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United Nations Industrial Development Organization

UPGRADING AND IMPROVEMENT OF MAINTENANCE AND REPAIR FACILITIES IN PANAMA

Final Report

by

An Exploratory Mission

(November 1972)

TECNIBERIA
MADRID-SPAIN

U N I T E D N A T I O N S

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

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FINAL REPORT

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AN EXPLORATORY MISSION

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Contract No. 72/38
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TECNIBERIA

Madrid - Spain

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SYNOPSIS OF THE REPORT

In this report we give our impressions regarding the standard of maintenance of industrial equipment in Panama.

Included are the justification of the methodology employed and the circumstances that have motivated its adoption.

The chapter relating to the collection of data includes surveys of several companies selected for this purpose, and the report is based on the results of these surveys.

Maintenance of equipment is deficient in the private sector. This deficiency, clearly evident in the small and medium-sized firms, does not appear in companies with more than 150 workers (large undertakings), although, in general, they do not have an organized system of preventive maintenance.

The analysis also covers the situation of maintenance of transport vehicles and of equipment for road building, which belong to the Ministry of Public Works. This survey shows a complete lack of means in the transport sector, as also certain deficiencies in road building equipment.

As a remedy for this situation it is proposed to establish a central workshop to cover the needs

of private industry and to complement the means presently available to the Transport Centre.

The two programmes are not linked to one another and we recommend that a start be made with the second suggestion put forward, namely the completion of the Transport Centre. The implementation of these programmes requires machinery, a list of which is given in detail, and the advice of experts - an engineer and a mechanic - specialized in maintenance; their services will be required for a period of one year in order to complete the Transport Centre project, and of one and a half years to fulfil the Central Workshop programme. This latter programme requires that the engineer should spend an additional month in the Ministry of Industry and Commerce, establishing the site for the Workshop and preparing the Preliminary Plan.

I - INTRODUCTION

Owing to its strategic position as an obligatory passage between North and South America, the Republic of Panama has its economic bases firmly established in activities of a commercial nature. Of decisive importance for the preservation of this status is the passage through the Canal, the economic benefits of which are beyond question.

In view of this fact, an industry of primary nature has been developed, the fundamental objective of which is production of consumer goods with the aim of eliminating or reducing certain imports. It is not surprising, therefore, that Panama's industry is concerned with the activity of production, rather than embodiment of a technology complementary to the industrialization of the country: to this rule, there are few exceptions.

It is therefore logical that the auxiliary services relating to production may not have been considered as priorities and, consequently, are in an embryonic state.

This is the case with respect to maintenance of equipment, which plays an important part in the reduction of production costs.

To this fact there should be added the inadequate degree of skill and knowledge of non-executive technically trained personnel; the improvement of which skill is presently one of the national goals being pursued by means of different pro-

grammes, financed either from Panama's own resources, or on a joint basis which counts with the aid of International Agencies.

The ease with which spare parts, and even complete assemblies of important elements of machinery can be imported, has made a decisive contribution to the existing situation in Panama.

Our examination of this situation has clearly demonstrated that the existing circumstances do not comply with the standards of acceptability demanded by the national economy of the country under study.

It is difficult to justify the importation of a multitude of simple parts, and likewise the reasons for the effecting of such imports; it is an aspect which requires careful consideration. The fact should not be overlooked that this phenomenon represents a factor of considerable importance when it comes to the reduction of costs of production. As such, this facet should be examined with meticulous scrupulosity.

The study that follows has a triple purpose: it analyses the existing situation, as detailed above; it pinpoints the most present requirements and it proposes some possible solutions. This study is followed by a critical appraisal of each of the options proposed.

As will be appreciated, the suggested solutions

and/or options may be contemplated as self-contained units or as integral elements of an overall plan, the implementation of which would inevitably demand a larger input both of economic resources and of labour. In our judgment, the requirement of such a major plan necessitates a highly critical analysis and evaluation from all the points of view involved.

II - SCOPE OF THE WORK

1 - AIMS OF THE REPORT

The aims of this mission are to carry out an investigation of the technical level of maintenance of machinery and installations and the degree of application of the maintenance methods used today in the industries of Panama; to determine and qualify the insufficiencies or inadequacies revealed by this investigation, and to propose one or several solutions appropriate to the present time, such as:

- To determine what maintenance methods firms use from their "in-house" resources or from those of third parties for the two aspects of maintenance - corrective and preventive.

- To determine the adequacy of the type of maintenance and repair undertaken, according to the groups (depending on the size of the company and the nature of its operations).

- To define the possibility of manufacturing spare parts considered to be of special interest because of their multi-purpose applications, simplicity of construction and frequent use, for example: axles, gears, special screws, gudgeons and bolts, bearings, simple parts for machine tools and spare parts of a specific nature (moulds), the manufacture of which does not require specialized skills.

- To propose, in agreement with the Authorities, a plan of action to improve maintenance ser-

vices, determining the human means and material resources that the execution of the plan would require.

2 - DESCRIPTION OF THE WORK CARRIED OUT

This chapter deals with the work carried out, preliminary notes on Panama's industry and related activities, the methodology employed and personal impressions gathered on the standard of maintenance in the different groups studied.

2.1 Initial considerations

The industry of Panama is comprised of a large number of activities (see Table 1). There exists a number of basic industries around which a group of subsidiary firms has been created with the aim of meeting the needs of these industries.

In addition to these there are many other firms specializing in the manufacture of consumer goods, with the sole aim of meeting present national needs.

From the impressions gathered, it can be stated without doubt that industry in Panama, with rare exceptions, is not automated. For this reason, production is closely linked to the number of workers in each firm. It is advisable to make this statement because when later commenting on large or small firms, we shall refer to this standard in accordance with their respective labour forces; which, for this purpose and subject to the established man-production ratio is sufficiently exact.

Naturally, these standards do not correspond to the meaning given in other countries to the

terms large, medium and small, but it should be borne in mind that it is useful to make a differentiation which facilitates the study at the level of development under consideration.

Consequently, speaking in terms of size, it is evident that the average industries are predominantly medium and small, that is to say with the number of workers varying between 25 and 150 in the case of the medium-sized, and therefore less than 25 for the small companies. There are some that exceed these numbers, which are not important to industrialization (the ready-made clothing industry, for example), but which, from the statistical point of view can be considered as medium-sized firms. In the annexes (see Table 2) a summary of firms is given, showing the number of persons employed, these being paid or unpaid workers of an administrative, technical or operational nature.

As we have previously stated, there exists a wide range of activities. The Department of Statistics and Census groups them in a conventional manner (see Table 1) into 41 classified types, together with a special category grouping of those that are difficult to classify specifically. A more detailed analysis of this classification would lead to a further classification that would underline this variety. Nevertheless, for our present purposes, the existing classification suffices.

Standing out from all the rest are the firms manufacturing consumer goods and goods to meet primary needs, such as breadbaking, with 72 firms, the clothing industry with 61, furniture and other complementary accessories with 54. Close behind are the publishers and printers with 40, and the manufacturers of cement and non-metallic mineral products. The official census records the total number of establishments as 586, distributed widely among the rest of the groups classified. (Estadística Panameña Año XXXI)

With regard to the number of persons employed, the statistics confirm, in general terms, the hypothesis that was considered at the beginning, on the direct relation between the number of persons employed and production capacity. This is more marked if the comparison is solely with operational personnel.

The sole objective of the foregoing is to present an overall picture of the industrial composition of Panama which, to a certain extent, justifies the methodology used in the investigation that we propose.

We have, therefore, endeavoured to incorporate into this report data on firms in each one of the existing magnitudes, which on occasions involves the determination of the activity of such firms. In other words, the production in which a particular firm is engaged automatically limits its size, according to the limited market in

which it operates.

The problem of maintenance is closely linked to the size of the firm, so that it is necessary to detail the problems connected with size.

The industrial structure of the country is based on the initiative of private companies, aided by specific incentives or importation facilities for essential sectors. Therefore State or quasi-State enterprises, as such, do not exist.

Nevertheless, and although it is not an enterprise in itself, we have included in this report the Transport and Road Building Services of the Ministry of Public Works, because it constitutes an important chapter as far as maintenance is concerned.

2.2 Methodology

Initially, a plan of action was established aimed at gaining an effective knowledge of maintenance in the different industries by means of a suitably prepared questionnaire. At the same time it was envisaged that the impressions gathered through the questionnaire would be supplemented by a series of personal visits by experts to certain firms.

In accordance with this criterion, a selection was made of 50 firms which were considered a sufficiently representative sample, and a model of the questionnaire was drafted.

Later, and through a series of reconsiderations of a practical nature, it was decided to increase the number of visits and reduce, as a consequence, the information obtained indirectly.

As a result of this, 20 interviews were conducted and information was obtained on a total of 33 private firms. In some cases, the information received was augmented with a personal visit to the firm itself.

Many of the questionnaires delivered and not returned could have been obtained had the length of our stay permitted it.

Reports were made from the data collected and these are included in points 2.3 and 2.5 of the present chapter.

Similarly, at the end of point 2.4 summaries for the Private Sector are given in the form of tables in which the points of interest that have prevailed in our study are specified and on which we have based our conclusions.

2.3 The Private Sector

What follows is, basically, a report on the most representative firms which have served as the basis for the compilation of data, whether directly (personal visits) or indirectly (questionnaire).

Undoubtedly, those visited personally constituted

a more valuable source for the purposes of this report, not only because the accuracy of the data, at least the greater part, has been verified by us, but because through direct appreciation, a more complete impression was obtained. Nevertheless, we consider that, at least from the statistical point of view, the data obtained indirectly notably enrich the knowledge of the existing maintenance problems.

We have extended our report to cover those firms which, particularly owing to their size, encounter problems less easily solved, because of financial requirements and which would, therefore, benefit more from a solution which would apply to them all.

REPORT Nº 1

CERVECERIA NACIONAL (National Brewery)

(Plant)

1 - General data

This firm is engaged in the brewing and bottling of beer and various soft drinks.

The total personnel is 900, of whom 600 are directly engaged in production. Approximately 225,000 hectolitres of beer and 6.5 million litres of soft drinks are produced.

This was the first brewery to be established in Panama (in 1937), and the latest equipment was acquired in 1957.

2 - Maintenance

Strictly speaking, no maintenance service exists. This work is carried out by the personnel in charge of the installations. There are 60 specialist workers trained at vocational schools. In many cases, however, the jobs pass from father to son and the knowledge concerning the equipment is transmitted in the same way.

The maintenance workshops are well equipped with machine-tools, although some of the equipment is somewhat antiquated. They have bench lathes of three metres long for machining long axles.

The person responsible for maintenance also advises the personnel on how to deal with repairs and similar work.

A programme of preventive maintenance exists: data cards, manuals and documentation concerning the machines, lists of parts to be checked, and even statistics on breakdowns. Greasing is carried out systematically so that a list of greasing points is not considered necessary. All this information was given verbally, so that it was not possible for us to verify the accuracy of these reports.

However, according to the statement of the person responsible for maintenance, the firm has the means to repair breakdowns, and counts with the efficient co-operation of its spare parts store.

REPORT Nº 2

CERVECERIA NACIONAL (National Brewery)

(Vehicle Maintenance)

1 - General data

This department belongs to the brewery as a whole and is entrusted with the maintenance of the distribution network, drink dispenser machines, vehicles, display material for salesmen, etc.

2 - Maintenance

The maintenance of the distribution network is in the hands of a recently appointed Department Head (previously engaged in commercial service), an assistant and 103 workers comprising mechanics, electricians, sheet-metal workers, carpenters, welders, etc: in general, workers without special training, who have acquired their knowledge at the plant or, in some cases, in automobile repair workshops.

There are several workshops which carry out repairs and even manufacture soft-drinks dispenser machines.

These workshops include:

- Vehicle repair shop	Mechanical repairs of company vehicles and delivery trucks.
- Sheet metal shop:	Repairs and paint spraying of sheet metal work.
- Carpentry:	Manufacture and repair of refrigerator housing structures.

Tinsmith's shop: Manufacture and repair of refrigerators (metal parts).

Together with these workshops, others exist where the work is not so clearly defined; these include Signs and Display and the Refrigeration Departments.

These workshops are adequately equipped with machinery of all types. However, part of this machinery has deteriorated or remains unused because of lack of knowledge of how to handle it, particularly in the case of specialized material such as oscilloscopes, spark plug testers, pressure meters, voltmeters and ammeters.

A spare parts store for automobiles and trucks does exist, but no preventive maintenance of any type is carried out there. This fact, added to the general mishandling of the vehicles by the drivers, causes the vehicles to be taken out of circulation and replaced after only a very brief period of service.

In this respect there is no type of organization or control, save that when it is considered that repair will be very expensive, a decision is made to sell the vehicle.

REPORT Nº 3

CEMENTOS PANAMA, S.A.

1 - General data

This firm manufactures cement for the construction industry exclusively.

It has a labour force of about 300, only 50 of whom belong to the production sector.

At present, they produce approximately 200,000 tons of cement per year, but this figure is expected to be doubled in the near future.

The original equipment, which dates from 1948, was imported from the United States, and was augmented in 1961. The most recent extension, consisting of Danish machinery, is now under completion.

2 - Maintenance

Maintenance is undertaken by a team of about 60 people, including mechanics, electricians, bricklayers, etc. The team is headed by a recently recruited engineer.

The majority of the persons on the team do not have theoretical knowledge; they have been trained in the company itself. The heads of the Mechanics Department and of the Workshop, assistants to the engineer, were trained at the Don Bosco Technical Institute.

Repairs are effected in a reasonably-equipped workshop with four lathes (one of a ten ft. bench), one milling machine, one radial drill, one plane, one mechanical saw, oxyacetylene and electric

welding apparatuses (several sets), one bending machine, one horizontal press (300 tons and with 12 inches run), and even a forge.

There is an adequate spare parts store, owing to the fact that there is a delay of three to four months between ordering parts and receiving them. Repairs are carried out on the premises except for special occasions when they resort to the workshops of the Canal.

A complete maintenance plan does exist, although recently it has not been adhered to because of an excessive demand for cement; nevertheless, at the time of our visit a kiln was being cleaned, taking advantage of the testing of the new installation.

REPORT Nº 4

INDUSTRIA PAPELERA NACIONAL, S.A. (Paper Industry)

1 - General data

This firm manufactures toilet paper exclusively.

It has a work force of 21, of whom six are engaged in production, which is approximately 1,000 tons of paper per year.

The installations and machinery come entirely from the United States and Japan. The first was acquired in 1963 and the second in 1966.

2 - Maintenance

Maintenance is the responsibility of a supervisor, who is helped by a precision lathe operator, an assistant for welding and mechanical jobs, and an electrician. All these have been trained at vocational schools, but have gained practical experience in the plant itself.

The following equipment exists to carry out repairs: several old lathes, one relatively modern one, a milling machine and an antiquated drill, as also a mechanical saw and a plane.

A spare parts store exists to deal with most of the breakdowns on the spot without recourse to external assistance.

In theory a system of preventive maintenance has been introduced with data cards, lists of greasing points, parts to review, etc., but in practice this is not carried out. All that can be said in effect is that breakdowns are only repaired when they occur.

REPORT Nº 5

COMPAÑIA PANAMEÑA DE ACEITES (Vegetable Oils)

1 - General data

This company is engaged in the processing of vegetable oils (soya, palm, maize, etc.), the manufacture of margarines, detergents, soaps and disinfectants, as well as the manufacture of plastic containers and tins for their products.

The labour force is 350 strong; of this number, 320 are manual workers.

The company produces about 10 tons of oils and margarines per year, plus another seven tons of soaps and detergents.

The machines installed come from different sources, with a machine from each country concerned; they date from 1950 up to the present.

The overall aspect of the installations shows lack of care, with different types of fluids leaking in several sections of the pipe network.

2 - Maintenance

Maintenance is the responsibility of the head of the workshop. The workshop employs about 50 persons, including five lathe operators, most of them without formal qualifications, having acquired their knowledge in the firm itself.

The functions of this team range from the repair of machines to bricklaying, and similar work. To carry out this work, they have at their disposal fairly modern equipment, consisting of lathes,

plane, drills, different measuring apparatus, a grinder, a copying milling machine (for moulds), welding apparatus, hand tools, etc.

There is a spare parts store and, so far, there has been no difficulty in replacing spare parts.

Preventive maintenance is not carried out at the present time, although the head of production assured us that they intend to do so in the near future.

At present all repairs are carried out in the firm itself without outside help.

REPORT Nº 6

TABACALERA ISIMEÑA (Tobacco Industry)

1 - General data

The firm concentrates on the preparation of different qualities of tobacco and the manufacture of several brands of cigarettes.

It employs a total of 100 people, approximately 83 of whom comprise the production staff.

It has an annual production of 600 million filter cigarettes: the filters are also made by the firm itself.

The firm's machinery comes from England and the United States, and was acquired between 1961 and 1972. The boilers, compressors, and air-conditioning plant are American, while the machines for making cigarettes and filters, cutting and packing are English. We were not able to evaluate their condition.

2 - Maintenance

Maintenance is under the direction of a supervisor, a mechanic who has a certain amount of knowledge acquired in courses followed outside Panama, and seven assistants trained in different skills (mechanics, electricity, etc.) by the company itself. This team is entrusted with repairs or modifications to the machines, as also other repairs, masonry work, and preventive maintenance. This work is carried out in a shop equipped with a lathe, milling machine, drill, electric sander,

bandsaw, oxyacetylene and electric welding equipment, and hand tools.

The spare parts store is able to supply the parts required for run-of-the-mill breakdown, but in the case of parts of a specific size, such as large axles, they must have recourse to outside assistance.

Preventive maintenance is carried out according to a programme, data cards of the machines, lists of items for greasing and review; however, statistics are not kept on breakdowns.

REPORT Nº 7

PRODUCTOS ALIMENTICIOS PASCUAL (Food Products)

1 - General data

This firm makes biscuits, sweets and various classes of cocktail biscuits, etc.

There are 205 employees, 170 of whom are engaged in production. The biscuit-making machines, kneaders, mixers, ovens and packing machines, are mostly English, while the confectionery-making equipment (moulds and packing machines) is exclusively of Italian origin.

The dates of purchase differ considerably; the oldest machine is 20 years old and the most modern machines were acquired only a month ago. All the machines, even the oldest, are in excellent condition.

2 - Maintenance

Maintenance is the responsibility of a Maintenance Supervisor, trained in Spain. He is aided by two assistants, one trained in Switzerland and the other in Panama, and seven skilled workers as follows: one lathe operator, one greaser, one electrician, two machinery fitters and two assistant labourers; the latter have been trained in the firm itself.

There is a repair workshop equipped with lathe, milling machine, drill, plane, mechanical saw and grinder, as also a set of hand tools. The equipment is modern and of recent acquisition, the oldest having been acquired five years ago.

There is a store of spare parts, although approximately 30 per cent of these are made in the firm, which permits the repair of breakdowns without undue delay.

In general, the firm is capable of repairing any mechanical defects using its own means, including the making of new moulds of its own design.

A programme of preventive maintenance exists, constituted by machinery data-cards, lists of items to be reviewed or points for greasing, and although statistics of breakdowns are not kept, records are kept of the cost of breakdowns.

In the case of new installations, the work is contracted to specialist firms, as is the case of the new electricity supply system which is at present being installed.

REPORT Nº 8

AZUCARERA NACIONAL (National Sugar Company)

1 - General data

This company is engaged in the preparation of crude and refined sugar and, as a secondary product, alcohol for liqueurs.

During the sugar-harvesting season the number of hands engaged in the production as specified reaches 275; this figure is reduced to 150 in the off-season.

Annual production is approximately 730,000 quintals of sugar (approximately 33 million kilogrammes) and some 540,000 litres of alcohol.

The machinery is of United States origin, except for the crystallizers, which are, in part, German, and the distilling plant, which is French.

Machinery has been acquired in keeping with the increase in the size of the firm. There are mills that date from 1957, but most of the machinery was purchased between 1965 and 1970, while the centrifuges have been acquired during the present year.

2 - Maintenance

There is a maintenance group consisting of 25 persons, including welders, lathe operators, electricians, mechanics, etc., supervised by a mechanical engineer trained in the United States, where he obtained his professional qualifications. The members of the group, for the most part, were trained at vocational schools.

There is a fully-equipped workshop for repairs; this is equipped with several lathes, milling machine, drills, plane, welding machine, etc. Because of the requirements of certain types of repairs, a lathe with 20 ft. bench and 48 inches turning capacity was recently purchased by the firm. In general, the machinery is bought second-hand, and is relatively modern and well kept.

They have a large spare parts store, and in general there have been no problems in this respect.

At the end of each season the installations are reviewed, changing the worn parts or those that in the opinion of the Head of Maintenance should be replaced. During the review, greasing and cleaning of all machinery is carried out; all breakdowns are repaired within the firm itself, the necessary spares being made in the firm's own workshop.

The breakdowns that occur during the working season are minor and are usually put right immediately without production being affected.

REPORT Nº 9

INGENIERIA AMADO (Metal Products Department)

1 - General data

This company is one of the components of a group known as Ingeniería Amado, S.A. It manufactures perforated angle pieces and metal shelves for assembling shelving for storage of products. It also manufactures some pressed metal components and expanded metal mesh.

The firm has 31 employees, 29 of whom are engaged in production.

The machinery is of diverse origin; the spot welding equipment and the presses are Spanish; the shears and perforators English, the benders American and the press for expanded metal mesh, German, while the greater part of the installations - washing tanks, angle benders, etc. - was made by the firm itself.

Except for the perforators and shears, which are very old, the rest of the machinery is relatively modern and its state is satisfactory.

2 - Maintenance

Maintenance of the machinery and installations is in the hands of five lathe-operator mechanics, who carry out all necessary repairs. On those occasions when the firm's machine-tools cannot adequately deal with repairs, another workshop within the Ingeniería Amado group effects the repairs.

For the most part, mechanics in the maintenance department come from vocational schools and have been trained in the firm by the head of that department. They have the means available to carry out repairs and to make their own spares, the equipment for which consists of:

1 milling machine
1 plane
1 turret lathe (low capacity)
1 band saw
1 large lathe
1 drill
1 grinder

and also hand tools.

A spare parts store does exist, although the company manufactures a large proportion of these spares. Although no programme of preventive maintenance exists, a periodic review of the machinery is carried out; this includes the equipment in the maintenance workshop, which we had the opportunity to see.

REPORT Nº 10

ALUMINIOS PANAMA (Aluminium)

1 - General data

This firm manufactures aluminium tubes and profiles and production is complemented with the manufacture by injection of saucepans, and chairs, tables and other products of earth-cast aluminium.

The firm produces some 800,000 kilogrammes of tubes and profiles per year; the figures corresponding to the other articles are difficult to determine, and vary greatly.

The firm has a total of 84 employees, approximately 60 of whom are engaged in production work.

For the most part the machinery comes from the United States, except for a few small presses and a rip-saw, which are Spanish.

Except for the 750 ton extruder, the age-hardening oven for aluminium and the anodizing plant that were acquired in 1963, the rest of the high-performance modern machinery was purchased relatively recently, in 1968 and 1969.

2 - Maintenance

Maintenance of the equipment and installations is the responsibility of a mechanic and an electrician, under the supervision of a head of department who was trained in the United States; the two operatives acquired their knowledge through practical work in the firm itself.

For the repair of breakdowns and general maintenance there are several (very old) lathes, a column

drill, small electric drills, a milling machine, plane, electric saw, tool grinder, tempering ovens and a recently-acquired particle crusher. In addition, there is a complete set of tools, and a spare parts store, but in general there are not many breakdowns as the machinery is essentially modern.

Preventive maintenance is carried out based on data cards for the machines and lists of greasing points, and items to be reviewed in each machine. Statistics are not kept on breakdowns, but the latter are not frequent.

In the maintenance workshop, moulds are made for the aluminium injectors, some minor spare parts, as also some machines, for instance, the aluminium shavings press.

All the breakdowns are dealt with in the firm, without recourse to outside assistance.

REPORT Nº 11

CORRE AGUA, S.A.

1 - General data

The activities of this firm include the production of galvanized sheet and tubes, and the manufacture of continuous welded tubing and corrugated sheeting of various kinds. The firm employs a total of 46 persons, 38 of whom form the production staff. Although the company functions autonomously, it belongs to the Amado group, mentioned in other reports.

The machinery is almost all Spanish and American, although the continuous galvanizing equipment, the galvanizing baths for tubes and the plate shears are of the firm's own manufacture. Almost all the machinery was acquired in 1967 and 1968, but due to defective maintenance the continuous galvanizing equipment in particular, is in a lamentable state.

2 - Maintenance

Maintenance of the installations is in the care of two operatives, one of whom undertook a year's study in electricity and the other in mechanics; neither stated where or when. In general, these operatives deal with small breakdowns, and they usually have an average of one or two incidents per day, a high figure in our opinion if one takes into account the size of the installations.

For carrying out repairs they possess one modern lathe, a small drill and a mechanical file, all in good condition. The lathe is used exclusively to machine the neoprene-coated cylinders used in the

draining of galvanized sheeting, which needs continual supervision, and for the cylinders that deposit zinc on the tinplate.

In the case of large-scale repairs being necessary, the general services of the Amado Group are used.

The spare parts store, which is not large, serves for the repair of breakdowns within the firm (or group of firms) without necessity for other assistance.

A team from the group, which visits all the firms therein, carries out periodic preventive maintenance monthly or twice a month, although the general condition of the machines belies this.

Specialist firms are contracted for the re-covering of tanks and cylinders with neoprene.

REPORT Nº 12

PANIFICADORA LA FAVORITA (Breadmaking)

1 - General data

This firm produces bread and confectionery, but concentrates on breadmaking.

It employs 70 persons, 55 of whom form the production staff.

The firm makes about 800,000 kilogrammes of bread and similar products annually. For the most part the machinery is of American origin, except the ovens which are of Mexican manufacture, and a moulder from Germany.

The greater part of the machinery was acquired between 1970 and 1971, except for a kneader and a beater which are 12 and 16 years old respectively.

The general state of repair is relatively satisfactory, although as it is modern machinery it should, in our opinion, be in better condition.

2 - Maintenance

Maintenance of the installations is in the care of two mechanics, who only intervene when it is a question of mechanical repairs; in the case of other breakdowns, the services of outside specialists (electricians in particular) are used. Some simple repairs, such as welding or trueing-up elements of the machines, are carried out in the repair workshops, which are situated within easy distance of the firm's premises.

The mechanics responsible for the maintenance of machinery were trained at the School of Arts and Crafts, and gained practical experience in the firm itself.

For carrying out repairs there are no means other than some hand tools (screwdriver, pliers, spanners, etc.). There is no workshop for the repair of elements, and, therefore, this has to be carried out wherever the machine is located.

There is a sparsely stocked spare parts store. This lack of spares creates major problems, especially in the case of the German moulder, the machine which breaks down most often.

The firm does not carry out preventive maintenance, limiting itself to maintaining the installations in working order, lubricating them from time to time and in keeping with the standard set by the mechanics themselves. Of the breakdowns that occur, only two per cent are repaired within the firm, the rest requiring the assistance of outside agents.

REPORT Nº 13

COLGATE PALMOLIVE CENTRAL AMERICA

1 - General data

This firm manufactures articles for household cleaning and personal toiletry.

It employs a staff of approximately 95, of whom 44 belong to the production personnel. The machinery comes from the United States, Sweden, France, England, etc. Approximately 25 per cent dates from 1965, and the rest is of recent acquisition.

Its general state is certainly good, at least externally.

2 - Maintenance

Up to quite recently there was a Head of Department in charge of maintenance, helped by an assistant and three operatives. The Head was a mechanical engineer, while the others had received their training at the Vocational School of Divisa and the Don Bosco Technical Institute. At present, the post of Head of Department is vacant.

The firm has a workshop, equipped with a lathe, a milling machine, a drill, arc and oxyacetylene welding apparatus and a grinder. In general, all this is in good working order, although it is not modern machinery.

There is a spare parts store, but in view of its nature, it is necessary to import parts in their entirety.

A plan for maintenance exists, but official support for it has been delayed, pending the appointment of a new Head of Department.

In general, breakdowns are repaired without the help of outside firms or workshops.

REPORT Nº 14

CREACIONES ITALIANAS

1 - General data

This firm specialises in the manufacture of women's shoes and sandals. It has a total staff of 62, of whom 56 are skilled workers.

The firm makes about 70,000 pairs of shoes and sandals a year. The machinery used comes from different countries, principally England, Germany and Italy.

2 - Maintenance

Three persons are engaged in maintenance, their knowledge being based on experience acquired in the factory. They do not possess any kind of machinery or tools for repair work. They carry out periodical cleaning of the machinery in a routine manner, and without any kind of administrative support.

They can only handle 60 per cent of the breakdowns by themselves, having to seek outside assistance for the rest.

There is a spare parts store, but as some spares can be acquired locally the stock is not large.

REPORT Nº 15

PLASTICOS MODERNOS, S.A.

1 - General data

This firm is engaged primarily in the manufacture of plastic containers such as glasses, trays and plates, as well as the cardboard covers for the glasses.

The total work force is 35 persons, of whom only 23 comprise the production staff.

They manufacture about 200,000 units (glasses, plates and trays) annually, especially the latter two items.

The machinery for production, such as extruders, moulders and injectors, is of German origin; the rest - compressors, PVC mills and mixer - are from the United States.

With the exception of the compressor which dates from 1964, the rest of the machinery, bought from other firms, was acquired in 1969. The state of repairs is, frankly, poor, which is confirmed by the frequent breakdowns.

2 - Maintenance

There are no persons encharged exclusively with maintenance, which is the responsibility of two shift workers, lathe mechanics by profession, with experience and knowledge gained over a number of years.

The only means at their disposal for repairing breakdowns are some hand tools and a grindstone

and, consequently, they have to seek outside assistance to carry out the repairs; on occasions this is not very effective as is the case of the screws situated in the head of the extruder for plastic sheet. These screws, because of metric thread, must be turned in Panama with inadequate materials, non-resistant to high temperature of the head, and this is the cause of frequent breakdowns.

They maintain the standard procedure of ordering parts directly from the manufacturer of the machinery; this causes delays of up to six months, during which time some machines of necessity remain idle. The duplication of these machines usually keeps production going.

There does not exist preventive maintenance of any kind, and the repairs are not of a high quality; this, in our opinion, is the cause of the lamentable state in which the machines are found.

REPORT Nº 16

OPERADORA INDUSTRIAL

1 - General data

This firm manufactures matches in cases and matches in boxes.

It employs a total of 50 persons, of whom 44 form the production staff of operatives.

The present production is some 50,000 book matches and boxes of matches, which is approximately the national consumption.

For the most part, the machinery is American although the equipment for the manufacture of matches comes from Mexico and the rest is modified by the personnel of the firm itself.

The American machines were acquired in 1969 and the equipment for making matches is five years old, and has been modified to improve its efficiency.

The general state of repairs is good, although we cannot give a definite classification as they did not permit us to examine the machinery.

2 - Maintenance

The maintenance of the machinery is the responsibility of two mechanics who carry out all types of repairs. The mechanics were trained at the Don Bosco School and later gained practical experience in the firm.

The firm possesses a workshop for repairs which comprises the following:

1 milling machine
2 lathes
1 grinding machine
1 set of soldering equipment
1 band saw for wood
1 edge plane (made by themselves)

Although this machinery is very old, it functions well.

As the firm manufactures 80 per cent of the spare parts, there is only a small spare parts store.

Production stops during the month of December when a systematic revision of the machines is carried out.

Control is kept by means of file cards on the machines as well as for oiling points on each machine that must be oiled.

All repairs are undertaken by the firm itself without the intervention of outside agents.

REPORT Nº 17

PRODUCTOS ASFALTICOS

1 - General data

This firm produces special asphalts, such as plastic asphalts, liquids, oxidated and joint sealers.

It employs a staff of ten persons, of whom only four are engaged in production since the processes are basically chemical and do not require the services of operatives except on rare occasions.

The firm produces about 500,000 kilogrammes of asphalt and 40,000 of joint sealer annually.

All installations are of American origin and the entire plant, bought second-hand, was acquired in 1967.

The state of repair is normal for this type of installation.

2 - Maintenance

The maintenance of the installations is in the hands of a turner-mechanic, trained in the School of Arts and Crafts, whose duties are to carry out adaptations that permit the machinery to continue to function while definitive spare parts are sent for. The tools for carrying out this work are very primitive, consisting of a drill, grinding machine, electric and oxyacetylene welding equipment and a rather old lathe of doubtful efficiency.

The spare parts store is small in size, area and content, and limited solely to tubes of different diameters and some joints.

The firm does not carry out preventive maintenance although there was a stoppage of work due to marketing of the product; however, breakdowns are usually repaired with the means available without having to resort to outside assistance.

REPORT Nº 18

DISCOS ISTMEÑOS

1 - General data

This firm concentrates on the recording of magnetic tapes and the production of records. The total number of staff was not indicated, but we did learn that four persons were engaged in the production of records.

The firm puts on the market some 180,000 records annually. The machinery is entirely American; the record presses were manufactured in 1950; while the proportioners are relatively modern. All the machinery is in very poor condition; at the time of our visit only two of the four presses were functioning.

2 - Maintenance

There is nobody in charge of maintenance work, the responsibility being that of the mechanic in charge of production, who was trained at the Thomas A. Edison Institute (Panama), a type of vocational school.

The only machinery in their possession is a grindstone, an electric drill and hand tools. The breaking of moulds represents their most frequent breakdown, hence replacements are always on hand. Seventy-five per cent of the repairs are handled within the firm; for the rest outside help is sought from workshops in and around the area. The latter type of repairs include the turning of axles and dies, grinding of moulds, etc.

A monthly review of the machinery is carried out, although its general condition belies this.

REPORT Nº 19

CONFECCIONES BOSTON

1 - General data

The firm manufactures ready-made clothing.

It employs a staff of 119 persons of whom 80 are skilled workers.

Production is approximately 300,000 pieces, consisting of shirts, and trousers of varying qualities. The machinery, which is three years old, comes from Japan and the United States.

2 - Maintenance

The head of production, assisted by a mechanic, is responsible for the maintenance of the machinery. They have only a soldering set and hand tools with which to carry out repairs.

There is a spare parts store although with the proliferation of this type of industry in Panama it is easy to acquire spares, 50 per cent of which can be bought locally; the rest is imported.

A very elementary maintenance plan exists and, in general, machines are repaired within the firm itself; the winding of electric motors is done outside.

REPORT Nº 20

INDUSTRIAS LACTEAS, S.A.

1 - General data

The firm is concerned with the processing of milk and milk products.

The total work force is 193, of whom 138 belong to the production staff. The installations are entirely American in origin and all the machinery dates from 1956.

2 - Maintenance

Maintenance of the installations is undertaken by a team of 21 persons, the majority of whom have been trained at the firm, although three of them come from the School of Arts and Crafts and have followed advanced courses in Mexico and the United States.

They possess only several drills, soldering equipment and hand tools with which to carry out repairs; consequently they often have to seek outside assistance from other workshops.

There is a spare parts store in which only five per cent of parts are of national origin; the rest must be imported. There is also a preventive maintenance plan, with file cards of machines, parts to review and oiling points, although they do not keep statistics of breakdowns.

REPORT Nº 21

FABRICA NACIONAL DE SACOS, S.A.

1 - General data

This firm makes and sells sacks. It employs a staff of 16 operatives out of a total number of 21.

The firm manufactures approximately three million sacks. The machinery comes from the United States, although the weavers are Japanese and English. They are almost all of recent acquisition, except a winder and some sewing machines that date from 1954 and 1962 respectively.

2 - Maintenance

Maintenance of the machinery is in the hands of a mechanic whose knowledge has been acquired through experience. To effect repairs there is a drill, plane, and electric and oxyacetylene welder, but only 40 per cent of the repairs can be carried out in the firm; the rest requires external assistance.

There is a store for spare parts, although these can be easily acquired.

Preventive maintenance is not undertaken except for the cleaning of the machines.

REPORT Nº 22

CONSERVAS PANAMEÑAS SELECTAS, S.A.

1 - General data

This company prepares and processes fruit juices, various pastes, and marmalades. It has a staff of 38 people, of whom only seven make up the production team.

Its machinery was acquired in 1960, although in 1967 and 1968 a sealer and two filling machines were purchased. The majority of the equipment comes from the United States although some Italian machinery was acquired recently.

2 - Maintenance

Maintenance is the responsibility of a Chief, graduate of the Institute of Mechanical Arts, and an assistant who was trained inside the company itself. They have a drill, planes and grinder, relatively satisfactory, to carry out the repair work.

There is a small storehouse of spare parts. Preventive maintenance is not carried out. Some 40 per cent of the repairs to be done are beyond the firm's capabilities and must be done outside the company or by personnel from outside.

REPORT Nº 23

INDUSTRIA NACIONAL DE CONFECCION, S.A.

1 - General data

The activities of this company are confined exclusively to the manufacture of clothing.

It has a total of 130 employees of whom 120 form the production staff. They make trousers and shirts exclusively, about 36,000 and 240,000 units respectively.

The greater part of the machinery dates from three years ago and its state of repair is satisfactory.

2 - Maintenance

There is one mechanic from the Colombian Technical Schools to carry out maintenance. Mechanical repairs, or electrical work of minor importance, are effected, and in any other case, such as the winding of motors, outside assistance is requested.

There is a small store of only the most essential spare parts, since other parts can be found locally, imported by the distributor of the manufacturing machinery.

In some cases the firm makes its own small pieces of stainless steel plate. For repair work, there is only one electric drill and a grinding machine, both small, and one set of equipment for autogenous welding.

There is a very elementary but effective preventive maintenance programme, without schedule or controls.

2.4 Summary of Information

The tables which follow summarize the information obtained, and the companies which have helped in the compilation of this study; they allow a quick appreciation of the maintenance situation in these companies.

The evaluation given in each of the sections has been made in conformity with the concepts expressed in the following:

A.- Origin of Manufacturing Equipment

- One nationality - This signifies that at least 80 per cent of the machinery comes from the same country.
- Two nationalities - In this case, the machinery comes from two places and the percentages are divided equally between the two nationalities indicated.
- Multiple - The machinery does not have one predominant nationality and, in general, comes from more than three countries at least.

B.- Condition of the Manufacturing Equipment

- Old - Some 80 per cent of the machinery was acquired at least ten years ago.
- Mixed - Approximately 50 per cent of the machinery was acquired less than ten years ago.
- Modern - Some 80 per cent of the machinery is of recent acquisition (less than three years).

C.- Application of Maintenance Service

- Exclusive - In the event that the only purpose of the service is maintenance of the machinery.
- Non-exclusive - Whenever the maintenance of machinery is shared with other activities.

D.- Functions of Maintenance Service

- Complete - In the event that the activities include:
  - repair or modification of machines
  - miscellaneous work (masonry, electrical system)
  - preventive maintenance
- Partial - In those cases in which some of the aforementioned activities are not performed.

E.- Material Means

- Adequate - Those cases in which 80 per cent of the repairs can be performed with the means at hand, even though these means are not important or numerous.
- Inadequate - If 80 per cent of the repairs cannot be performed, even though the means at hand may have some degree of importance.

F.- Preventive Maintenance

- Complete - In cases in which there is an organization, that is to say, a plan, as well as an adequate degree of administrative support.
- Partial - Whenever the organization lacks at least some aspect of those mentioned above.

- Non-existent - When there is no organization or any provision for it and only repairs are made.

G.- Outside Assistance

- Never - When all repair work is done with the company's own means, without the assistance of repair shops or individuals outside the company.
- Low - When 80 per cent of the repair work is done with the company's own means and the remainder by other workshops.
- High - When only 20 per cent or less of the repairs is done with the company's own means and it is necessary in the majority of instances to resort to other companies, workshops or specialists.

The remainder of the data in the summarizing tables does not require clarification and is solely complementary.

TABLE - SUMMARY OF INFORMATION FROM THE COMPANIES CONSIDERED

SMALL UNDERTAKINGS

	COMPANIES	Nº of operators	Total Nº of staff	Manufacturing equipment		Maintenance Service					
				Origin	Condition	Application	Nº	Functions	Means	Preventive maintenance	Outside assistance
x	PLASTICOS MODERNOS, S.A.	23	35	USA-German	Mixed	Non-excl.	1	-	Inad.	Non-exist.	Low
x	DISCOS ISTMEÑOS	4	-	USA	Old	Non-excl.	1	-	Inad.	Non-exist.	High
x	HELICOPTEROS PANAMA	-	15	USA	-	Excl.	3	Partial	Inad.	Partial	Low
x	ING. AMADO (Prod. Metálicos)	29	31	Spain-Eng.	Mixed	Excl.	5	Partial	Ade.	Non-exist.	Low (1)
x	PRODUCTOS ASFALTICOS	4	10	USA	Old	Excl.	1	Partial	Inad.	Partial	Low
x	INDUSTRIA PAPELERA NACIONAL	6	21	Japan-USA	Mixed	Excl.	3	Complete	Ade.	Partial	Low
	EMPRESA NACIONAL DE SACOS	16	21	Japan-USA	Mixed	Excl.	1	Partial	Inad.	Partial	High
	CONSERVAS PANAMEÑAS SELECT.	7	38	USA	Old	Excl.	2	Partial	Inad.	Non-exist.	High

(1) Receives assistance from the group to which it belongs.

(x) Interview

TABLE - SUMMARY OF INFORMATION FROM THE COMPANIES CONSIDERED

MEDIUM SIZED UNDERTAKINGS

	COMPANIES	Nº of operators	Total Nº of staff	Manufacturing equipment		Maintenance Service					
				Origin	Condition	Application	Nº	Functions	Means	Preventive maintenance	Outside assistance
x	TABACALERA ISTMEÑA	83	100	USA.England	Mixed	Excl.	8	Complete	Ade.	Complete	Low
x	CORREAGUA, S.A.	38	46	Multiple	Old	Excl.	2	Complete	Inad.	Partial	High(1)
x	ALUMINIO PANAMA	60	84	USA	Modern	Excl.	3	Complete	Ade.	Complete	Never
x	OPERADORA INDUSTRIAL, S.A.	44	50	USA & Mexico	Mixed	Excl.	2	Partial	Ade.	Partial	Never
x	PANIFICADORA LA FAVORITA	55	70	Multiple	Modern	Excl.	2	Partial	Inad.	Non-exist.	High
x	COLGATE PALMOLIVE, S.A.	44	95	Multiple	Modern	Excl.	5	Partial	Ade.	Complete	Never
	POLYMER EXTRUSION, S.A.	107	200	Multiple	-	Excl.	13	Complete	Ade.	Complete	Low
x	INDUSTRIA NAL. CONFECCION	120	130	USA	Modern	Excl.	1	Partial	Inad.	Non-exist.	Low
	CREACIONES ITALIANAS	56	62	Multiple	-	Excl.	3	Partial	None	Partial	High
	CONFECCIONES BOSTON, S.A.	80	119	USA-Japan	Modern	Excl.	2	Complete	Inad.	Complete	Low
	CIA. CHIRICANA DE LECHE, S.A.	118	140	Multiple	Mixed	Excl.	13	Complete	Ade.	Partial	Never
	TABACALERA NACIONAL, S.A.	15	66	-	-	Excl.	3	Partial	Inad.	Non-exist.	Low

TABLE - SUMMARY OF INFORMATION FROM THE COMPANIES CONSIDERED

MEDIUM SIZED UNDERTAKINGS (Cont.)

COMPANIES	Nº of operators	Total Nº of staff	Manufacturing equipment		Maintenance Service					
			Origin	Condition	Application	Nº	Functions	Means	Preventive maintenance	Outside assistance
VENTANAS DE ALUMINIO, S.A.	38	50	USA	Old	Non-excl.	-	-	Inad.	Non-exist.	High
CONCRETO, S.A.	56	141	USA	Mixed	Excl.	16	Complete	Ade.	Partial	Low
HARINAS PANAMA,S.A.	32	38	Italian	Old	Excl.	6	Complete	Ade.	Complete	Never
ACEROS PANAMA, S.A.	-	-	Multiple	Mixed	Excl.	14	Partial	Ade.	Non-exist.	Never

(1) Receive assistance from the group to which they belong.

(x) Interview

TABLE - SUMMARY OF INFORMATION FROM THE COMPANIES CONSIDERED

LARGE-SCALE UNDERTAKINGS

	COMPANIES	Nº of operators	Total Nº of staff	Manufacturing equipment		Maintenance Service					
				Origin	Condition	Application	Nº	Functions	Means	Preventive maintenance	Outside assistance
x	PANAMEÑA DE ACEITES, S.A.	320	350	Multiple	Mixed	Excl.	50	Partial	Ade.	Nonexist.	Never
x	CERVECERIA NAL. (PLANT)	600	900	USA	Mixed	Non-excl.	60	Complete	Ade.	Complete	Never
x	" " " " (vehicles)	-	-	Multiple	-	Excl.	105	Partial	Ade.	Nonexist.	Never
x	CEMENTO PANAMA, S.A.	50	300	USA, Denmark	Modern	Excl.	60	Complete	Ade.	Complete	Never
	AZUCARERA NACIONAL	275	425	USA	Modern	Excl.	25	Complete	Ade.	Complete	Never
x	PROD. ALIMENTICIOS PASCUAL	170	205	Multiple	Modern	Excl.	10	Complete	Ade.	Complete	Never
	CIA, PANAMEÑA DE ALIMENTOS	350	400	Multiple	Mixed	Excl.	50	Complete	Ade.	Complete	Never
	INDUSTRIAS LACTEAS, S.A.	138	193	USA	Modern	Excl.	21	Complete	Inad.	Complete	Low
	ENVASES NACIONALES, S.A.	-	-	Multiple	Mixed	Excl.	20	Partial	Ade.	Complete	Never

(x) - Interviews

2.5 Public Works Sector

Taking into account the vital importance of the Public Works sector, particularly in those countries where the building of roads is one of the main objectives of the short-term plans during the initial stages of development, we thought it advisable to include a survey of this sector in the present report.

Consequently, the reports on maintenance and repair activities for road building equipment and means of transport (for personnel as well as for materials) are included in the following pages.

The problems affecting the equipment and the transport vehicles are dealt with separately because, although both belong to the Ministry of Public Works, they are administered by different departments in separate locations, each having its own facilities and staff.

Report on: TRANSPORT AND WORKSHOP CENTRE OF THE MINISTRY OF PUBLIC WORKS.

This Centre was set up in order that all the vehicles of the various Ministries should be repaired and inspected at this central point.

According to calculations made by the Director General of the Centre. Major C.E. Tejada, the number of vehicles intended for official service reaches a figure of approximately 4,000.

In addition to repair work, the supplying of petrol is centralized at the Centre.

Although this latter operation is carried out reasonably efficiently, the same cannot be said of the principal objective, as we shall see from what follows.

The entire staff of 51 persons is divided in the following manner:

Mechanical Workshop	12 mechanics and 8 assistants
Electro-mechanical Workshop	1 technician and 3 assistants
Upholstery Workshop	3 specialists and 2 assistants
Paint Shop	4 specialists and 1 assistant
Welding Shop	5 welders
Tyre Shop	2 operatives
Lubrication	1 operative

Motor Wash	1 operative
Cleaning	3 operatives
Spare Parts Storage	4 operatives

The majority of the mechanics come from vocational schools, and in some cases they have taken courses in Automotive Mechanics in the IFARHU.

Only certain vehicles, particularly those used by the Ministry of Public Works itself, are repaired in the workshops; the rest, with some exceptions, are responsible for their own repairs, or in the event that the allowance has been used up, vehicles remain out of service. In general, this Centre has been converted into a garage where vehicles which do not function are stored, without any assurance whatsoever as to their fate or future repair.

This situation has its origin in the existing administrative system, which does not allow the Centre to undertake repairs unless the Ministry concerned has approved the estimated cost in advance of the repair work; naturally, the Ministry cannot give its approval if the funds for this purpose have already been used.

There can be no doubt that the amount of these funds considerably affects the present situation, but apart from this, there are other reasons, of which the following may be emphasized:

- There is a great diversity of brands, of which there are subsequently various models and sizes.

It is obvious that as a result the management of spare parts is a matter of considerable difficulty. The automobile industry itself contributes to this situation with continuous changes.

- There is no periodic inspection of vehicles, not even for attending to the most urgent necessities such as lubrication, brake checking, checking of battery levels, etc., and even less for other more complicated operations. This inevitably leads to the destruction of the vehicle.

- The drivers, in general poorly trained, limit their responsibility to the driving of the vehicle, rejecting any other responsibility, whatever it may be.

  Only in the event of a collision or accident is responsibility and the degree of responsibility investigated. In short, the vehicles are badly cared for and badly treated, proof of which lies in the fact that 90 per cent of the breakdowns could have been avoided. Under these conditions, the average life of a vehicle is drastically reduced.

Paradoxically, the workshops are not capable of carrying out important reviews, being limited to the following equipment:

- Car lift
- Motor washing machinery
- Equipment for lubrication and oil changes
- Brake drum grinder

- Wheel balancing equipment (practically unusable)
- Inner tube mounting and dismounting equipment

The same applies to the much older and inadequate repair machinery, namely:

- Small hydraulic press
- Very small drill
- Relatively large, but very old drill

To complete this, there is a painting installation for air drying and autogenous and electric welding (two units).

The carpentry shop, which manufactures office furnishings for the Ministry, is better equipped. But, over all, there is a lack or inadequacy of material.

As regards the organization of periodic inspections and general control, it can be said that Major C.E. Tejada, with the limited finances available, is trying to introduce gradually a system which would enable him to exercise control, thus increasing the efficiency of the services for which he is responsible; this, as we have said before, does not now exist with regard to the vehicles of the Ministry of Public Works.

Report on: DEPARTMENT OF HIGHWAYS, AIRPORTS AND DOCKS EQUIPMENT (CAM)

This department, which is responsible to the Ministry of Public Works, is in charge of the construction of highways and docks. In the past, it was also responsible for airports, now the province of Civil Aviation, even though the department retains its old name. The machinery is distributed among six divisions, namely:

- Panamá
- Chorrera
- Aguadulce
- Santiago
- Chitré
- David

In each of these divisions there is a workshop for the maintenance and repair of the various items of equipment in the division. Each workshop is run by a chief, helped by two assistants, one in charge of heavy machinery and the other light machinery. There is also a Director of Maintenance.

In order to obtain first-hand personal knowledge, we visited the Division of Panamá, located on the outskirts of the capital, although we had previously had direct contact with Javier de Leon, Engineer and Director of Ministry Equipment, who had provided us with an initial general impression on the various problems of maintenance of Public Works Machinery.

We did not see the Director of Maintenance, Alfredo Riggs, who was away on an unexpected trip, but in his absence information was provided by the Head of the Mechanical Sector, responsible for the repair and maintenance workshops.

The system in use is explained in what follows. There is a maintenance team permanently located on the site, to whom the defective machinery or machinery which has to be checked periodically is brought by appointment. Complementary to this, there are two cars assigned to Maintenance, which are used to transport specialist personnel to the place where the machinery requiring attention is to be found. Finally, there are various mechanics and assistants who reside in the area where the machine is operating and who are responsible for providing "first aid" in the event that it is needed. Only if the know-how or spare part is lacking is the machine sent to the workshop for repairs.

The workshop is divided into various sections and the personnel assigned to each section can be either permanent or floating; these sections are listed as follows:

Heavy machinery workshop	31 operatives (5 permanent)
Light machinery workshop	10 operatives (10 permanent)
Plate shop	4 operatives (4 permanent)
Welding shop	6 operatives (6 floating)
Lathe shop	9 operatives (9 permanent)

The equipment available for repair work is reasonably adequate, sometimes somewhat out of date, but in perfect working condition. This equipment includes a lathe with a two-metre bench, which was acquired recently and has not yet been put into operation, and, in addition:

3 medium sized lathes (1 small)
2 planers
2 upright drills
1 small electric drill
1 milling machine
2 hydraulic presses

To these must be added one painting installation, for air drying, a small kiln of infra-red rays to dry highway-indicating signs, lubrication, washing, vehicle lifting apparatus, and some hoisting blocks.

Organizationally, there is a system of filing cards for machine handling, work order books, and operative control, the efficiency of which is beyond doubt.

The preventive maintenance plan cannot, in our opinion, be strictly enforced; despite our requesting to see the index cards they were not shown to us as, apparently, they were in the possession of the Director of Maintenance, absent at the time. In many instances preventive maintenance is carried out at the place of work.

The machinery, both light and heavy, comes from the United States. There are problems with the acquiring of spares, the delivery of which is not

as speedy as could be wished for, at times as much as three months or more.

There is a school for the professional training of the personnel who handle the machinery. However, the fact that there was quite a number of heavy trucks in good condition but without engines caused us to think that perhaps this training could be extended.

III - CRITICAL ANALYSIS

1.- LARGE-SCALE UNDERTAKINGS

The following information was obtained from nine companies, five of which we personally visited.

1.1 Corrective Maintenance

Each of the companies surveyed has a maintenance service, which makes it totally independent with regard to the repairing of defective machinery. Only in very special cases, and quite infrequently, must outside assistance be sought. These special cases are usually caused not by any incompetence on the part of the company's own service but as a result of the lack of some piece of machinery whose special nature and low utilization factor would make it an unprofitable investment.

In approximately 60 per cent of the cases the maintenance department also takes care of general building repairs (masonry, carpentry, electrical work, etc.)

Almost all of the companies have their own material resources, enabling them to repair the mechanical failures that occur. In addition, they have specialist personnel capable of making high quality repairs.

This leads us to the conclusion that companies which we have defined as "large" recognize the importance of the maintenance of capital goods - no easy task if one considers that only 50 per cent of those under review have machinery of only one national origin. This latter fact undoubtedly

complicates and multiplies the problems, both with regard to spare parts and to knowledge of the equipment which involves systems of highly diverse types.

This independence extends to about seven per cent of the total number of companies, but the fact is significant if it is borne in mind that these companies manufacture 47 per cent of the total sales.

This would result in minimal or insignificant benefits to this seven per cent if activities intended to raise the level of maintenance in industry in general were introduced.

1.2 Preventive Maintenance

Even though the companies in question possess adequate repair equipment, it does not necessarily mean that they have an operational maintenance plan. At least 75 per cent of them do have such a plan, together with the necessary administrative support and a definite organization, but the majority of suggested solutions are not effected in accordance with the plan; instead, they are subject to manufacturing requirements and, therefore, the application of the plan is indecisive.

There are some companies within this percentage grouping which have a reasonably high record in the prevention of breakdowns, but, in general, they lack the organization to complete the plan, or if they do have such a system it is not very strictly enforced.

More surprising is the case of the remaining 25 per cent in which a maintenance plan does not exist at all. In these companies deficiencies are superficially hidden by the efficiency of the repair team, although there is no doubt that the costs, due to the lack of preventive maintenance, affect production costs. In some instances there is interest on the part of management to introduce an efficient system which would assist in the reduction of these costs, but its introduction is not enforced for a variety of reasons, the main one being the lack of personnel with the requisite knowledge for the implementation, regular operation and control of the projected system. Another frequent cause is lack of motivation; despite the fact that the directors of the companies are aware of its importance there is no genuine impulse to take serious action.

2.- MEDIUM-SIZED UNDERTAKINGS

In this instance and because they are more numerous (approximately 45 per cent of the total number), the investigation has been extended to 16 companies engaged in various types of activities. We visited 50 per cent of them.

2.1 Corrective Maintenance

Some 94 per cent of the companies designated in this report as "medium-sized" have a maintenance service; only in one case nothing is specified in this respect. For this reason, although we could include all companies in this percentage grouping, the conclusions arising from information obtained about other companies suggest that the figure of 94 per cent is correct.

If this gives the impression that these medium-sized companies also enjoy complete independence with regard to maintenance, such an assumption is not correct, as we shall see, and the average medium-sized company is rather deficient in this field.

This is due to the fact that the functions of the maintenance service - if one exists - are restricted to repairs of minor or secondary importance, whereas if there is any problem that requires a certain degree of specialization, outside assistance is necessary.

Fifty per cent of these companies contract their carpentry, electrical and masonry work to other

companies specialized in these areas, leaving their own personnel free to attend exclusively to mechanical types of repair work. This is possibly due to lack of skilled personnel.

Similarly, with regard to materials, tools and machinery, only 55 per cent of these companies have the spares necessary for repair work. Some 40 per cent of them have few tools, rather old, while the remaining five per cent have practically no tools at all.

The fact that 55 per cent of these companies are adequately equipped should not lead us to believe that they possess such equipment in large quantities. Generally, the supply is limited, though sufficient for repairing such mechanical failures as may occur. Considered in this way, it should be noted that a company manufacturing ready-made clothing, for example, is fully equipped with very limited material, while a metallurgical company, say, is inadequately equipped with a range of equipment. In the qualification of means this relativity has been taken into account.

All of the foregoing is confirmed by the fact that only 30 per cent of these companies repair their own breakdowns without outside assistance; similarly, some 35 per cent require assistance occasionally, particularly for those difficult cases requiring treatment out of the ordinary. The remaining 35 per cent request outside assistance frequently for the fabrication, correction and repair of

tools used in the manufacturing process (moulds for plastic pieces, etc.).

All of this leads us to the conclusion that in a company of this size, maintenance is clearly deficient, both with regard to personnel and to material, the latter being compensated for by the utilization of outside means. The personnel entrusted with the repair work are equally lacking in training, which in the majority of cases is limited to the practical experience acquired over a period of years but without a theoretical basis.

This group of medium-sized companies requires the greatest amount of assistance with regard to maintenance services, inasmuch as they have a basis from which to start in addition to material and personnel. This is a situation which no longer exists in large companies but which has not yet been achieved by the small companies, as we shall see later on.

On the other hand, it should not be forgotten that these companies contribute 40 per cent to the value of sales and that their numbers, approximately 200, confirm our hypothesis.

2.2 Preventive Maintenance

From a study of corrective maintenance it is easy to see that these companies do not have systems of prevention. From a sampling of this group we find that only 35 per cent of them have a plan for reviewing machinery and installations,

organizing the service and for administrative support. Some 30 per cent carry out unsystematic lubrication infrequently. This, naturally, leads to doubts about its efficiency and even about the correctness of its application.

The rest of the companies do not undertake any activities of this type, although in some companies the machinery is inspected, particularly if there are any machines without a work load, or if the replacement is a relatively simple matter. This is the case with companies engaged in the manufacture of ready-made clothing where the sewing machines can be interchanged and easily inspected.

In general, the teams in charge of the maintenance service are small, consisting of from two to eight persons; few companies exceed this figure, and this, to a large extent, affects the existence of a prevention system.

Medium-sized companies would greatly benefit from the adoption of such a system, not only because it reduces the number of work stoppages, but also because it concerns a sector whose machinery is of varied origin, frequently bought second-hand, all of which increases the difficulty of obtaining spare parts. And, as a result, the medium-sized companies would require spare parts stores proportionately larger than those of the large companies, which is both uneconomical and financially impossible.

Despite the fact that we found many companies extremely dissatisfied with the situation and desiring improvements, the majority do not have the time required to study, adapt, introduce and continue a preventive maintenance system. We suggest, therefore, that for the time being this objective be given low priority rating.

3. SMALL UNDERTAKINGS

This report is compiled from a sampling of eight companies, six of them from direct observation, a number considered quite sufficient for the purposes of this study.

3.1 Corrective Maintenance

Some 75 per cent of the companies investigated have a maintenance service, but this cannot be considered as an organization as half of the companies have only one person dealing with maintenance and his services are not exclusive. He may be a mechanical lathe operator with some years of experience and with more ingenuity than formal knowledge, but advantage is taken of his superficial knowledge of mechanics for the carrying out of certain simple repairs.

For this reason the companies under review are frequently forced to depend on the assistance of workshops engaged in mechanical repairs, the standard of whose work is not considered satisfactory.

One of the methods used to avoid this problem is the importation of all sorts of spares, whether they are complicated pieces difficult to manufacture or elementary parts whose fabrication presents no difficulty.

Even though we cannot infer from this that the small companies contribute to this entirely, it is a fact that the importation of spare parts increases every year.

Table 3, Attachment 1, lists the machinery and spare parts imported between 1967 and 1970; unfortunately, there is no breakdown between the two items to show the figure corresponding to each one, but it is logical to assume that the importation of spare parts follows a line parallel to that of machinery, a hypothesis which, if true, would lead us to conclude that spares have increased two-fold in a period of four years. Perhaps this statement is too strong but without any doubt there has been an increase and, certainly on occasions, it has been due to the lack of quality in the spares fabricated in the country.

All of these companies lack adequate means to manufacture even the simplest spare parts. This fact, added to the inadequate training of the maintenance personnel, results in the already-old machinery presenting an aspect of obvious neglect.

This sector, which represents approximately 45 per cent of all companies - the rest are companies of fewer than five persons - does not greatly influence total sales in the country, contributing only 15 per cent to the market figure.

Consequently, these companies do not have many machines and are frequently engaged in the manufacture of simple products that take a short time to produce. Breakdowns are usually followed by stoppages, some prolonged, awaiting the arrival of the spare parts. Naturally, this limited production is not as significant as in the case of a company with large quantities and established production lines.

These small companies, as also those of medium size, are most deficient in maintenance but, for the reasons previously stated, they are reluctant to accept products manufactured in the country.

3.2 Preventive Maintenance

There is no preventive maintenance in the small companies; half of those under review carry out periodic lubrication and cleaning throughout the year. There is also irregular dis-assembling and re-assembling of machinery to check their condition. In the rest of the companies, however, no such activities take place and machines are repaired only when they break down.

4.- PUBLIC WORKS SECTOR

This Sector is here analyzed to complement the Private Industry sector. In it are included all heavy machinery, such as vehicles for the transportation of materials and persons.

In view of the fact that this analysis has been made throughout the reports presented so far, we now limit ourselves to making a brief summary of these reports.

4.1 Corrective Maintenance

This is carried out with relative efficiency in the area of heavy equipment or equipment used for the construction of highways; for light equipment and vehicles for the transportation of persons, the position is different. Here it is necessary to have a larger and better trained team than at present exists, and also adequate organization, both in terms of people (structural) and administration - something that does not at present exist.

However, there is a general problem with spare parts as, generally, the machinery represents different types of manufacture and even within the same type of machinery, elements of other makes, such as engines, have been used.

With regard to machinery for carrying out repairs, we believe that what is in stock, supplemented by recent acquisitions, will be sufficient to take care of any repair work that might arise. However, the Transport Centre does not benefit from this fact and must undertake its repairs with its limited resources. This is because the CAM workshops

and those of the Transport Centre are located in different places, and even though they belong to the same Ministry, they come under different administration.

In summary, the CAM workshops have the material means but lack the qualified personnel, while the Transport Centre lacks everything - a situation which is obvious without in-depth study.

4.2 Preventive Maintenance

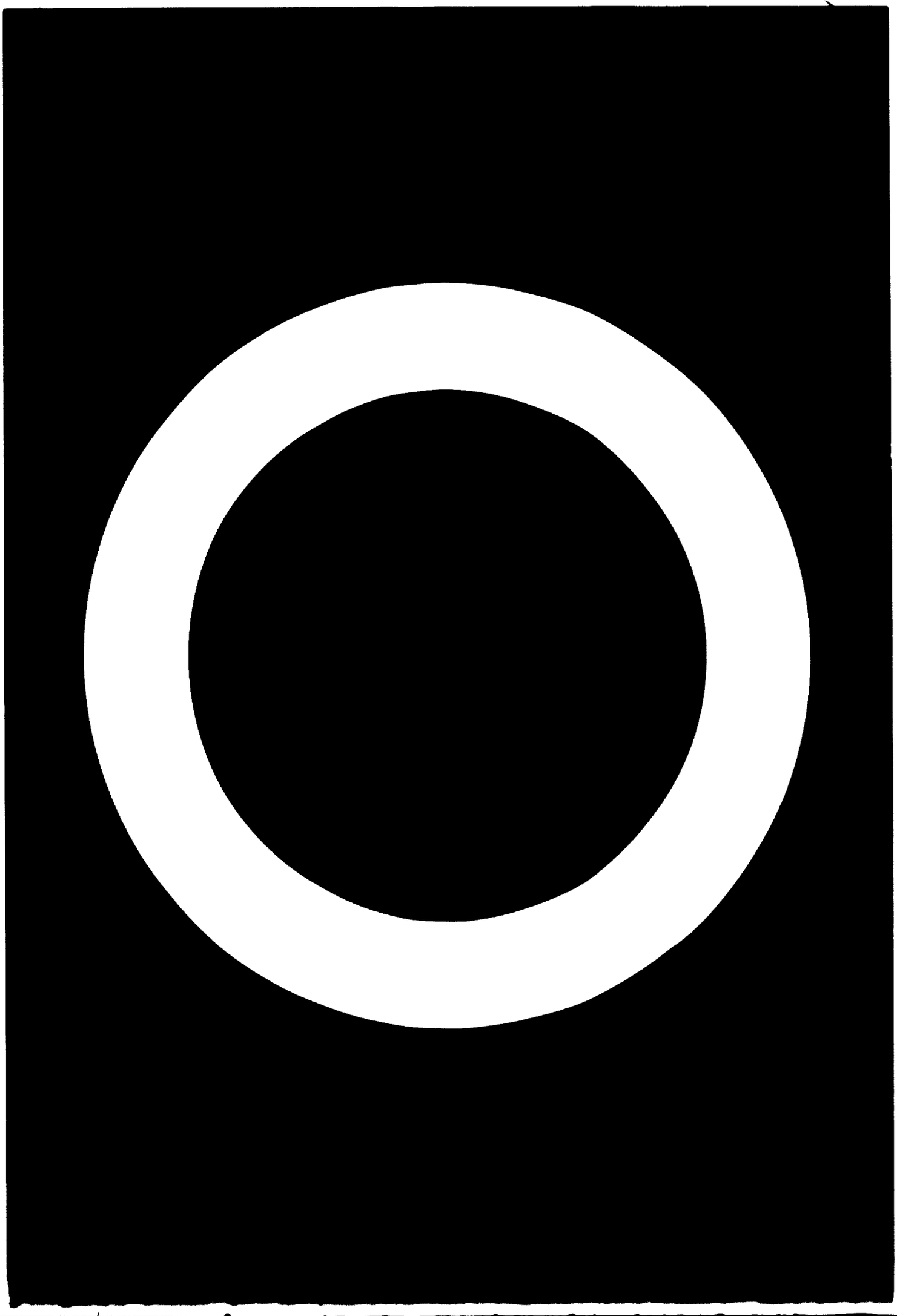
As we have already stated in these reports, preventive maintenance exists theoretically for heavy machinery, while the transport vehicles are without any type of care.

The number of vehicles out of service because of breakdowns, often needing only minor repairs, could be drastically reduced if they were submitted to periodic inspection. For this it would be necessary to begin immediately an effective plan for inspection.

Similarly, the management of spare parts lacks any organization; there is a warehouse, but the majority of the spares contained therein are now outdated and are unserviceable as a result. This is due to the fact that a study has not previously been made of spare parts requirements.

In general terms, it may be stated that both the CAM and the Transport Centre are deficient in preventive maintenance either through lack of

organization or through failure in the carrying out of the established plan. In view of the effect of this deficiency on the average life of the vehicles involved, we believe that the establishment of preventive maintenance is of primary importance. This should be supplemented with a properly structured organization consisting of persons who are capable of operating the system satisfactorily, thus ensuring its efficiency.



IV - RECOMMENDATIONS

1.- RECOMMENDATIONS CONCERNED WITH THE PRIVATE SECTOR

The results obtained from an analysis of the present situation lead us to the conclusion that approximately 90 per cent of the private companies (small or medium-sized) are struggling to carry out their repair work plagued by enormous difficulties, and that the principal cause is the lack of adequate material and human resources.

1.1 Proposed Solution

The most adequate solution would be the establishment of a central workshop. Its purpose would be:

- To advise those responsible for repairs on the most suitable way to perform them, with suggestions for emergency solutions.
- To construct simple spares such as bearings, axles, gear wheels, etc., or advise those companies which have the means but lack adequate ability how to construct them.
- To maintain constant contact with the companies in order to become aware of the problems arising in the field of maintenance, propose solutions, and collaborate with the parties responsible in the search for solutions.
- To prepare and schedule, either by their own means or with the assistance of outside advisers, courses, relating to systems of maintenance and repairs, for each group of companies with similar or identical activities, the duration of the courses to be decided on later.

- To issue information on specific problems common to the various companies, in such a way that the experiences of each may serve to enrich the knowledge of the others participating in similar activities.

- To keep alive always an interest in everything related to the subject with which we are concerned and facilitate the transmittal of information among companies by means of talks, conferences and seminars.

The means required to carry out this programme would be:

- A workshop with all-purpose machinery, comprising:

  1 - A horizontal lathe for large size spares
  2 - A horizontal lathe for the remaining spares
  3 - A universal miller
  4 - A surface grinding machine
  5 - An upright drill
  6 - A vertical grinding machine
  7 - Oxyacetylene welding equipment
  8 - Electrical welding equipment
  9 - Hydraulic press
  10 - Kiln for heat treatment
  11 - Equipment and tools for general adjustment jobs
  12 - Elements for the hoisting of spares

- The personnel necessary to man the installations, the number of whom would depend on the volume of work to be done; for this reason it is advisable to commence work with the bare minimum,

which we estimate at 12 persons:

- 2 lathe-milling operators
- 2 adjustor-diemakers
- 1 welder (gas and electricity)
- 3 mechanics
- 3 general assistants
- 1 shop chief

- In addition to this, it should be borne in mind that personnel will be needed for administration, billing, payments, material purchases, etc.

- Auxiliary facilities including:
  - Offices
  - Material storage space
  - Assembly and classroom
  - Covered area, not enclosed, for repair work

- Means of transport consisting of small units, like motorized tricycles to transfer material to nearby points, and one or more vehicles for longer runs (this last item could be charged to the companies being served and thus be eliminated).

This organizational system would be determined in part by the laws of the country and the limitations imposed by them; for this reason, before proceeding with any action, the statutes regulating such action should be agreed with the government.

1.2 Criticism of the Solution

The recommended solution would be ideal in theory; however, it is necessary to consider its practical side.

We are not unaware that the scope of repair work is limited, and that specific spare parts would have to continue to be imported.

In the same way, it would be necessary to overcome the conscious or unconscious scepticism of the companies, due to their lack of confidence in the spare parts manufactured in the country, the justification for which we have previously explained.

The operation of the workshop and its degree of acceptance is in direct ratio to the type of administration decided upon. The personnel should be the indispensable minimum in order to achieve an acceptable degree of return, or put another way, the workshop should be self-supporting and not represent an economic load for the government.

Finally, it should be borne in mind that there are already a number of workshops of minor importance carrying out similar work, of more or less average quality and, therefore, the introduction of the workshop would occasion competition. To this, one can only submit that the quality of the work being done is not what is required and that this quality would be guaranteed by the means we have suggested. Also, the series of associated activities (advising, technical assistance, courses, etc.) would contribute to a more acceptable image of the workshop.

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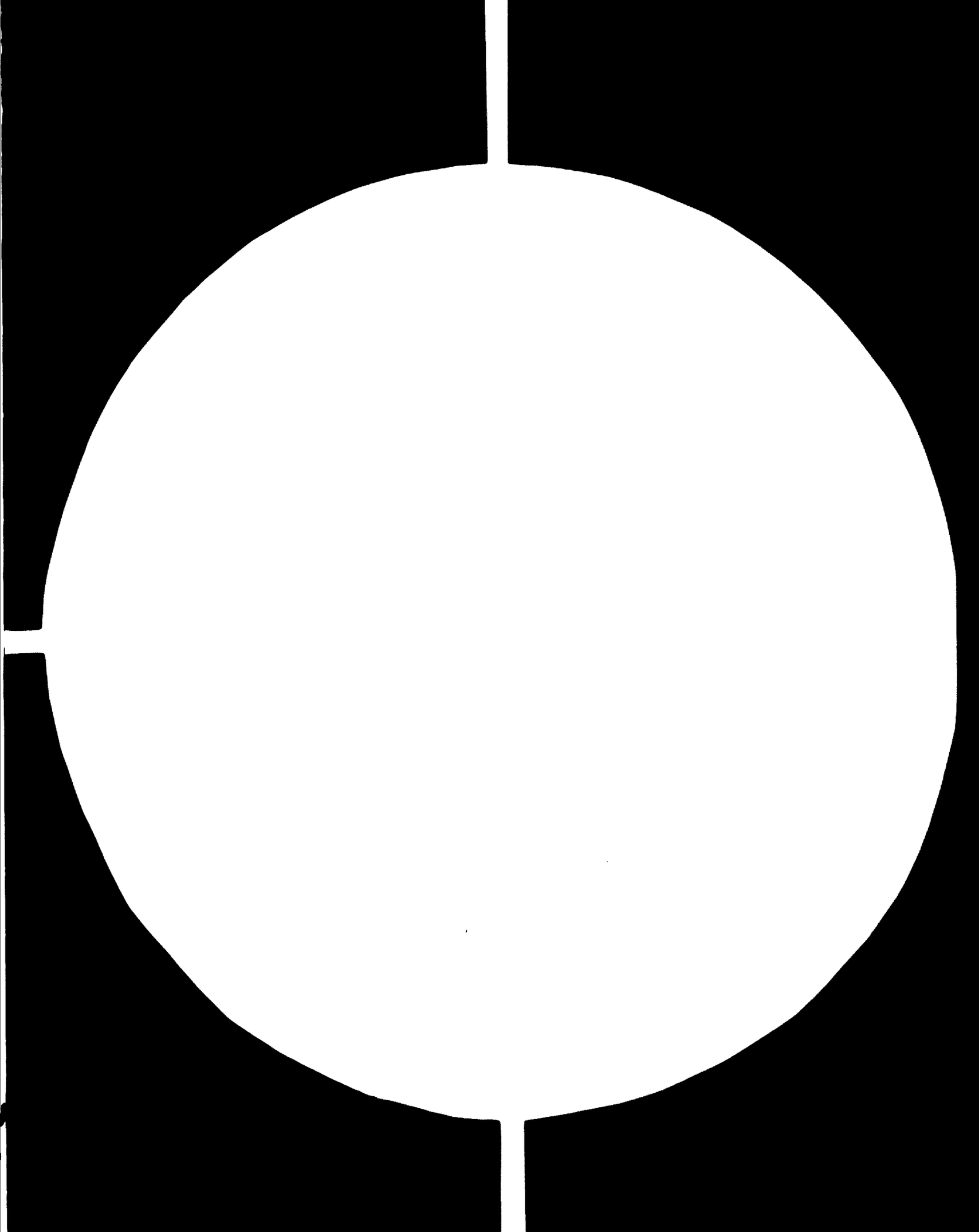

2.- RECOMMENDATIONS CONCERNED WITH THE PUBLIC SECTOR (1)

An analysis of the sector has led to the conclusion that the workshops concerned with heavy machinery are adequately equipped to carry out repairs, even though these means could be increased for greater efficiency. On the other hand, in the workshops for transport vehicles almost everything is lacking, and the installations are in no way adequate to carry out the functions demanded. Consequently, the solution proposed is concerned exclusively with the achievement of improvement.

2.1 Solution Proposed

In this instance we do not refer to the creation of a central workshop as, theoretically, it already exists, but rather to the modernization of its installations and its organization, and to the better qualification of its personnel, with the employment of more qualified staff members.

The purposes of this workshop would be those for which it was created, the care and repair of the State's transport fleet.

In this case there are no problems resulting from lack of authorization as we already know that this is the responsibility of the Ministry of Public Works.

The equipment necessary for the proper operation of the Centre can be specified as follows:

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(1) See Annex IV - Project Proposed

A). Mechanical shop

Work benches (3)
Portable electric drills (2)
Bench drill
Bench grinder
Grinding machine for flat surfaces
Horizontal lathe
Milling machine
Fissure detector
Wheel alignment equipment
Trolley jacks (2)

B). Electrical workshop

Manual coiler
Electric equipment test bench
Headlight alignment equipment
Battery charger

C). Sheet-metal workshop

Arc welding equipment
Hand sheet-panel shears
Hand tools

D). Chair and upholstery workshop

Sewing machine
Upholstery bench

E). Paint workshop

Painting equipment

F). Lubrication workshop

High-pressure greasing equipment

Part of the equipment indicated already exists (see Report), and it would therefore only be necessary to acquire a certain number of items from the foregoing list.

The introduction of an organized system of periodic inspections and preventive maintenance of spare parts would also constitute a significant reinforcement and, in our opinion, an indispensable one.

2.2 Criticism of the Solution

The proposed solution constitutes a theoretical and practical answer to the existing requirements, and we therefore consider its feasibility to be beyond all doubt, and that it may be said from the outset that it is the only viable approach.

The profitability of this solution is assured, provided that steps are taken not to encumber the Centre with an administrative system that would endanger its efficiency.

There would be no problem of competition since the services would be exclusively for the State, while private requirements would continue to be met by the existing private workshops.

3.- IMPLEMENTATION OF THE PROGRAMME

We have indicated previously that the solutions proposed may be applied jointly or individually, since they are independent of one another.

With regard to the order of priority, we consider that the implementation of the Programme should begin in the Public Sector, since the needs of the latter are more pressing; once these needs have been met, the establishment of the Central Workshop, intended to cover the needs of the Private Sector, can be begun.

If this approach is adopted, the putting into practice of the solutions proposed would require the following:

- The provision of machinery in accordance with requirements.
- The co-operation of outside advisers, whose technical experience and knowledge would be sufficient to meet the existing requirements.
- Other complementary actions (scholarships, etc.).

Solution A. (See Recommendation 2, p. 88).

Organization of the Transport Centre Workshop (Public Sector)

As a first step, the machinery should be renewed and modernized, in accordance with the requirements stated in point 2.1. The objective is not, of course, to establish a model workshop, but rather to provide the Centre with the means necessary to offer repairs of an acceptable

standard. The justification of our opinion is set out in Annex IV.

Again, a fundamental requirement is the assistance of two advisers: one of whom should be a qualified Mechanical or Industrial Engineer, an expert in Organization and Methods and in Maintenance Systems, with a wide knowledge of Plant Layout, and who, in co-operation with the staff of the Ministry of Public Works would undertake the following activities:

- Preparation of a plan of action, starting from the date on which the equipment is received
- Preparation of the layout for the various workshops of the Centre
- Direction and supervision of the work of starting up the machinery; he should be personally responsible for compliance with the safety standards required
- Establishment of the most suitable structure for optimum operation of the workshop; he should specify the composition of the labour force and its functions
- Study and design of a system of preventive maintenance
- Establishment of a training plan for the Panamanian personnel concerned with the use and operation of the repair workshop equipment
- Coordination of the activities of a second expert and the personnel of the Ministry of Public Works

- Assumption of responsibility for the execution of the project, and of the programme established before or during its development; he should act as the Head of the Project Team.

A second adviser, a qualified mechanic, with detailed knowledge of maintenance and vehicle repair, whose functions would be:

- Co-operation with the Project Manager in the establishment of the General Plan
- Application of the Plan for the training of personnel who will use the machinery and installations. Training would include theoretical aspects as well as practical demonstrations, in accordance with the plan established
- Establishment and starting up of a system of preventive maintenance, job definitions, points to be checked and frequency of inspection; the means to be used, in accordance with the directives established by the Project Manager
- Technical advice for the diagnosis and location of breakdown in vehicles, and for their repair. This advice would decrease as the trained personnel gained the necessary practical experience.

The services of both experts would be required for a period of one year, starting from the date that the equipment is received. It is necessary that both experts be fluent in Spanish, written and spoken.

In addition, it would be advisable to have some personnel trained outside the Republic. For instance, a small number of qualified workers, for example three,

could be sent to similar institutions in other countries, for periods of not less than six months.

Solution B. (See Recommendation 1, p. 84).

Establishment of a Central Maintenance Workshop (Private Sector)

This requires the assistance of two advisers. One of these, who would assume the responsibility for the Project, should be an expert in the organization of workshops and administrative control, with a sound knowledge of mechanics and electricity; if possible, he should be a qualified Industrial Engineer, and would, in collaboration with personnel of the Ministry of Industry and Commerce, carry out the following activities:

- Drawing up of the General Plan in accordance with the objectives of the project
- Preparation of the plan for the training of personnel, previously selected, to take charge of the installations and machinery. This would include both office employees and workers
- Training of administrative personnel in the system of control to be established. He would likewise be responsible for the study of this system, including the design or adaptation of the forms which will serve as support for the system.
- Preparation and execution of a programme of lectures on maintenance for Company management staff
- Establishment and organization of seminars and short courses for personnel concerned with maintenance in private industry

- Coordination of the activities of the second expert, indicating the lines to be followed by the latter
- Provision of technical assistance and co-operation with the second expert in the development of the programme for personnel training
- Technical and administrative supervision of the operation of the central workshop, in co-operation with the manager appointed by the Ministry to direct the workshop.

The second adviser should be a qualified mechanic, with knowledge of electricity and maintenance of machinery in general; he should also be experienced in the strength of materials and in the operation of generally-used machine tools.

The functions of this second adviser would be the following:

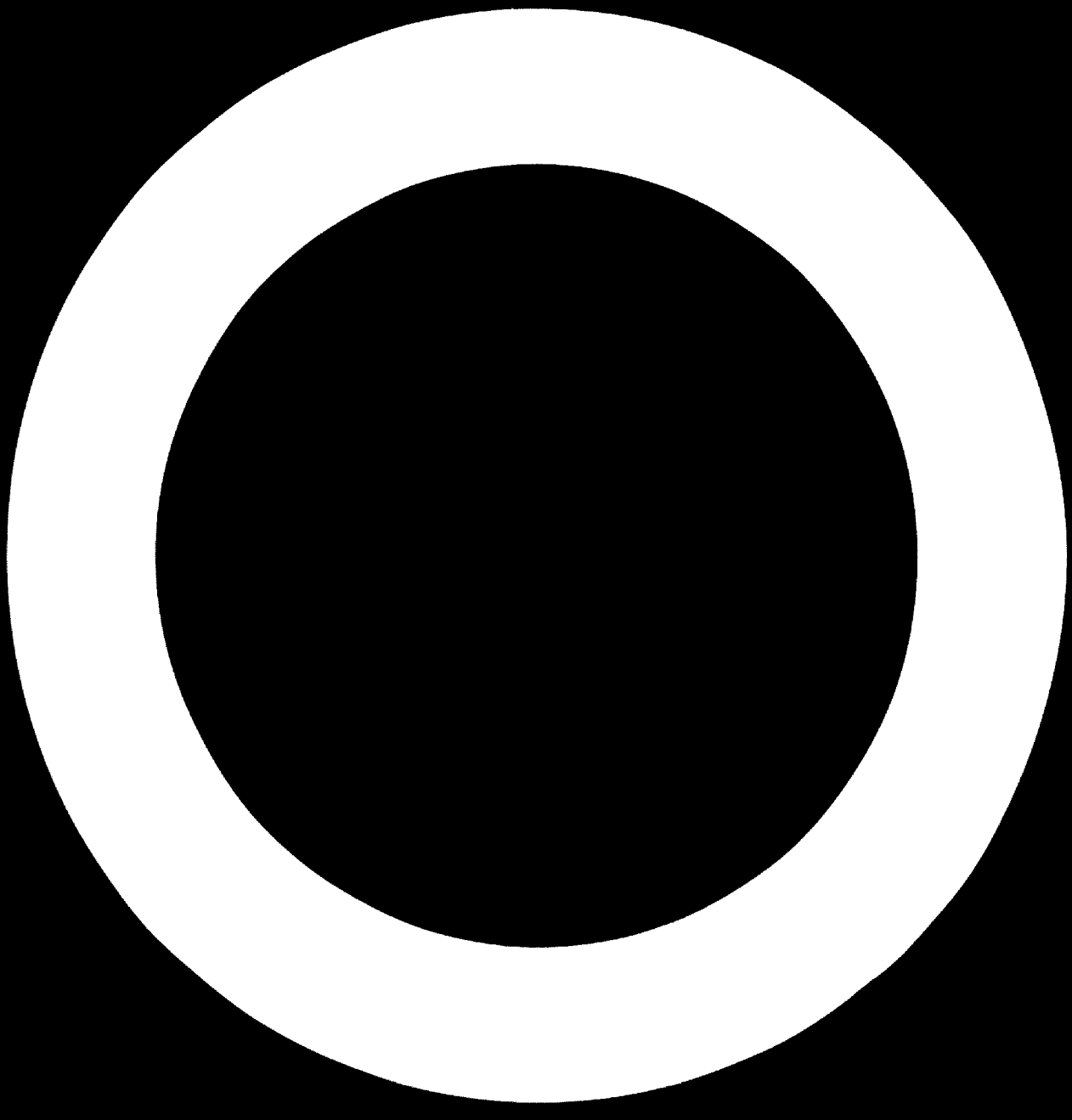
- To collaborate with the Project Manager in the preparation of the General Plan and Training Programmes
- To attend seminars and courses, which would include practical demonstrations of maintenance and technical repairs
- The theoretical and practical training of personnel on how to handle the workshop equipment and installations in accordance with the plans established
- To direct the central workshop personnel; he should provide them with advice concerning the manufacture of parts and the repair of breakdowns

- To advise private companies on their specific problems, when so requested.

The services of both experts would be required for a year and a half for the development of the work envisaged; this period would begin as from the date of reception of the machinery and equipment.

To this period, an additional month should be added for the Project Manager, with the assistance of the person designated by the Ministry, to choose the site for the workshop, as well as determine the necessary dimensions. Both experts should be proficient in Spanish, written and spoken.

ANNEXES



ANNEX I

INDUSTRIAL STATISTICS

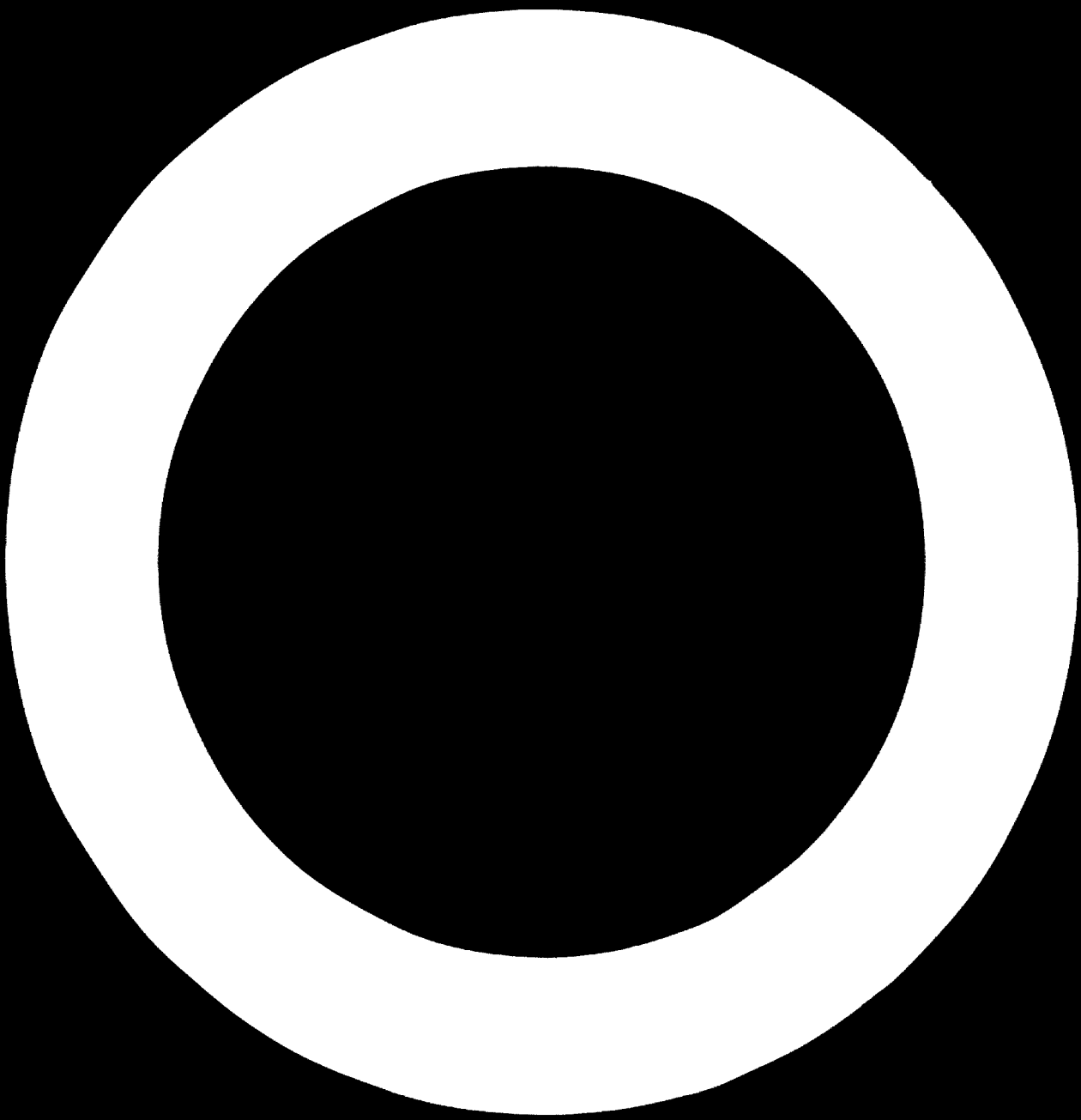


TABLE 1.- CHARACTERISTICS OF INSTALLATIONS OF THE MANUFACTURING INDUSTRY, WITHIN THE REPUBLIC, LISTED BY ACTIVITIES: 1970 (1)

ACTIVITIES	Reporting firms (1)	Number of jobs	(Value in '000 Balboas) Value of Sales
Printing, publishing and allied industries .	40	1,666	12,140
Industrial chemicals, basic other than fertilizers	4	56	1,087
Paints, varnishes and lacquers	3	86	2,625
Pharmaceutical and medical	4	138	2,033
Soap and cleaning compounds, perfumes, cosmetics, etc.	10	390	6,788
Chemical products, n.s.o.tp:	4	109	1,192
Tyres and tubes	3	50	724
Plastics, n.s.o.tp:	13	329	4,280
Glass and glass products	5	82	805
Clay building materials	3	331	2,280
Cement and non-metal mineral products n.s.o. tp:	38	1,590	18,725
Iron and steel basic industry	4	293	3,738
Non ferrous metals	3	139	3,534
Furniture and appliances, mainly in metal ..	7	128	1,079
Metal structures	16	644	6,353
Metal products, n.s.o. tp: other than machinery and equipment	15	467	6,872
Construction of machinery other than electric	4	77	559
Construction of machinery, apparatus, accessories and other electrical supplies, n.s.o. tp:	3	81	1,128
Shipbuilding and shiprepairing	4	105	1,129
Jewellery and similar products	3	46	694
Manufacturing industries, n.s.o.tp:	12	695	74,601

TABLE 1.- CHARACTERISTICS OF INSTALLATIONS OF THE MANUFACTURING INDUSTRY, WITHIN THE REPUBLIC, LISTED BY ACTIVITIES: 1970(contd.) (1)

ACTIVITIES	Reporting firms (1)	Number of jobs	(Value in '000 Balboas) Value of Sales
Abattoirs and meat processing	10	527	11,214
Dairy products	12	794	19,663
Fish, crustaceans and other sea products .	7	420	8,326
Flour products	28	551	16,326
Bakery products	72	1,361	11,396
Sugar (production and refining)	3	796	14,796
Cocoa, chocolate and confectionery	5	163	1,602
Other foodstuffs	29	820	20,549
Fodder	9	348	6,232
Distilling, purifying and blending of spirits:	11	369	10,528
Malt and malt beverages	4	623	11,959
Non alcoholic beverages and sparkling water	6	601	6,957
Tobacco industry	2	325	10,010
Clothing, knitted wear fabrics and ready-to-wear goods, other than shoes	61	2,957	17,396
Tanning and finishing	5	127	890
Leather goods and imitation leather goods, other than shoes and clothing	3	30	104
Shoes other than of rubber (vulcanized or moulded) and plastic	20	861	5,224
Sawmills, planing workshops, manufacture of wooden and bamboo containers, and other woodworking workshops	33	1,083	5,938
Furniture and accessories, other than those made mainly of metal	54	1,164	8,847

TABLE 1.- CHARACTERISTICS OF INSTALLATIONS OF THE MANUFACTURING INDUSTRY, WITHIN THE REPUBLIC, LISTED BY ACTIVITIES: 1970 (contd.) (1)

ACTIVITIES	Reporting firms (1)	Number of jobs	(Value in '000 Balboas) Value of Sales
Wood pulp, paper and cardboard	3	174	1,994
Packaging materials and boxes made of pulp, paper or cardboard n.s.o.tp:	11	585	12,523
TOTALS	586	22,181	354,977

(1).- Refers to firms with five or more workers.

THE REPUBLIC, LISTED BY NUMBER OF EMPLOYEES : 1970 (1)

EMPLOYEES	Reporting firms (1)	Number of jobs	(Value in '000 Balboas) Value of Sales
5 - 9	135	942	8,590
10 - 19	160	2,139	24,040
20 - 29	93	2,246	26,034
30 - 49	87	3,315	46,957
50 - 99	59	4,012	40,479
100 - 199	40	5,720	83,417
200 and more	12	3,807	125,460
TOTALS	586	22,181	354,977

(1) Refers to firms with five or more employees.

TABLE 3.- TOTAL IMPORTS TO THE REPUBLIC, ACCORDING TO TARIFF ITEMS: YEARS 1967 AND 1970

(FOB value in Balboas)

Tariff description	Unit	1967		1970	
		Amount	Value	Amount	Value
Machinery and vehicles			54,149,982		90,004,427
Steam generating boilers ...	g.k.	108,295	171,259	217,501	347,039
Marine engines	units	888	706,721	729	476,610
Accessories and spare parts, n.s.o.tp. for int. combustion engines and diesel and semi - diesel engines	g.k.	334,487	1,220,723	325,027	1,435,836
Agricultural machinery and - apparatus (harvesters, mowers, thrashers, graders, etc.	units	374	303,145	254	713,088
Tractors	units	246	844,096	369	4,229,724
Spare parts for tractors	g.k.	220,900	480,247	417,348	1,182,724
Typewriters, manual	units	5,495	307,202	9,060	566,934
Accounting machines	units	110	301,912	111	380,529
Machinery for metal working other than machine tools. Accessories and spare parts are included n.s.o.tp.	g.k.	517,034	858,584	207,378	598,895
Pumps for liquids, n.s.o.tp. and their accessories	g.k.	196,572	624,726	318,605	879,498
Stationary or mobile machinery for excavating, levelling, boring and extracting earth (inc. accessories and parts)	g.k.	343,541	481,758	1,908,531	3,043,309
Machine tools for working wood, cork, bone and other similar - materials (Accessories and - parts are included) n.s.o.tp..		174,838	450,858	231,808	813,100

TABLE 3.- TOTAL IMPORTS TO THE REPUBLIC, ACCORDING TO TARIFF ITEMS: YEARS 1967 AND 1970 (Cont.)

(FOB value in Balboas)

Tariff description	Unit	1967		1970	
		Amount	Value	Amount	Value
Machinery for the paper industry (accessories and spare parts are included) n.s.o.tp.	g.k.	1,565,485	1,565,240	96,775	485,742
Machinery for printing and bookbinding (Spare parts are included plus types and other printing accessories, photogravure apparatus and other photographic apparatus)	g.k.	422,600	1,832,078	278,110	960,977
Industrial sewing machines	units	315	178,932	775	396,970
Household sewing machines	units	8,105	389,696	8,911	352,817
Self-regulating air conditioning equipment complete. Fans for air renewal and air purifiers	g.k.	447,632	941,175	745,904	1,801,735
Refrigerating equipment for industrial and commercial use n.s.o.tp.	units	40	155,305	135	218,346
Commercial electric refrigerators	units	347	183,219	297	205,548
Accessories and spare parts for air conditioning and refrigerating equipment and machinery	g.k.	200,196	446,783	200,707	638,738
Machinery and tools - - - - - (non electric) n.s.o. tp.	g.k.	440,605	987,834	162,931	403,753
Accessories and spare parts for non-electric machinery	g.k.	486,584	1,191,267	498,417	1,647,546
Ball, roller or needle bearings .	g.k.	99,951	363,943	142,676	579,430
Ballcocks and taps, valves and other metal devices for control of fluid flow in piping	g.k.	244,506	474,572	114,293	328,099

TABLE 3.- TOTAL IMPORTS TO THE REPUBLIC, ACCORDING TO TARIFF ITEMS: YEARS 1967 AND 1970 (Cont.)

(FOB value in Balboas)

Tariff description	Unit	1967		1970	
		Amount	Value	Amount	Value
Generators and dynamos, with or without engine, other than those for int. combustion engines or explosion engines	units	168	430,211	243	639,535
Electric motors	units	2,657	166,751	3,668	193,671
Transformers, alternators, rectifiers, converters and other similar apparatus for modifying the electric current, with the exception of special devices for radio, telegraph and telephone	g.k.	317,536	459,568	448,529	692,587
Devices for operating switches and switchboards and distributors, including motor starters and control rheostats	g.k.	99,974	351,599	101,816	463,620
Electric batteries and cells, dry	g.k.	780,901	615,515	906,505	803,546
Bulbs and glowing tubes for electric lighting, of all types and voltages, including sealed beam automobile lights	g.k.	117,001	294,608	140,181	348,542
Radio receivers, electric	units	7,648	178,791	9,310	212,987
Radio receivers combined with tape recorders or record players	units	10,649	312,091	16,210	580,038
Radio receivers, battery	units	97,593	702,596	108,263	729,052
TV receivers	units	17,322	1,416,791	27,843	1,862,763

TABLE 3.- TOTAL IMPORTS TO THE REPUBLIC, ACCORDING TO TARIFF ITEMS: YEARS 1967 AND 1970 (Cont.)

(FOB value in Balboas)

Tariff description	Unit	1967		1970	
		Amount	Value	Amount	Value
Tubes, transistors, condensers and other accessories and parts for radio, TV and other elec -- tronic apparatus n.s.o.tp (save for the corresponding furniture which is classified according - to materials)	g.k.	84,187	424,337	96,386	511,120
Apparatus for wireless telegraph telephone and other wireless - telecommunication equipment n.s. o.tp., accessories and parts - thereof	g.k.	37,727	497,034	54,707	1,234,233
Apparatus for telegraph, and - telephone other than wireless .	g.k.	210,152	1,309,438	503,436	3,741,105
Electric household appliances (washing machines, dryers, pressers)	units	2,934	323,758	4,951	559,684
Cables and coated wire for electricity conduction with or without connection terminals	units	1,156,898	1,299,657	1,461,174	1,979,886
Plugs, switches and other similar material n.s.o.tp.	g.k.	563,257	774,635	626,030	1,166,284
New passenger motor vehicles, - including station wagons, complete, other than motorcycles and buses	units	4,565	7,048,733	6,740	10,366,068
Used passenger motor vehicles, including station wagons, complete, other than motorcycles or buses	units	1,489	1,636,025	934	657,450

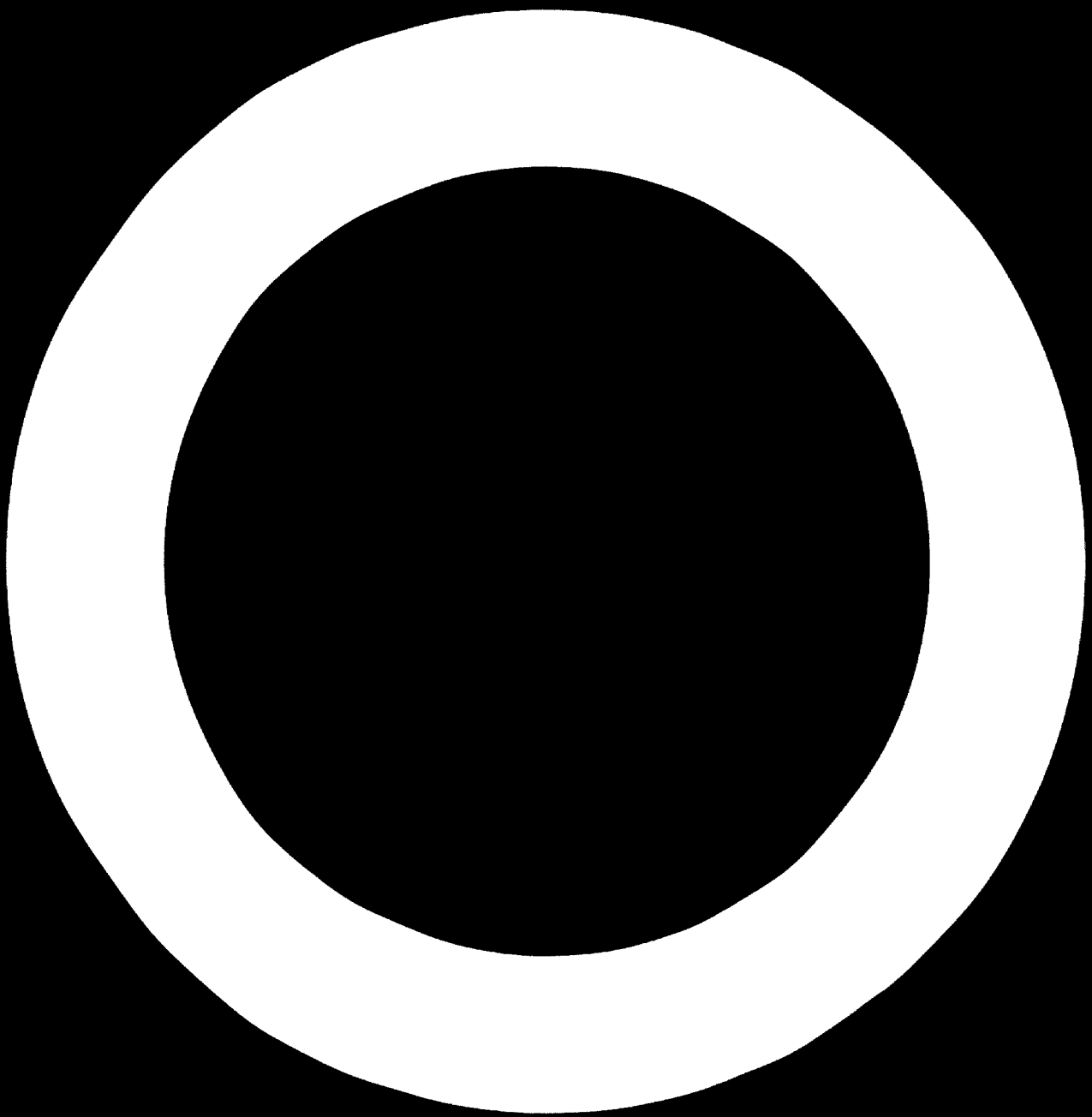
TABLE 3.- TOTAL IMPORTS TO THE REPUBLIC, ACCORDING TO TARIFF ITEMS: YEARS 1967 AND 1970 (Cont.)

(FOB value in Balboas)

Tariff description	Unit	1967		1970	
		Amount	Value	Amount	Value
Autobuses or omnibuses and other automotive vehicles for passenger transport n.s.o.tp.	units	291	847,283	471	1,541,814
Trucks and other automotive vehicles for transport of goods ..	units	793	1,313,470	1,660	4,935,612
Crane trucks, irrigation trucks, sweepers and other automotive vehicles with stationary units, other than for transport of goods n.s.o.tp.	units	14	200,152	64	791,580
Automotive vehicles, fourwheel traction, up to one ton	units	415	958,294	703	1,721,734
Chassis for buses, trucks, etc. with engine fitted	units	397	1,662,684	823	4,061,936
Other spare parts for automotive road vehicles n.s.o.tp. other than spare parts for motorcycles, scooters and side cars, rubber tyres, engines and electric parts	g.k.	1,155,542	2,576,007	1,770,822	4,168,173
Other goods			12,888,679		23,354,429

n.s.o.tp. = non specified in other Tariff positions

g.k. = gross Kg.

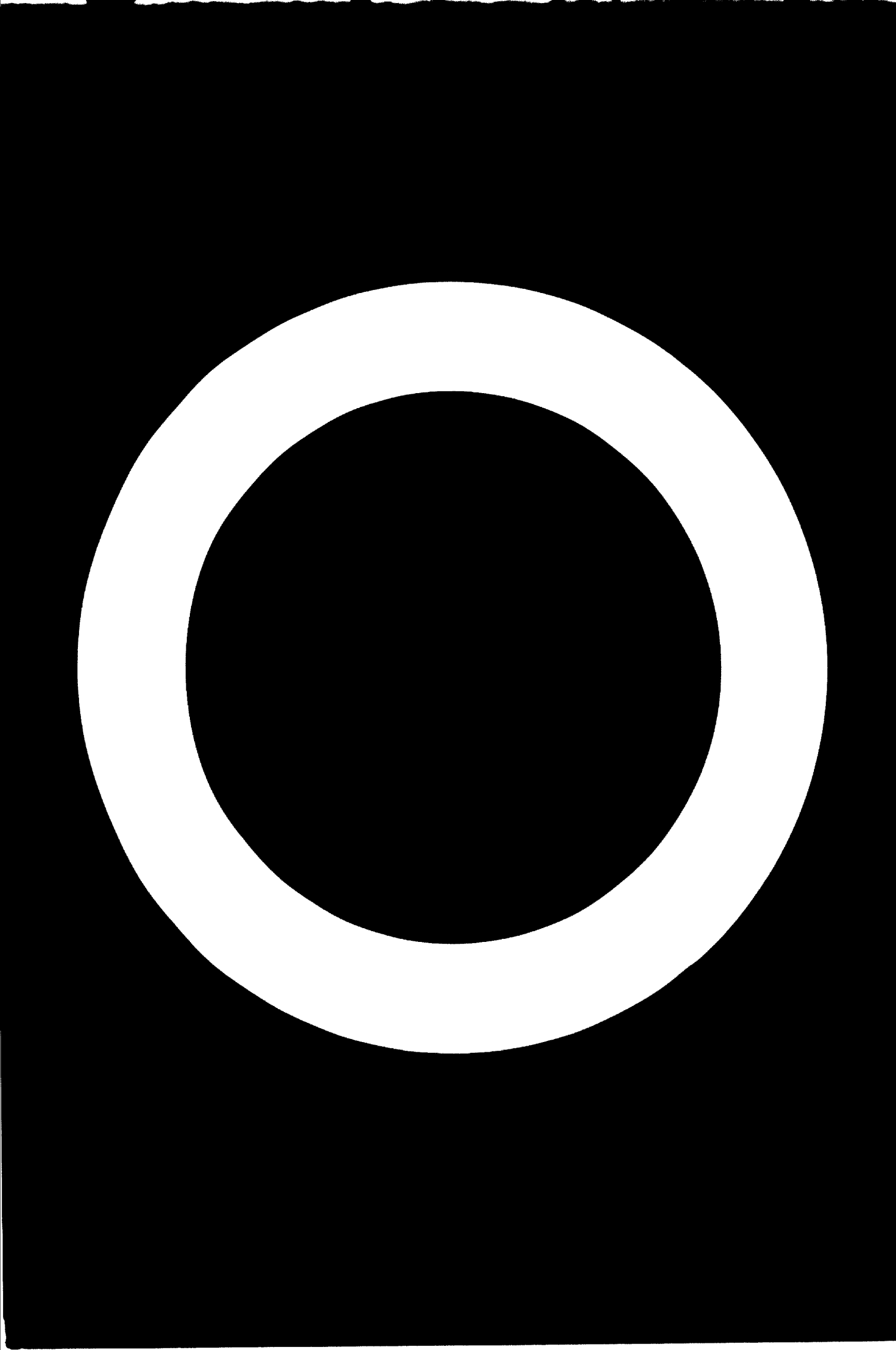


ANNEX II

EDUCATIONAL PLANS

AND

IFARHU COURSES



EDUCATIONAL PLANS

The National Department for Educational Planning has developed a wide variety of educational opportunities which students may follow in accordance with their abilities and interests. The Secondary Education Study Plans at present in force have been summarized, and are detailed below.

Upon the completion of primary education, the following plans of study are available:

1.- Elementary Course of General Culture
2.- The Basic Cycle
3.- Primary Industrial
4.- Quignard Experimental Plan
5.- Intermediate Seamanship
6.- Practical Agriculture and Livestock

Upon completion of the Basic Cycle or the Elementary Course of General Culture, a diversified education is offered which allows specialization in:

1.- Industrial Baccalaureate
2.- Secondary Industrial
3.- Agriculture and Livestock
4.- Commerce
5.- General Science
6.- Standard Education
7.- Domestic Science
8.- Agriculture
9.- Dressmaking

The studies of Higher Seamanship, which lead to the position of Chief Engineer, require that the student have passed the course in Secondary Industrial or General Science in the Secondary Cycle educational level.

PRIMARY INDUSTRIAL

DURATION: Two years.

REQUIREMENTS: Successful completion of primary studies.

CHARACTERISTICS: The courses of the First Cycle are completed in two years and in addition knowledge of an industrial specialization is acquired in one year. On completion, the student receives a Certificate which accredits him in the industrial occupation studied.
The specialities may be: Hairdressing, Sheet Metal Work, Book Binding, Forging and Welding, Tinsmithing, Domestic Appliance Fitter, Tailoring, Upholstering, and Smelting.

SCHOOLS OFFERING COURSES:

1.- Arts and Trades "Melchor Lasso de la Vega"

2.- Louis Martinz Vocational Centre

3.- La Palma - Los Santos Vocational Centre

4.- Abel Bravo College

5.- Mechanical Arts Institute

SECONDARY INDUSTRIAL

DURATION: Three years.

REQUIREMENTS: Successful completion of Basic Cycle.

CHARACTERISTICS: During the first two years the courses corresponding to the third year of the Elementary Course are completed, in addition to selected workshop course. In the third year, an industrial specialization is taken up. On successfully completing the plan, the student receives the certificate of the First Cycle and a diploma accrediting him in the industrial occupation studied. The specialist courses offered are: Graphic Arts, Auto and Diesel Mechanics, Precision Mechanics, General Mechanics, Leadworking, Refrigeration and Air Conditioning, Repair of Commercial Machinery.

SCHOOLS OFFERING COURSES:

1.- "Melchor Lasso de la Vega" Arts and Trades School

2.- Felix Olivares C. College

3.- Abel Bravo College

QUIGNARD EXPERIMENTAL PLAN

DURATION: Three years.

REQUIREMENTS: Successful completion of VI Grade of Primary School.

CHARACTERISTICS: This is an experimental cycle which aims to offer the student more practical experience and activities channelled toward the vocational field.

Specializations: Clerks in the Isabel Herrera Obaldía Professional School. Primary Level Vocational Studies in: Upholstery, Sheet Metal Work, Tailoring, Cabinetwork and Carpentry, and Forging and Welding in the "Melchor Lasso de la Vega" Arts and Trades School and Abel Bravo College.

In the Quignard Experimental Plans a First Cycle with 30 hours of classwork weekly is offered; this tends to leave more free time for personal work.

SCHOOLS OFFERING COURSES:

1.- Panamá First Cycle
2.- Angel María Herrera Secondary School
3.- Manuel María Tejada Roca School
4.- David First Cycle (now David Standard Institute)

INDUSTRIAL BACCALAUREATE

DURATION: Three years.

REQUIREMENTS: Successful completion of First Cycle.

CHARACTERISTICS: The student is formed culturally and scientifically, allowing him to pursue university studies in: Engineering, Architecture or Technical Education. In the industrial area his training is described as Elementary Technician (B) and he is qualified to be an Engineering Assistant.

The Industrial Baccalaureate offers the following fields of study: Mechanics (metallurgy), Construction, Electricity, Chemistry and Electronics.

SCHOOLS CURRENTLY OFFERING COURSES:

1.- "Melchor Lasso de la Vega" Arts and Trades School

2.- José Dolores Moscote Institute

3.- Don Bosco Technical Institute

IFARHU SPECIALIZATION COURSES

ANALYSIS OF THE VARIOUS COURSES IN CONSTRUCTION

1. Construction Carpentry (Basic Training)

   This course is designed to prepare carpenters for construction work at a semi-qualified level.

   The techniques included in this trade are: use of carpentry tools, wall framing, column framing, framing of beams and cantilevers, slab and eaves framing, interpretation of drawings, installation of stairways, construction of forms, construction of ceilings, installation of framework for ceilings, construction of flush ceilings, installation of beams for concrete flooring.

   At the same time, a knowledge of the technology, calculations and safety principles of each technique is imparted.

   This course lasts for six months and consists of approximately 850 hours.

2. Interpretation of Construction Drawings (Further Training)

   The object of this course is to provide semi-skilled workers with technical and practical knowledge of basic units of: scale interpretation, interpretation of nomenclature, location drawings, foundation drawings, plan drawings, elevations, detail and other drawings, in such a way that the participants acquire the ability to interpret construction drawings.

   Parallel with this instruction, technical and safety knowledge is imparted.

These courses continue for approximately 50 hours.

3. Installation of Stairways (Further Training)

In this course, lasting approximately 50 hours, the carpenters learn to perfect the technique of making stairways.

Units of levelling, installation and design of stairways, treads and risers, reinforcement of risers and construction of stairways on sloping ground train the participant in the task of building stairways. Along with the timetable in practical work, students are also given theoretical and safety training relating to the practical classes.

4. Calculation of Materials (Further Training)

This course is designed to instruct carpenters to determine materials by means of the units of drawing interpretation, as well as to assess material for dividers, floors, flush ceilings, scaffolding, shoring, columns, slabs, beams, stairs and ceilings.

In addition, knowledge of techniques and safety principles involved is provided.

The duration of this course is approximately 60 hours.

5. Door Hanging; Hardware and Locks (Further Training)

In this course construction carpenters and cabinetmakers learn the art of door hanging and fitting handles, locks, etc.

The course programme includes sessions in construction of frames, setting up of frames, hanging of doors, fitting of locks, etc. Concurrently with this, a knowledge of the technology, calculations

and safety principles is developed.

This is a 70-hour course.

6. Carpentry in Construction (Further Training)

The object of this course is to train construction carpenters to a semi-skilled level within a short period of time.

The courses making up the programme are: use of carpentry tools, wall framing, column framing, framing of beams and cantilevers, slab and eave framing, installation of stairways, construction of framework, construction of flush ceilings and installation of ceilings.

Along with this, a knowledge of the technology, calculations and safety principles related to each technique is developed.

This course has a duration of approximately 500 hours.

ANALYSIS OF MASONRY COURSES

1. Masonry (Basic Training)

The object of this course is to train masons to a semi-skilled level in the techniques of: preparation and excavation of materials, setting of blocks, surface plastering, construction of floors and slabs, construction of lintels and tie beams, plastering of flush ceilings, installation of artifacts and ornaments, construction of cobblestone walls, interpretation of drawings and calculation of materials.

Parallel with this, knowledge is imparted of tech-

nology, calculations, drawings and safety principles.

The course extends over a period of 800 hours, with a schedule of six hours a day.

2. Rural Construction (Basic Training)

In this course, masons are trained to build simple structures to a semi-skilled level.

The programme consists of the following techniques: use of carpentry equipment, setting of blocks, construction of floors and slabs, preparation of hangers, rings, grids, columns and tie beams, construction of ceilings, installation of metal roofs, construction of flush ceilings (partial), stuccoing of surfaces and installation of ornaments and artifacts. Together with each technique, knowledge of technology, calculations, drawing and safety principles is also imparted.

Duration of course: approximately 800 hours with a schedule of seven hours a day.

3. Masonry (Further Training)

This course gives workers competence in construction work to a semi-skilled level.

The techniques which make up the course are: preparation and excavation of materials, setting of blocks, plastering of surfaces, construction of floors and slabs, construction of lintels and tie beams and installation of ornaments and artifacts.

Parallel with this course of study, knowledge is imparted of the technology, calculations, drawing and safety principles related to each trade.

Duration of the course is 450 hours, with a schedule of three to four hours a day.

4. Tile Work (Basic Training)

The aim of this course is to train setters of tile, mosaic, ceramic tile and other kinds of facing such as bricks, "bestome" and ornamental elements.

The course lasts for six months, that is approximately 850 hours, with a daily schedule of six hours.

Together with each technique, knowledge of technology, calculation, drawing and safety principles is imparted.

5. Wall Finishes (Complementary Training)

The object of this course is to provide masons or tile setters with skill in various types of wall finishes.

The programme includes: preparation of the work area, levelling, placement of rulers, preparation of mortar, stuccoing surfaces, fixing of gauge, setting of "bestome", sheets of brick and marble. Parallel with this, knowledge with regard to technology, calculation, drawing and safety measures is developed.

The duration of the course is 65 hours, with a daily schedule of two to three hours, depending on the availability of the workers.

6. Setting of Floor Tiles (Complementary Training)

In this course masons are instructed in the art of placing ceramic tiles.

The course of instruction includes: preparation

of the work area, levelling, placement of rulers, stuccoing of surface, foundation setting, setting of ceramic tiles, application of grout, setting of ceramic tiles in columns, doorsills and floors.

Parallel with this instruction, knowledge relating to technology, calculations, drawings and safety measures is imparted.

This course lasts for approximately 80 hours, with a daily schedule of two to three hours.

7. Calculation of Materials (Complementary Training)

The purpose of this course is to complement the training of masons in the technique of calculating quantities of masonry materials used in construction work.

The course includes the following subjects: interpretation of construction drawings; establishment of the quantities of materials necessary for the construction of floors; calculation of quantities of glazed wall-tiles; calculation of internal walls; calculation of undercoatings and coatings; calculation of concrete; and cost estimation.

The duration of the course is approximately 60 hours: depending upon the availability of the worker, he attends the course from two to three hours per day.

8. Setting of Glazed Wall-Tiles (Complementary Training)

This is a complementary course, intended to train masons in the setting of glazed wall-tiles.

The course includes the following subjects: pre-

paration of the working area; levelling; use of straight-edges; scratch-coating of wall surfaces; setting of bases; setting of tiles; grouting; setting of glazed wall-tiles on columns; stairways and floors.

9. Reinforcement (Basic Training)

The object of this course is to give instruction in reinforcing to a semi-skilled level.

The programme includes: preparation of reinforcing material, preparation of assemblies and rings, construction and fixing of grids and columns, construction of beams and cantilevers, reinforcing floor slabs, interpretation of drawings, reinforcing stairways, reinforcing walls and calculating material.

Parallel with this training, knowledge relating to technology, calculations, drawing and safety measures is imparted.

This is a six-month course, with a total of approximately 850 hours and a daily schedule of six to seven hours.

ANALYSIS OF ELECTRICAL INSTALLATION COURSES

1. Preparation and Installation of Tubes

To develop the skills of electrical workers in the preparation of electrical tubes and raceways to work in accordance with electrical drawings.

The course covers the preparation of electric tubes, 90 degree bending of tubes, bending tubes in waves and kinks, installation of tubing, metal

raceways, flexible tubes, reinforced cable (BX).

This course will last for approximately 70 hours and will be given in accordance with the availability of the participants.

2. Installation of Magnetic Control Panels

To perfect the electromechanical electrician in the technique of installing magnetic control panels.

The following skills will be taught: installing controls, wiring controls, checking lines, connecting lines, regulating protection, phases, linear balance of loads.

Parallel to this, instructions in safety and hygiene principles, as also of technology and calculation will be given.

The training session will last about 48 hours and will be given in accordance with the availability of the participants.

3. Electrical Estimate

The object of this course is to further instruct practising electricians in the calculation of quantities of material necessary to do a job in accordance with the construction plan.

The programme covers calculation of tubing, calculation of distribution accessories, determination of outlets of schematic board, total quotation for electrical material (first stage), determination of the electric outlet points on the schematic board, total quotation of material (first and secone stage), estimate. In addition to the skills of the trade, instruction will be given, as necess-

ary, with regard to technology and calculations related to this technique.

The course will last for approximately 50 hours and will be given in accordance with the availability of the participants.

4. Electrical Installation

The object of this course is to train electricians in construction work to a semi-skilled level.

The course, which will last for approximately 400 hours and will be given in accordance with the availability of the worker, will cover the use of manual electrical tools, preparation of junctions, electrical connections, preparation and installation of electric ducts and raceways.

5. Electrical Drawing Design

This course is directed at maintenance electricians, and the programme includes: basic concepts of drawing, measurements and metric scale, symbols, code, tables, ruling and electrical calculations. Parallel with this, knowledge of technology, calculation, drawings as related to this technique, will be developed.

Duration of the course: approximately 60 hours, to be given in accordance with participants' availability.

6. Location of Failures in Electric Circuits

The object of this course is to perfect the electrician in the technique of locating failures in electric circuits.

The course will cover aspects such as: checking failures in fuses, location of conduits to ground, checking on open conductors, localization of short circuits, repair of electric circuit, circuit wiring, circuit balancing, restoration of electric outlets.

Parallel with this, knowledge will be developed in technology, calculation and principles of safety and hygiene.

Duration of the course: approximately 50 hours, to be given in accordance with the availability of the workers.

ANALYSIS OF THE VARIOUS COURSES IN GENERAL MECHANICS

1. Pinion Cutting (Complementary Training)

The object of this course is to perfect precision mechanical workers in the technique of cutting pinions: preparation of the cutter, calculation of gears, cutting straight pinion, cutting helicoidal pinion.

Parallel to this, knowledge of technology, calculation and principles of safety and hygiene will be developed.

The course will have a duration of 80 hours and will be given in accordance with the availability of the workers.

2. Vertical, Horizontal and Oblique Milling (Complementary Training)

The objective of the course is to perfect the workers in the field of precision mechanics in the

technique of handling milling machines.

Cutting operations on metal pieces with multiple tooth rotary cutters, control and checking of pieces, selecting and changing tooling; parallel to this, knowledge of basic technology, methods of calculation, safety, health safeguards, etc., will be made available to those participating in the course.

The duration of the course is 100 hours: the timetable will be adjusted in accordance with the availability of the workers concerned.

3. Cylindrical Turning (Complementary Training)

This complementary course is designed to train workers in the techniques of facing and surfacing; the production and machining of parts, and the calibration and checking of such parts.

Parallel to the above, classes in basic technology, methods of calculation, and safety measures are given.

The duration of the course is 60 hours: the timetable is adjusted to the availability of the workers concerned.

4. Fitting (Basic Training)

This course is designed to train workers to execute tasks connected with the production and manual and mechanical machining of work-pieces; shaping and filing of surfaces of all kinds, laying-out, drilling, manual and mechanical threading, scraping, heat treatment, calibration and checking of the work-pieces produced; and the maintenance of the tools and equipment utilized.

Parallel to the above, instruction is given in basic technology, methods of calculation, safety and health precautions, and standards of professional behaviour.

The duration of the course is 500 hours: the time-table will be adjusted in accordance with the availability of the workers concerned.

5. Turning (Basic Training)

This course is designed to train workers to produce and machine mechanical pieces; to endow them with practical knowledge of the use of lathes, cylindrical turning, conical turning, threading and tapping by using the lathe, grinding of work-pieces; assembly work; adjustment of machinery; and the calibration and checking of the finished pieces.

Parallel to the above, instruction is given in basic technology, methods of calculation, safety and health precautions, and standards of professional behaviour.

6. Milling (Basic Training)

The purpose of this course is to train workers in tasks concerned with the production and machining of mechanical parts.

The course provides practical knowledge of operating milling machines, the making of symmetrical cuts, planing operations, inclined planes, construction of key seats, drilling, contouring, execution of straight racks, inclined racks, straight, helicoidal and conical gears, work with the accessories of the milling machine; parallel to the above, instruction is given in technology, calculation, safety

and hygiene, professional behaviour and other subjects.

Duration of the course is 600 hours. It is given in accordance with the availability of the participants.

7. Threading with the Lathe (Complementary Training)

This course is designed to provide further training, for workers engaged in precision mechanics, in operations concerned with the making of threads by means of the lathe, such as setting-up of the machine, triangular, square and other threads.

Parallel to the above, instruction is given in technology, calculation and safety.

Duration of the course is 80 hours. It is given in accordance with the availability of the participants.

8. Interpretation of Mechanical Drawings (Complementary Training)

This course provides further training for mechanics in the technique of reading and interpreting sketches and plans of projections and perspectives, freehand drawing, use of scales, etc.

Parallel to the above, instruction is given in technology, calculation and safety measures.

Duration of the course is 60 hours. It is given in accordance with the availability of the participants.

ANALYSIS OF THE VARIOUS COURSES IN WELDING

1. Reading and Interpretation of Drawings of Metal Structures (Complementary Training)

This course is designed for workers engaged in the fields of electric welding and structural ironwork. The main purpose of this course is to give the participants further training in the proper manner of reading and interpreting drawings in the above-mentioned fields.

Instruction in the following subjects will be given:

- Use of measuring instruments
- Interpretation of ironwork assembly sketches
- Interpretation of details
- Nomenclature
- Plan drawings
- Elevation drawings
- Other drawings

Parallel to the above, instruction will be provided in knowledge of technology, calculation, and in safety and health precautions.

2. Arc Welding (Basic Training)

This course is designed to train workers to a semi-qualified level, and it covers the following techniques:

- Operation of welding equipment
- Flat welding: downhand welding
- Horizontal welding
- Vertical welding
- Overhead welding
- Welding of cast iron

- Pipe welding
- Basic knowledge of iron smithing
- Use of oxyacetylene welding equipment
- Elements of oxyacetylene welding

Parallel to the above, instruction will be provided in knowledge of technology, calculation, drawing, and safety and health precautions related to this trade.

The mastery of these techniques will enable trainees to obtain positions immediately, where the following tasks, as part of their specialization, can be performed: assembly work, cutting of material, preparation of pieces, etc. The constant exercise of these techniques will ensure rapid improvement in trainees' skills.

The duration of the course is 600 hours, on the basis of 6 hours per day.

3. Vertical Upward Welding (Complementary Training)

This course is designed especially for electrical welding workers and has as its ultimate aim their improvement in this skill by the end of the course. The trainee will be able to carry out the following work units in a given time:

- Operating and adjusting the equipment
- Reinforcement of flat welding
- Preparation of surfaces
- Butt welding, lap welding, corner welding in vertical position

Knowledge of the respective technologies, such as safety, calculation and hygiene, will be imparted at the same time.

Mastery of the units of instruction will enable

trainees to obtain promotion to new jobs in the industry in which they work.

Duration and timetable: 50 hours; night classes.

4. Flat Welding and Oxyacetylene Welding (Complementary Training)

The primary objective of this course is the further training of the workers engaged in Precision Mechanics. The programme includes instruction which is closely related to the profession of the trainee. At the end of the course, the trainee will be in a position to:

- Handle electric welding equipment
- Handle oxyacetylene welding equipment
- Make bead welds in flat position
- Fill surfaces in flat position
- Make oxyacetylene welds in flat position

At the same time, knowledge of various technologies relating to these operations, such as calculation, drawing, safety and hygiene, is imparted.

Mastery of these skills will have considerable influence on the integral technical education of the trainee, thus increasing the quality of Panamanian industry in general.

Duration and timetable: 50 hours; night classes.

5. Aluminium Welding (Complementary Training)

This course aims to perfect welders, theoretically and practically, in the method of joining pieces of aluminium by means of an electric arc and an appropriate electrode.

During this course, the following units of instruc-

tion will be given: preparation of the surface to be welded, use of welding equipment, pre-heating of pieces, selecting electrodes, bevelling of pieces and welding.

At the same time, instruction in technology and other subjects relating to the units studied will be imparted.

6. Cast Iron Welding (Complementary Training)

This is designed for workers in arc welding and has as its purpose the further training of these trainees in the welding of cast iron pieces. The course includes the following elements: preparation of surfaces, cast iron pieces, welding of thick and thin cast iron sheets, welding of cast iron pieces (cold and hot methods), reinforcement of welds in mild steel.

At the same time, additional knowledge will be imparted with reference to technology, safety and calculation.

Mastery of the subjects mentioned above will place the trainee in a position to assemble and repair cast iron pieces at the same time that he is learning methods of joining, as well as give him in depth knowledge of special electrodes in this type of joint.

Duration and timetable: 50 hours; night classes: 2 hours per day.

7. Welding of Piping (Complementary Training)

The aim of the course is to provide further training for workers engaged in electric welding. The course

includes other subjects, such as: reinforcement of vertical welds, spot welding of pipes, welding of piping.

Parallel to this, additional instruction is given. The mastery of these units will place the trainee in a position to perform tasks related to the preparation and execution of work in pipes designed to conduct liquids at high and low pressures.

The trainee will also acquire skill in the process itself, and will be given instruction in safety procedure.

Duration and timetable: 50 hours; night classes: 2 hours per day.

8. Overhead Welding (Complementary Training)

The participants in this course will be trained to improve their skills in electric welding. To this end, they will be instructed in: operation of welding machines, reinforcement of flat welds, reinforcement of vertical welding, preparation of surfaces, selection of electrodes, butt welding of sheets in overhead position, and welding in corners in overhead position.

Parallel to this, knowledge of technology, calculation, safety and hygiene related to the main subject will be imparted.

Complete mastery of this course will allow the trainee to undertake work of major responsibility, thus making promotion possible for him.

Duration and timetable: 50 hours; night classes: 2 hours per day.

9. Oxyacetylene Welding (Basic Training)

This course is intended for non-qualified individuals, and its object is to train them to a semi-qualified level in the following skills: handling of oxyacetylene welding equipment, making welds in flat position, making welds in horizontal position, making welds in upward vertical position and in overhead position, manual flame cutting, introduction to automatic flame cutting.

Parallel to these techniques, technical knowledge will be imparted concerning calculation, safety and health.

Mastery of these techniques will allow the trainee who has completed the course to attain, in very little time and by means of the constant exercise of his occupation, a corresponding professional level.

Duration and timetable: 400 hours, approximately 6 hours per day.

10. Construction of Metal Structures (Ironwork - Basic Training)

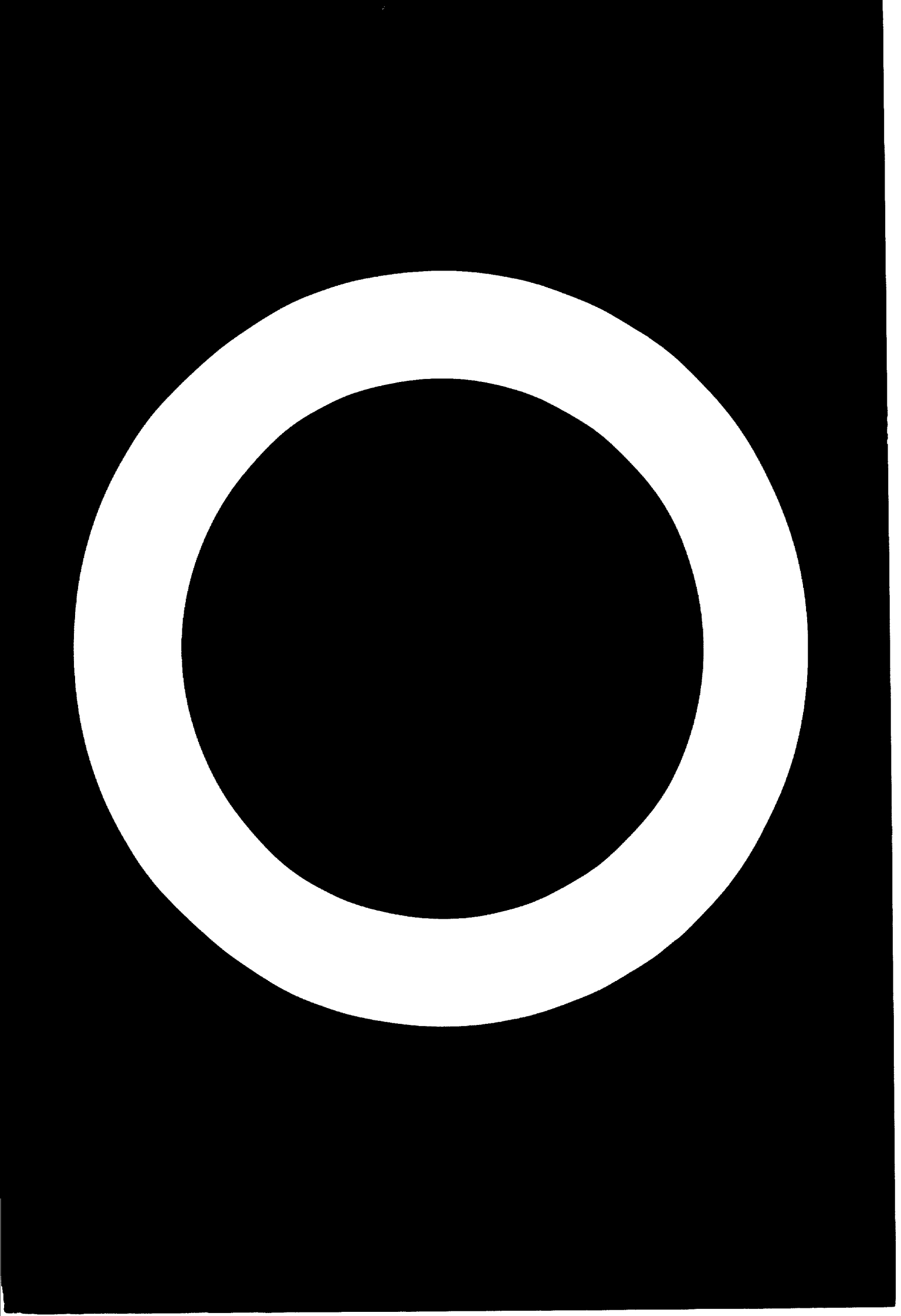
This course is intended for unqualified personnel, to train them to a semi-qualified level, and includes the following subjects: flat welding, construction of gratings, furniture, metal doors, frames and other metal structures.

Mastery of the techniques listed will allow the trainees completing the course to achieve professional standards within a short time by means of constant exercise of these skills.

Duration and timetable: 620 hours, 6 hours daily.

ANNEX III

QUESTIONNAIRE



MINISTRY OF COMMERCE AND INDUSTRY

INDUSTRIAL DEVELOPMENT AND PRODUCTIVITY CENTRE

1.- **DETAILS OF FIRM**

Name of firm .....

Address ..... City .....

Telephone .....

2.- **Description of activities:**

3.- **Products** **Annual Production**

4.- **Nº of Workers** ..... **Total Personnel** .....

5.- **Industrial Equipment** (Machinery and facilities)

Denomination Country of Origin

6.- **Maintenance**

6.1.- Organization Personnel

Are there any members of the staff entirely devoted to maintenance? .....

Number of people, organization and level of knowledge:

_____

_____

_____

_____

How did they acquire their technical training?

_____

_____

_____

6.2.- Functions of the Maintenance Service:

- Repairs or modifications YES or NO
- Miscellaneous repairs (masonry, electricity, etc.)
- Preventive Maintenance

6.3.- Material means (proper to the firm) available to the Maintenance Service (lathes, milling machines, drills, planes, etc.). Specify age of machinery.

6.4.- Administrative Support

Is there a programme for preventive maintenance work? YES .... NO ....

- Are there data sheets for machines?
  YES .... NO ....
- Are there lists of components to be checked checked? YES .... NO ....
- Are there lists of lubricating points?
  YES .... NO ....
- Is a statistical record of breakdowns kept? YES .... NO ....

6.5.- Spare parts

- Is there a spare parts store?
  YES .... NO ....
- What is the percentage (%) of domestic production of spares?

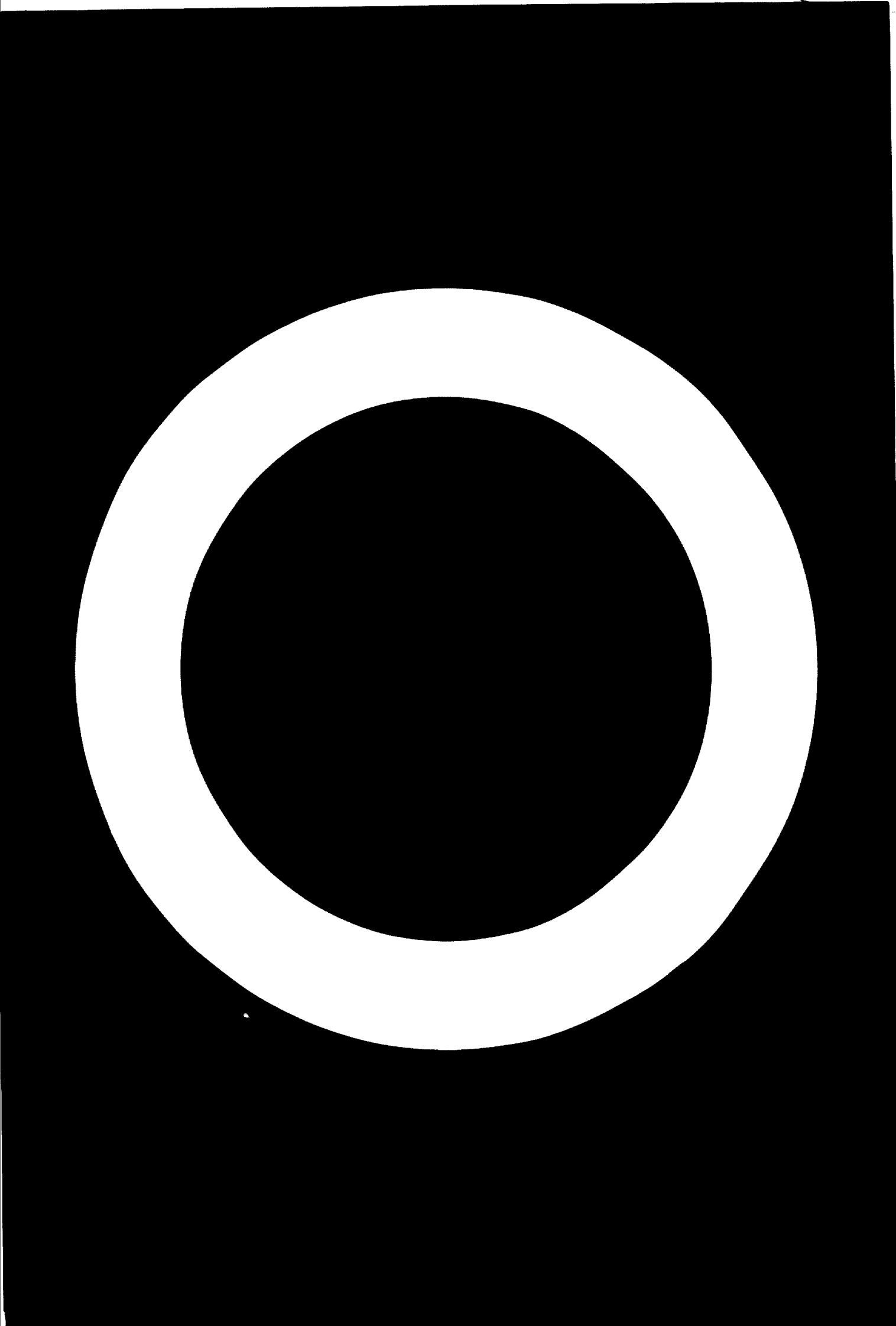
- Is it possible to import spares?
  YES .... NO ....
- What is the down time produced by the lack of spares?
  - Maximum _____ Minimum _____
- What is the % of breakdowns dealt with within the firm?

_____

_____

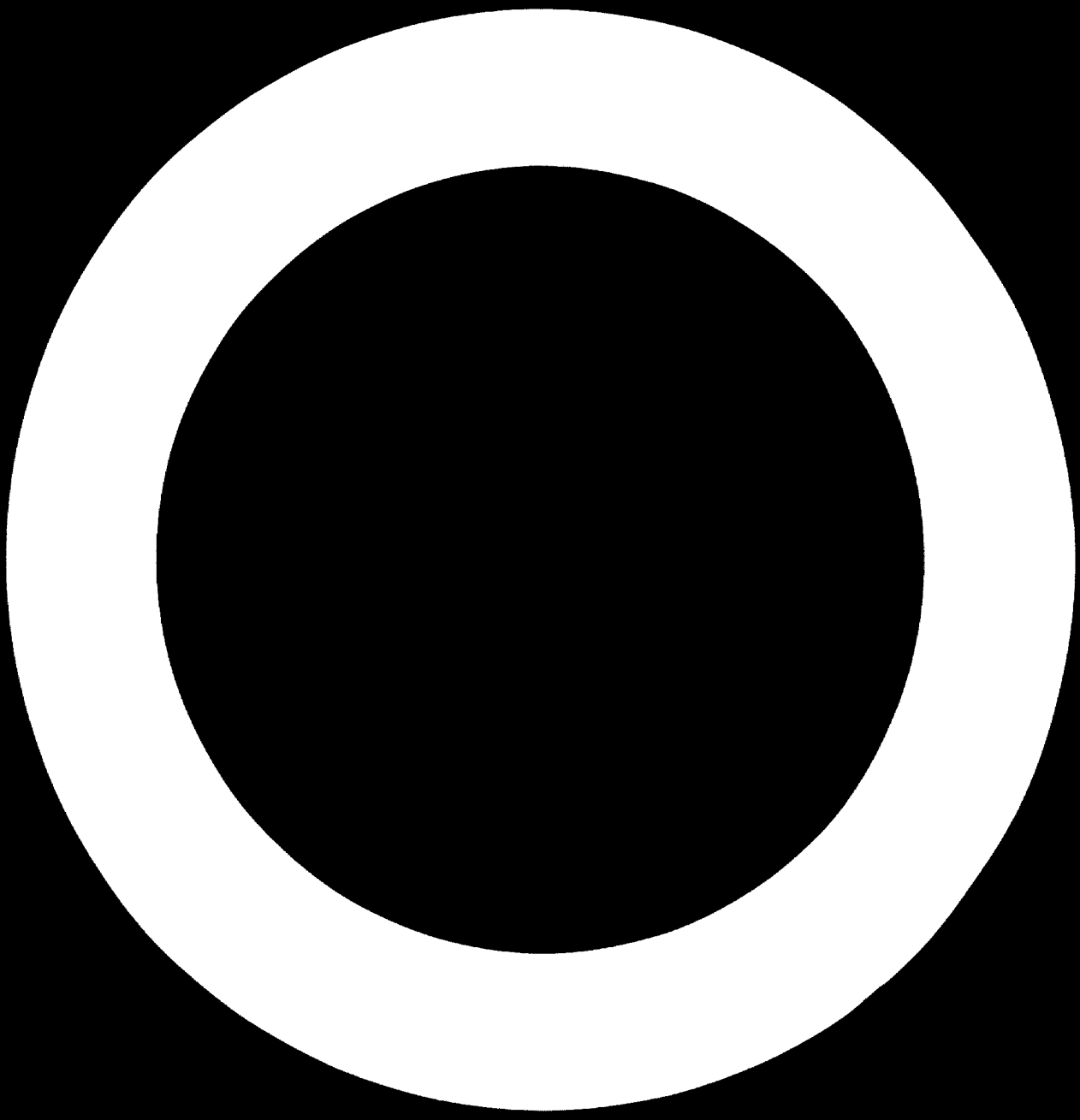
_____

7.- SUGGESTIONS AND REMARKS



A N N E X IV

PROPOSED PROJECT (SOLUTION A)
FOR THE REORGANIZATION AND MODERNIZATION
OF THE TRANSPORT CENTRE WORKSHOP



I.- Justification of the Project

The implementation of this project is intended to endow the Transport Centre with the means essential to carry out repairs to the vehicles for which it is responsible, by increasing its capacity and autonomy, and consequently augmenting its efficiency.

As a complement to the foregoing, it is planned to create an organization that will contribute in a direct manner to a more rational utilization of the Centre, and which will improve and increase its services in both a quantitative and a qualitative sense. In this connection, we would recall the fact that, at the present time, the Centre is utilized more as a reserve park than as a workshop for the repair and conditioning of vehicles.

II.- Short- and long-term objectives

As a result of the actions that are proposed, it is expected that the following will be achieved:

On a short-term basis

- the reduction of the replacement index of vehicles to acceptable levels, which, again, signifies an important saving
- an increase in the working life of the vehicles, which will result in more reasonable amortization figures

- the maintenance in constant operation of the maximum number of vehicles, the result of which will be to provide the services required, which are, logically, increasing; but this policy will not simultaneously augment the number of vehicles
- the creation of a maintenance centre which will ensure the repair and entry into service of the vehicles concerned in a minimum time
- the establishment of a system which will serve to organize the supply of spare parts in such a way as to reduce to the minimum the capital invested in the latter.

<u>On a long-term basis</u>

In addition to these objectives of a practical character, there are other objectives which, although equally important, require a longer period for their achievement. Their markedly social nature endows them with a preferential character. Thus, in a relatively short period of time, it is hoped to be able to count with an important nucleus of specialists, together with a large group of trained workers, who will contribute to raising the general technological level, and particularly that of the Centre. The social results of this policy cannot be foreseen at this moment in time, but there can be no doubt that they will constitute a highly important contribution to the development of Panama.

In any event, we would stress the fact that it is not intended to create a workshop whose possibilities are unlimited, but to endow the Centre with the means indispensable for carrying out the necessary repair work as economically as possible.

This stage represents an important advance insofar as maintenance is concerned, and it may be considered as the first of a series of measures which should be subsequently undertaken.

III.- Contributions requested from the PNUD

		Cost (in U.S.$)
1 - Project personnel		
- An Industrial Engineer or Mechanic	12	30,000
- An expert in the maintenance and repair of automobile vehicles	12	30,000
2 - Vocational training		
- 3 scholarships (six months each)	18	11,100
3 - Equipment (See annexed list)		
Expendable equipment (tools, etc.)		3,260
Permanent equipment (machinery)		21,185
GRAND TOTAL		95,545

LIST OF ESTIMATED MACHINERY REQUIREMENTS

	$
2 portable electric drills	140
2 bench drills, 3.5 HP up to 50 mm ø, with a working range of 800 mm	5,340
1 bench grinder: 1.1 HP. To grind 250 x 32 mm	110
1 horizontal lathe: 1,500 mm; 10 HP	6,780
1 milling machine: 1,066 x 240; 3 HP	3,650
1 wheel alignment equipment	425
2 trolley jacks (6,000 kgs.)	340
1 electric equipment test bench	1,525
1 headlight alignment equipment	390
1 fissure detector	190
1 battery charger	175
1 grinder for flat surfaces (with magnetic plate	2,000
1 manual sheet panel shears	120
TOTAL:	21,185

LIST OF ESTIMATED MACHINERY REQUIREMENTS

		$
Cutting tools: (cutter bits, drill bits, lathe blades, etc.)		2,000
Hand tools: (screwdrivers, hammers, open-end spanners, elbow spanners, ring spanners, box spanners, hacksaws, hand shears, etc.	(4 sets)	400
Measuring instruments: (Feeler gauges and calipers)	(4 sets)	60
Miscellaneous:		
Hand coiler		150
Piston ring extractor		150
Valve grinder		150
Bearings and gear-piece extractor		150
Tool cupboards (2)		100
Tool trolleys (2)		100
	TOTAL:	3,260

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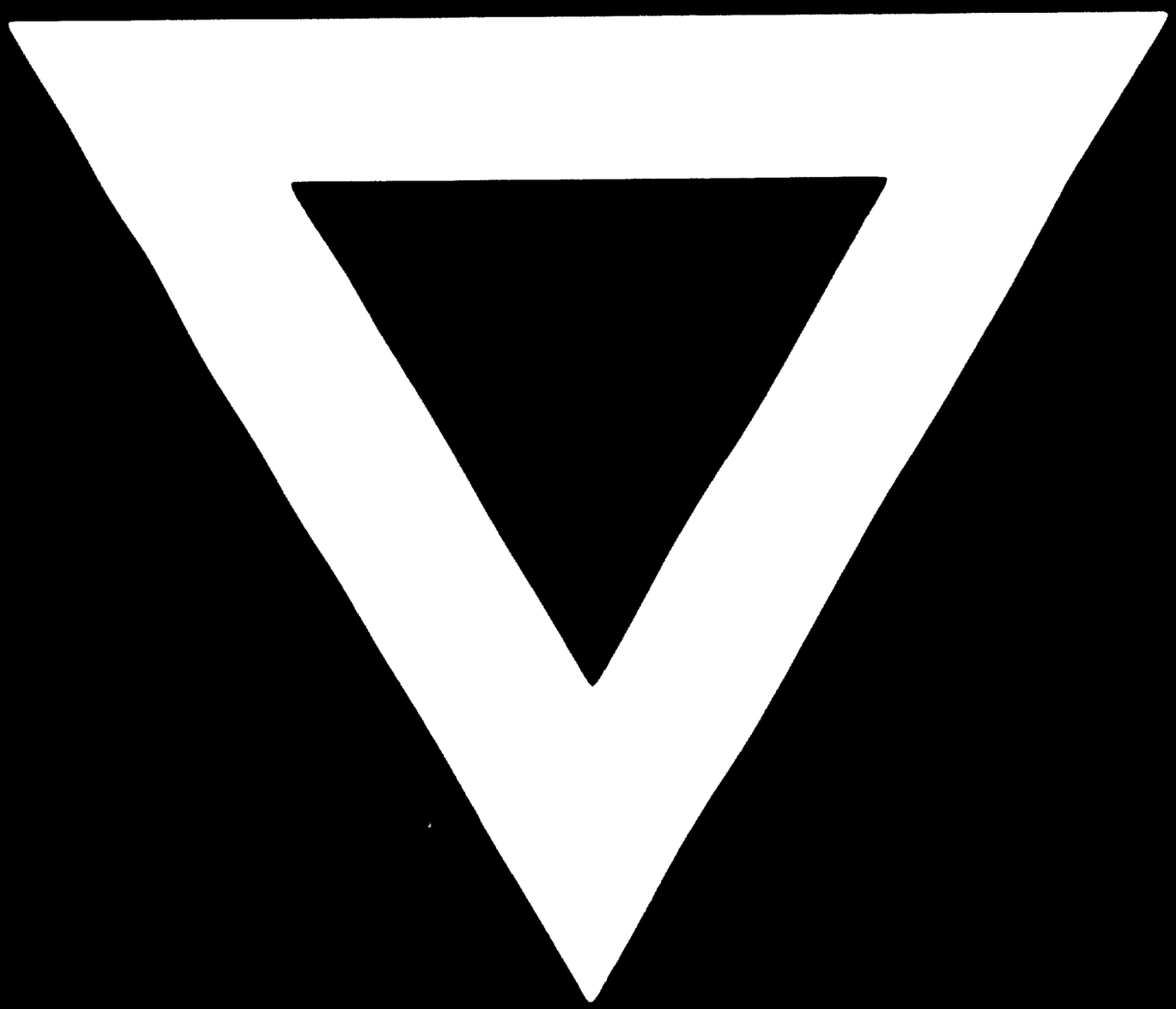

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