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REPAIR AND MAINTENANCE OF INDUSTRIAL EQUIPMENT IN COLOMBIA

SALZGITTER INDUSTRIEBAU GMBH

JUNE 1969

FINAL REPORT

Repair and Maintenance of Industrial Equipment

in

COLOMBIA

prepared by

Salzgitter Industriebau GmbH

Federal Republic of Germany

for

United Nations Industrial Development Organization

June 1969

[redacted]

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INTRODUCTION

The Industrial Development Board of United Nations Industrial Development Organization (UNIDO) considers the possibility of giving special assistance to the repair and maintenance of industrial equipment in countries under development and is, therefore, interested to learn of ways and means whereby this goal can be achieved. In this connection, UNIDO starts from the right point in considering that if funds are available and used for repair and maintenance, there is every prospect of achieving a great positive effect within the scope of the industrial development.
To enable it to establish an efficient programme for such technical assistance, UNIDO ordered to carry out studies regarding the specific problems in selected countries, which, amongst others, included Colombia.

In consequence, it was required that those studies should aim at providing recommendations which might be described as optimum solutions under the prevailing particular conditions and which would make it possible for UNIDO

(a) to choose amongst the investigated countries those in which it would be recommendable to start implementation of the campaign;

(b) to establish a long-term working programme for the technical assistance to be rendered to the countries chosen;

(c) to identify crucial fields in the surveyed countries, in which assistance is urgently needed. This will enable UNIDO to render such assistance as quickly as possible;

(d) to help UNIDO in drawing up a long-term policy for assisting countries under development in the field of repair and maintenance.

The required investigations in Colombia were carried out by an expert team of Salzgitter Industriebau GmbH, Federal Republic of Germany, during the period January 22, 1969, to February 18, 1969. Salzgitter Industriebau GmbH gratefully acknowledge their debt to all who granted valuable advice and unselfish support in these investigations and were always ready for direct discussions. From the survey regarding repair and maintenance in Colombia, Salzgitter Industriebau GmbH have concluded several proposals for UNIDO and are convinced that the complete or even partial realization of these proposals will contribute essentially to the further industrial development of the country.

SUMMARY AND CONCLUSIONS

After approximately a decade of political and economic instability, the present government had to adopt certain restrictions and controls to restore stability. This policy has shown impressive results, but has, on the other hand, created some problems which are reflected in mostly all fields of activities, including the subject of repair and maintenance.

Concerning equipment and machinery both for production and maintenance exists a lack of standardization.

Due to the effects of the policy aimed at stability, stocks of spare parts are often inadequate.

The adoption or establishment of repair and maintenance systems differs widely from near zero or none to absolute sufficient systems.

The idea of repair and maintenance and its requirements is often not sold properly to the managerial level. - Having established repair and maintenance sections in production units there were often no competent counterparts in the holding management. Repair and maintenance equipment is sometimes not properly used or even lies idle.

The skill of repair and maintenance personnel is judged differently, but steady improvements are stated to have occurred due to the efforts of the Servicio Nacional de Aprendizaje (SENA).

There exists an absolute lack of capable technical personnel for intermediate supervisory.

Assistance is obviously needed and can possibly be established in the field of

Standardization

Organization

Maintenance Demonstration

Formulation of Industrial Policy with a special view towards Preventive Maintenance

Training of Technical Personnel for Supervisory Level

Preparation of a Feasibility Report regarding Spare Parts Manufacturing Facilities

ECONOMIC BACKGROUND

(a) Regional Diversification

Due to the topographical situation of Colombia its economy shows a strong regional diversification which created in most cases independent centres of economic activities, such as

- The Sabana of Bogotá
  with the Departamento Cundinamarca
- The Departamento Antioquia with Medellin
- The Caribbean Coastal Zone with Cartagena, Barranquilla and Santa Marta
- The Cauca Valley with Cali
- The Pacific Coastal Zone with Buenaventura, and
- some minor regions within the vicinities of such towns as Bucaramanga, Pereira, Manizales and others.

Due mainly to the effects of developing means of transportation, the inter-regional exchange of goods and services, which previously was almost non-existant, has very recently grown rapidly. However, there are always difficulties in respect of bulk goods, at least as regards freight rates.

There is a trend toward rapidly growing urbanization. About 53.6 % of the total Colombian population are living actually in towns and 46.4 % in rural areas. 1951 this percentage was 38.9 % in towns and 66.1 % in rural areas.

(b) Contribution of Manufacturing Sector to GDP

In 1967, the manufacturing sector accounted for 16,350 millions of Col. Pesos or some 21.7 % of the total G.D.P., this contribution showed an increase of 26.6 % over the figure for the previous year compared with an increase of the total G.D.P. of only 14.9 %. (see Table 1).

TABLE 1

GROSS DOMESTIC PRODUCT AT FACTOR COST
(1962 - 1967)

		1962	1963	1964	1965	1966	1967
Agricultural Sector	million col.Pesos	9.910.6	12.228.1	16.307,5	17.303.6	20.336.1	
	%	31,1	30,2	33,0	31,5	30,7	
Fishery and Hunting	million col.Pesos	100.4	104.1	138.1	148.5	139.8	
	%	0,3	0,3	0,3	0,3	0,2	
Forestry	million col.Pesos	138,3	168.9	179.6	223.9	267.2	
	%	0,4	0,4	0,4	0,4	0,4	
Mining	million col.Pesos	991.9	1.069.1	1.342.7	1.465.5	1.401.9	
	%	3,1	2,6	2,7	2,7	2,1	
Manufacturing Industry	million col.Pesos	5.552.3	7.553.1	8.490.2	9.771.7	12.365.0	16.350.0
	%	17,5	18,7	17,2	17,8	18,6	21,7
Construction	million col.Pesos	1.437.9	1.698.1	1.931.0	2.044.9	2.833.9	
	%	4,5	4,2	3,9	3,7	4,3	
Commerce	million col.Pesos	3.788.2	4.803.9	5.841.8	6.623.9	7.927.4	
	%	11,9	11,9	11,8	12,0	12,0	
Transports	million col.Pesos	2.047.0	2.679.8	2.969.9	3.122.8	3.853.2	
	%	6,4	6,6	6,0	5,7	5,8	
Communications	million col.Pesos	260.3	395.0	420.2	474.0	597.5	
	%	0,8	1,0	0,9	0,0	0,9	

		1962	1963	1964	1965	1966	1967
Electricity, Gas and Water	million col.Pesos	348.5	463.7	566.9	740.2	871.0	
	%	1,1	1,1	1,1	1,3	1,3	
Banking, Insurance & other Financing	million col.Pesos	1.040.3	1.310.7	1.571.7	1.838.2	2.231.8	
	%	3,3	3,2	3,2	3,3	3,4	
House Renting	million col.Pesos	1.803.6	2.185.0	2.773.9	3.400.6	3.993.0	
	%	5,7	5,4	5,6	6,2	6,0	
Services	million col.Pesos	2.418.0	3.126.5	3.837.2	4.380.7	5.204.4	
	%	7,6	7,7	7,8	8,0	7,8	
Government services	million col.Pesos	1.992.4	2.689.9	3.025.9	3.394.5	4.298.6	
	%	6,3	6,7	6,1	6,2	6,5	
T O T A L	"-	31.829.7	40.475.9	49.396.6	54.933.0	66.300.8	75.550.0
	%	100,0	100,0	100,0	100,0	100,0	100,0

Source: Banco de la Republica/Departamento de Investigaciones Económicas

A breakdown of the contribution to GDP of the different sectors of the manufacturing industry was not available. However, a compilation of the gross production values of the manufacturing industry in 1965 with a breakdown sector-wise, shows that some 56 percent of the total came from such commodities as textiles, clothing, foodstuffs and beverages (see Table 2).

It was reported that most of the industrial subsectors showed increases during recent years, and that the situation of manufacturing industry is expected to be favourable for the near future.

(c) Electric Power

Another indication of the rapid growth of the manufacturing industry is the increasing demand for electric power. The total of electric power generated in 1967 was 5, 936 million kWh, that means an increase of 422 million kWh or 8 % more than 1966. (see Table 3).

TABLE 2

Production of Manufacturing Industry 1965

Sector	Number of firms	total employees	gross value of production (million pesos)	percentage of total
Food	3,075	43,482	7,403.3	26.69
Beverages	236	16,799	2,631.0	9.48
Tobacco	177	3,714	804.8	2.90
Textiles	462	44,533	3,460.9	12.47
Clothing	2,210	33,510	1,332.3	4.80
Wood and Wood Products (excluding Furnitures)	427	6,397	259.9	0.94
Furnitures	424	5,116	146.3	0.53
Paper and Paper Products	111	5,860	794,7	2.86
Printing, Publishing, Advertising	511	11,793	573,5	2.07
Leather (excluding Footwear)	297	4,764	346.6	1.25
Coutchouc Products	70	6,983	623.5	2.25
Chemicals	561	20,814	2,634.6	9.49
Derivates of petroleum and coal	23	2,066	1,204.8	4.34
Non-metal minerals	1,104	26,065	1,267.9	4.57
Basic Metal Industries	41	3,954	865.0	3.12
Manufacturing of Metal Products (excluding Machinery and Transport equipment)	738	20,265	1,145.8	4.13
Construction of Machinery (excluding Electrical)	270	5,029	253.1	0.91

Sector	Number of firms	total employees	gross value of production (million pesos)	percentage of total
Construction of Electrical Machinery and Equipment	258	10,001	853.8	3.08
Construction of Transport Equipment	646	14,933	591.7	2.13
Manufacturing Industry not mentioned elsewhere	318	9,141	552.9	1.99
Total	11,950	294,221	27,749.3	100.00

Source: Banco de la República,
Departamento de Investigaciones Económicas

T A B L E 3

Electricity Generated and Sold in Colombia
1962 - 1967
(in million KWH)

Year	Electric Power Generated	Sales Bogotá, Medellin, Cheo and CVC			Sales Costa Atlantica
		Residential	Commercial and Industrial	Others	
1962	3,524.0	782.7	892.3	262.6	285.9
1963	4,072.0	914,9	1,035.1	303.2	319.6
1964	4,569.0	992.1	1,172.2	359.5	321.8
1965	5,034.0	1,097.3	1,265.0	406.0	343.8
1966	5,494.0	1,157.2	1,387.9	474.4	396.6
1967	5,935.0	1,259.1	1,452.7	620.1	422.4

Source: DANE
Departamento Administrative de Planeación

(d) Industrial Capacity Versus Market Requirements

Due to low purchasing power within the country and also, to a certain extent, to excess capacity installed, exists a gap between capacity and actual requirements which often does not permit optimum operating efficiency by means of economies of scale. This is the result of a wrong general economic policy, and especially the lack of an industrial policy that is properly formulated and carried out.

(e) Policy for Stability

Following the 1959 - 65 period which was marked by successive budgetary deficits resulting in heavy inflation, an excess of imports and substantial capital flight, it became clear that certain restrictions were necessary to restore stability.

In order to achieve the long desired stability, the government had to initiate certain controls and restrictions. The object is to maintain current payments up-to-date with a view to preserving adequate creditability.

Controls are not due to a dogmatic approach but to special circumstances and are based in the realization that Colombia must rely on its own resources, that means development of new export markets, better utilization of productive capacity, and an ever growing internal consumer market. The effects of the restrictions are to be observed in all fields of economic activities.

(f) Availability of Credit

Due to distortions within the capital market, funds which should normally be used to develop agriculture and industry are often misused for commercial purposes. The Colombian industry, therefore, lacks of working capital, a situation that is especially difficult for smaller and medium-sized enterprises.

(g) Import Licensing

To correct the unfavourable balance of payments, import controls are strict, but it is understood they will be gradually liberalized as and when the situation improves.

Officially it is claimed that the criteria for granting import licenses are impartially applied. Industry complains, however, that the procedure is time-consuming and that justified applications are often rejected owing to protective policies which do not take into proper consideration the real position and possibilities of local suppliers.

(h) Advance Deposits

In addition to import licenses, importers are required to make advance import deposits which range up to 200 percent, depending on the nature of goods. Deposits earn no interest and are non-transferable.

Initially, these deposits were meant to limit the total import volume but they are now essentially designed to serve as an instrument of credit policy and have no more direct relation to import policies. It must be realized that the system imposes a heavy burden on enterprises and reduces the already limited amount of working capital available. This severely affects smaller and medium-sized enterprises particularly with respect to adequate stocks of spare parts. As soon as circumstances permit, the advance deposit requirement should gradually ease off. Even a small initial move in this direction would encourage entrepreneurs and would improve the situation for urgently needed spare parts from abroad.

(i) Industrial Policy

Industrial policy is largely formulated by the Ministerio de Desarrollo Económico and the Departamento Administrativo de Planeación and over the years has been guided by such criteria as employment effects, import substitution and export promotion.

Officially sponsored industrial development has contributed to the pace of industrialization but has frequently tended to promote enterprises which are strongly dependent on imported materials, the value increase by manufacturing of which is a minimum. A recently envisaged reorientation of industrial policy is placing greater emphasis on the

establishment of enterprises with prospects of achieving efficiency by means of economies of scale and by relying more closely on local sources for material with higher value added to manufacturing.

(k) Tools for Implementation of Industrial Policy

The following institutes are used for the implementation of industrial policy and are responsible for the development of industry:

- The Corporaciones Financieras
  These institutions spread all over the country are for the time being not sufficiently organised for coordinated efforts.

- The Instituto de Fomento Industrial (IFI)
  which is an autonomous government agency. Sometimes certain objections have been made that IFI could become a too powerful instrument of government intervention, but there is no doubt of the valuable services it is able to render.

  Furthermore, IFI declared the intention of relinquishing its participation in a given venture as soon as possible in order that the operation may revert fully to the private sector.

- The Caja de Crédito Agrario Industrial y Minero which is mainly concerned with development of agriculture, rural industries and mining.

(i) **Prospects**

Colombia has recently been witnessing developments which suggest that it is able to achieve sound economic growth within the scope of a sounder political climate. The prospects for a further steady growth of the economy and particularly the manufacturing sector are favourable, provided the authorities cope adequately with the new lines of industrial policy and ease the restrictions as soon as circumstances permit.

FACTS CONCERNING REPAIR AND MAINTENANCE FACILITIES FOUND DURING THE CARRYING OUT OF SURVEY

1. Important Industries

(a) Number of Firms of reasonable size and the Type and Volume of Manufacture they are engaged in. A group of small firms, which engage in the same type of activity and which may form an important activity as a group, will also be of interest.

This question is answered partly by Table 2. It shows number of firms, employed personnel and gross production figures of the manufacturing industry. Furthermore can be evaluated the average number of employees per company; in the group between 90 and 100 employees in the average, are found such sectors as caoutchouc, basic metal industries and textiles, followed by derivates of petrol and coal, beverages, paper and paper products, electrical equipment, chemicals and metal products.

For the economy as a whole no reliable statistical information was available regarding this subject. This is true to official as well as private sources.

The establishment of a roster showing the required information, however, would be backed by such industrial associations as

Asociación Nacional de Industriales (ANDI)
Asociación Colombiana Popular de Industriales (ACOPI)
and Federación Metalúrgica Colombiana (FEDEMETAL)

The local counterpart could be the
Departamento Administrativo Nacional de Estadistica (DANE) (see recommendations)

(b) Age of the Firms and other pertinent Information
see explanation under para 1 (a).

(c) Importance and Impact on National Economy
see explanation under para 1 (a).

Following an information of DANE the manufacturing industry of the departments

Cundinamarca (Bogotá)
Valle del Cauca (Cali), and
Antiochia (Medellin)

contribute 67.5 percent of the total production.
In recent years the industrialization of the Atlantic coastal area (Cartagena, Barranquilla) has grown remarkable.

Table 2 shows the importance of the different sectors of the manufacturing industry.

- It is expected that the portion of the food and beverage industry will slow down slightly, on the other hand the textile industry will improve its position by higher production of synthetics. Furthermore, the chemical and petrochemical industry is increasing its production. Special consideration for developments will be given to the manufacturing of metal products. For that reason the capacity of the steel mill Paz del Rio which is today about 190,000 tons ingot steel annually, is planned to be increased up to 500,000 tons This would cover local requirements up to 70 %.

- There is a great number of small and some medium sized foundries. Forges, however, are found only scarcely and heat treatment and annealing equipment is lacking nearly at all.
  The largest forge, Forjas de Colombia (FORCOL), in Bucaramanga is still in the implementation of a sufficient production programme in order to increase utilization of existing facilities.

- Manufacturing machinery equipment counts for some 4 percent of the total production value of the manufacturing industry. Some of the more important

sectors of industry have their own affiliated companies for production of such machinery, equipment and spare parts as required by themselves.

. Automobile assembling is still in the planning stage with exception of the Crysler Corporation of USA.

. Within the public sector the road network has to be mentioned. The main portion of the goods traffic is still using the road network which consists of about 35,000 kilometres. The worse condition of the roads affects the road transportation equipment badly. A sufficient network exists only between Bogotá, Cali and Medellin with branchings to Tunja, Bucaramanga, Neiva and Popayan.

. Second by importance and impact on national economy after road transport regarding freight traffic, are the railways. They are state owned and consist of a total track length of only 3,100 km.

The rolling stock and the superstructure are in a most worse condition. Due to that reason the services of the railway are deficient. The total utilization is absolutely too low as to justify the original investment.

- The most important air carrier is AVIANCA with its affiliates. The importance for the passenger service is obviously shown as the air traffic has 28.5 percent more passenger kilometers within Colombia than the railways.

- Inland water traffic on the Magdalena River which was somewhat important in the early fiftieth has diminished since that time and is nowadays almost negligible.

- The state owned Empresa Puertos de Colombia (Colpuertos) administers the four important harbours Buenaventura, Santa Marta and Barranquilla and Cartagena. Colpuertos is planning the extension of the capacity as well as increase of efficiency of its ports.

- The Flota Mercante Grancolombiana is the only international shipping company of Colombia and has a modern fleet.

- Telecommunications are planned to be improved under a scheme provided by the Asociación Nacional de Empresas de Teléfonos. The latter has received already financial assistance through the World Bank.

(d) Importance in the field of Export
see explanation under 1 (a)

. Traditionally coffee is the most important export commodity and accounts for about 60 - 70 % - depending on the world market situation - of the total foreign earnings.
Besides coffee there are other agricultural products as bananas and other tropical fruits, cotton and tobacco which are worthwhile to be mentioned.

. The "exportaciónes menores" which cover all commodities except coffee, raw oil and gold contribute some 23 % of the total foreign earnings. From the latter portion another 60 % cover industrial commodities of the manufacturing industries of which the most important are food, textiles and oil derivates. The activity of the rest of the industry is dominated by the aim to meet local requirements as much as possible in order to substitute former imports.

(e) Type, Age and Condition of Equipment in the different Firms

Equipment

- Installed Operational Equipment
All designs of operational machinery and equipment, sometimes 40 years old, up to very recent designs

are installed within the manufacturing industries. This includes the very modern designs such as semi- and fully-automatic equipment.

- Excess Equipment

There is an excess of equipment leading to over-capacities which are not in line with market requirements. This is due to

- former import policies,
- nowadays it seems to be easier to get loans and import licenses for new equipment than for spare parts for reconditioning of existing equipment,
- saving of financial losses due to the fluctuation of the foreign value of the Colombian Peso as well as inflation, the latter diminishing gradually ,
- setting up double line production, as repairs in case of breakdown are time-consuming or even impossible due to lack of spare parts,
- unreasonable purchase of equipment due to speculation.

- Condition of Equipment

The condition of equipment differs widely due to the general attitude of the management towards main-

tenance. Sometimes it is comparable to international standards, and sometimes not, due to the lack of working capital and sometimes also a gap of knowledge of adequate methods, techniques and routines of maintenance including lubrication (no manuals) and subsequently no introduction of maintenance programmes.

- Average Life Expectancy of Equipment
  This shows partly a gradually lower average life expectancy for equipment. Sometimes, however, the reverse is the case due to the fact that obsolete equipment has to be utilized longer as no normal replacement by import is possible. This results, however, in insufficient qualities and high waste.

- Utilization of Equipment
  There are only few industries which work on a three-shift cycle. Very often the utilization of equipment, even on a one-shift cycle, is less than 50 % of the capacity, due to low market requirements.

- Maintenance Equipment
  The physical condition of maintenance equipment is often inadequate and poor in comparison with productive equipment.

  In some cases, when enterprises use contractors for repair and maintenance jobs, maintenance equipment is completely lacking.

Sometimes repair and maintenance equipment as well as tool making equipment is not properly handled and utilized or even lies idle.

Remarkable exceptions regarding the above statements on the positive side were found in the following sectors:

textiles
clothing
food (partly)
beverages
paper and printings

Flota Mercante Grancolombiana SA
AVIANCA, and
Empresa Colombiana de Puertos.

2. **Existing Repair and Maintenance Physical Facilities**

(a) **Survey of existing Repair and Maintenance Facilities in the different Factories and in the country as a whole. Are there independent Repair and Maintenance Sections in the different Factories with a responsible Manager, and are there Repair and Maintenance Programmes (or any being planned).**

Due to the general attitude of the managerial level or entrepreneurs the adoption or establishment of repair and maintenance systems differs widely from near zero or none to completely sufficient systems.

- In the larger and partly in the medium sized industry whether foreign influenced or not the idea of repair and maintenance is not only conceptionally adopted but mostly realized, however, with a limited effectiveness only.

  In such production units independent repair and maintenance sections specially equipped and adequately staffed, are existing. This applies to all the main sectors of the manufacturing industry and services.

  Remarkable positive examples have been found in the following sectors

  textile industry
  clothing

beverages
food (partly)
chemicals (partly)
paper and printing
tobacco industry
sugar industry

. Additionally to the above-mentioned industries within the manufacturing sector there are worthwhile to mention

AVIANCA
Flota Mercante Grancolombiana
Colpuertos (in implementation stage)

- Sometimes in medium sized firms or smaller production units of large holding companies, even of foreign owned groups, there was found a strong trend to avoid the establishment of repair and maintenance sections and to make more economic use of available contractors.

It was reported that time-limited assignments of foreign experts, for instance for reconditioning of equipment, is judged as to be more economical.

Examples for this attitude were found especially in fruit processing factories. Simple repair jobs are executed in those factories by operational personnel.

- The third group of enterprises, to a lesser extent large or medium sized but mostly smaller sized, has not established for the time being repair and maintenance systems in the real sense and as described for the first group. On the other hand they are not willing to employ local contractors or foreign experts. They have more or less only an emergency type of repair service and are not going ahead in advancing their services as to cover maintenance in the real sense. The main reason for this attitude is to be found in general low utilization of equipment (see page 25).

  This fact was found especially in the

  metal processing and manufacturing industry
  chemical industry (partly)
  carton and paper bag industry
  motor production.

- The following compilation of companies within the manufacturing industry shows figures regarding the importance with a breakdown by size e.g. smaller companies, medium companies and larger companies (see Table 4).

  Besides the manufacturing industry, certain other economic sectors have to be mentioned. For instance in the transport sector there is AVIANCA, which has to observe international standards and regulations for the safety of its equipment as fixed by ICAO.

Table 4

Important Figures of the Manufacturing Industry
(1967)

	percentage of total		
	small firms	medium firms	large firms
Number of firms	84	12	4
Number of employees	25	22	53
Salaries and wages	11	20	69
Production	15	23	62
Investments	7	15	78

Source: Banco de República

Repair and maintenance facilities are established at the main airports and are sufficient.

. The Flota Mercante Grancolombiana executes repair work on bord of their ships by a special technical staff. Main maintenance jobs as to cope with international classification and insurance provisions are done by shipyards abroad.

. The Empresa Puertos de Colombia (Colpuertos) is just in the implementation stage of repair and maintenance programmes in its main harbours. Specific programmes cover all loading and unloading as well as transport equipment.

. The Ferrocarriles Nacionales de Colombia have established a renewing programme for its rolling stock in 1966. In order to improve the lacking repair and maintenance of the rolling stock it is intended to implement a Central Repair and Maintenance Workshop in Facatativá near Bogotá.

. The Ministerias de Obras Públicas has several workshops disseminated throughout the country in order to maintain public properties of all types.

The workshop in Bogotá is combined with a machine tool factory with facilities for spare part manufacturing. But important equipment for heat treatment and annealing purposes, however, is lacking totally.

(b) Survey of centralized repair shops, with volume of work, type and condition of equipment and quality of work. Are these shops privately owned or government owned?

In general, Colombian enterprises prefere to execute repair and maintenance jobs with their own staff if independent maintenance departments for a single production unit or group of such units within a holding are established.

However, there are some exceptions already mentioned which rely on contractors if available.

- The following government-owned centralized repair and maintenance shops are known:

  . Ministerio de Obras Públicas with a number of regional units spread over the country. Repair and maintenance programmes cover mainly the road transport fleet and earth moving equipment. Due to budget restrictions, equipment for repair and maintenance as well as

spare parts are lacking somewhat. Taking into consideration the prevailing situation, quality of the work performed is adequate, but needs improvement.

. The Ferrocarriles Nacionales de Colombia repair and maintain their own rolling stock and superstructure. The repair and maintenance equipment is planned to be improved and will be in more adequate condition if and when the Central Repair and Maintenance Workshop in Facatativá is fully working.

In Cartagena the Colombian Navy has an own repair and maintenance section. Here again budget restrictions affect condition of equipment, availability of spare parts and the quality of work, the latter especially due to low wages.

- Outside the public sector are two examples for firms with centralized repair and maintenance workshops which are engaged mostly for their own purposes:

. AVIANCA has such centralized units in Barranquilla and Bogotá.

Both units are able to perform the required checks and inspections. In Barranquilla airframes and

motors are reconditioned as in Bogotá only minor repairs on turbines are performed. Larger repairs and general overhauls are done in Europe. Condition of repair and maintenance equipment and the quality of work performed are comparable with international standards.

AVIANCA performes also repair jobs for foreign carriers touching Colombian airports.

The steel works Paz del Rio have established only recently an independent repair and maintenance section by merging of the former repair stations and the utilization of existing facilities for a centralized workshop. The planning of repair and maintenance programmes has been completed during the last three years and the implementation is expected to take another two years.

The condition of repair and maintenance equipment is adequate and the quality of work performed differs but is expected to improve.

The centralized workshop is partly engaged in contracting jobs for affiliated companies such as mining.

- Another important example for centralized workshops is found in larger industrial groups within the manufacturing sector. The different production units in such groups do not have their own maintenance sections but only smaller repair shops. Maintenance, however, is programmed and performed by specialized companies which are affiliated to the group as a whole. This fact was found for instance in the textile industry in Medellin as well as in a large industrial group in Bogotá. The reasons for this procedure were stated as follows:

  centralized workshops for maintenance allow
  more and better equipment
  more experienced staff
  better utilization of equipment installed
  and higher quality of work performed.

  Remarkable examples are
  Fabricato SA
  Coltejer and
  Bavaria SA.

- The group of reliable independent contractors for repair and maintenance purposes is small. However, the few companies recommended to be visited such as

Union Industrial SA in Barranquilla,
Talleres Faeza in Barranquilla, and
Siderúrgica del Pazífico in Cali

have been found adequately equipped. The volume of work performed differs as all companies are working mostly by order. The quality of the work performed could partly be improved as and when the raw material quality will be higher and better heat treatment facilities are available.

(c) Availability of Spare Parts and Restrictions, if any, for their importation.

There are some Colombian manufacturers for certain spare parts, but the main complaint is that the local spare parts are in most cases not comparable in quality and precision. This fact, which is true today, will possibly improve. Many enterprises, therefore, complain to be dependent on imported spare parts.

- Import Licensing

  In order to achieve after a decade of instability the long desired stability, the government had to initiate certain controls and restrictions. The object is to maintain current payments up-to-date with a view to preserving adequate credit worthiness. Thus,

import licensing procedures are to be maintained until the foreign exchange situation improves.

To correct the balance of payments deficit, import controls are strict, but it is understood they will be liberalized as and when the situation gradually improves.

Officially it is claimed that the criteria for granting import licenses are impartially applied. Industry complains, however, that the procedure is time consuming and that justified applications are often rejected owing to protective policies which do not take into proper consideration the real position and possibilities of local suppliers.

- Advance Deposits

In addition to import licenses, importers are required to make advance import deposits which range up to 200 %, depending on the nature of goods. Deposits earn no interest and are non-transferrable.

Initially, these deposits were meant to limit the total volume of import but they are now essentially designed to serve as an instrument in the credit policy and have no longer any direct relation to import policies. It must be realized that the system imposes a heavy burden on enterprises and reduces the already limited amount of working capital available.

The larger industrial concerns and partly the medium ones, when settled down properly, are able to cope with the excessive capital requirements for advance deposits. The rest of the industry, however, is handicaped by this measure and hopes that it will be eased gradually as circumstances permit.

Even a small initial move in this direction would encourage entrepreneurs and would improve the situation as regards urgently needed spare parts from abroad.

- Spare Part Supplier Agencies
  Because of the restrictions for stability, supplier agents in Colombia are not able to hold adequate stocks of spare parts, due to the high investment involved.

- Firms' Own Stocks of Spare Parts
  Due to the restrictions , stocks of spare parts in enterprises vary from none to an absolute minimum. Only a few exceptions were found which had a reliable stock, taking into consideration the problem of long delivery times.

- Delivery Times
  In many cases it was claimed that factories were short of spare parts due to long delivery times and

that they could not overcome the situation due to additional time-consuming licensing procedure.

- Agents Abroad
  Sometimes it was claimed that suppliers' agents have adequate stocks of spare parts in Miami, Panama or Venezuela and that it was at times more economically to depend on those stocks than on their own, owing to the restrictions.

- Distortion of Spare Part Supplies
  Besides the difficulties arising from the restrictions all other distortions are judged to be of minor importance.

(d) Availability of Spare Parts Manufacturing Facilities. Quality of Parts produced and, if possible, ratio of locally manufactured Parts to total Consumption.

There are some Colombian manufacturers for certain spare parts, but the main complaint is that the local spare parts are, in most cases, not comparable in quality and precision. This fact, which is true today, will possibly be improved. It needs much more time and experience for the manufacturing of those specialized parts. What is lacking today is quality of the raw material, e.g. special steel, and heat treatment facilities. Many enterprises, therefore, complain to be dependent on imported spare parts.

As described under para 2 (b) there are certain large groups within the manufacturing industry which have established centralized repair and maintenance workshops with facilities for spare part production. The statement regarding quality has to be applied also for such installations.

The ratio of locally manufactured parts to total consumption was reported to be between 10 and 50 % according to the requirements of specific industries.

(e) Availability of organized adequate Stores

There are all types of systems for stockholding of spare parts from visualized Cardex to computerized systems. Taking into consideration the effects of the present restrictive measures, the systems available seem to be adequate, as far as such systems are established.

However, more information about the economic benefits of most modern systems which enable companies to have optimal stocks of spare parts would improve the general situation of repair and maintenance.

3. Prevailing Conditions of Repair and Maintenance Activities and Diagnosis

(a) Are existing facilities of repair and maintenance sufficient?
If not, indicate aspects that will give an idea on the magnitude of inadequacy, such as production losses due to repair and maintenance, idle time in important factories and for certain expensive machines.

In order to judge the adequacy of actual facilities and activities for repair and maintenance, are to be realized the reasons for maintenance as follows:

The general aspect of maintenance is -

- in the economic aspect - to reduce operating
  costs because of less downtime
  fewer repairs
  less production losses
  utilization of manpower at a higher percentage
  to prolongate life expectancy of equipment and
  consequently better utilization of fixed assets

- in the technical aspect -
  to indicate cases in which a minor repair or adjustment will prevent a major breakdown

- to take such safety measures whatsoever, to prevent fire or other hazard which could cause injury to an employee or cause a production loss.

Taking these aspects into consideration it is obvious that the measures are only partly carried out, if at all.

In those settled factories of the manufacturing industry which have already established repair and maintenance programmes (s. page 27), the effectiveness of these systems suffers due to lack of such important elements as spare parts. Even in bigger factories or groups, distortions arising from inadequate deliveries are not taken into due consideration. Optimal stockholding of spare parts is therefore not observed. This situation can be overcome if the management attitude towards a realistic solution for this problem will improve and the restrictive measures being eased.

- Preventive Maintenance
  Where industry is subject to foreign influences - by capital or education - preventive maintenance is established and comparable to international standards.

- Breakdown Maintenance
With some exceptions it is mostly the smaller industry which has a fire fighting type of maintenance , rushing from one breakdown to another, but in many cases even such enterprises have conceptionally adopted the benefits of preventive maintenance systems although they are not able to establish such systems due to the following:

  . low utilization of capacity due to low market requirement

  . therefore high unit costs and no economies of sale

  . limited working capital due to distortions in the capital market and the effects of the restrictive measures.

They are mostly unable to establish maintenance systems under the prevailing conditions (s. page 29).

- Maintenance and Newcomers in Industry
Obviously the development of the economy and particularly the manufacturing sector has been too fast, as some minor or middle entrepreneurs are still what they had been in former times - traders and merchants - and have not become industrialists

in the modern sense. But Colombians are mainly money conscious. Besides other measures of industrial policy it therefore needs a campaign for the promotion of the idea of repair and maintenance and for the demonstration of benefits, routines and techniques of maintenance to convice them and to improve the situation.

- Maintenance Programme
  A maintenance programme has to be sold from down up to the managerial levels. The idea of repair and maintenance and its requirements is often not sold properly by the engineering side to the management considering the prevailing Colombian conditions, but in a too sophisticated way.

- Lack of Coordination
  Larger industrial groups with separate manufacturing units have established maintenance departments, but the engineers in charge have not competent counterparts in head offices of the holding management. To overcome this distortion better organization is needed.

The measurement of production lost because of repair and maintenance or idle times is difficult due to the fact that a great number of factories is working only on

a one-shift system and that there is sometimes an idle double line of equipment, due to financial speculations and in contrary to the actual market requirements.

In cases where a two or three-shift routine is applied - for instance in such sectors as textiles, food and beverages - it was stated that the total utilization of capacities attains about 80 percent.

In the metallurgical sector, however, this level of utilization is not yet reached. In the steel works Paz del Rio for instance only the cokery and the blast furnace attain a utilization of about 80 percent whereas other productive units attain only 50 to 60 percent, due to often occurring breakdowns, for instance in the steel plant, with idle times in the following production units such as blooming and rolling mills. It is expected that after implementation of the proposed repair and maintenance programmes the utilization will steadily improve.

(b) Industries or industrial equipment in which the problem of repair and maintenance is particularly acute.

The field of industries, services and industrial equipment in which the problem of repair and maintenance is particularly acute are

railway transportation

road transport facilities, e.g. trucks, busses and road conditions

steel mills and steel melting plants

rolling mills

foundries

forges

annealing plants or sections

machine tool factories, especially in respect of automotive spares and other spare parts

smaller sized industries in general.

This compilation is to be judged as an important crucial field in respect of industrialization, and particularly of repair and maintenance.

(c) Factors affecting the adequacy of maintenance and repair facilities and grading of these factors according to their importance and impact.

The fact of not having established repair and maintenance programmes particularly within smaller sized factories is due partly to a certain lack of the management attitude towards repair and maintenance, but on the other hand due tu the negative effects of restrictive measures (see pages 29 and 43).

Obviously the development of the economy and particularly the manufacturing sector has been too fast, as some minor or middle level entrepreneurs are still what they

had been in former times - traders and merchants - and have not become industrialists in the modern sense. But Colombians are mainly money conscious. Besides other measures of industrial policy it therefore needs a campaign for the promotion of the idea of repair and maintenance and for the demonstration of benefits, routines and techniques of maintenance to convince them, and to improve the situation.

In factories where such programmes have already been established, the effectiveness is lacking because of shortcomings of spare parts. Again this is partly a lack of management attitude as proper appliance of such systems is only possible if all important elements including an optimal stockholding of spare parts is taken into due consideration (see page 42).

It was reported from larger industrial concerns, and partly from medium ones too, that when settled down properly, that they were able to cope with the excessive capital requirements for advanced deposits necessary for the importation of spare parts.

On the other hand, the rest of the industry is hit worse by this high capital requirement and hopes that it will be lifted gradually as circumstances permit.

For the sectors as mentioned under para. 3 b, e.g. railways and metallurgical industries, the lack of information about techniques, routines and methods of repair and maintenance is obvious.

Assistance in this field including the provision of manuals will improve the situation.

(d) Effect of absence of standardization and unnecessary variety of equipment on maintenance and repair.

- Attitude to standardization
  The necessity for standardization of equipment which leads subsequently to lower investment in spare parts is accepted conceptionally. However, due to pressure of actual requirements which often need on-the-spot decisions and purchase it seems to be mostly impossible to implement standardization of equipment under the prevailing situation. Entrepreneurs are often forced by circumstances to purchase immediately or even to use second-hand equipment in order to keep their factories running.

On the other hand there is an excess of equipment due to the following facts:

. saving of financial losses due to the fluctuation of the foreign value of the Colombian Peso as well as inflation, the latter diminishing gradually

. setting up double line production, as repairs in case of breakdown are time consuming or even impossible due to lack of spare parts

. unreasonable purchase of equipment due to speculation.

In such cases the observation of standardisation of equipment is lacking totally.

- Standards

  In this connection, standardization must not necessarily be taken as the provision of the same equipment from the same manufacturer. Rather it is to imply that uniform standards should be aimed at for all industrial equipment.

  This goal, also, has not yet been attained in Colombia.

- **Change in designs**

  In this respect it was reported that ordering of spare parts becomes more difficult sooner than expected. Suppliers change equipment and subsequently spare parts. Spare parts for older equipment are not being provided over long periods.

- ISO standards

  This particular problem arises out of the fact that ISO standards (International Organisation for Standardization) are actually not generally adopted.

- Summary

  Improving standardization or the implementation of uniform standards and its observation would have by all means positive effects, regarding optimal stocks of spare parts and programming.

(e) Are there any Government organizations or private institutions dealing with repair and maintenance and how effective are they?

The Instituto de Investigaciones Tecnologicas (IIT) provides through its technical divisions practical assistance including information about repair and maintenance. It furthermore renders assistance in the form of seminars, courses and group assistance. The efforts of IIT were reported to be successful.

The Servicio Nacional de Aprendizaje (SENA) has set up recently special courses for repair and maintenance. Nothing is known so far about the effectiveness.

(f) Are there any Government policies affecting repair and maintenance?

Direct policies affecting repair and maintenance have not been found during the survey.

On the other hand the restrictions in order to restore economic stability aggravate the adoption and realisation of preventive maintenance in respect of stock-holding of spare parts.

4. Personnel

(a) Availability of skilled personnel

Number of personnel who have had or are undergoing training in repair and maintenance

- Qualified Engineers

  The skill of qualified engineers for repair and maintenance is satisfactory. A certain number got their education not only at Colombian Universities but also abroad. Sometimes re-adaptation to Colombian conditions seems to be difficult.

- Technical Supervisory Staff

  There does not really exist a technical supervisory staff. The available staff reached this level only by promotion and not by ability in the real sense.

- Mechanics and Electricians

  The lower technical level learned their trade in former times not by education or training but only by experience and by repeating the same job year after year. They were, therefore, not interchangeable and had to be given additional training if general changes due to modern production methods occurred, but due to efforts of SENA which is providing adequate knowledge of sciences this situation is improving.

- **Education and Experience**

  Graduates of Technical Colleges and/or SENA, having gained basic technical knowledge, are in the beginning lacking in practical experience but are, in most cases, willing to undergo further training in industry.

- **Status of Maintenance Personnel**

  The status of maintenance personnel at all levels is acknowledged and in cases where they have proved to be a success they are better paid and even in the highest salary bracket.

- **In-plant Training Schemes**

  To cover their requirements of skilled personnel various enterprises have established their own in-plant training schemes and have them implemented partly on their own and partly in cooperation with SENA.

- **Level of Skill**

  The judgement of the level of skill of repair and maintenance personnel differs only slightly, but seems to be somewhat too positive. However, steady improvements by efforts of SENA have been stated in most cases.

- **Emigration**

  There is certain emigration in particular trades and professions, especially of high skilled personnel. This, however, affects maintenance engineers only to a small extent. On the other hand, benefits from the reverse, namely from additional training abroad, were reported.

- **Total Manpower Resources**

  The country provides annually about 380, 000 new potential labourers, of which the industry can absorb only one third. As there is a natural feeling for mechanics among the Colombians, one may rely, therefore, on constant possibilities of recruiting technical personnel.

- **General Situation of Education**

  The efforts of SENA are concentrated mainly on vocational training.

  Apart from this, mention must also be made of the positive effects of the general educational policy, e.g. in 1964 illiteracy among the population dropped down to an average of 27.1 %. During the period of 1965 - 1968, the structural relation of the educational levels changed as follows:

	1965	1968
Primary School	2,270,000	2,669,000
Secondary School	405,000	569,000
Superior School	45,000	60,000

- Number of trained personnel

  Official and private information regarding the number of personnel that had or are undergoing training in repair and maintenance were differing widely and therefore not reliable.

  The only reliable information was given by SENA. In 1968, 547 adults were taking part in courses with the specific subject repair and maintenance provided by SENA in its own institutes. The respective number of apprentices was 514.

  For 1969, it is expected that these numbers will increase by about 25 percent.

(b) Availability of training facilities;
vocational training centres,
in-plant training and programmes
for training (locally and abroad).

- Academic

Academic education is provided by the Engineering Facilities of the following Universities:

Mechanical Engineering

	1966 Entries	Graduates
Universidad de America Bogotá	18	24
Universidad Nacional de Colombia - Bogotá	-	-
Universidad Industrial de Santander - Bucaramanga	46	48
Universidad de Pereira Pereira	-	-
Universidad de Los Andes Bogotá	-	-
Universidad Bolivariana Medellin	34	11

Electrical Engineering

Universidad Nacional de Colombia - Bogotá	-	-
Universidad Industrial de Santander - Bucaramanga	43	33
Universidad de Pereira Pereira	-	-
Universidad Bolivariana Medellin	20	6

Electrical/Mechanical Engineering		
Universidad del Valle Cali	13	13
Business Administration		
Universidad Nacional de Colombia - Bogotá	-	-
Universidad Jorge Tadeo Lozano - Bogotá	94	7
Colegio Mayor del Rosario Bogotá	-	-
Escuela de Administración y Finanzas de Medellin Medellin	28	27
Universidad de Medellin Medellin	15	2
Universidad de Paula Santander Cucuita	-	-
Universidad del Norte Barranquilla	-	-
Universidad Tecnológica del Valle del Cauca Cali	-	-

The level of education in these universities is judged to be high or acceptable.

- **Training Centres**
  Several training centres run by industrial associations, certain enterprises or religious entities provide trade and industrial courses at the pre-apprenticeship level.

- **Servicio Nacional de Aprendizaje - SENA**
  The objectives of SENA are to improve the general level of skill in all trades and technical fields. This includes basic training, advanced training, special training concerning those items as productivity, production techniques, quality control, safety regulations and repair and maintenance.

  To achieve those integrated training targets, the attendants of SENA courses receive not only pedagogical training but also information concerning social, physical - ethical and cultural development. SENA has 15 training centres disseminated throughout the country, with a total of 238 different workshops (see Table 5). SENA not only provides courses within its own training centres and workshops but also assistance to in-plant training schemes set up by enterprises.

TABLE 8

SENA Training Centres which provide courses in mechanical and electrical engineering.

Instituto Técnico Central	Bogotá
Instituto Técnico Distrital	Bogotá
Instituto Industrial Piloto	Bogotá
Instituto Pascual Bravo	Medellín
Instituto Técnico Industrial	Barranquilla
Instituto Técnico Industrial	Pereira
Instituto Técnico Industrial	Neiva
Escuela Industrial Julio Florez	Chiquinquira
Instituto Industrial Francisco José de Caldas	Manizales
Instituto Técnico Industrial	Cucuta
Instituto Técnico Industrial Damaso Zapata	Bucaramanga

- Maintenance Courses provided by SENA

SENA provides courses for:

Construction
Metal mechanics
Electrical mechanics
Motor mechanics
Foundries, and
Textiles.

Within this scope it has set up special courses for repair and maintenance.

- Lack of Text Books

SENA has developed its own teaching manuals for maintenance but is lacking adequate basic text books in the fields of telephony, mechanics, electronics, electrical control, hydraulics, heat treatment systems, measuring systems, plastic tool making, die making and all automotive industries.

- In-plant training

Various firms have their own in-plant training schemes or are just starting them partly by assistance of SENA. They establish such schemes in order to cover their own requirements of skilled personnel including personnel for repair and maintenance.

It provides practical technical assistance including repair and maintenance to a great variety of industries such as plants for food processing, fertilizers, chemicals, plastics, metal working, including foundries as well as bakeries, meat, egg and dairy industries.

It furthermore renders assistance in the form of seminars, courses and group assistance.

- Training abroad

Training abroad with the special subject of repair and maintenance has been found scarcely.

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RECOMMENDATIONS

5. Future Policy

(a) Survey of maintenance and repair needs and establishment of priorities.

In surveying all efforts in Colombia whether to establish new ones or to improve already existing repair and maintenance facilities, the most crucial problem is to be judged that of spare part supplies in nearly all fields. There were only a few enterprises which have solved the problem sufficiently, due to taking into account the proper facts of the prevailing situation, e.g. technical requirement against economical possibilities. In most cases there was found a compromise.

There are some Colombian manufacturers for certain spare parts, but the main complaint is, that the local spares are in most cases not comparable in quality and precision. This fact, which is obviously true today, will possibly improve.
Many enterprises therefore complain to be dependent on imported spare parts.
But with a view to preserving adequate creditworthiness the Governnent had to initiate certain

controls and an import licensing system.
In addition to import licences, importers are obliged to make advanced import deposits, which are heavy financial burdens on the enterprises (see pages 36; 37; 38).

To ease this situation all efforts should be made to improve local manufacturing of spare parts. It needs much time and experience for manufacturing specialized parts. What is lacking today is quality of the raw materials e.g. special steel and heat treatment facilities of different types.

Taking these facts, one has to recommend improvements within the existing forging and foundry capacity in Colombia (see recommendation under 5 g, page 78)

Additionally to these action-oriented steps, to be taken in the field of spare parts manufacturing, a general demonstration of all kinds of benefits due to the implementation of repair and maintenance facilities is to be judged as a most useful assistance (see recommendation under 5 c, pages 73, 74)

The effects of such an assistance will be threefold:

. to assist such firms in establishing repair and maintenance programmes which have no at all for the time being

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- to assist such companies which have only incomplete systems

- to recommend such guidelines as to improve the physical condition of existing repair and maintenance equipment and other facilities e. g. optimal stockholding.

The demonstration will include special courses, assistance for the introduction of maintenance systems, assistance for organization, standardization and programming problems, provision of technical information, repair and maintenance manuals and the establishment of important rosters providing statistical information about equipment etc.

This all will certainly improve the situation by achieving generally a better attitude towards repair and maintenance and especially in such industries where this is lacking.

These efforts would be strongly supported by certain governmental measures which have to be taken simultaneously such as:

- gradually lifting of the restrictions for imports, particularly for necessary spare parts and/or high graded raw material for their manufacturing, which are not available from local sources.

. provision for repair and maintenance in loan agreements for new establishments and for the extension of old ones.
(see recommendation under 5 b page 69)

Furtheron SENA needs assistance for specialized courses for medium level technical supervisors and foremen, as not really exists a technical supervisory staff today. (see recommendation under 5 e, page 75)

Sectorwise priorities for assistance should be given to:

. transportation sector excluding aviation and shipping

. metallurgical firms, and

. smaller firms in the manufacturing industry.

(b) Recommendation on the up-grading of existing facilities.

Taking the physical conditions of existing facilities and the conceptionally adoption of repair and maintenance systems as granted the efficiency of the existing facilities will be up-graded by the following recommendations:

- Establish a Campaign
"Information regarding purchase and implementation of equipment according to technical and economic criteria only".

In Colombia exists today an excess of equipment leading to over capacities, which are not in line with market requirements.
The reasons for this development were explained in detail under 1 e (pages 23 and 24) e. g.

- former import policies
- easier loans and import licences for new equipment
- saving of financial losses
- setting up double line production
- unreasonable purchase due to speculation.

In spite of excess equipment such important facilities as for instance heat treatment equipment is lacking.

Colombias general econonic situation of today does not support the idea of repair and maintenance. Therefore, this campaign is suitable to overcome partly this crucial situation, but its effects will be seen only after a certain period.

This campaign shall provide special courses, seminars and advice and concerns equipment in general, equipment for repair and spare parts including formulas for capacity estimates.
It will provide such guidelines and information as to improve even existing repair and maintenance equipment.

If necessary and advisable such a campaign could be repeated.

Joint venture of

UNIDO (1 expert) and local counterparts such as
Instituto de Investigaciones Tecnologicas (IIT)
Asociación Nacional de Industriales (ANDI)
Asociación Colombiana Ingenerios Contratistas (ACIC)
Asociación Colombiana Popular de Industriales (ACOPI)
Federación Metalurgica Colombiana (FEDEMETAL)

SHORT TERM ACTION

- Standardization

  Intensify standardization with a special view to problems of repair and maintenance and up-grading of existing facilities in assisting the Instituto Colombiana de Normas Técnicas (INCOTEX). This assistance seems to be necessary only for the implementation stage of standardization actions, the effects of which will be seen only in the long run, but which nevertheless have to be started (see 3 d, pages 48; 49; 50).

  In this connection, standardization must not necessarily be taken as a provision of the same equipment of the same manufacturer. Rather it is to imply that uniform standard should be aimed at for all industrial equipment.

Supplementary to the assistance in formulating standardization regulations the training of local counterparts would be possible. The expert should not be assigned as to complete the standardization regulations but just to start them up. The local counterparts shall continue in observing the regulations afterwards.

Joint venture of
UNIDO, and
Instituto Colombiana de Normas Técnicas (INCOTEX)
SHORT TERM ACTION

- Roster of Equipment
Establish a roster of such used, but not obsolete production and maintenance equipment which lies idle but is available for other manufacturing firms in case of urgent replacement, giving due consideration to the spare part situation and also in respect of starting standardization.

Joint venture of
UNIDO (1 expert)
Instituto de Investigaciones Tecnológicas (IIT)
Asociación Nacional de Industriales (ANDI)
Asociacion Colombiana Popular de Industriales (ACOPI)
Federación Metalúrgica Colombiana (FEDEMETAL)
SHORT TERM ACTION

- Establish a roster showing such statistical information as

  . number of firms and type and volume of manufacture they are engaged in;
  . age of the firms and other pertinent information;
  . importance and impact on national economy;
  . importance in the field of export;
  . availability of repair and maintenance systems;
  . availability of in-plant training systems, and
  . number of personnel employed with a breakdown whether
    skilled
    semi-skilled or
    unskilled
  . and kind of special training and experience.

  Joint venture of
  UNIDO
  Departamento Administrativo Nacional de Estadistica (DANE)
  SHORT TERM ACTION

- Industrial Policy
  Assist the Ministerio de Desarrollo Económico, the Departamento Administrativo de Planeación and the executing agencies such as Instituto de Fomento Industrial (IFI) and the Corporaciones

Financieras in formulating and executing their industrial development policy with a special view to problems of repair and maintenance, e.g. junction with loan agreement for soft loan: "No soft loan without provisions for preventive maintenance".
The todays level of interest paid for loans is enormous and in most cases prohibitive.
The only national sources for getting loans, bearing normal interest, for new industrial development or readjustment of existing capacities are IFI and the Corporationes Financieras.

In spite of checking and advising debtors, those are often not able to serve the loans due to lack of provisions for repair and maintenance.
For that reason, the investment banks should make written provions in their respective loan agreements and give expert advice where necessary to establish systems for preventive maintenance within the enterprises. This action needs constant controls afterwards in order to keep the systems functioning.

The assigned qualified industrial engineers (maintenance) should be interchangeable within the group of executing agencies, thereby securing the coordination of the efforts. Besides the assistance in formulating and executing the industrial policy it would be possible to train local counterparts who could take over the duties of the foreign experts later on. The experts should

not be assigned for an extremely long period but just to start up this policy.

Joint venture of

UNIDO

Ministerio de Desarrollo Económico

Departamento de Planeación

Instituto de Fomento Industrial (IFI)

Corporación Financiera Colombiana

Corporación Financiera del Valle

Corporación Financiera Nacional

Corporación Financiera del Norte

Corporación Financiera de Caldas

Caja de Crédito Agrario Industrial y Minero

SHORT TERM ACTION

- Supervisory Level

Assist SENA in establishing such "Specialized Courses for Technical Supervisors and Foremen" as will provide a higher and wider scope of training and ensure an adequate level of skill for medium technical supervisors and foremen. Having such medium level of technical supervisors and foremen, the utilization of installed capacity will increase due to better knowledge of technical functions. This is true also with a view towards repair and maintenance as decisions on when and how actual repairs have to be performed, should be taken preferable on this level.

This special training should be started immediately in order to enjoy benefits from such up-grading measures as soon as possible.

The courses should be provided continuously.

Joint venture of
UNIDO and
other appropriate International Organizations
Servicio Nacional de Aprendizaje (SENA)
LONG TERM PROGRAMME

- Text Books
As there is a lack of basic text books for almost all technical trades and professions, assist SENA in selecting and translating adequate text books not available in Colombia today.

Joint venture of
UNIDO and
other appropriate International Organizations
Servicio Nacional de Aprendizaje (SENA)
SHORT TERM ACTION

- Maintenance Manuals
Provide up to date maintenance manuals for specific industries which will enable the respective industries to establish preventive maintenance programmes with only short term assistance of foreign experts in each case. In this respect mother factories or suppliers should give more emphasis on this subject (see recommendation 5 h page 77)

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Gesellschaft m b H

(c) Recommendations on the establishment of new facilities if necessary; central (regional or national) repair shops, in-plant of repair and maintenance facilities, the establishment of repair and maintenance programmes in the different factories.

In order to demonstrate all kinds of benefits due to the implementation of repair and maintenance programmes, and to achieve a realistic and more favourable attitude, should be established a

Central and Mobile Repair and Maintenance Workshop.

- This workshop with partly mobile equipment will act as contractor predominantly for the small sized industry and will furtheron promote and demonstrate all positive effects of preventive maintenance.
  This multi-purpose unit will provide

  . performance of contracting jobs in the field of repair and maintenance
  . assistance for the introduction of adequate maintenance systems including stockholding systems
  . courses especially on preventive maintenance
  . demonstration of repair and maintenance methods, techniques and routines
  . maintenance manuals

It is understood that the workshop will charge for performing contracting jobs and will compensate as far as possible the local expenditure. Besides the fact of having a well equipped and organized repair shop this unit will certainly improve the whole situation and particularly the attitude towards repair and maintenance.

Due to the topographical situation of Colombia there are independent centres of economic activities. To start this campaign, a first unit should be established in Bogotá. After having gained experience, other units can be established in Barranquilla for the Caribbean Coastal Zone, and in Cali for the Cauca Valley.

Joint venture of

UNIDO (8 experts)
Instituto de Investigaciones Tecnológicas
(8 local counterparts, 6 skilled labour, local,
1 office clerk)

LONG TERM PROGRAMME

(d) Recommendations on improving existing stores and the establishment of new ones.

See explanation under para 5 (b)
"Formulating the Industrial Policy", and
para 5 (b)
"Stockholding Systems".

Provisions for repair and maintenance in loan agreements should cover also the stockholding systems and the availability of spare parts.

LONG TERM PROGRAMME

(e) Required Training with Establishment of Priorities; Vocational Training Centres, Short Period Classes in Factories and In-plant Training, Specific Training for specific Machinery.

Vocational training is provided and will be improved furtheron by in-plant training schemes independently or combined with SENA.

What is lacking is an adequate level of skill of medium technical supervisors and foremen.

Therefore SENA needs assistance in establishing such "Specialized Courses for Technical Supervisors" as will provide a higher and wider scope of training and ensure and adequate level of skill for technical supervisors (see recommendation 5 b, page 71)

Joint Venture:

UNIDO

and other appropriate International Organizations

Servicio Nacional de Aprendizaje (SENA)

LONG TERM PROGRAMME

(f) Recommendations on the establishment of spare parts storage systems; in-plant stores or control stores. (See explanation under para 5 (d) page 74)

No additional recommendations.

(g) **Recommendations on the establishment of spare parts manufacturing facilities with a programme.**

Under para 2 (d), the situation of the spare parts manufacturing facilities in Colombia was explained. The main statement was that locally produced spare parts are in most cases not comparable in quality and precision. What is lacking today, for instance is, the quality of raw material, e.g. special steel and heat treatment facilities.

Many enterprises therefore claim to be dependent on imported spare parts. The well-known import restrictions aggravate the situation of spare part supplies. All efforts to overcome this crucial situation, should take into consideration the following evaluation:

Preliminary estimates show a minimal requirement on spare parts for

automotives
earthmoving equipment
railway accessories

on forings	3,000 tons annually
steel castings	1,200 tons annually
malleable, grey and nodular castings	2,400 tons annually.

It is to be expected that these minimum requirement will certainly increase up to 50 percent for other sectors.

The mentioned quantity of forgings can be covered by FORCOL after small investments to complete its existing facilities.

The existing foundry capacity of Colombia is not able today to achieve those standards of quality and precision as required by the above-mentioned sectors.

Whether the up-grading of existing facilities or the establishment of new and specialized ones with most modern equipment will be the optimal solution was not possible to determine during the limited time of the survey.

Therefore, the following recommendation seems to be necessary:
"Preparation of a Feasibility Report"
tackling the following subjects:

- Requirement of special forgings and castings
- Establishment of a production programme
- Survey of existing facilities and possibilities of up-grading
- Survey of possible locations for new facilities
- Economic evaluations
- Summary and recommendation.

Joint venture of:

UNIDO (contractors)
Departamento de Planeación
Instituto de Fomento Industrial (IFI)

SHORT TERM ACTION

(h) Role that can be played by Developped Countries and Mother Factories:

Many large firms, when foreign influenced, receive already assistance from their mother factories, which assign specialized engineers for a certain time in order to improve repair and maintenance.

Smaller companies are often handicapped regarding such foreign assistance.

i Help in the establishment of central spare part stores

No recommendations.

Within the larger or foreign influenced industry can be observed a strong trend to free economy without any government intervention.

Furthermore, there is no real feeling for cooperative methods, as a cooperative member, who is also a competitor might be able to control operations to some extent. However, here are a few exceptions.

ii Help or share in financing central repair facilities,(see above explanation under para 5 (h) i).
However the equipment for the Central and Mobile Repair and Maintenance Workshop

(see recommendation in para. 5 c) could be a donation from the International Assistance Organizations, from National Organizations or from potential suppliers of such type of equipment.

iii Help in organizing repair and maintenance in the different factories and in constant training courses for particular equipment:

Potential suppliers of equipment and/or mother factories could assign technical experts for a limited time in order to render assistance in organizing repair and maintenance programmes using particular equipment and providing maintenance manuals for special machinery. (see explanation under para 5 (b).

iv Help in establishing or perhaps in sharing in financing the establishment of spare parts manufacturing facilities.

A suitable recommendation depends on the result of the respective feasibility report to be prepared.

v Supply of personnel to advise on repair and maintenance problems generally and in the different factories.

See explanation under para 5 (h) iii.

Additionally should be established special training courses and/or seminars in industrialized countries or in production units of potential suppliers of equipment and other processing industries.

6. SUGGESTED PROGRAMME OF IMPLEMENTATION

A Central and Mobile Repair and Maintenance Workshop (see para 5 (c))

Maintenance Manuals (see para 5 (b))

Stockholding Systems (see para 5 (b))

LONG TERM PROGRAMME

			US $
(a)	Workshops, office and garages		13,500
(b)	Workshop equipment		14,000
(c)	Store materials		2,000
(d)	VW Minibus		2,500
(e)	1 special truck with winch and hoist		3,600
(f)	3 VW station cars		6,000
(g)	Equipment of mobile repair unit		1,400
			43,000
(h)	Water, power, cleaning, refuse disposal	annually	1,300
(i)	Maintenance of vehicles	annually	3,200
(k)	Postage, telephone, stationery	annually	2,500
		annually	7,000
(l)	Project manager	annually	24,500
(m)	1 teacher for specific training on preventive maintenance courses	annually	24,500
(n)	2 maintenance engineers/programming	annually	49,000
(o)	2 maintenance engineers/implementation	annually	49,000

			US $
(p)	2 maintenance engineers, job performance	annually	48,000
(q)	8 local engineers	annually	57,600
(r)	6 highly skilled workmen, local	annually	28,800
(s)	1 office clerk, local	annually	3,000
(t)	1 helper, local	annually	1,600
(u)	Expert offices free of charge		-
Implementation of workshop			43,000
Fixed assets		annually	7,000
Salaries and wages		annually	287,000
Subtotal			337,000
10 % contingencies			33,000
			370,000

(Travelling expenses born by Colombian Authorities)

and for each additional year:

Fixed assets	7,000
Salaries for experts only	196,000
Subtotal	203,000
10 % contingencies	22,000
	225,000

(Remark: Salaries and Wages for local employees from revenues.)

Central and Mobile Repair and Maintenance Workshop in Bogotá, Colombia

- Breakdown of equipment

(i) Workshops, Office and Garage

1 Building with Workshop Office, Garages, and Workshops
approx. 9 m x 18 m, approx. 5 m high = 800 m^3
1 m^3 = 15 US $ 13,500 US $

(ii) Workshop Equipment

1 hand-operated crab, 1.5 t carrying capacity	700 US $
1 small lathe, height of centres: 100 mm distance between centres: 500 mm	625 US $
1 lathe, height of centres: 250 mm distance between centres: 1000 mm	2,000 US $
1 milling machine, height of centres: 250 mm distance between centres: 1000 mm	1,500 US $
1 upright drilling machine 0 - 10 mm	100 US $
1 upright drilling machine 0 - 20 mm	250 US $
1 grinding machine 125 mm	75 US $
1 grinding machine 300 mm	125 US $
1 belt sanding machine	250 US $
1 plate shears, length of cut: 800 mm length of cut: 500 mm	300 US $
2 hand drilling machines 0 - 6 mm	75 US $
1 hand drilling machine 0-12 mm	80 US $
1 hardening furnace with salt and oil bath	1,000 US $
1 coil winding machine	900 US $
1 drying chamber, infra-red heating	150 US $
2 oxyacetylene welding outfits	125 US $
2 small welding transformers	250 US $
1 spot welding machine	200 US $

4 , 3 soldering irons, electrically heated	90 US $
1 small circular saw	75 US $
1 small band saw	90 US $
1 small panel planing machine	400 US $
1 joiner's bench	50 US $
1 mobile compressor for 7 kg/cm^2 gauge compressed air	450 US $
1 sheet metal roller, hand-operated	150 US $
1 tube roller, hand-operated	50 US $
1 bending press, hand-operated	200 US $
tinsmith's tools	125 US $
1 anvil with 2 horns and block	80 US $
1 forge	40 US $
4 work benches	300 US $
4 vices	50 US $
1 hot washing plant	240 US $
2 pulley blocks 500 kg	60 US $
2 " " 1000 kg	80 US $
3 oil pumps, 20 tons	90 US $
ropes, chains	300 US $
6 voltage detectors 0 - 600 V	180 US $
2 ammeters	120 US $
4 tool cabinets, containing	
various hammers,	
water pump pliers,	
pipe wrenches,	
various pliers,	
combination pliers,	
side cutting pliers,	
end cutting nippers,	
various screw drivers,	
various files,	

reamers,
pins,
punches,
twist drills,
thread-cutting tools,
scraping tools,
saws,
plate shears,
various chisels
tapping devices up to 250 mm,
grease guns,
various spanners,
various box wrenches,
various wrenches for socket head cap screws,
various socket wrenches,
cable lamp 4 x 200 = 800 US $
various measuring instruments

12,705 US $

10 % small shop tools 1,295 US $

14,000 US $

(iii) Store Materials 2,000 US $

Mobile Workshop

(iv) 1 VW Minibus 2,500 US $

(v) 1 Special Truck with Winch and Hoist 3,600 US $

It is proposed that the vehicle should be of the station wagon type with double cabin, designed for 1,5 t useful load.

The loading surface should be covered and the cover supported by a solid superstructure.

Holding devices for the various tools could be prepared according to requirements. The installation of special tool cabinets has not proved useful. However, it must be ensured that the load will not slip out of place.

(vi) Equipment of Mobile Repair Unit

1 gripping tackle, 3 t
2 return pulleys (rope block)
1 lifting tackle, 1.5 t
1 Lukas pump, 50 t
1 Lukas pump, 20 t
2 pump boxes for Lukas pumps
1 freight handling winch, 1.5 t
1 freight handling winch, 3 t
1 hemp rope 16 dia. x 25 m lg.
4 slinging ropes 12 dia. x 1 m lg., 16 dia. x 2 m lg.
2 crow bars
4 support chocks, 100 x 100 x 500
8 wood wedges
1 drilling machine, up to 13 dia. (air-operated)
2 drilling machines, up to 10 dia. and up to 23 dia. (electrically operated)
1 traneformer 220/42 V
1 cable placed on cable drum, approx. 50 m
1 drum for compressed air hoses, compl.
1 portable grinder (air-operated)
1 portable grinder (electrically operated)
1 welding transformer, 220 V, incl. accessories (small transformer)
1 oxyacetylene welding outfit, consisting of burner box gas and oxygen cylinders and hoses, approx. 25 m lg.
1 blacksmith's sledge

1 blacksmith's chisel
1 drift pin
2 spanners each of 50 - 55, 60 - 65, 70 - 75, 80 - 85
1 Gedore box 10 - 32
1 Gedore box 22 - 50
1 set of drills 3 - 23 dia,
1 set of wrenches for socket head cap screws 3 - 24
1 set of tool[illegible] devices
2 clamps
1 set of measuring instruments: caliper rule, inside and outside calipers, thickness gauge
various screws, split pins, washers, lock washers
2 spatulas
1 case containing cotton waste and cleaning rags, packing material, asbestos cord, Klingerit, Epple
2 cans containing brake fluid
1 can containing HP oil
1 bucket containing grease G2h
1 can containing petrol for cleaning purposes
1 hand grease gun
2 sets of miscellaneous tools
sundry material 1,400 US $

Summary

Workshop, Office and Garage	13,500 US $
Workshop Equipment	14,000 US $
Store Materials	2,000 US $
VW Minibus	2,500 US $
1 Special Truck with Winch and Hoist	3,600 US $
Equipment of Mobile Repair Unit	1,400 US $
3 VW station cars	6,000 US $
	43,000 US $

B Industrial Policy (see para 5 (b))

SHORT TERM ACTION

"No loans without preventive maintenance"

			US $
UNIDO	3 experts	annually	73,500
	travelling expenses in Colombia	annually	12,000
	2 counterparts by IFI		-
	5 counterparts by Corporaciones Financieras		-
	Subtotal		85,500
	10 % contingencies		9,500
	Office at IFI		-
		Total	95,000
	each additional year		95,000

C "Preparation of a Feasibility Report concerning Spare Parts Manufacturing Facilities" (see para 5 (g))

SHORT TERM ACTION

	US $
Contractors selected by UNIDO	
Timing and cost breakdown:	
2 experts, 10 weeks field survey	17,500
2 x air-faires, e.g. Vienna/Bogotá	1,800
2 x insurance and connections in Europe	450
2 counterparts by IFI	-
1 counterpart by Planeación	-
Inland traffic expenses born by Planeación	-
2 experts, 10 weeks, evaluation of facts found in Colombia and preparing of Draft Final Report	11,200
Translation english/spanish	2,700
2 experts, final discussions and preparing of Final Report, 4 weeks inland	3,200
1 week abroad	1,250
travelling expenses in Europe including final discussion in Vienna	750
20 copies in english 10 copies in spanish	1,200
risk and contingencies	6,000
approximately	46,050
say	46,000

Total time required: 6 months

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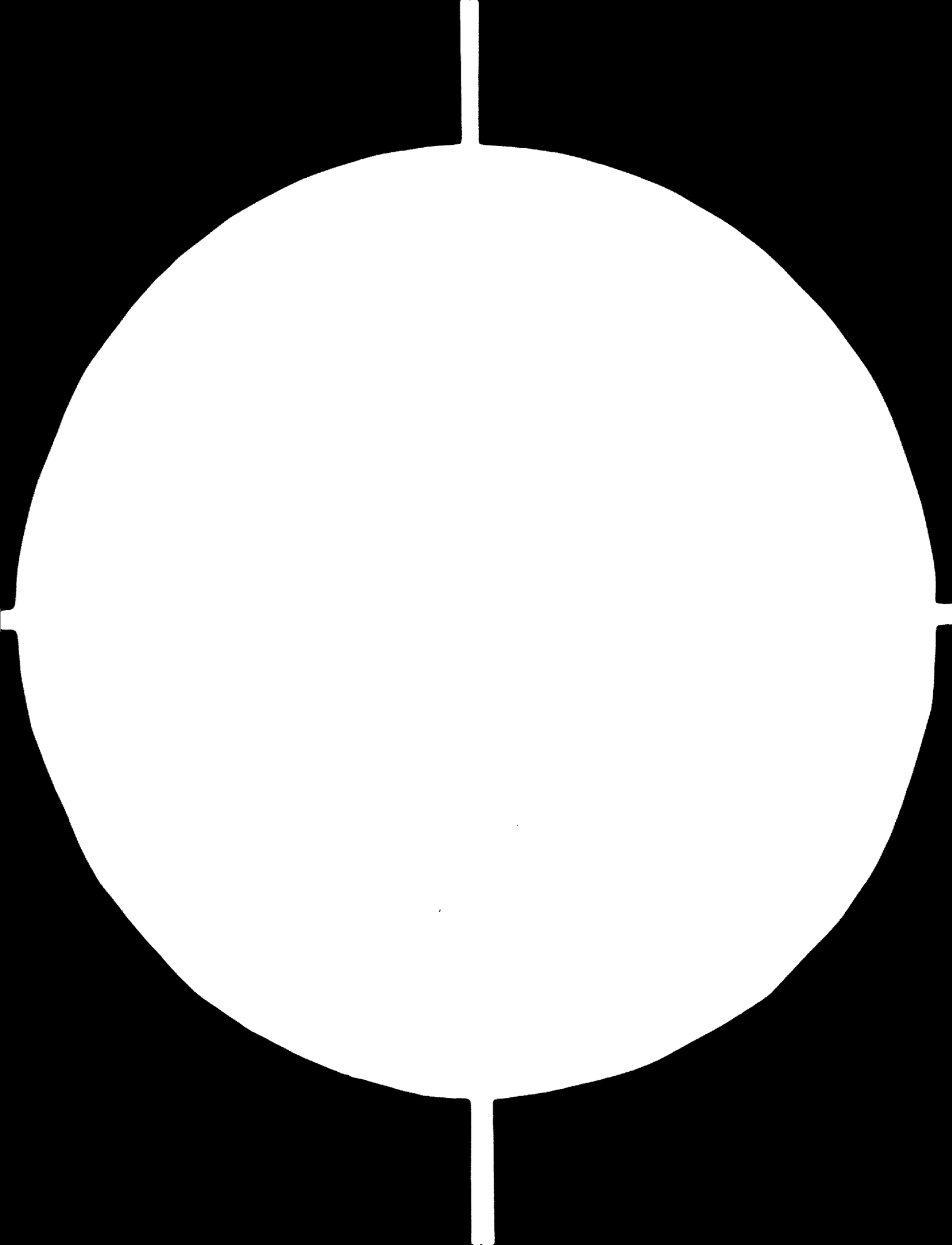

D Standardization (see para 5 (b))

SHORT TERM ACTION

	US $
1 expert annually	24,500
1 counterpart by INCOTEX	-
travelling expenses	5,000
literature	500
Subtotal	30,000
approximately 10 % contingencies	3,000
	33,000
each additional year	33,000

E Roster of Equipment (see para 5 (e))
Information regarding purchase and implementation of equipment

SHORT TERM ACTION

	US $
1 expert annually	24,500
5 counterparts IIT/ANDI/ACIC/ ACOPI/FEDEMETAL	-
travelling expenses	5,000
literature	600
other cost items	600
Cardex systems	1,200
Subtotal	31,900
approx. 10 % contingencies	3,100
annually	35,000
each additional year	35,000

F Roster of Statistical Information (see para 5 (b))

SHORT TERM ACTION

1 expert	annually	24,500
2 counterparts by DANE		-
Travelling expenses for expert	annually	2,500
literature	annually	600
other cost items	annually	1,000
Subtotal		28,600
contingencies		3,400
annually		32,000
each additional year		32,000

G Supervisory Level (See para 5 (b) and 5 (e))

LONG TERM PROGRAMME

		US $
2 experts by UNIDO	annually	49,000
2 experts by other International Organizations		49,000
4 experts by SENA		-
travelling expenses	annually	16,000
educational material	annually	4,000
Subtotal		118,000
contingencies		12,000
	annually	130,000
each additional year		130,000

H Text Books (see para 5 (b))

SHORT TERM ACTION

Translation fees	
30 x 200 pages at 2,50 US $	15,000
Licenses - author 10 % of 2,00 US $ editor 10 % of 2,00 US $	
30 x 10,000 = 300,000 x 0,4 US $	120,000
other items	15,000
	150,000

ANNEX

List of Official Entities, Agencies and Commercial Firms Interviewed

A. Ministries and other official entities

Ministerio de Desarrollo Económico	Bogotá
Ministerio de Obras Públicas	Bogotá
Ministerio de Minas y Petróleos	Bogotá
Ministerio de Educación, Sección de Educación Industrial	Bogotá
Departamento Administrativo Nacional de Estadística	Bogotá
Departamento Administrativo de Planeación	Bogotá
United Nations Development Programme Colombia	Bogotá
Instituto de Fomento Industrial	Bogotá
Instituto Colombiana de Normas Técnicas	Bogotá
Instituto de Investigaciones Tecnológicas	Bogotá

B Public Services

Empresa Puertos de Colombia	Bogotá
Colpuertos, Terminal Atlántico	Barranquilla
Colpuertos, Terminal Atlántico	Cartagena
Colpuertos, Terminal Pacífico	Buenaventura

Zona Franca Industrial y Comercial de Barranquilla	Barranquilla
Base Naval, Jefatura de Mantenimiento	Cartagena
Ecopetrol	Bogotá
(Ecopetrol) Terminal Maritimo	Cartagena
Instituto Approvechamiento de Aguas y Fomento Eléctrico (Electroaguas)	Bogotá
Asociación Nacional de Empresas de Telefonos	Bogotá
Corporación Social de Desarrollo y Bienestar	Medellin
Corporación Social de Desarrollo y Bienestar	Rio Negro

C Industrial and Commercial Associations

Federación Metalúrgica Colombiana	Bogotá
Asociación Nacional de Industriales	Bogotá
Asociación Nacional de Industriales	Medellin
Asociación Nacional de Industriales	Bucaramanga
Asociación Colombiana de Ingenieros Contratistas	Bogotá
Asociación Colombiana Popular de Industriales	Bogotá
Cámera de Comercio Colombo-Alemana	Bogotá

D	**Financing**	
	Corporación Financiera Colombiana	Bogotá
	Corporación Financiera del Norte	Barranquilla
	Corporación Financiera Nacional	Medellin
	Corporación Financiera del Valle	Cali
	Caja de Crédito Agrario, Industrial y Minero	Bogotá
E	**Transport**	
	Flota Mercante Grancolombiana SA	Bogotá
	AVIANCA	Barranquilla
	AVIANCA	Bogotá
F	**Education**	
	Asociación Colombiana de Universidades	Bogotá
	Universidad Industrial de Santander	Bucaramanga
	Servicio Nacional de Aprendizaje Cundinamarca	Bogotá
	Servicio Nacional de Aprendizaje Dirección Nacional	Bogotá
	Servicio Nacional de Aprendizaje División de Industria	Bogotá
	Escuela de Aprendizaje Niessen	Barranquilla
	Centro Don Bosco	Bogotá

G	**Food, Sweets, etc.**	
	Empresa Grasa Colombia SA	Cartagena
	Ingenio Manuelita SA	Cali
	Conserves California SA	Barranquilla
	Frutera Colombiana SA	Cali
	Compañia Colombiana de Tabacos	Medellin
	Procarnes SA	Barranquilla
	Industria Pesquera SA	Buenaventura
	Acopesca SA	Buenaventura
	Fábrica de Dulces Colombiana Ltda.	Cali
	Ingenio Riopaila	La Paula/Valle
H	**Beverages**	
	BAVARIA SA	Bogotá
	Gaseosas Colombianas	Bogotá
	Gaseosas Postobon	Medellin
I	**Textiles**	
	Fabricato SA	Medellin
	Sedeco SA	Medellin
	Planta Acabados SA	Medellin
	Rosellón Ltd.	Medellin

	Coltec Fábrica SA	Medellin
	Coltejer SA	Medellin
	Everfit SA	Medellin
	Cicodec SA	Medellin
K	Metallurgical Sector	
	Acerias Paz del Río	Belencito
	Forjas de Colombia SA	Bogotá
	Forjas de Colombia SA	Bucaramanga
	Siderúrgica de Pacífico SA	Cali
	Empresa Siderúrgica SA	Medellin
	Fundición Técnicas SA	Medellin
	Apolo SA	Medellin
	Aluminio Reynolds SA	Barranquilla
	Productora de Maquinaria Industrial SA	Medellin
	Fundiciones y Repuestos SA	Medellin
L	Mechanical Engineering	
	Talleres Faesa SA	Barranquilla
	Unión Industrial SA	Barranquilla
	Astilleros Magdalena	Barranquilla
	Colmotores SA	Bogotá

	Fundición y Maquinaria SA	Bucaramanga
	Refrigeradores Colombia SA	Cartagena
	Empresa Nacional de Carrocerias SA	Cali
	Corona SA	Bogotá
M	Chemical Industry	
	Planta Soda de Colombia SA	Cartagena
	Planta Petroquimica SA (ESSO)	Cartagena
	Petroquimica Colombiana SA	Cartagena
	Sopas Colombiana SA	Cartagena
	Industria de Mangle SA	Buenaventura
	Sucroquimico Colombiana	Palmira
N	Cement Industry	
	Cementos Boyacá SA	Nobsa/Sogamoso
	Cementos del Valle SA	Yumbo
O	Paper and Printing	
	Carton de Colombia SA	Barranquilla
	Producción Papeletas SA	Yumbo
	Carvajal y Cia	Cali

P	Leather	
	Industria Colombiana de Curtidos	Bogotá
Q	Others	
	German Foreign Trade Information	Bogotá

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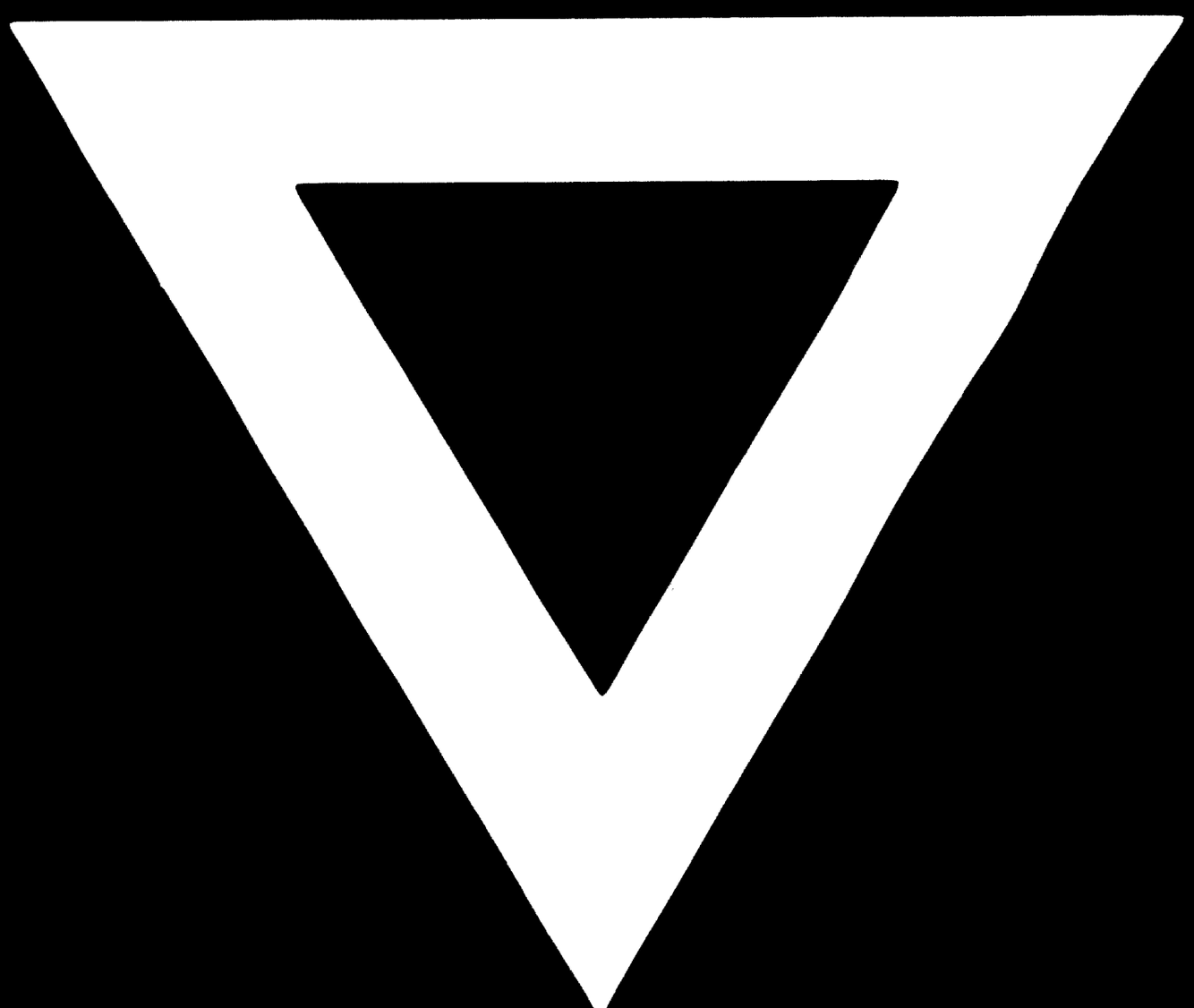

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