed (USA conditions).

64. Direct materials are the materials that go directly into the finished products and either constitute a part of such products, or are necessary for combining or containing the constituent parts. Supplies are the materials necessary for the maintenance and running of the machinery and equipment and for the performance of administrative and clerical operations.

65. As far as electric power is concerned, a few industries must have their own generating facilities as a stand-by in case of power failure, e.g. where continuous furnace operations are called for and where serious loss of materials or damage to equipment would result from a failure to maintain heating operations. In such cases the cost of the generating plant is included under equipment in the fixed capital requirements (Col. 4).

66. Where an industry needs transport facilities of its own, the capital cost is included in the fixed capital and the annual running cost is included under manufacturing overheads. As regards manpower, this is calculated on the basis of one shift operation. Where it is desirable to work more than one shift in order to make better use of the scarce investment funds, it will be necessary to increase the number of employees accordingly.

67. Depreciation has been calculated on the basis of the following life periods:

Buildings	20 years
Equipment, furniture and fixtures	10 years
Dies	5 years
Tools	3 years
Trucks	4 years

68. Column 6, total capital, is the sum of the fixed capital and the working capital. It is to be noted that financing of the two components of the capital will be on different bases.

69. Column 7, foreign currency component of total capital, is taken as the cost of equipment, furniture and fixtures plus the component of working capital covering direct materials and supplies not locally available. Column 8 gives the remainder of the total capital.

70. Column 9, direct labour, covers the labour used directly in the manufacturing process itself. Column 10, the indirect labour, covers managerial, clerical and other labour not directly attributable to the manufacturing process, such as janitorial, maintenance and book-keeping personnel. Column 11 gives the total number of employees needed.

71. Column 12 gives the fixed capital investment per employee (Column 4 divided by Column 11) and column 13 gives the annual gross sales revenue. Column 14 gives the total annual costs, including depreciation.

72. The gross annual profit is given in column 15, and as percentages of total capital and of gross sales in columns 16 and 17 respectively.

73. Column 18 gives the annual foreign currency requirements. These are taken as the cost of direct materials and supplies not locally available, plus an instalment to cover the foreign currency component of capital cost, assumed equal to 10 per cent of this cost on the average. In the first years of operation additional foreign currency will be needed for expatriate management and other supervisory and technical staff. Column 19 gives the annual foreign currency saving, which is taken as the annual gross sales revenue assumed to be equal to the c.i.f. cost of the product minus the annual foreign currency requirements.

74. Column 20 gives the value added per annum. It is taken as the value of production or the gross sales revenue minus the value of material inputs. It includes the depreciation allowances. The value added is given as a percentage of gross sales revenue in Column 21.

75. The last column, 22, gives the capital output ratio, or the ratio of total capital (Col. 6) to the value added (Col. 20).

Change to conditions in Africa, 1965

76. To change from American conditions in 1959/1960 to conditions in Africa in 1965 a number of factors must be taken into account, and these vary from one African country to another. However, an average case is taken to produce Table IV.4 (2), along the following lines:

Land

77. Considering that the cost of land is only a small percentage of total expenditure, and in view of the fact that land for industrial purposes is scarce in Africa and therefore more expensive than ordinary land, the figures given for American conditions are used for African conditions.

Buildings

78. The average costs used for USA conditions are US$3.5 to 4 per sauare foot, and these can be adopted for the Sub-region.

79. Equipment, furniture and fixtures

1. Taking into account the increase in prices from 1959/1960 to 1965 and the difference in prices between Europe and the USA, the 1965 f.o.b. prices for Africa may be taken as the USA figures for 1959/1960 increased by 5 per cent.

2. Add 12 per cent to the f.o.b. prices to obtain average c.i.f. prices for the Sub-region.

3. Inland transport

   (i) The weight of machinery and equipment may roughly be estimated on the basis of a price of US$ 1.0 per kilogramme.

   (ii) Inland transport costs vary from about US$20 per ton for Uganda, Rhodesia and Malawi to about US$ 32 for Zambia, US$36 for Burundi and US$64 for Rwanda. An approximate weighted average of say US$22 per ton may be adopted.

(iii) An addition of 1 per cent ad valorem should be made for inland insurance.

Taking these factors in consideration, an addition of 3 per cent can be made to the c.i.f. value for inland transport.

4. Add 10 per cent to meet increased erection costs in the Sub-region.

The cost of machinery and equipment should therefore be increased by 30 per cent over the USA figures.

80. Manpower

Indirect labour

(i) Manager will be an expatriate for the first few years in most instances, costing about 30 to 40 per cent more than the USA figure. He will have an understudy who will take over from him within a few years, but in the meantime this will increase management costs. When the expatriate is no longer needed, costs will be nearly half the USA figure as long as there is scarcity of the higher level manpower in the developing country. For simplicity of calculation, the USA figures may be used as an average over the next decade in the case of an average African country.

(ii) Office staff

Numbers to be doubled for lack of mechanization etc., but pay per man would be about 30 per cent of the corresponding USA figure until education is more general in Africa, so costs would be about 60 per cent the USA costs.

(iii) Maintenance staff

Expatriates will be needed for some time in most African countries, but local staff can take over in a shorter period than in the case of the manager. Pay of the locals would be about 30 per cent of the corresponding USA figure until the available local personnel are in much greater numbers. With the number of African maintenance staff about double the USA figures, the costs would be about 60 per cent the USA costs.

81. Direct Labour

(i) For skilled workers the same number of operators would be needed, but costs would be half the USA costs. Production would be lower on non-repetitive work.

(ii) For semi-skilled workers, the number of operators would be increased 50 to 60 per cent, each getting about 25 per cent to 30 per cent of the USA pay for his opposite number. Thus the cost would be about 40 per cent the USA cost.

(iii) For unskilled workers, the numbers should be trebled, each getting one-tenth the pay of the USA unskilled worker, and so costs would be three-tenths of the USA costs.

82. Direct Materials and Supplies

Add about 15 per cent to cover the freight and insurance costs of materials not locally available.

83. Power, Fuel and Water

For simplicity, double the USA costs.

84. Own Transport

Capital cost is included in the cost of equipment and dealt with accordingly. Annual operating and maintenance costs would be double the USA figures.

85. Depreciation

Although the life years taken as basis for the USA figures of cost are low by non-American standards, yet in view of the less capable handling and maintenance, and considering that the depreciation is not too large an item of costs relatively in most cases, the USA figures may be taken for simplicity.

86. Administrative Costs

The USA figures may be taken for simplicity.

87. Sales Expenses

Considering the large amount of advertisement normal in USA practice on the one hand and in view of the lack of sales facilities in

most African countries on the other hand, the costs in Africa may be taken as 50 per cent the USA costs.

88. Working capital

In the USA figures allowance for direct material is fixed at 30 or 60 days. In African conditions, materials not locally available take considerable time for delivery, and allowance should be on the basis of 3 to 4 months. Direct labour, manufacturing overheads and other components of working capital may be taken on the basis of 2 months except for training costs where 3 months may be taken as basis in the average case.

89. Annual Sales Revenue

Landed costs in the Sub-region in 1965 would be about 15 per cent higher than the USA figures for 1959/1960, but this may be balanced by lower output. However, sales revenues depend on the policies of the governments as regards industrialization, pricing and the assistance or protection given to industry. It would be safe to assume that an industry would be started if it can meet landed costs, and the USA figures may be taken for the annual sales revenue.

90. Materials, Supplies, Electricity, Fuel and Water needed for the Electrotechnical Engineering Industries covered in Tables IV.4 (1) and IV.4 (2)

The annual requirements of materials, supplies, electricity, fuel and water needed by the industrial plants with possibilities for developing countries covered in Tables IV.4 (1) and IV.4 (2) in order to meet the production figures given in these tables are given in detail in Annex I.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Foreword

91. The conclusions and recommendations made in this Chapter are based on the foregoing analysis and discussion. However, it is necessary to make some remarks and comments which will help in arriving at the conclusions and in making the recommendations.

The Development Plans

92. Ethiopia, Somalia, Kenya, Tanzania, Malawi and Zambia have prepared development plans, covering periods ranging up to 1967, 1969 and 1970. Malagasy and Uganda are in the course of perparing their development plans. Rhodesia, Burundi and Rwanda have not prepared any development plans. No information is available on French Somaliland, Mauritius or Reunion. All the development plans prepared by the countries of the Sub-region depend to a considerable extent on foreign financing, excepting Zambia whose plan is based mostly on local finance. These plans do not give electrotechnical engineering industries any importance in the development programmes.

Place of Electrotechnical Engineering Industries in Economic and Industrial Development

93. A country on the threshold of industrial development usually starts with industries for processing agricultural products and such industries as textiles and sugar, the products of which are needed by all the population including low-income groups. Engineering industries other than electrotechnical usually come at a later stage and electrotechnical industries often come last, with few exceptions of some branch industries, since electrical commodities are, in general, either luxury items used by the higher income groups or products required for advanced needs.

94. Factors to be taken in account in considering the establishment of electrotechnical engineering industries in the Sub-region

I. Manpower

The main problem in industrialization in developing countries is manpower. With the shortage of qualified persons and skilled labour, those available have to be used to the best advantage to give highest return and to cover the most urgent needs.

Like most African countries, the countries of the Sub-region are very short of qualified personnel, and skills in industry are mostly non-African. Training schemes are in general insufficient for the needs of accelerated industrial development, although a few industrial concerns have good training facilities and have gone a long way towards training their African employees. Engineering industries do not employ large numbers of workmen, but they generally need highly skilled operators. Electrotechnical engineering industries involve a considerable amount of repetitive work, which African workers are capable of doing.

II. Raw Materials and other Inputs

The development of the mineral wealth of the countries of the Sub-region, having been export oriented, does not provide materials in the form needed by engineering industries in general and electrotechnical engineering industries in particular. Besides, since the countries of the Sub-region have not gone far in the process of industrial development (Rhodesia excepted), semi-manufactures needed for engineering products are lacking. As a result, electrotechnical engineering industries established in the Sub-region in the next decade would be dependent on imported materials and semi-manufactures.

III. Size of Market and Economy of Scale

All the countries of the Sub-region have very limited markets, which cannot support the majority of electrotechnical engineering industries. Kenya, Uganda and Tanzania, fully realizing this fact, have agreed to maintain the common market approach to industrial development. The Kampala Agreement, by virtue of which the three countries have each

been allotted industries to be established on the basis of the whole of the Common Market, is worth the time and effort spent in making it and offers an example to be followed by other countries of the Sub-region. Even then, it is only about 4 million inhabitants out of the 27 million persons in Kenya, Uganda and Tanzania that have purchasing power for consumer goods.

IV. Import Substitution

A common approach to industrial development is import substitution. The fact that Kenya has in the past manufactured many products for export to Uganda and Tanzania and that Rhodesia has similarly manufactured products for Malawi and Zambia are definite indications that the recipient countries have opportunities for import substitution. However, it should be noted that in the case of consumption goods, only about 80 per cent of imports can be replaced by local production if the raw material base is available, and the remaining 20 per cent are unlikely to be replaced by the year 1975, due to lack of technical knowledge and labour and management skills and on account of market limitation. As far as capital goods are concerned, a very much smaller percentage of imports is likely to be replaced by local production by the year 1975 (only about 20 per cent) for the same reasons.

V. International Competition

Electrical commodities are produced on massive scales by international enterprises that have long held the market in developing countries. These commodities are generally high value articles which can bear high transport costs, and foreign products can therefore compete with local production. Another factor to be taken into consideration is safety requirements, which need a high standard of manufacture for an electrical commodity to be acceptable to the consumer. Consequently, electrical commodities manufactured in developing countries are unlikely to be able to compete in world markets.

Recommendations

95. The following recommendations are put forward for consideration, not as suggestions capable of being translated into investment decisions, but as indications of industrial possibilities in the electrotechnical engineering field, needing comprehensive feasibility studies before any final decision can be taken on them. They are not meant for countries that have made industrial progress like Rhodesia, but are intended to help the countries on the threshold of industrial development. Moreover, the present study is to be considered a first step, to be followed by others, in order that fuller information may be obtained and more definite proposals made.

96. In Chapter IV Section IV.2 and Table IV.3 (1), data relative to manufacturing operations in Europe have been given to enable the various countries to decide, in the light of fuller knowledge of their own circumstances, on some relatively large electrotechnical engineering industries which may be considered for implementation, mostly on an area basis covering more than one country or on a Sub-regional basis. Such industries need inter-country agreements (along the lines of the Kampala Agreement) before implementation. Section IV.3 and Table IV.4 (2) give data relative to electrical engineering industries with possibilities for developing countries, put forward for consideration mostly for national markets.

97. Industrial development in the Sub-region will depend, for some time to come, on assistance from the industrially advanced countries, both for know-how, managerial and technological skills and finance. The importance of international co-operation cannot be overemphasized. With the rapid technological development which is taking place, the industrialized countries will continuously have new products to export to the developing countries of the Sub-region, while assisting these countries to manufacture the older and less complex products.

98. In the choice of plants for the industries to be established, mixed technology should be adopted. This requires the use of advanced machinery

only for those operations which determine the competitive quality of the product. All other operations should preferably take the form of cheap hand operations.

99. From the market point of view and considering transport difficulties, it would be well to treat the Sub-region in three sections (see map):-

(i) The North, covering Ethiopia, French Somaliland and Somalia, which have better communications with neighbouring countries to the north than with those to the south.

(ii) The Centre, comprising Kenya, Uganda, Tanzania, Burundi and Rwanda. These countries have considerable ties with Congo (Leo.) to the west.

(iii) The South, comprising Malawi, Zambia and Rhodesia. These have ties with Mozambique to the east and Angola to the west.

Malagasy, Mauritius and Reunion could join either the central or the southern sections.

100. For the development of engineering industries in general and electrotechnical engineering industries in particular, the following preparatory steps should be taken:

(i) Manpower development comprising (a) higher education in the sciences, engineering, applied economics and accounting, and (b) training of technologists and of the labour force, both in training centres and within industry. Manpower Surveys must be undertaken as a preliminary step towards manpower development.

(ii) Detailed market studies.

(iii) Standardized industrial statistics.

101. With the limitations and reservations previously mentioned, the following industries are recommended as possibilities to be investigated with a view to the establishment of those industries which feasibility

studies prove to be viable and to have sufficient priority in the economic and industrial development programmes of the various countries of the Sub-region:

A. Industries to be established on a country basis:

Lead acid accumulators
Electroplating
L.T. Cables for internal wiring
Small size electric cooker

B. Industries to be established on an area basis (requiring markets in more than one country):

Domestic Radio Receivers (assembly)
Domestic Refrigerators
Electric bulbs and lamps
Transformers
Electric water heaters

C. Industries to be established on a sub-regional basis:

Electric Motors
Motor Starters
Electric fans
Insulated cables
Specular reflectors
Dry cells
Domestic washing machines

- - - - -