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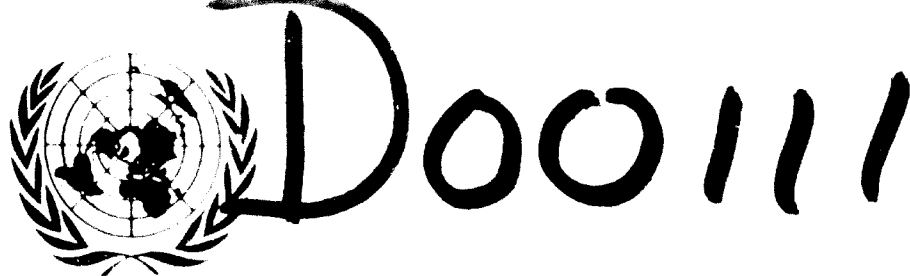
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We regret that some of the pages in the microfiche  
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**MANUFACTURE OF TELECOMMUNICATIONS EQUIPMENT IN  
DEVELOPING COUNTRIES<sup>1/</sup>**

by

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<sup>1/</sup> The views and opinions expressed in this paper are those of the author  
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## Introduction

Much has been said and written about the importance of communication between individuals as one of the most important means of development in any given country and statistics show the intimate relation between the degree of development of any given country and its communications network. In developing countries, where physical communications between populated areas frequently present great difficulties and require very high investments, the importance of telecommunications, often being the only regular means of communication as such, cannot be overestimated.

This basic fact, taken up from two different sides, leads to the following conclusions:

- the government of the country: this industry being of vital importance to the future of the country, it will be mandatory - if at all feasible - to develop an independent industry of this nature to contribute to the overall development plans of the country.
- the potential manufacturer: there is a basic and urgent demand, expanding gradually, today covered by exports (own and competition), which soon will come to the point of being able to sustain an economically sound manufacturing operation.

Starting from this basic situation, the present report attempts to develop all necessary facts to lead to the actual establishment of a telecommunications factory in a developing country.

Special emphasis has been placed on developing this industry as an economically sound enterprise, finally able to compete successfully in the world market. It therefore takes special account of the main difficulties that arise, when

- starting a highly sophisticated manufacturing operation
- in a country with a limited market
- having to form, sometimes from scratch, the personnel to run the operation.

It proceeds through the steps of:

- analyzing the market potential
- selecting the products viable for local manufacture
- defining the degree of local manufacture in accordance with the world market requirements
- analysing the basic steps of the manufacturing plan and
- determining the necessary environmental conditions to make the operation successful.

It furthermore shows the possible influence on industries already established in the country and attempts to outline the possibility of a multi-national operation of this nature.

The basic starting assumptions for the present analysis are:

- a country with no telecommunications industry of its own up to now but with an existing though not yet specified demand
- a manufacturer never having built up a telecommunications subsidiary in a developing country.
- both sides being interested in starting such an operation for mutual benefit.

**i.e.** It intends to be a short form handbook for the planning of a factory for telecommunications equipment, a procedure guide for a successful operation, from which specific case studies, once country and manufacturer are defined, can be derived.

## 1. THE IDEA OF SETTING UP LOCAL MANUFACTURE OF TELECOMMUNICATIONS EQUIPMENT

The basic idea can be originated by one of the two parties involved, the local administration/government or a manufacturer of telecommunications equipment, but experience shows that it normally happens at both ends at nearly the same time.

The reason is obvious: there seems to be a requirement, which is or will be large enough to make such a project look realistic. Even if the motivations of both parties are quite different, they will come to this same conclusion, and the facts on which this conclusion is based are available to both parties simultaneously.

In the following the major motivations for both parties will be listed and analyzed, with special views to the consequences they might have for the other party.

### 1.1. Motivations of the Administration

From the administration's own point of view the basic motivation is always a future expansion of the existing telecommunications network with:

- the possibility of having control over the supplier of their equipment technically, so that any special requirements dictated by the specific local environment can and will have to be fulfilled by the local manufacturer.
- the considerable improvement in training of the administration personnel, which can be much more detailed and deep and with no tight time limits as in the case of an external supplier.

Additionally combined administration/government interests will appear as well:

- possible saving of foreign currency expenditure, normally of great interest in developing countries and very often overestimated in the manufacture of this type of equipment.
- attraction of foreign capital investment.
- creation of additional employment - and training - of local labour.
- additional market for existing local industries, supplying to the new plant (and vice versa).
- export possibilities into neighbouring countries not big enough on their own to start separate manufacture and with which trade agreements exist.
- all sorts of political considerations, prestige, fear, etc., which often can be strong enough to over-ride economic aspects.

All these points of view - which are by no means complete, but represent the major headings - must be recognized and carefully considered by the interested manufacturer,



as they can develop into strong assets for him if correctly taken into consideration when planning the activity, but which can, as well, turn into heavy liabilities if overlooked or underestimated, facing him with obligations difficult or undesirable to fulfil.

1.2. Motivations of the Manufacturer:

The motivation of the manufacturer is basically an expansion of existing business volume, where local manufacture in a specific country is the only possibility to enter or expand activities in it. The main reasons why a manufacturer considers a new nucleus of production in a new country are:

- condition set by the local administration to participate in a major tender: generally the case when the country considers the establishment of a completely new telecommunications network countrywide or similar.
- selling argument of the manufacturer, included additionally when participating in a major tender of the country in question, without a specific requirement of the administration.
- unsolicited proposal of the manufacturer to the local administration to secure a supply agreement in order to expand the already existing export business into this country with all the advantages to the administration as listed under 1.1.
- unsolicited proposal as per above, in order to penetrate into a new market, not yet tackled by the manufacturer.

Once the basic interest of both parties is recognised it is necessary to define the main points of discussion between them, so that an understanding can be reached on how best to put the plan into operation, emphasising or considering in the proper form the main motivations of the administration in order to make it a worthwhile project.

If, for instance, the main motivation of the administration is the employment of local labour, it might be necessary for the manufacturer to provide for manual operation in certain manufacturing steps, which are made automatically in the home plant today. Typical examples would be testing processes with individual measurements instead of automatic multi-testing equipment, internal transport in the plant, etc. This can have the advantage of reducing the initial investment and often also actual production costs for the simple reason that high cost equipment has to be depreciated over a comparatively small volume. Frequently extra labour is more economic as well as more desirable, than extra machinery.

These considerations are to be kept in mind for whatever equipment is going to be made and whatever the quantities required are going to be. These are the next two points to investigate.

## 2. WHAT BASIC INFORMATION IS NEEDED ON THE SIZE OF THE REQUIREMENT?

### 2.1. Products, area, customers: definition

If we leave aside for the moment all those requirements appearing only in small quantities in any country, like satellite communications or submarine telecommunications equipment, there remain two main sectors, as far as the equipment required is concerned:

- voice frequency communications, i.e. from the subscriber set to the exchange and vice versa, and
- carrier frequency communications, i.e. from one exchange to another.

There are obviously requirements that from the operational point of view should be included in one sector, but from a technical point of view would nevertheless come under the other. For example, single channel radiolinks to connect a remote subscriber directly into an exchange, subscriber carrier equipment to allow multisubscriber operation over the same pair into an exchange, or otherwise voice frequency connections over multipair cable connecting a central exchange with satellite exchanges in the same town.

But for the evaluation of the overall requirements of a country the basic operational division only applies.

As far as the geographical area to be covered is concerned, we will have to consider:

- the pure local requirements of the administration concerned.
- a possible export - which can be simultaneous with local supply - into countries with which trade agreements exist.
- a future export into world market against world wide competition.

Typical examples would be Algeria for local requirements and the Maghreb as next step, Iran and the Iran-Turkey-Pakistan association, etc.

The last point to consider is the customers to be served with the local manufacture. Obviously the main one is the local P&T administration. But others, like military authorities, police, gendarmerie, private enterprises like oil companies, mining etc. should not be overlooked, as their combined requirements can well amount to a sizeable percentage of the total P&T needs. Obviously not all of these requirements can be served by the planned manufacture, due to very special conditions, which the equipment will have to fulfil, but even then a local partial manufacture or even assembly can be envisaged, if a local manufacturing operation for the P&T already exists.

In spite of all these possible and very attractive additions, the basis of the local manufacture must remain:

- the pure local requirement of the P&T administration.

**(An exception would be local manufacture to serve the open market, like the manufacture of PABX, to supply private customers - under regulations or by of the P&T - comparable to a manufacture of radio and TV sets, lamps, or similar, under completely different market research aspects).**

Once the procedure for analysis of this basic requirement is established, the same methods will be utilized for the evaluation of the requirements of the other customers/areas listed above.

Each of these requirements will then be provided with a correction factor ( $<1.0$ ), which reflects:

- (a) the limited technical possibility to supply the specific need out of the local production
- (b) the confidence factor to obtain orders if technically possible to supply and with this added to the basic requirement.

## **2.2. Scope**

Whatever the reason for starting a local manufacture it might be of the ones listed under point 1, it will always be necessary to carry out a thorough market evaluation in cooperation with the administration (and with the customers selected).

The necessity for doing so is obvious, if the manufacture is to be started as a general project to supply the local telecommunications requirement. But also in case the local manufacture is tied to a specific project, it will be necessary as the operation should be able to continue after completion of the original project supplying the following demands of the administration, or even be conceived from the beginning in such a way that it can supply also simultaneous requirements besides the specific project.

The resulting evaluation should:

- be agreed between administration and manufacturer
- cover both fields: voice frequency and carrier frequency equipment as defined above
- cover a time period of at least five, preferably ten years.
- be an agreed means between the administrations long term planning (five-year plan or similar) and an independent evaluation of the manufacturer.

The basis of a general market survey for telecommunications is always the requirement for telephone lines. Once this is established, the demand for switching equipment can be derived rather easily.

As far as the transmission sector is concerned the requirement for transmission of radio and TV broadcasting programmes represents an important factor. (Even if these requirements are dictated by the Ministry of Information or equivalent institution, they are considered in this study as part of the P&T requirements, as this administration is normally responsible for provision and operation.) Nevertheless the bulk of a possible local manufacture will mainly be the number of channel ends (channel modems), direct responsibility of the P&T, while broadcasting requirements will mainly determine or add to the basic bandwidth to be provided by the required transmission systems.

### 2.3. Basic data to carry out a market survey

#### 2.3.1. Voice frequency communications

The basic data on which an extrapolation for future consumption can be carried out, are:

- the actual number of subscribers broken down by urban and rural population and within this by domestic and business application.
- relation of these figures to the population in the different concentration points.
- estimated reasons for abnormal changes shown in the past growth pattern per analyzed concentration point (such anomalies can occur for instance in a normally growing town, where oil is found, thus boosting industry and attracting investment, whereby the telephone requirement jumps suddenly to very high values compared with other similar towns in the same country; another example for an opposite trend would be the move of government administrations out of a certain town, with a consequent decrease in demand for newly installed telephones, etc.)
- growth pattern over the last ten years (or similar value, showing a sizeable change between first and last figure) per analyzed concentration point.
- per capita income of the country overall and - if available - for the different main concentration points. In many of the countries analyzed there is a clear difference between the per capita income of the capital the main industrial town or towns and the rest of the urban population, amounting sometimes to something like 30% and from there again to the rural population. It is obvious that all these data will normally not be available in form of clear statistics, but rather good estimates can be obtained through site visits and discussions with the local civil authorities and administrations.
- growth rate of the per capita income over the last 5 to 10 years or any significant period of time, representative for the actual political and economic situation (normally the Gross National Product figures will

be available in an easier form than the per capita income).

- expected growth rate of the per capita income as per government's long term planning, taking into consideration the increase in population (past and projected) to arrive at fairly reliable figures.
- list of major development projects planned per concentration point by the government (for example: a certain town is designated by the government to be the development nucleus for a specific industry of the country, for instance in Iran, Shiraz for the electrical industry), which will raise a stronger increase than normally extrapolated in the telephone requirement.
- waiting lists for telephone applications - if possible per major concentration point - and their development over a sizeable period of time.

Obviously in most cases only a portion of these data will be available or obtainable through own research. Others will have to be added through best possible estimates from as many different sources as possible, to arrive at a good total estimate.

### 2.3.2. Carrier frequency communications

As outlined above, two basically different requirements will have to be served: inter-urban telephone traffic and broadcast programme transmission.

For the first group the basic data to collect will be:

- existing network of transmission and its historical development, initial bandwidth, initial number of channels, increase in bandwidth, increase in number of channels (value, timing).
- increase in telephone density of the linked points (as per 2.3.1.)
- limitations of the links in terms of hours in operation technically (if applicable).
- utilization factor of the channels (average).
- waiting time for subscribers, to obtain a communication over the links.

As far as the second group is concerned, direct economic factors are not the deciding ones, as no direct revenue will be obtained. The data, on which an estimate of future requirements will be done, are therefore only:

- existing studios for radio and TV broadcast programmes originated.
- existing transmitters for radio and TV broadcast and areas covered, programmes transmitted.
- existing links between studios and transmitters.

## 2.4. Procedure

Three independent assessments can now be carried out and the results compared and discussed.

### 2.4.1. Extrapolation of requirements out of the basic data collected under 2.3.

It isn't the intention of this study to show an experienced market research man how to do his job, once the basic data have been collected, but a certain number of indications might be helpful. For instance, to assess the validity of extrapolation it is very convenient to consult the statistics of the development of countries with similar conditions, but already at a more advanced stage, i.e. same population, same area or similar, similar geographical conditions, but a higher per capita income, the number of existing telephones already considerably higher, etc.

All comparisons of this sort must obviously be treated with many reservations as conditions will never be equal in a developing country today as they were in another country years ago. The main factor is that the economic increase per year develops today at a higher growth rate than it did say 10 years ago in another - then similar - country.

One of these examples, with reservations, would be Iran - Spain.

A relationship similar to that between countries in different stages of development exists between towns in the same country. The capital or major town has developed at a certain speed, with all the drawbacks and difficulties of a first experiment. The following towns will reach the saturation level of the main one in a much shorter period of time, as they have "learned from experience".

Therefore, to extrapolate the telephone requirements, a geographical representation of the growth of telephone density up to the present plotted against the growth of the per capita income will show the first trend. This trend will then be corrected with the main influencing factors, i.e. major events past (to rectify the actual figures) and future (to correct the basic trend line), comparative values of other countries or towns, etc.

If possible, these evaluations should be done not only for the country as a whole, but where existing statistics (or obtainable ones) are available, for the major concentration points.

To extrapolate the interurban requirements is a more difficult task and can be basically divided into two different sections:

- a link between two points already exists and will have to be expanded in the future: out of the utilization factor or the existing channels in the peak hours, the waiting times and the expected telephone increase in both towns a fair judgement of future requirements can be made.
- a link between two points does not exist yet. Here a purely comparative method will have to be applied, i.e. to choose two similar towns (if one of them is one of the two newly contemplated, much the better) already linked together and determine their traffic.

**evolution. The traffic expected between the two new towns will be directly proportional to the number of telephone stations existing and inversely proportional to the square of the distances involved.**

**The extrapolation of broadcasting programme transmission must be basically deduced from the areas still not covered by the existing broadcasting stations (mainly FM and TV) and the importance of the different programmes for these areas. From this information it can be decided whether or not it is desirable to transmit to the new broadcaster sites from the studio producing an original programme.**

**With these evaluations a fairly good overall development figure can be drawn up as a first estimate of the future requirements of the country, under the assumption that the administration concerned will be able to provide the equipment required, which means that sufficient funds will be allocated to the administration for it, which in turn means that sufficient equipment can be produced at the planned factory.**

#### **2.4.2. Comparison of the extrapolation to forecasts by mathematical methods**

**The III Plenary Assembly of the CCITT in 1964 in Geneva set up a Special Autonomous Working Party GAS 5 to consider and analyze the problems of economic and technical development, with special view to the developing countries, and to elaborate specifically on the subjects:**

- **influence of economic factors on the development of telecommunications**
- **traffic forecasts**

**The results of these studies are compiled in the publication "Economic studies at the national level in the field of Telecommunications (1964-1968)" and contain extremely valuable data, comparative analysis, traffic equations, etc.**

**With these studies a separate evaluation of the requirements of a country can be made for comparative purposes with the results arrived at through 2.4.1.**

**It is very unlikely that major discrepancies will appear, but if they do, a justification will have to be found, thus possibly leading to new aspects for certain parts of the study.**

#### **2.4.3. Comparison of the future requirements with the administration's own figures and budget.**

**This will not be a separate step in itself but rather be closely related to 2.4.1. and 2.4.2.**

The purpose is to arrive at a common understanding with the administration as to the validity of the figures representing the requirement in principle. Once this is obtained, the administration's budget and budget projections will put the actual time scale of priorities to it, and with this the production volume per year over a certain period of time.

(Special attention should be paid to the equipment prices, on which the budget is based, as the resulting number of units - as production basis for the new factory - must be produceable at these prices locally. This already will define roughly the selection of products most indicated to start the local manufacture.)

Depending on the already existing telecommunications facilities and the economic position of the country, the long term budget of the administration can have the following relationship to the actual demand:

- (a) demand (requirement) and the budget run roughly parallel. This means that a constant backlog will exist, so ensuring the future operation of the company.
- (b) the budget increase is lower than the increase in demand. The backlog will build up continuously. The factory will have secured a future work load, but the volume that the budget allows should be carefully analyzed to see whether local production is still justified.
- (c) the budget, which has been running low against demand, is aimed at catching up with the backlog during a rather short period of time. The period after this catching up time is the decisive one for assessing the feasibility of the operation; in this case two possibilities exist:
  - the factory is built to a capacity that just copes with the demand after the first period, in which case the further requirement of the first period will be filled by imports - preferably from the mother company.
  - the factory is built to the requirement of the first period, in which case the manufacturer must make sure that the overproduction after it can be sold in export markets.

A correct judgement on this depends obviously on the length of this first period as compared with the amortization of the factory installations. Future production of other equipment required by the same market, once the initial period is over, must also be taken into account.



### 3. DETERMINATION OF THE EQUIPMENT TO BE MANUFACTURED

Once it has been established what quantities of equipment are required and will actually be bought by the administration over a period, it is necessary to define:

- which equipment is suitable for local manufacture.
- what are the exact specifications of the equipment to suit the local requirements.

#### 3.1. Equipment suitable for local manufacture

The bases for a preliminary judgement are:

- the cost of production raises with decreasing volume.
- the equipment has to be produced at a price acceptable to the administration.

These two premises already eliminate a certain number of products, mainly in the transmission area, for example radio equipment for broadband radiolinks, ancillary TV equipment and similar. If their manufacture is feasible, the same will apply to all other products related to them.

For every product there exists at the mother company a certain key figure below which manufacture of this product becomes uneconomic or where production has to be very carefully scrutinized.

Some of the key figures could be:

transmission channel moderns	2-3,000 per year
switching equipment	30-40,000 lines per year
plastic capacitors	10-12,000,000 per year

In a rough approximation it can be stated that if the ultimate capacity of the planned factory will never come near these figures, production will not be economic. On the other hand - even if the administration is willing to provide a certain degree of protection during the first years of manufacture - it will be the aim of the administration (and of the manufacturer) to decrease this protection, to make the factory a self supporting competitive unit.

#### 3.2. Definition of the term "manufacture"

The expression "manufacture" is very often used as opposed to "assembly", the latter being a term not well received by most administrations, because importing complete motorcars without tyres and mounting them locally could also be considered as "assembly". This actually cannot be the aim of any administration

nor of any serious manufacturer.

On the other hand a genuine assembly can well be considered as a first step of manufacture. Therefore it will be convenient to ban the expression assembly and consider only manufacture of various degrees. To do this, the full manufacturing process of the equipment considered will be divided into its major steps and the number of these steps performed locally will determine the degree of manufacture of the product locally.

Considering, for example, cost transmission equipment, the basic steps of production could roughly be:

- |   |                             |
|---|-----------------------------|
| (1) rack testing                                  | (10) framework manufacture  |
| (2) rack assembly                                 | (11) coil assembly and test |
| (3) subrack testing                               | (12) coil winding           |
| (4) subrack assembly                              | (13) metal pieceparts       |
| (5) cabling                                       | (14) plating                |
| (6) printed circuit testing                       | (15) plastic moulded parts  |
| (7) printed circuit assembly                      | (16) jacks and plugs        |
| (8) incoming inspection electrical and mechanical | (17) tool manufacture       |
| (9) printed board manufacture                     | (18) components manufacture |

If we group these into subgroups, which logically belong together, we will have as an example:

1	through	5	manufacturing degree	1	(genuine assembly)
1	"	8	"	2	
1	"	12	"	3	
1	"	15	"	4	
1	"	17	"	5	

(18 might be a separate industry, to be commented later)

Such groupings will obviously be different from equipment to equipment and also in the views of every manufacturer, who can subdivide each of the basic operations again, make more subgroups out of them, etc, but the basic principle remains.

It will always be the aim of any manufacturer - and of any administration - to produce locally as much of the equipment required as possible with the highest degree of manufacture economically achievable. On the other hand, many of

the manufacturing steps of basically different equipment are similar and could be performed by the same operators and basically with the same equipment - even if tools might differ. This leads automatically to the conclusion of a step by step plan of manufacture, in which the producer starts with manufacturing degree "1" of the most promising looking equipment out of his market research operation, proceeding to augment the degree of manufacture step by step by adding other products as soon as their volume arrives at the critical value necessary through the growth of the market.

The reason for this is clear: to perform every manufacturing step in an economic form, a minimum quantity of each operation has to exist. The actual production volume of a certain type of equipment (where the quantity is given through the market figures) can be increased through adding other equipment to the production range, which requires the same operation, thus bringing production up to a total figure near or above the critical quantity.

### 3.3. Practical example:

Let us assume that the requirements of a certain country are defined for specific products, the key figures for an economic production of these products are known and a factory plan has to be developed.

The operation will follow along these steps:

- comparison of the market size with key figures
- determination of the earliest possible time to start operations
- basic philosophy and application to the specific case
- complete time grid

#### 3.3.2. Comparison of market size with the key figures.

Year from now	1	2	3	4	5	6	7	Key figure
Channel ends	500	1000	1500	2000	2500	3000	3500	2000-3000
Single ch r/link term	100	200	300	400	500	600	700	500- 750
12 ch o/w terminals	10	20	40	60	80	100	150	100- 200
3 ch o/w terminals	10	30	50	75	100	200	250	100- 200
24 ch radio TX/RX	30	50	75	100	150	200	250	200- 300

Each product has its own growth pattern, which does not allow manufacture of all of them to start at the same time. Simultaneous starting is ideal from the economic point of view but not from the operational. Once the factory is completed and operations are to start, it is preferable to start in a step by step form in order to allow a running in of the whole operation, smooth on the job training to keep the number of expatriates low, etc.

It must therefore be determined how to synchronize most favourably the convenient growth of the manufacturing capability of the factory with the growth of the market requirement.

### 3.3.2. Determination of the earliest possible time to start operations

As an order of magnitude it generally takes about two years from negotiations with the administration (once the market research is completed) until the first pieces of equipment start being produced. This develops in the following standard steps (0 being the month of start of acquisition of site):

negotiations and agreement administration	.. - 0
acquisition of site (pre-selection already done)	0 - 3
building design and construction	0 - 16
ordering to delivery of plant equipment	0 - 18
installation of plant equipment	12 - 24
selection and training of local personnel	0 - 24
trial operation	20 - 24

Depending on the support and help of administration and government, this time period of 24 months can sometimes be brought down to 18 months, but as a rule of thumb a forecast of 2 years is safe. (Figures indicate months)

### 3.3.3. Basic philosophy and application to the specific case.

The basic philosophy will always foresee the synchronization of factory and market growth, as indicated above, which in practice will mean:

- short operations with the lowest manufacturing degree of the fastest growing product, i. e. at the time production is going to start the product nearest to its key figure.

All other products will be imported, whereby it is important to note that at least the products related to the first manufactured one should be imported from the mother company of the manufacturer to avoid interface problems (example: if operation is to start with channel ends or multiplex, the terminal equipment for it, i. e. 12 ch o/w and 3 ch o/w terminals and repeaters, should come from the same company).

- increase the manufacturing degree of the starting product to degree 2 and continue importing all others. Once manufacturing degree 2 runs smoothly, i. e. the personnel is capable of following the step by step plan, further products can be added.

- add manufacturing degree 1 of further products, in accordance with market requirements.
- continue adding products and deepening the degree of manufacture, taking into consideration that the investment required additionally for every further degree of manufacture is in line with the total volume of production (i.e. even if the number of channel ends has passed the key figure, it still might not be worthwhile to go into the investment required to manufacture printed boards or plastic moulded piece parts, unless other products were added to justify the necessary investment).

This basic philosophy will now be applied to the specific case in question, substituting in our market evaluation (see 3.3.1.) the requirement figures by the corresponding possible degrees of manufacture. The table will then look as follows:

Years from now	1	2	3	4	5	6	7
channel ends (multiplex)	x	x	1	2	3	4	4
single ch r/link term	x	x	-	1	2	3	4
12 ch o/w terminals	x	x	-	-	1	2	3
3 ch o/w terminals	x	x	-	1	2	3	4
24 ch radio TX/RX	x	x	-	-	1	2	3

(It obviously would be easier, if the administration could be convinced to incorporate the 12 channel open wire requirements into the 24 channel radio-links, in which case both together would allow bringing the manufacturing degrees forward, but it is assumed that these discussions have already taken place and the requirement as stated is the ultimate).

From the different manufacturing processes listed under 3.2. it is clear that heavier investment is required for manufacturing degrees 3 onwards than 1 and 2. In order to cover as many products as possible when starting degree 3, a re-arrangement of above table could therefore be done as follows:

#### 3.3.4. Final time grid

Years	3	4	5	6	7
(1) channel ends (multiplex)	1	2	2	3	4
(2) single channel radio link terminals	-	1	2	3	4
(3) 12 ch open wire terminals	-	-	1	3	4
(4) 3 ch open wire terminals	-	1	2	3	4
(5) 24 ch radio TX/TX	-	-	1	3	4

As can be seen, in the first product the degree 2 has been extended to allow for products 2 and 4 to come in on it, and in products 3 and 5, degree 2 has been omitted, passing over directly to degree 3, as this would be already justified through the other products.

#### 3.4. Cooperation with already established local industries

Obviously, market growth is not always so favourable to a harmonic growth of the factory. Also the administration might require a faster schedule in the manufacturing degrees than a truly economic operation would allow. In this case the logical solution might be to postpone the starting of the operations by a certain period of time, but this might be undesirable for a certain number of other reasons, e.g. economic or political.

In such a case the following two possibilities exist:

- (a) Obtain sub-supply from local companies performing in their manufacturing programme one or more similar technological steps as required for the new factory.

Examples would be: a local manufacturer of radio and TV sets, producing his own printed boards, could well supply the new factory, if the necessary information and designs are provided. The same would apply to metal piece parts, plastic moulded elements and the like. This would have the further advantage of keeping the investment in the new factory low, or at least postponing additional investment until it is self supporting.

- (b) Reverse the situation by supplying related industries with by-products out of their own manufacturing resources, i. e. supply for example local manufacturers of radio and TV sets with printed boards, etc.

This is a point well worth investigating in any case and possibility (a) is the preferred one to follow during the initial years of operation, even if not absolutely necessary for the sub-contractor's own production, and to consider point (b) anyway, once the new operation is established. That both of these policies will find full support and agreement of the government is already outlined in chapter 1.1.

#### 3.5. Exact requirements of the equipment to be manufactured

The local environmental conditions under which telecommunications equipment will be required to operate will normally be rather different from those of the mother company.

**The differences will mainly concern:**

Climatic conditions (temperature, humidity)

Power supply (one of the most important factors in developing countries)

Vulnerability (fauna and flora, vandalism, etc).

**plus any other specific to each country, impossible to list in the present study.**

**Typical difficulties presented are:**

In deserts buried cable repeaters being laid bare or deluged by sandstorms.

Bush fires destroying open wire pole routes.

Periodic floods preventing access to equipment for servicing.

**and many others.** None of these will affect the basic structure or design of the equipment, but it might require some changes in the choice of the components used, or in the housing and external protection. It is of paramount importance to establish all these requirements beforehand and in detail with the administration so that the equipment produced really is capable of operating to the full satisfaction of the administration. As a secondary effect this will encourage the administration to disregard outside competition.

### **3.6. Components manufacture**

It is an aim of many administrations - in order to become as independent as possible of external supplies (imports) - to set up a local manufacture of components, e.g. semiconductors, ferrites, capacitors, resistors and the like.

For this type of product the key figures are extremely high and it will be essential, therefore, to envisage the procedure outlined in 3.4.b. It should be kept in mind that:

- **electronic components are typical mass production products, which benefit critically from large volume production due to:**
  - low value per unit
  - high material and low labour cost
  - high investment in machinery for the necessary degree of automation
- **the difference in quality and production processes between professional and consumer product components is continuously decreasing, the only differences in many cases being:**
  - different types of finish or encapsulation
  - selection of professionally suitable units out of production batches

- It is the aim of any manufacturer of professional equipment to utilize consumer type of components to the largest extent possible, to have the advantages of:

- low cost of standard components
- uncritical design
- easy replacement in the factory and on site.

**Some examples of key figures for economic production would be:**

plastic capacitors	12,000,000 units per annum
resistors	200,000,000 units per annum
semiconductors	20,000,000 units per annum

provided that the numbers of types is small.

The obvious conclusion is that the manufacture of electronic components only becomes a viable operation where there is sufficient market volume, which must be based principally on the consumer industry and out of which the professional components requirements can be derived.



#### 4. POSSIBILITY OF A MULTI-NATIONAL TELECOMMUNICATIONS FACTORY

The critical points of all manufacturing programmes for developing countries are:

- the relatively small market volume
- the variety of equipment required

and considering that export of the manufactured products into neighbouring areas under the same conditions or even into the world market is a factor which should not be taken into account as a condition sine qua non to make the operation viable in itself, the logical conclusion would be to base the manufacture of telecommunications on the requirements of more than one country, the countries being related by firm agreements and in such a way that an interdependence between all of them exists.

The agreements can be of general technical cooperation, like Turkey-Iran-Pakistan or purely related to telecommunications like the UAMPT (Union Africaine et Malagache de Postes et Telecommunications). The interdependence between the countries involved should be such that it becomes undesirable to any of them to break out of the agreement. To create such an interdependence, the two following variables exist: the different steps of manufacture and the different types of products. Along these two the division by countries may be established:

##### 4.1. Division by different steps of manufacture

This would mean that each of the countries involved would perform one or more of the groups of manufacturing steps, defined as degrees of manufacture under 3.2., starting from degree 5. The difficulties lie in this case in the problem of dividing the steps in equitable form between the participants in terms of contribution to the finished range of products and investment, preferably in relation to the overall resources and requirements of the individual country in question. On the other hand it would give each of the participants the feasibility to perform certain operations in the most economic form, due to combined volume. To secure the activity, if the one before in the chain breaks out, there will always be the possibility of importing the piece parts to perform the necessary steps. But if the one after breaks out, the situation becomes more critical. The only possibility then would be to serve related industries in their own country. Any manufacturing unit under these conditions would obviously insure itself against this risk by doing so anyway. But this would pull the emphasis of the operation away from telecommunications with its rather small but sophisticated volume compared to, for instance, the consumer products industry. The whole chain would become too vulnerable in its entirety and knowing this, it is rather unlikely that such a system could be put to operation.

##### 4.2. Division by different products

Each of the participating countries would fully manufacture the total requirements of all the countries, of one specific type of equipment, thus arriving easily at the key figure in question for each of them. A possible division in the transmission field would be for example: Country A to manufacture all multiplex requirements, country B terminal equipment and repeaters for cable or open

wire, country C TX/RX for radiolinks. Each of the countries would then have its own complete product and the interest would be genuinely bilateral: if one country does not buy its requirements of the product made by another of the group, the direct danger for the sale of its own product is imminent, which under 4.1. would not be the case. Although the interdependence in this case is not as strong as under 4.1. in terms of putting the operation to work at all, the interest to keep it operating might be higher because each country is directly related to all others in the group.

Under these conditions even the manufacture of components might become a viable operation, if one of the countries is assigned to manufacture them for the whole consumption and in turn buys its finished product requirements from each of the other participating countries. (If the total requirements are nevertheless still too low for rational components production, a considerable improvement in the manufacturing costs of all products could be achieved through a common purchasing board to serve the bulk of the requirement, thus obtaining prices a single country with its individual requirements would not be able to achieve.)

Which products to be manufactured in which country with what degree of manufacture depends entirely on the countries involved, their degree of industrialization and their requirements as a portion of the overall group and in relation to the participation of the individual products in the group.

While this can only be defined for every specific case, the clear conclusion is that a multinational operation of this kind is bound to be successful from the economic point of view, if an agreement between the governments involved is reached.

If for one reason or another the agreement must be terminated, it will still leave each of the countries with a fully operational industry and the best possible chances for exporting, thus making it desirable to continue the former procedure without a specific agreement.

In principle the possibilities of such an operation would not be linked to this group of countries: in the same way that a central purchasing board can be set up so a central exporting group can be put into operation, drawing from the manufacturing programme of all the participants. The organizational questions appearing in this respect have been solved in different ways in internationally operating companies and should, therefore, not present any insufferable problems.

The basic thoughts about such an operation only scratch the surface of the possibilities and it would go far beyond the scope of this article to develop them in detail. In the following chapters, as in the preceding, basically national aspects will be considered again, but they will apply in the same form to any multi-national operation.

## 5. FINANCING POSSIBILITIES

Policy of the manufacturer and laws of the country in which the operation is going to be established, determine the financial participation of the manufacturer in the project. This can range from a single licensing agreement, providing know-how and management without own capital investment or equity in the new operation to minority interest, majority interest and even complete ownership.

Except in the last case the manufacturer will look for financial partners in the new enterprise, which can be basically:

- private, semi-private or governmental enterprises in the country of origin of the manufacturer.
- private, semi-private or governmental enterprises in the country of establishment of the proposed factory.
- the PTT administration (as different from the above) of the new country, being the major customer of the new enterprise.

It is not our concern to analyze how the two first possible partners listed obtain their participation and as far as the third partner is concerned, its possibilities and resources are detailed in Chapter VII of the CCITT - CAS 5 publication, already mentioned above "Economic studies at the national level in the first of Telecommunications (1964-1968)".

But it will be of utmost importance to analyze how the choice of the right partners can contribute to the success of the operation.

### 5.1. Considerations of the influence of financial partners in the equity

It should be clearly established that the term "financial partners" is only used for those entities that participate in the profits of the company as shareholders (or equivalent) and not for those who, although contributing also to the financing of the operation, do this in the form of a loan to the enterprise at defined interest rates and for a fixed repayment period.

There will not be many cases to cite in which partners of the first category listed are involved. It would be conceivable though that the government (or a government administration) of the home country of the manufacturer will invest in a developing country within the framework of a technical cooperation agreement. But in such a case a national call for tender will have to be issued with exactly defined conditions triggering the whole project off. The risk will then not be with the manufacturer or rather the manufacturer will be in the role of a partner to its own government.

As far as the second and third categories of possible partners are concerned, the following criteria will apply:

- interest in making the company successful beyond the interest in getting as high a dividend as possible.
- thorough knowledge of and power to enforce the application of all laws and regulations relevant to the establishment of such an operation.

- ability to obtain foreign exchange
- ability to obtain local credits
- relations with customers, mainly the PTT
- knowledge, ability and influence to simplify the setting up and operating of the company by obtaining agreement to special requirements/regulations (initial semi-permanent and permanent), easing of red tape and the like.

Some of these criteria are intrinsically related to the different possible partners. Where this is not the case, the partner in question should be carefully scrutinized as to his ability, leading possibly to the choice of an additional partner.

The percentage of participation will depend on the participation of the manufacturer, his own views on the above criteria and thorough discussions with the partners envisaged. Normally for this type of operation the most suitable partners are the PTT itself, if the laws of the country permit such a participation, and the local Development Banks or similar institutions.

## 5.2. Credit

This can be obtained either in the home country of the manufacturer or locally, and the equity to credit ratio will depend on the usual policy of the manufacturer and the regulations of the country.

The credit resources in the country of origin of the manufacturer are of great variety and best known to the manufacturer. On the credit facilities locally available, the local partners will be able to give best possible advice.

The percentage of local to external credit will have to be determined under the following main considerations:

- working capital requirements in local currency
- transferability
- cost of money at different sources
- general credit conditions
- devaluation risk

## 6. THE BASIC STEPS OF THE MANUFACTURING PLAN

Every enterprise has its own nomenclature for the calculation of manufacturing costs, but basically they reduce to the following:

- Production costs:** material  
direct labour (directly producing)  
indirect labour (supervision, purchasing, stocks, inspection, etc.)  
depreciation (machinery, tools, buildings)  
utilities (electricity, water, gas, etc.)
- Related costs:** rejects and other manufacturing variances, inventory adjustments, packing and shipping costs, etc.
- "Overheads"** administration and general costs (from General Manager to cleaning women and watch dogs)  
marketing and sales promotion  
finance costs, interests, etc.  
royalties, management fees, know-how transfer  
taxes  
net income

Additional to these running costs of the operation will be the start-up costs, not yet included in the above list in the form of depreciation. These will mainly be:

- Purchase of land
- Training costs of personnel (initial training)
- Running-in of machinery
- Other manufacturing start-up costs
- Marketing launch costs

which will have to be financed and the recuperation of which will also have to be spread over a certain number of years.

Out of these factors the selling price of the equipment will be determined in the usual way.

Although some of these components of the selling price are determined directly through general policy of the manufacturer, rules and laws of the country of investment, etc., others will have to be analyzed in detail for every case.

### 6.1. Basic local information

In order to do this, a certain amount of basic information has to be obtained from local sources (financial partners, local agents, lawyers, government entities), the most important of which are:

- site of the proposed factory: does the Government have any preference for locating industries in certain parts of the country? If so, what would the Government incentives be - tax reduction, lower cost of land, etc? Would

other sites be preferable from an operating point of view (availability of utilities, transport facilities, labour resources, etc)? Comparisons will lead to a decision on the most suitable place to establish the factory.

- cost of land
- cost of building in the selected site
- availability and cost of utilities (power, water, drainage, gas, telephone lines, etc): are they available on the selected site or have new lines and pipes to be laid, wells to be opened, etc. If so, what is the cost involved? What are the running costs of the utilities (kWh, gallons of water, cu.ft. of gas, etc.)
- costs of security
- costs of labour (average) for skilled/semi-skilled/unskilled male and female; availability of this labour, transport to site and back, social regulations of the country (canteen, first aid, etc.), social charges on wages.
- working hours, paid holidays, regulations covering overtime, etc.
- availability of middle and top management, salaries and social charges, educational ratings, experience in related industries.
- depreciation regulations for buildings, machinery and tools.
- official laws and regulations concerning foreign investment: in most cases published by the Government in comprehensive form covering:
  - taxes, customs duties for machinery and materials
  - repatriation of profits and capital
  - management contracts, management fees, know-how and royalty transfer, etc.

## 6.2. Production costs

To determine the production costs, the equipment to be manufactured will be divided into the different steps of manufacture as outlined in 3.2. Each of these manufacturing steps will then be the subject of a separate production cost analysis to determine the most economic way of production. This will be the most suitable compromise between:

- low foreign currency investment
- low foreign currency recurrent expenditure
- maximum use of local resources

### 6.2.1. Material (raw material, piece parts and components)

The material required for each of the manufacturing steps can be procured through:

- local purchase from related already established industries
- own local production (not applicable to raw material)
- import

**In order of preference.**

**Purchase from established local industries:** even though this is the preferred procedure, it should be carefully checked in terms of quality for the professional application envisaged and price in relation to open market procurement to achieve this quality. It will be convenient to have this assessment made in the presence of a representative of the Ministry of Industry or similar entity. Needless to say if the local manufacture stands up to the requirements, a detailed supply contract has to be agreed with a particular manufacturer, outlining the information, tools, etc. required by him and his responsibility as a supplier.

**Own local production:** this will be envisaged as the next step if there is no local supplier available or suitable. A rough crosscheck of the investment in machinery required against the utilization factor of this machinery as compared to the activity in the source house will determine whether it is worth going into details or passing straight over to imports. The comparison basis will always be between the landed cost of the imported article with its high content of foreign currency expenditure and imported raw material, with its high total expenditure on manufacture.

If the utilization factor is within the right order of magnitude and the growth of production envisaged will bring it near to a reasonably economic figure the two following possibilities can be evaluated:

- start importing the material until production becomes viable
- seek supply possibilities to related industries and start manufacture from the beginning of operations.

The latter possibility should again be explored together with a representative of the relevant authorities, in order to ensure that the requirements of the market will actually be filled out of this envisaged source. A separate agreement for manufacture will have to be set up with the Government.

Obviously as soon as the possibility of local manufacture of material (piece parts) is envisaged, this production will be a complete manufacturing planning exercise in itself, comprising again the steps outlined above for production costs and related costs as far as applicable. The total cost of material will finally be the sum of:

- raw material and pieceparts bought in locally
- production and related cost of pieceparts of own local manufacture
- landed cost of imports, whereby the charges for landing the material should be carefully evaluated and determined in terms of taxes, customs duties (special possible reliefs), customs clearance expenses and local transport to factory site.

#### **6.2.2. Machinery and tools**

Once the availability of material is determined, the necessary machinery and tools to produce the finished product are well defined. It can be assumed that all the machinery as well as the tools will have to be imported and it normally will be purchased from the source house, where

**all the necessary adaptations required to produce the envisaged product can be made to standard type machinery.**

**For the import of the machinery the Government normally allows special conditions, like exemption from duties and taxes.**

**The depreciation of the machinery as a portion of the manufacturing costs will be determined through the experience of the manufacturer and any existing local regulations.**

**It should be kept in mind that the purchase of machinery and tools is a recurrent item of foreign capital expenditure, so that provision for obtaining transferable currency at the appropriate time should be made upon agreement of the manufacturing plan with the Government.**

### **6.2.3. Labour**

**The quality and quantity of required man hours for the different grades of labour are arrived at from the cost of labour, basically determined as per 6.1., and from an analysis of the manufacturing process.**

**Where required, an efficiency factor should be used to take account of the comparability of labour, which then might reflect back on to the tool and possibly even machinery requirements.**

**The conversion of final man hours into individual persons on the company's payroll will then be done in accordance with the local regulations as set out under 6.1. The analysis of optimum usage man/machinery will then be done in the usual form, considering the priorities of low foreign capital expenditure, maximization of employment of local labour and regulations on single/double shift working. The result can often be different from the optimum distribution in the mother company.**

**Especially in the manufacturing processes requiring a higher degree of skills (and normally requiring less machinery, but more tools), bottlenecks are likely to appear. It would therefore be convenient to plan for two shift working in these instances.**

**When the organizational structure and the number and qualifications of labour on the shop floor are well defined the necessary job descriptions can be written up, basically as a copy with slight adaptations of those existing in the mother company.**

**Providing labour will now comprise two steps:**

- selection**
- training**

**Relevant government agencies as well as the manufacturer's own agent or future financial partners will help to obtain access to the labour resources of the country. It is then up to the manufacturer to carry out selection testing and evaluation (possibly by sub-contracting specialized consultants).**



**This will enable the manufacturer to ascertain individual aptitudes and talents for specific jobs, giving at the same time some views on the potential of the individuals for future development.**

**Training is one part that should be most carefully planned and costed, as well as properly phased-in during the build up period, so that as little time as possible is lost once the factory is ready for operation. (Please refer also to Dr. H. Ebenberger's paper "Some telephone problems in developing countries"). For this a special training programme has to be set up, comprising:**

**Training of supervisory level must be adapted to the specific requirements of the individuals selected, this training programme will consist of the following three portions:**

- **General training on supervision, covering subjects like psychology (basics of working in a team), sociology, employee policies, management organization and control, communications in an organization, work planning, record keeping, relationship of supervisor to production and profits and the like.**
- **Training on the specific job to be performed: detailed knowledge of the manufacturing process under the supervisor's control, planned subdivision in individual functions, job descriptions of the individual functions, performance standards of the functions and of the total process, input and output, machinery and tools employed, operation, maintenance engineering, information and training of supervised personnel, own responsibility and additional existing facilities.**
- **General information on the job and the performed activity within the overall environment of the factory and its contribution to the finished product, knowledge of the preceding and following manufacturing processes, relation between factory and mother company, the factory in the national environment and its contribution to the overall economic development of the country and the like.**

**The first and third categories of this training are independent of a specific location and can be undertaken wherever convenient. The second category can be performed either in the mother company or in the new factory, but it will preferably be a combination of both in order to obtain an optimum compromise between cost and time. The main factors opposing each other are:**

- **duration of the overall training period**
- **higher cost of training in the mother factory**
- **cost of unproductive time of the machinery in the new factory**
- **cost of expatriates as training supervisors**

**It has proven most convenient to divide the overall training requirements into preliminary training, to enable the supervisor to execute his function, and on-going training, to develop his additional skills and abilities. The latter will be carried out at regular intervals, once the factory is in operation in the form of seminars, courses, workshops, etc.**

**Training of workers:** this training comprises basically the same steps as the training of the supervisory level, but the accents will be set in accordance with the activity performed. It will be convenient to appoint a training officer for the company, who - supported by the supervisors - will carry out the so-called vestibule training. In this the worker will be trained to do his job under simulated working conditions, before he is actually required to perform it. In this way he enters his employment with the confidence - and efficiency - of an able worker.

At the same time, the worker will receive a full orientation course on the overall position of the job and of himself as an individual in the company. This will include working hours, pay schedules, health and welfare benefits, an understanding of the plant layout and organisation, the relationship of the plant to the economy and to the company and his part as a member of the overall effort.

The workers' training will be continued at regular intervals with specialised courses aimed at developing and improving his capacities to rise to higher productivity and to higher positions. The cost of labour, as part of the manufacturing plan, will therefore comprise not only the pure operational costs, but also the pre-operational training period, as well as the cost of recurring training.

#### 6.2.4. Utilities and related production costs

Utilities will be included in the manufacturing plan in the usual form and at the costs determined through the basic information as outlined under 6.1. The continuity of utility supply and the impact of an interruption on the manufacturing process will have to be determined in detail. The utilities required will, therefore, be categorized in respect of their availability as follows:

- utilities produced in the factory : compressed air, water (if necessary through wells)
  - utilities stored in the factory : bottled gases, oil
  - utilities under continuous supply: electricity, telephone
- utilities produced in the factory: the design of the factory will ensure that appropriate space is allocated for the production and storage of these utilities and the machinery will be included in the overall heading to take care of the necessary depreciation. Therefore, as far as this concerns utilities also produced in the mother factory there should be no problem. A critical point can be the water, on tap at the mother factory, as required, but possibly not available in the new one. The solution of this problem depends on the site of the factory and the possibility of other industries existing or moving nearby. The costs for surveying the territory, finding the optimal location of the new well, transporting the water from the well via one's own or common storage tank to the factory can then be shared with the other future users or an agreement can be reached with the Government's site development administration on the financing and partial repayment.

- **utilities stored in the factory:** the only point to consider here is the continuing in availability. This will lead to an investigation of alternative sources of supply and, if necessary, the provision of adequately large storage space on the factory floor plus an adjustment of the higher container costs.
- **utilities under continuous supply:** the reliability of this continuity will determine the solution to be applied. In the example of electric power it will also depend on the processes of manufacture in which it is required. While on soldering operations or testing instruments a short interruption will not really affect the process, certain chemical processes might not stand a break-down. The procedure in the mother factory will then have to be adapted, leading to the provision of floating batteries with alternators for certain processes, overall generating sets, or a combination of both with the necessary switchgear, stabilising units and the like. As far as telephone and telegraph service is concerned it might be desirable to agree with the administration on the installation of a single channel radiolink into the exchange (preferably of own production), to ensure a continuity of service.

The related production costs will primarily be determined by the manufacturer's own experience in the mother factory as well as company policy regulations. These will then be adapted to the local environment and to special customer requirements. The manufacturing variances, for examples, will be a function of the ability and skills of the labour as well as of the efficiency and result of their training and might have to be included with a higher value at the start of operations, decreasing to the standard practice level over an estimated length of time.

Packing and shipping costs will depend highly on the location of the customer (utilization site and responsibility of the manufacturer to get the product there), the means of local transport and handling during transport, climatic and other influences on the finished product between leaving the factory and arrival on site, etc, which might require a special design of packing and establishment of packing procedures. It could also be the case that suitable transport facilities are not available, in which case the manufacturer together with the administration will have to establish his own means of transport or adapt the existing ones to the specific requirements of the finished product.

### **6.3. Installation and maintenance**

Even though this does not form part of the manufacturing process as such, it is a service required by the customer and should be provided by the manufacturer preferably out of the new factory to the largest possible extent.

It can be assumed that the customer will normally contract the manufacturer on a turnkey basis and request as well the necessary maintenance and operation training for his personnel. A group will therefore be foreseen in the new organization with the ability to provide the following services (either by themselves or through sub-contracting of local firms or with assistance of the mother companies):

- **System planning:** complete layout of the job to be performed, site surveys and definition of resulting activities involved, equipment to be supplied (own production plus bought in), installation, maintenance, training.

- **Civil works subcontracting: for access roads, buildings, antenna masts and foundations, power supply (lines or generation), etc.**
- **Processing of the equipment of local manufacture through the factory, procurement of bought-in equipment.**
- **Installation personnel for the equipment manufactured. For the bought-in equipment the supplier will provide the necessary personnel himself.**
- **Initial maintenance and operation with simultaneous training of customers' personnel to take over.**
- **Project management, with overall responsibility for the timing of all the processes listed above.**

These services and the share of it to be performed by the staff of the new company will depend very much on the type of product (from telephone sets to radiolinks) and the type of project, i.e. the extent to which the manufacturer's own product forms a major part of the overall project (in the case of a broadband microwave system, in which the local manufacturer only supplies the multiplex for example, the overall system responsibility will not be with him). This will determine the size of the group and the skills and abilities required from its members.

#### **6.4. Administration and general costs**

##### **6.4.1. Other functions in the factory and the setting up of the organization.**

The functions and their staffing defined up to this point are, summarizing:

- the different production steps with their workmen and supervisors
- the shop, machinery, tools and supplies maintenance group
- the project installation, maintenance and operation group
- the personnel management with responsibility for selection and training of the employees.

The following functions will now have to be added to coordinate, control and manage them, as well as to perform additional activities, to make it a complete operation:

**Additional functions for production:**

- production engineering and production control
- industrial engineering
- quality control
- purchasing and shop accounting

**Additional functions of the operation:**

- marketing and sales
- finance
- labour relations

**Ancillary functions:**

- communications (mail, telephone, transport of material and personnel)
- safety and social (security, first aid, canteen, etc.)

**Management:**

- general, marketing, technical/production, financial, personnel.

It is not the purpose of this article to draw up a general organization chart, as there are too many different philosophies on how to co- and subordinate the different functions to each other. Every company has its own rules and experience and will proceed accordingly.

#### 6.4.2. Staffing, recruiting and training of the higher echelons

It is unlikely that all the higher echelons of the manufacturing unit can be staffed with readily available local personnel. It will have to be envisaged therefore to staff them partially with expatriates from the mother company temporarily and provide for adequate selection and training programmes to develop nationals for taking over at a later stage. In most cases the mother company will not have personnel readily available either to staff all of these functions, so that a recruitment of expatriates will have to take place at the beginning.

The basis for this process is a collection of detailed job descriptions, based on the resulting final organization scheme of the new factory and on the job descriptions readily available in the mother factory for similar or comparable positions. Special emphasis should be given to this point, as the personnel selected will work in a new environment and to a great extent out of direct control of the mother factory.

The job description will therefore define in detail:

- the scope of the activity and exact reporting function
- the detailed breakdown of the activity into its individual components
- the interface with the other members of the organization, where existing
- the responsibility for results and performance standards.

This will be accompanied by a definition of requirements the individual to occupy the position should ideally fulfil, including:

- nationality preference, if any
- school and university education
- general experience in industry
- preferred special experience in similar activities or leading to them
- previous activity in developing countries
- language ability if essential

Based on these ideal requirements a recruitment in both countries will take place, whereby the ideal candidates would be nationals temporarily living in the country of the mother factory and having had their university education and practical industry experience there. Once the candidates have been selected, they will undergo an individual training tailored to the requirements of the future activity and the actual ability of the candidate, once individual performance appraisals are carried out, including such factors as organising, reliability, drive, motivation, etc.

The training programme will be determined in cooperation with the individual candidate and will comprise basically:

- job rotation, to permit the candidate to acquire actual work experience in the various areas of his future activity. For example candidates for

**General Manager, who have developed through marketing, will be rotated in the financial and production areas of the mother company.**

- coaching or tutoring conferences in specific areas of individual need.
- study committees and special study assignments dealing with specific problems in the mother company or of the planned new factory. Their suggestions and findings will be useful to the management of the mother company while at the same time the candidate familiarizes himself with different aspects of his future responsibilities.
- activity as assistant to senior executive of the mother company as a planned phase-in programme.
- home study course, depending on the individual needs, to broaden the business knowledge in related areas to their primary future function.

To the greatest extent possible they should actively cooperate in the planning and building up of the new factory within their future area of responsibility.

Once the initial staffing is completed on this basis, a long term programme will be established, to replace as many of the initial expatriates as possible by nationals. A useful source of future management potential will be young nationals, studying in universities or high schools abroad (preferably in the country of the mother company), who upon satisfactory completion of their studies enter the mother company, are developed there in accordance with their aptitudes and inclinations over a longer period of time (several years), until they are transferred to the new company as assistants to the expatriate managers, with the aim of taking over from them as soon as they have acquired the necessary experience and practice.

When costing this organization with its initial and final staffing, the overlapping periods and the training programmes, adequate calculations should be carried out to take into account the future growth envisaged for the factory, which will not only require a growth in the labour force but also in the staff organization.

It should be remembered as well, that the training need does not stop once the positions are filled, but that regular training courses, seminars, etc. will have to take place to keep the management in constant contact with the mother company, guarantee a parallel development in methods, techniques and procedures, etc.

#### **6.4.3. Licence fees, know-how and technical assistance**

The new factory will require patent licences from the mother company, to manufacture the proposed equipment. The determination of this licence fee will depend on international practice, licence fees already agreed with other manufacturers and regulations in the country of investment. They are normally given as a percentage of sales.

To take part in the continuing development carried out in the mother factory and in order to avoid own research costs in the new factory and therefore an

**actual duplication of efforts, the new factory will contribute to the total research and development costs of the mother factory, ensuring in this way that its own production will continuously be adapted to the latest state of the art. This will include the necessary technical assistance to transfer the developing know-how to the new factory on a continuous basis by regular information and training of the personnel of the new factory either there or in the mother factory. These services will also be estimated as a percentage of sales and often considered together with the licence fees in one common figure.**

#### **6.5. Pre-operational expenses and start-up costs**

**Some of those expenses and costs have already been considered in the context of other factors of the analyzed costs, such as training costs, costs of machinery and other investment to be amortized and the like.**

##### **6.5.1. Start-up costs not yet considered**

**These will mainly be the costs of the initial know-how transfer and required technical assistance in form of full documentation, drawings and designs (with eventually necessary translations), manufacturing flow charts, presence of specialized technicians of the mother factory in the new one for the supervision of installation of the machinery, running in of this machinery, trial production runs, adaptive engineering as far as required, etc.**

**Some marketing start up costs might have to be considered as well, even though for the typical customers for telecommunications equipment, these could be rather low.**

##### **6.5.2. Land and building**

**The selection of the site of the new factory as briefly discussed under 6.1. will depend mainly on the following factors:**

- **possibility of recruiting local labour of the required basic skills and keeping them.**
- **possibility of securing expatriates and/or nationals for the higher functions (this can become a more serious problem than often assumed).**
- **expenses involved in "opening the terrain" (supply of utilities).**
- **special incentives given by the Government to locate industry in certain regions of the country to develop the area. These incentives can sometimes be quite considerable, like long term tax exemption, soft loans for acquisition of land and erection of buildings, etc.**
- **possible additional cost of transport for the incoming material and the outgoing finished product, leading sometimes to the manufacturer having to provide his own means of transport.**

**As far as the actual building is concerned, the quantity of equipment manufactured, and therefore the machinery required, growing with increased quantity and increased manufacturing depth, the number of employees and their different functions will determine the floorspace necessary and its different characteristics:**

- **shop floor, with partially special climatic and air conditioning requirements (special rooms with defined temperature and humidity and the like).**
- **office space and subdivision.**
- **stock room for materials, semi-finished and finished products.**
- **ancillary space for first aid, canteen, etc.**

**The same considerations of efficient working apply as to any other factory. The only major point to keep in mind is the differing climatic conditions, for which appropriate measures have to be taken.**

**The choice between renting, buying or building will normally not be given. Only in most exceptional cases will suitable buildings for this sort of industry be readily available.**

### **6.5.3. Other pre-operational expenses**

**In order to complete all figures required for a profit and loss calculation other pre-operational expenses should be mentioned.**

**The major item in these will be the pieceparts, raw material and components ordered for the production as well as the work in process before the first sales are made.**

**Minor items well known to any manufacturer, like office furniture and the like, will not be analyzed in detail.**

### **6.6. The timing of the factory set-up**

**Once all the above elements necessary for the production are together, the major task of an accurate timing plan has to be completed. This is the place where the Project Manager requires all his skills due to the number and complexity of variables, where the variation coefficient - as far as the new country is concerned - is often not known, and where non-congruency of data can become a very expensive business both ways.**

**As a matter of practical experience it would be very convenient to have the future General Manager as Project Manager or at least taking an important part in this specific phase. Under 3.3.2. a rough outline of the major phases of this timing has been shown. Something along these lines will be the start of the final time plan. As each of the basic steps set out there is related to one or more of the others, each of them will be the subject of a detailed study with accurate requirements and timing of the different integral components of it with special views on the interconnection between them and with the other basic steps. Changes**



**In the timing of one will necessarily influence the timing of one or more of the other parts and it is this interrelation that has to be kept under tight control. PERT or similar studies have proven most helpful to obtain a clear picture and to foresee adequate measures in case one or the other of the operations does not run to schedule, e.g. the machinery ready for delivery and installation and the building still unfinished (and vice versa), labour recruited but training facilities still in planning stage, etc.**

**Ideally the Project Manager will have at his disposal the help of the relevant specialists of the mother company, each of whom will be assigned a specific area of responsibility. The individual time plans with critical date and action plans will then be integrated into one overall plan with an agreed policy of procedure like regular progress reports, signalization of red flag items, continuous review and adjustments, etc.**

**This will give the project manager the necessary tools to put the project in motion - and complete it to schedule - once the go-ahead signal has been given.**

## **7. DISCUSSIONS AND AGREEMENTS WITH CUSTOMERS AND AUTHORITIES: PRICING POLICY, PROTECTIONS.**

Now that all the cost elements have been determined including the financial charges not specifically mentioned in the foregoing chapters, the pricing policy will have to be established.

Continuous consultations with the customer and the authorities concerned with foreign investment will have already taken place on the lines of the above considerations taking into account all the necessary data in principle, like:

- tax exemptions or concessions on investment, imports, corporate taxes, etc.
- customs duties for machinery, import of components or pieceparts, etc.
- information on local labour and regulations for the employment of expatriates.
- local participation, cost of funds.

and all others of similar nature plus:

- mechanics of approval of the investment proposal.
- contents and presentation of the investment proposal.

It will now be necessary to establish the pricing policy in accordance with the profit policy envisaged. The next step will then be to insure that this profit policy can be maintained through:

- continuity of pricing policy
- continuity of order volume

The continuity - and increase - of order volumes requires the build up of the necessary funds for future expansion. These requirements are of a similar nature to the start-up costs mentioned above, but obviously of much smaller size at the time they accrue. These funds will allow for the purchase of additional machinery, broadening of the training facilities, etc. It will be a matter of local discussion, which portion of the required funding for this will have to be already available out of own resources at the time the expansion is actually carried out and which portion of it can be taken up externally and repaid out of the sales, once they become actual.

The profit policy will be determined in cooperation with the financial partners based on the general profit policy of the mother company, the profit policy and payment of dividends for the financial partners and the laws and regulations of the country.

### **7.1. Pricing policies**

The ultimate aim of the company will always be to become fully competitive.

- first against imports into the new country of manufacture
- second against imports into countries with which the new one has trade agreements.
- third in the open world market.

To achieve this two different pricing policies are conceivable.

### **7.1.1. Constant prices**

The depreciation of the start-up costs is done over a long period of time in such a way that the decrease in unit cost due to increase of production quantity is levelled off through adequate spreading of the amortization of the start-up costs, leading to a fixed price level. In the same way profits will be deferred.

This results in a price continuously above world market level by a fixed amount and the actual customs duties for imported products will determine its relation to actual landed costs.

On the export market the price is fixed by competition. It therefore remains to be determined what loading the exported material can carry and how the quantity exported can contribute to the overall cost structure.

### **7.1.2. Decreasing prices**

This policy consists in reflecting the small quantities at the beginning of production and the start-up costs directly in a price that starts at a rather high level and comes down gradually as near to world market prices as possible with increasing production quantity and amortization of the start-up costs.

As far as exports are concerned the same criteria as for 7.1.1. apply.

Obviously all sorts of intermediate pricing structures can be discussed as well, adopting one or the other of the basic policies to a greater or lesser degree. If calculated adequately the result will always be the same for the manufacturer if integrated over the time axis.

The basis for discussion will therefore be a group of curves between the two limiting curves of 7.1.1. and 7.1.2., the quantity of units produced being the parameter. Different values of this parameter will therefore produce different groups of curves shifted along the quantity axis.

### **7.1.3. Discussion**

A pricing policy proposition along the above lines and in accordance with the general policy of the investing company will be drawn up and discussed

- with the financial partners, among which - as outlined under 5.1. - the customer will be represented.

- the authorities concerned with foreign investment,

and adapted to the often conflicting interests as well as to the regulations of the country. The prime purpose of such a discussion is to adapt the price structure to the basic requirements of any factory in the long run: to be competitive in the world market, without having to increase local prices considerably over export prices.

Being practically in a monopoly situation, the pricing strategy agreed will form part of the overall project to be submitted for approval to the Government. At this instance the pricing will have to be sanctioned and it is up to the manufacturer and his main customer to ensure that it is done in the proper way.

A word of warning at this stage: even if the actual government, being very keen on putting such a manufacturing unit to work in its own country, is willing to accept rather high prices at least for the start, it is very unlikely that this will be maintained in the long run. If it is therefore clear through this final appreciation of the financial situation that without an "external" high protection the factory will not be able to operate, the whole project becomes doubtful. To try to keep it alive through exports from the start is a risky procedure due to the obvious factors that always work against a new and unknown supplier who is unable to show a successful record of achievements.

The pricing policy that will suit best such an operation will therefore be any sort of compromise between both, leading as soon as possible to decreasing prices.

#### 7.1.4. Price variation clause

In analyzing the production costs to simplify the basic discussion, it has been assumed that all items could be considered as constant over a comprehensive period of time. This leads to the possibility of decreasing prices with increasing utilization of the machinery. But the existing increase of labour and material costs will partly offset or even compensate this trend. The result will depend on the productivity increase through higher order book against the increase in labour and material cost.

Experience has shown that such a cost increase happens in developing countries at the same or even higher rates than in industrialized ones, and appropriate allowance will have to be made for it. As an exact forecast of this increase hardly can be carried out, a clause concerning price variation due to cost increase must be included in the agreement. The basic factors to define this variation clause will very much depend on the local situation and will have to be analyzed for every specific case.

## 7.2. Protections and concessions

The official laws ruling foreign investment in a country are always of a very general nature and apply to all sorts of industries with all sorts of customers.

In the case of a telecommunications enterprise we have a rather unique situation:

- highly sophisticated products
- limited local market, normally just big enough for one manufacturer only
- one main customer to absorb the output of the factory
- difficulties in exports: while the world market would buy without reservation all products produced out of the natural resources of a developing country, it will be reluctant to buy this type of equipment at the beginning, until the new factory has established itself and the products run satisfactorily over a number of years. Here the name of the manufacturer will help somewhat, but its influence should not be over-estimated.

**Taking these points into consideration, the general regulations should be adapted to the specific case. The concessions required will be of the following categories:**

- keeping the starting costs low
- protecting the current production
- supporting future exports

**The first two will be intimately linked with the pricing policies analyzed above. If a decreasing price policy has been adopted, theoretically there is no need for any protection at all, provided that the prices are high enough and no imported equipment will be allowed in the country. This being an unrealistic standpoint, a compromise will be reached in order to keep the prices from the beginning as competitive as possible and at the same time securing a reasonable return to the investors, local and foreign.**

**The procedure to reach an agreement will be a series of discussions in which certain figures will be assumed as constant and others as inter-dependent variables. The constant figures are:**

- projected quantities of production.
- f.o.b. cost of machinery and depreciation rates per step of manufacture.
- f.o.b. cost of imported piece parts and components and cost of locally produced material.
- labour, utilities
- know-how and license fees
- required return on invested capital

**The variables are:**

- customs duties and taxes on imported plant and equipment
- customs duties and taxes on imported piece parts and components
- corporate and other taxes
- tariff or import protection from outside competitors
- price of finished product
- steps of manufacture
- amortization period of start-up costs
- deferring of profits/dividends

**A multi-equational mathematical model can be built up on this basis, but it will be preferable to agree on certain reasonable compromises from the start in order to reduce the number of variables. Practically the following discussion points have proven suitable:**

#### **7.2.1. During the start of the operation (first five years)**

- exemption from customs duties and related taxes on the importation of plant and equipment for the factory. This will absorb a considerable amount of the start-up costs.

- corporate tax exemption (mostly in line with local regulations anyway, if the factory is to be built in a development area recognized as such by the Government) for the start-up period with gradual build-up to its normal value. A reasonable time scale for this is 10 years.

Purchase of finished products from the mother factory prior to actual production to optimize training of personnel for the new factory and for the customer and ensure compatibility of equipment.

#### 7.2.2. During current operation

- import barrier for outside competition. This will normally be in line with the Government's policy, but it must be clearly defined to which products with which characteristics it must apply: on one hand it cannot be expected that the manufacturer will produce all possible types of telecommunication equipment within his range of manufacture, and on the other hand the door should not be left open to imports of products fulfilling the same functions but with some variations, which might make them fall outside the import restrictions. A classical example would be radio-links with different frequencies. Obviously the manufacturer who commits himself vis-a-vis the customer to supply him with the necessary equipment will not be able to manufacture all possible frequency ranges. But the customer still could - if he wished - argue about the suitability for any specific job of a certain frequency not manufactured. It is therefore desirable to define the customs commodity as widely as possible, agreeing in the proposal and in conjunction with the manufacturer the exact specifications of the range of equipment required.

In any case special clauses can be included to the effect that piece parts for assembly can be imported from the mother company at advantageous conditions, should the requirement for different equipment for a one-off project really arise.

- protection against local competition. This is a requirement much more difficult to accomplish directly, but as necessary as the first one, as normally the consumption is hardly big enough for one manufacturer alone to operate competitively. By giving this sort of protection the government could accept virtually a monopoly situation of one manufacturer with all the possible negative consequences. It will, therefore, be up to the manufacturer to prove that:
  - he is not making unreasonable profits out of this situation
  - he is able to fulfill the requirements of his customer(s) in the agreed form and suitable mechanics will have to be developed and proposed to the government on how this can be regularly verified.

- **supply agreement.** This will ensure the sales of manufactured equipment, the manufacturer being in the unique marketing position of having only one major customer and no means of opening other markets in the country. Such an agreement, which should be reviewed every 5 years on average and which will protect the customer as well as the manufacturer, will basically include:

- the manufacturer will produce the types and quantities of equipment required by the administration in line with the jointly agreed manufacturing programme.
- the customer will buy all his requirements from the manufacturer and will not place any orders with outside manufacturers without having consulted the manufacturer first on the possibility of his producing equivalent equipment.

In order to accomplish this the customer and manufacturer will agree every year on the requirements by type, quantity and price in line with the manufacturing plan approved by the Government. Any basic changes in the equipment required by the customer will be discussed with the manufacturer well in advance to give him the necessary lead time for production. The manufacturer in turn will commit himself to adopt all technical and technological developments coming up in the research laboratory of the mother factory, thus ensuring that the customer is always getting up to date equipment.

### 7.2.3. Support of future exports

Possible future exports on which government as well as manufacturer will put major emphasis for many reasons, like:

- prestige
- demonstration of capability to compete successfully
- foreign capital income
- Increase of production volume to reduce costs in home market

can be achieved in different ways, whereby it is desirable to follow a step by step plan, the end of which is open competition in the world market.

To arrive at this point the manufacturer must be fully competitive in quality and price and this can normally not be achieved through one single step out of the purely domestic market.

The help of the government will, therefore, be required to ensure that this competitiveness can be arrived at by starting exports into countries with which trade agreements exist. These countries will still require full competitiveness, but the initial bias against an unknown manufacturer, as indicated

**before, can be eliminated. If then the governments involved define a supply agreement similar to that the manufacturer has put into operation with his domestic customer, a new market will be opened. The quantities supplied to the new country, even at prices ex-factory lower than on the home market, will ensure a better spreading of overheads, a reduced impact of depreciation on the equipment unit, etc, reflecting back on the domestic prices advantageously. But these additional sales at the first stage must be guaranteed by the government. This means that in case of a cancellation of the agreement due to reasons beyond the control of the manufacturer, the government will ensure the relocation of additional personnel hired for this additional production, the repricing of the equipment to the domestic customer, etc.**

But it is not only the government that can take the first step towards limited export. The manufacturer also has an opportunity to increase volume by concentrating production volume of certain products out of his total range between the mother company and the new factory. A classical example would be the production of telephone subscriber sets. If we assume that the mother company produces sets with normal dial and with push buttons for the home market and the new factory produces only dial sets, it is possible to produce the total quantity of dial sets required by both in the new factory.

In any case, it will be reasonable and necessary to agree with the government that all pieceparts and raw materials imported for export production will be considered as transit and no customs duties will have to be paid for them. This can sometimes be the key to starting a successful export business.

Many other sorts of export subsidies are practised in different countries like tax exemption for export production, government's export premiums and the like, and it will be up to the manufacturer and the government to agree on whatever is necessary to ensure export competitiveness once the above possibilities have been explored and put into practice and the results seen.

#### **7.2.4. General agreements**

The potential manufacturer will generally require certain financial assurances to invest in a new manufacturing operation in a developing country and the government will normally agree to them anyway through its normal rules for foreign investment. They are therefore only listed for the sake of completeness:

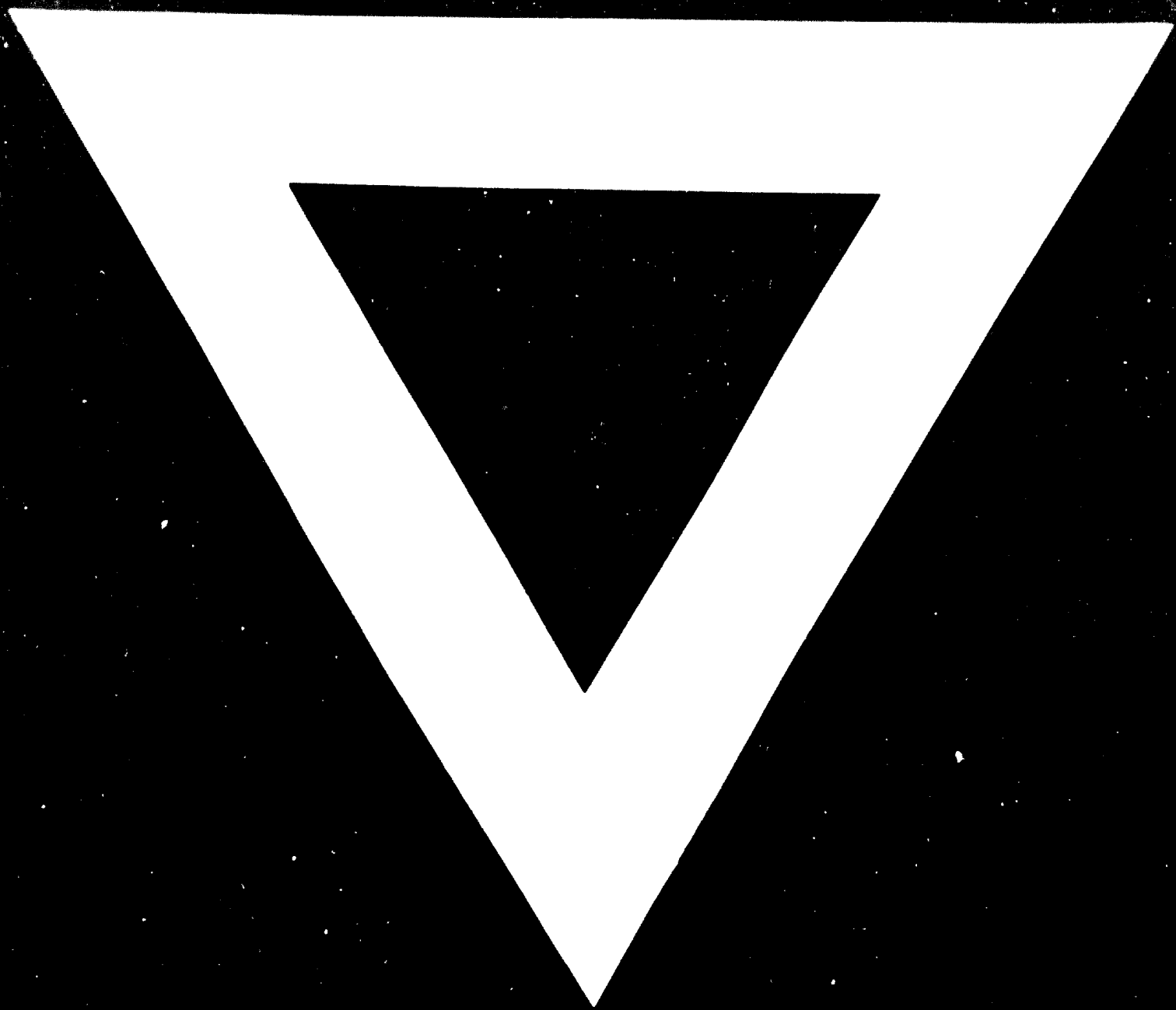
- repatriation of capital and profits after deduction of taxes, statutory reserves and the like.
- payment of licence fees and know-how in the currency of the investor.
- employment of the required expatriate personnel in the context of the overall programme and transfer of all or part of their salaries out of the country



Once these calculations have been carried out and basic understanding and agreements have been reached between the government, the customer and the manufacturer, the latter will proceed with the pure mechanics of formulating his proposal in the form prescribed by the government. This form varies considerably from country to country, but contains basically always the same main points which the manufacturer would analyze himself when establishing an operation in his own country and which have been analyzed in the foregoing chapters. It may be considered only as a pure formality, the purpose being to sanction and sign officially and bindingly the agreements already reached verbally, but as this document is the basis of the future operation its detailed completion is of the utmost importance.

From the moment of signature of this document, the hardest part of the task starts: the putting into practice of the operation according to the plans established. The difficulties, which obviously will occur from here on, are manifold and so varied that nobody can list them in detail, and offers an area where more study can be done. In conclusion, one should therefore point out to the manufacturer the importance of chapter 5.1, and the fact that it is in the interest of the customer and the government to create a new industry of key importance to the particular country.





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