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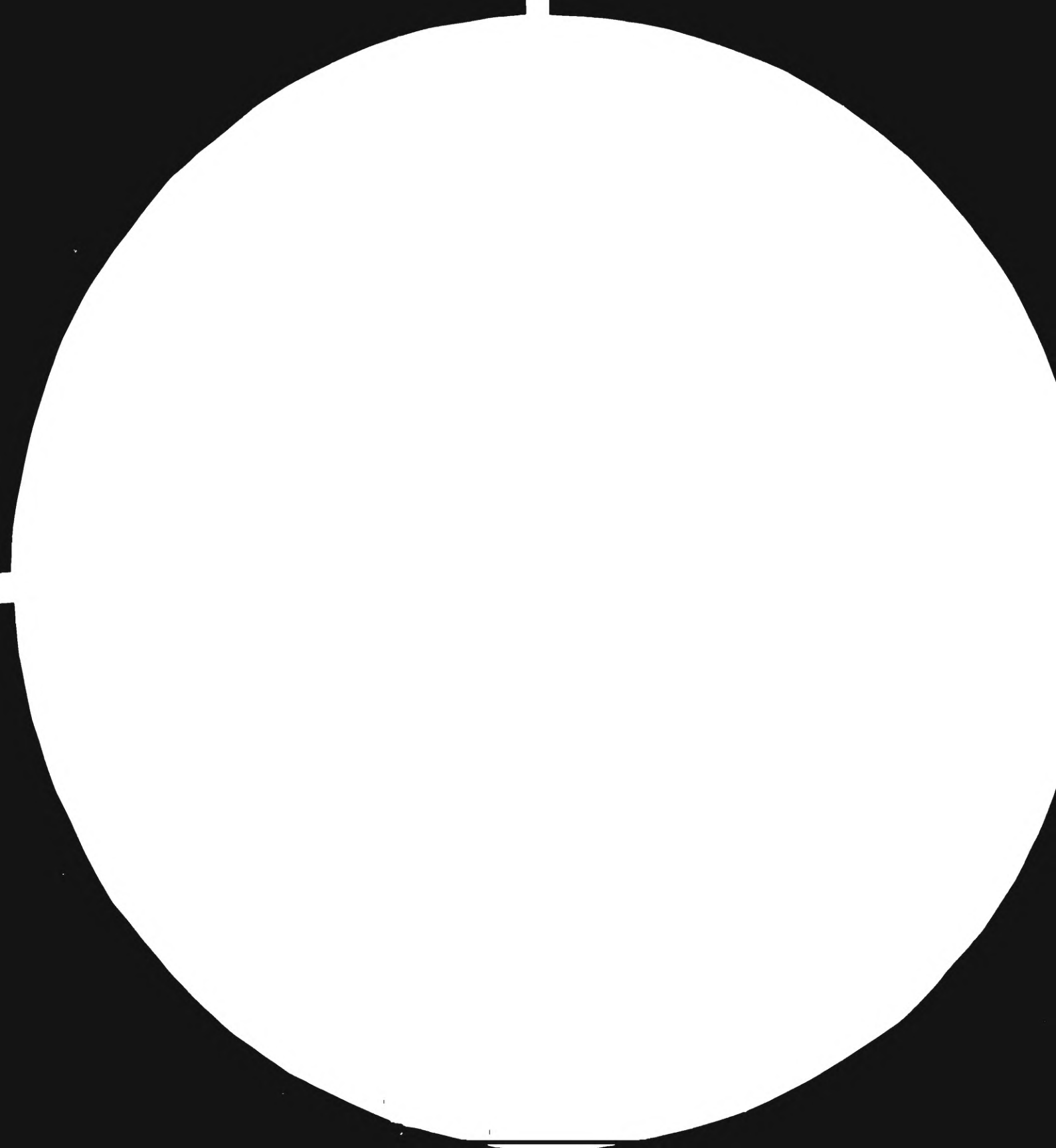

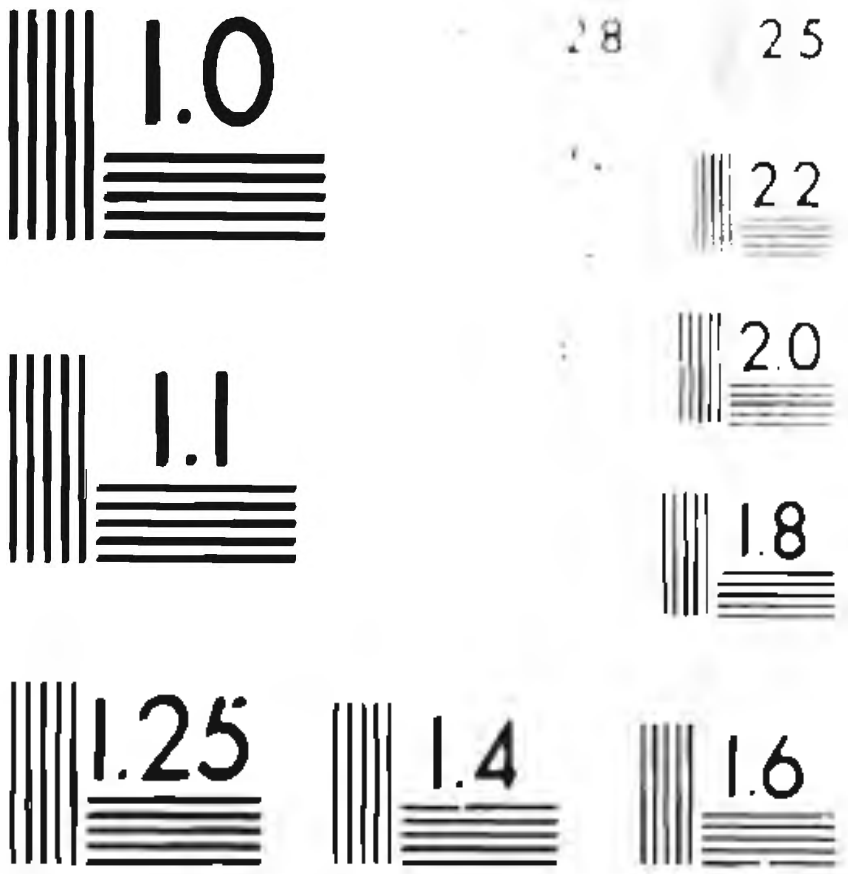
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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION (UNIDO)

VIENNA

13582

FEASIBILITY STUDY FOR THE MODERNIZATION, EXPANSION AND DIVERSIFICATION OF THE NATIONAL WORKSHOP IN SIERRA LEONE

FINAL REPORT

Project No.: US/GUI/81/120

CONTRACT No. 83/46

Prepared for the Government of Sierra Leone

by

ICME Business Consultants

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28 March 1984

icme

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Attachment 1: Casting technology and procedure in the new foundry

INTRODUCTORY NOTES

- The exchange rate used in the present study is 2.68 Leone = 1 $ US

- It is assumed that the assets of the existing National Workshop will be taken over by a private company. For this reason the initial investments include values for land, existing buildings, and existing machinery.

- In referring to the new enterprise, the term "new company" is used. In referring only to the part of the new company which would use the new machines and equipment, the terms "workshop" and "re-organized workshop" are used.

- The consultants would like to express their appreciation for the extensive and positive support provided by the following authorities. Without their cooperating care, this study would not have been possible.

  . The Government of Sierra Leone

  . Mr. V. Devenaux and the Top Management of the Workshop

  . Mr. I. Cantreras, First Technical Field Adviser of UNDP/ UNIDO in Sierra Leone

  . Many private entrepreneurs of Sierra Leone, who gave us valuable inputs for better understanding of the economic situation of the country.

1. PROJECT CONCEPT AND SUMMARY

1.1 Concept of the proposed project

The consultants were charged by UNIDO to develop a business concept which would meet social and economic objectives and result in a profit for the new company to be created from the National Workshop.

Thus, the concept addresses the objectives of:

- maintaining as many workplaces as possible
- providing for training
- providing for the development of skilled workers
- linking products to agriculture and rural development
- retaining and upgrading the existing basic foundry.

It was found that the best way to meet the above objectives while providing for a profit was to base the business concept on two parts:

- Part 1: a combination of business lines which would satisfy all of the social and economic objectives above.
- Part 2: an additional business line which would generate cash and profits from an investment smaller than that required for Part 1.

The financial analysis - done with UNIDO's COMFAR computer program - has shown us that we are on the right track with this approach, because the COMFAR results show an internal rate of return of 14.2 %, a net present value of $ 1'139'000, and a net foreign exchange gain of $ 365'100.

1. Project concept and summary

For Part 1, the three main business lines of the existing Workshop would be retained:

- Manufacture: Foundry products and metal-forming products
- Repair jobbing: repairs done to order for industrial establishments
- Metal fabrication: custom-order welded plate work.

These business lines would make extensive use of the existing facilities - including the foundry - complemented by about 90 % of the total investment in new machines and equipment. They would contribute about 50 % of the turnover.

At the same time, it is these business lines which would provide almost all the jobs in the new company and which require the development of some skilled workmen. On the other side, these product groups would not generate a satisfactory margin. For this it was necessary to find an additional business line which would generate cash, see under "part 2" of this page.

Training would be done in a separate apprentices' shop which would require about 5 % of the new investment in machines and equipment and which would not make a contribution to turnover. Financing of the training could be from the project itself.

Part 2 of the project would be the production of galvanized, corrugated iron roofing sheets from imported galvanized sheet.

In contrast to Part 1, the production of corrugated iron sheets would provide very few work places and require relatively lower skills while contributing about 50 % to the turnover on about 10 % of the investment in new machines and equipment.

Success of the project depends entirely on a high level of management ability.

1. Project concept and summary

1.2 Choice of products for manufacture (Part 1 of project)

Local and export markets were examined. Some potential does exist for exporting and should be developed very seriously.

The analysis revealed that the local market is adequate in size for many products which could be produced at an upgraded Workshop. Prices would have to be much lower than current market prices, which are "shortage" prices, so that the entire production could be absorbed.

The upgraded Workshop should address three markets:

- construction industry (building materials and equipment)
- agriculture (simple machines)
- consumers (charcoal irons, cooking pots, simple devices for food preparation).

Two broadly defined groups of products were chosen:

- Foundry products (for which a significant part of the cost is attributable to the foundry):
  - . universal mincer/maize mill
  - . charcoal iron/cast-iron cooking pot (alternative products: fresh air inlet, "Dutch" oven)
  - . castings for the Guma Valley Water Authority (alternative products: castings for Sugar Mill, other users)
  - . rakes (alternative products: digging fork, mattock, pick axe, hammers)
  - . palm oil press (alternative products: vises for carpentry and metal working)
  - . dispensing pump (semi-rotary)
  - . palm nut cracking machine
  - . rice huller (alternative product: coffee huller).

1. Project concept and summary

- Metal forming products

  . Wheelbarrow (alternative products: carts, simple materials handling equipment)

  . rice winnower (alternative products: rice thresher, cassava grater, groundnut sheller).

Each of the products was fully costed and each of the two product groups was evaluated as a cost center in the study. Several alternatives for production quantities and ex-works prices were tested for each group to arrive at the final adjusted mix.

During the implementation of the project, the mix could be adjusted further to take advantage of specific market opportunities at the time. The adjustment can be made between the two product groups as well as among products within each group.

The current fabrication of metal windows and doors would be terminated.

1.3 Choice of the product for Part 2 of the project

Corrugated iron sheets were chosen from among several alternatives; the others were:

- wire mesh (for building, fencing, windows, etc.)
- vitreous enamel holloware (mainly pressed pans of the type used by women selling at the markets).

While wire mesh offered a satisfactory margin, its market was small compared to the corrugated sheets and its production consumes higher amounts of electricity (which is scarce).

1. Project concept and summary

Holloware has a very large market, but the margin is small and much electricity is needed for the required oven.

Corrugated iron sheets have an adequate market, offer a good margin and are easy to produce. At the same time, they are much more vital to development than the alternatives.

1.4 Materials and inputs, Part 1 of project (excluding C-I-sheets)

Raw material for foundry products would be largely from scrap iron and steel.

Imports of mild steel sheets for the metal forming products would amount to about $ 75'000/year at full production.

Other imported materials would amount to $ 170'000/year, including materials for repair jobbing and metal fabrication.

1.5 Materials and inputs, Part 2 (corrugated iron sheets)

Imported galvanized iron sheet would cost $ 1'262'000 per year at full production.

1. Project concept and summary

1.6 Sales/production: capacity and program for parts 1 and 2

Figure 1 illustrates the sales progression which would be easily realizable before the new investments are made ("interim period"). The only required inputs are improvements in planning, marketing, and supervision.

Figure 2 shows the likely evolution of sales after the new investments are made in 1985.

> In analyzing Figures 1 and 2, the reader is cautioned against extrapolating the sales for 1984 and calculating a "multiplier" of 1984 sales for reaching 1990 sales. Such a calculation is totally meaningless for Manufacturing, because no "factory" exists. It will be installed in 1985.

With the product groups of part 1 and part 2, we set up a "Reference sales/production" program which is shown in Table 3. The assumptions on prices and quantities stated for this program, were of a very pessimistic nature to guarantee an almost "100 %"-probability of fulfillment. A considerable range of increases in price and/or quantities would not be exploited.

Our first calculations (without COMFAR) gave a rather low IRR of about 7 %, not safisfactory for a feasible project but with a very high probability to be fulfilled.

Within the approved range of prices/quantities we developed a "base case"-named program by using several multipliers. This final program was calculated in 4 trials by UNIDO's COMFAR. The exact steps will be explained in Chapters 3.7 to 3.10.

As mentioned before this base case is caracterized by the following 3 properties:

- acceptable IRR of 14,2 %
- still realistic prices/quantities
- still satisfactory probability to be fulfilled in future

Table 1a shows the development of Reference Program to the Final program.

1. Project concept and summary

Sales quantities at "full production" and production capacity are shown below for each product group:

	sales quantity	production capacity
(A) Foundry products	200 tons	400 tons
(B) Metal forming products	6300 units	7000 units
(C) Corrugated iron sheets	2200 tons	3000 tons
(D) Repair and Metal fabrication	(80 % of production capacity)	

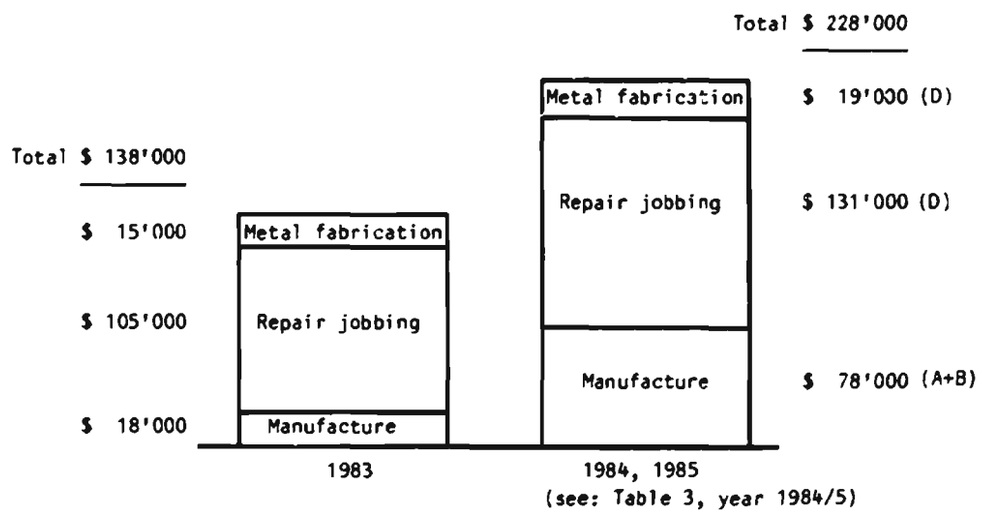


Figure 1: Proposed sales program for 1984 and 1985 compared to estimated results for 1983.

1. Project concept and summary

Table 1a: Development of the reference program to the final program (base case, figures rounded) in $ 1000

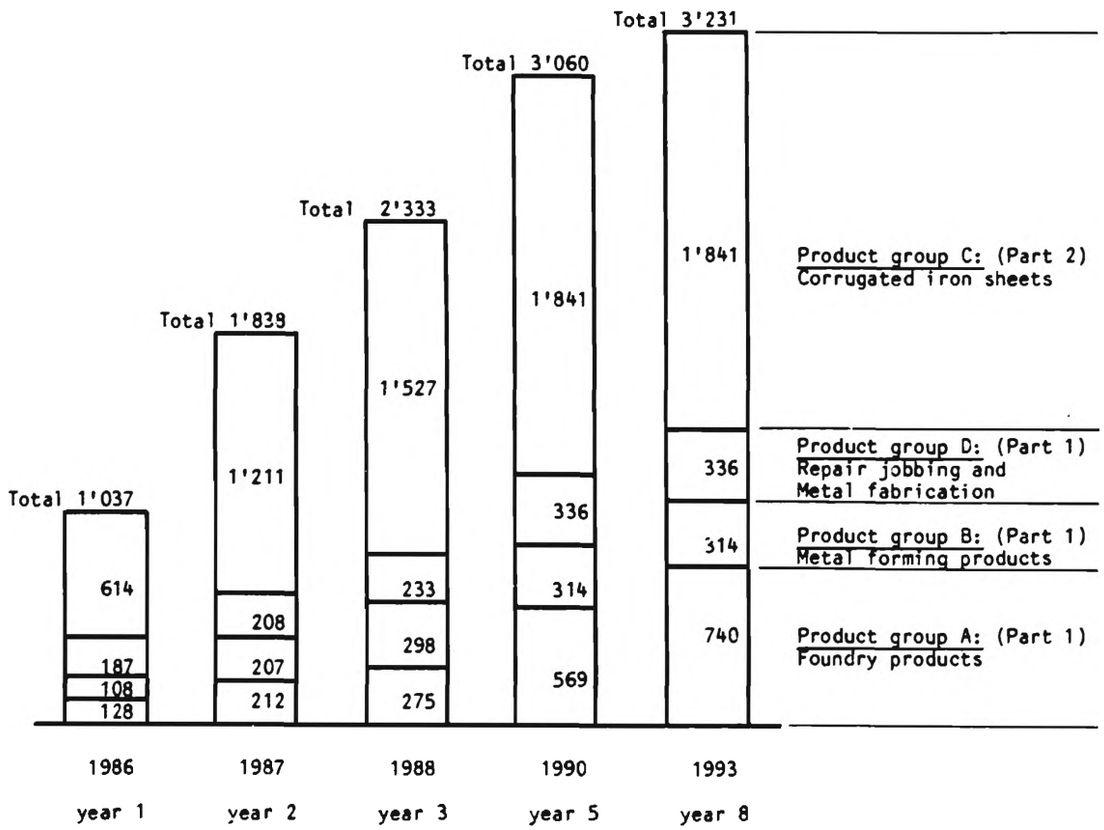
Product group		REFERENCE PROGRAM							FINAL PROGRAM		
		Interim years		Start up phase				Full prod.	increasing factor		
		1984	1985	1st year 1986	2nd 1987	3rd 1988	4th 1989	5th year 1990	5th year 1990		7th year 1992
Part 1	A	65	65	106	175	227	460	470	569	10 % price 10 % quant.	739
	B	14	14	90	172	248	262	262	315	20 % price	315
	D	149	149	187	208	233	262	336	336	-	336
Part 2	C	-	-	465	917	1157	1294	1395	1841	20 % price 10 % quant.	1841
Total		228	228	848	1473	1865	2279	2463	3060	-	3231
Calculated back on years			Invest.-year	1037	1838	2333	2842	3060			
Total increase				+ 22 %	+ 25 %	+ 25 %	+ 24 %	+ 24 %			

Begin of export sales

1. Project concept and summary

Figure 2: Evolution of sales for entire project, Part 1 and Part 2 (final program, base case)

Sales in thousand US dollars



1. Project concept and summary

1.7 Location and site

The site of the existing National Workshop is more than adequate for the project.

The relatively large and valuable building which now houses the Sierra Leone Railway Museum would not be required for any alternative envisageable for the project.

> The Museum building and its contents (historic locomotives, wagons, etc.) should be retained by the Government and preserved. 1)

It is proposed that the Government retain 40 % of the value of the remaining assets (including land) of the National Workshop (after accounting for the Museum) and sell the remaining 60 % (including land) to the private investors who will form the majority of the new company.

1.8 Project engineering, Part 1 of project

Castings for the foundry products would be produced in the existing foundry building using some new equipment in a completely redone layout. Additions would include a cupola oven (the smallest one available) for iron, an induction furnace for steel, and an arrangement of moulding machines.

Wheelbarrows would be produced on a separate line in the building now used for metal fabrication adjacent to the administration building. The chosen technology is that recommended in the Danish company Ravendo's feasibility study of 1982. No press is required for the pan, because it is formed from flat sheet cut to a pattern, bent on a form and welded on the same form. In this way, more jobs are created and the capital outlay is less.

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1) Funds are very likely available from donor international agencies and private foundations.

1. Project concept and summary

Rice winnowers would be made on a separate line near the wheelbarrow line. This product is currently produced by the workshop and requires only limited improvements to be a good quality product. Very little new equipment is needed.

A re-organized Metal fabrication unit would be located in the existing "plating shop", a separate building.

A re-organized Repair jobbing unit would occupy its existing place and would receive a few new complementary machines for better addressing the market for repair services.

1.9 Project engineering: Part 2, (corrugated iron sheets)

These would be produced in a building, which is now vacant, adjacent and parallel to the Railway Museum.

The chosen technology is semi-automatic for the basic rolling and cutting to length, and manual for the fabrication of special pieces such as roof ridges.

As explained above in the "Concept", the role of this part of the project is to generate cash and profits, not create jobs and skills.

1. Project concept and summary

1.10 Plant organization, manpower, and overhead

The organization of the new company would bear no resemblance to that of the existing Workshop, because the new activities will be essentially manufacturing. Thus, a typical form for a manufacturing plant is proposed. Several key elements are highlighted below:

- The General Manager would delegate authority to the manufacturing section's line managers: Production, Chief engineer, Finance, Marketing
- At the same level as these line managers (reporting to the General Manager) one supervisor would run the Metal fabrication section and another the Repair jobbing section
- In addition to the General Manager, line managers in manufacturing, and the supervisors mentioned above, other new, qualified people would be needed in the:
  - . forge
  - . foundry
  - . tool making shop
  - . apprentices shop.

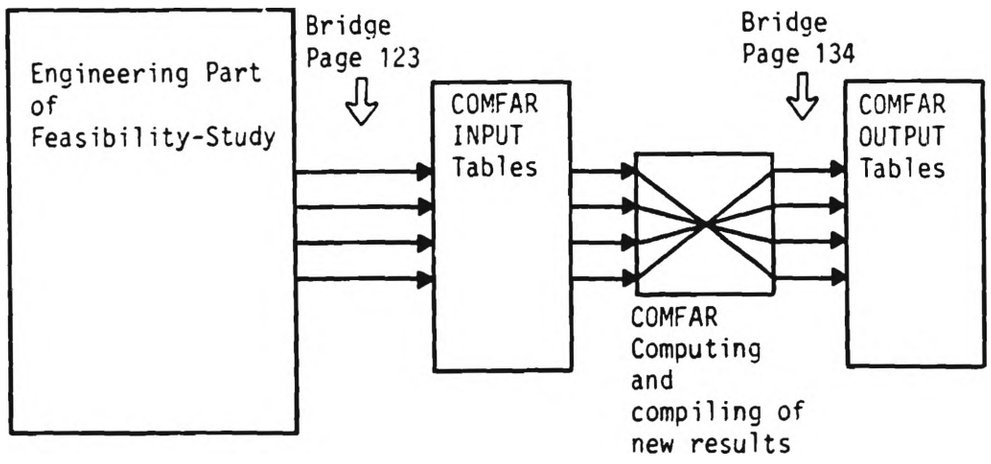
The key to success of the proposed project is highly skilled and experienced management. For a period of about three years, the General Manager and line managers in manufacturing should be experts recruited internationally. We propose, that the existing Top Management should either be partially incorporated in the Board of Directors, or that they will be charged with the notes of the local counterparts.

It should be stressed that the proposed project does generate the equivalent in local currency to pay for the four foreign experts for the pre-production period and three years of production.

1. Project concept and summary

Following chart is intended to support the understanding of input and output data at the interfaces with

- engineering/planning for the National Workshop
- computer input
- computer run
- computer output/results



1. Project concept and summary

The new company would employ the following schedule of personnel:

	new company		existing company
Managerial personnel recruited internationally	4	4	0
Managerial personnel recruited locally	6	6	8
Chief supervisory personnel recruited locally	11		
Supervisors, Foremen recruited locally	31	42	17
Skilled workers recruited locally	98		
Un-skilled workers recruited locally	33	121	127 *
Administrative/secretarial staff recruited locally	55	55	61
Apprentices (production)	10	10	56
Apprentices (apprentices shop)	15	15	53
Trainees	-	-	19
Total		263	341

* About 50 % of these 127 people are skilled workers charged with duties of a Foremen

The cost of training apprentices in the apprentices' shop would be treated as administrative overhead and would amount to about $ 24'000/year (64'000 Le/year).

1.11 Implementation scheduling

The next step after the present study should be the appraising of the assets of the existing National Workshop by an independent international expert.

Taking legal measures to create the new company, assembling shareholders, and arranging for financing would take until about the end of 1984.

At that time, a detailed equipment list and layout would have to be produced and a General Manager found. The latter would order the equipment and oversee its installation, which could probably be completed by December 1985. The other internationally recruited managers should arrive on site a few months before start-up. Assuming a start-up and running-in of one month, production could start in January 1986. This is the assumption used in the financial analysis of the present study.

1. Project concept and summary

1.12 Financial and economic evaluation

All figures have been calculated by the COMFAR computer program and are expressed in thousand US dollars.

- Investment costs, foreign currency

. buildings modifications			11.7
. new machinery and equipment			
- foundry	680.1		
- metal forming	412.5		
- corrugated iron sheets	114.8		
- repair jobbing and metal fabrication	14.7		
- apprentices' shop	113.2		
	1'335.3	1'335.3	
. auxiliary services and equipment			112.0
. pre-production capital costs			188.0
. working capital (1986)			189.8
SUB-TOTAL			1'836.8

- Investment costs, local currency

. land (acquisition by the new company)	174.0	1)
. site preparation, building, modification	106.2	
. new buildings	2.2	
. existing buildings (acquisition by the new company)	403.0	2)
. existing machines and equipment (acquisition by the new company)	150.0	3)
. auxiliary services and new equipment	130.1	
. pre-production capital costs	28.0	
. working capital (1986)	76.5	
SUB-TOTAL	1'070.0	
TOTAL INVESTMENT COST	2'906.8	

1, 2): Source: "National Workshop of Sierra Leone, Balance Sheet as at March 31, 1981"
3): ICME estimate

1. Project concept and summary

- Operating margins of cost centers at full production in 1995 1)

All figures in thousand US $

(A) Foundry products			
Sales			739.5
- Manufacturing costs	foreign	216.5	
	local	265.7	
	total		-482.2
Operating margin			257.3
(B) Metal forming products			
Sales			314.9
- Manufacturing costs	foreign	150.5	
	local	121.7	
	total		-272.2
Operating margin			42.7
(C) Corrugated iron sheets			
Sales			1841.0
- Manufacturing costs	foreign	1'283.7	
	local	71.7	
	total		-1355.4
Operating margin			485.6
(D) Repair jobbing and Metal fabrication (all local sales)			
Sales			335.8
- Production cost	foreign	97.1	
	local	111.8	
	total		-208.9
Operating margin			126.9
TOTAL OPERATING MARGIN (see output tables page 160)			912.5
TOTAL MANUFACTURING COSTS 1995			2'404.2

1) Last year in which depreciation is taken on machines (10th year of production). These figures are taken the COMFAR calculations of manufacturing costs by product group, not included in present report.

1. Project concept and summary

- Economic data (on entire project, Part 1 and Part 2 for the "base case")

With interest payable on loans taken as cash outflow:

. Net present value (cash flow, in constant dollars on inflows and outflows, discounted at 10 %)	160.2
. Internal rate of return	10.6

With interest payable on loans added back to net cash flow:

. Net present value (cash flow, in constant dollars on inflows and outflows, discounted at 10 %)	1'139.0
. Internal rate of return	14.2

The simple rate of return, net profit/investment is 18.2 % for the last year where depreciation is taken on machines, 1995.

Net profit on sales for the same year is 15.4 %

- Payback (base case)

The complete investment will be repaid by 1995.

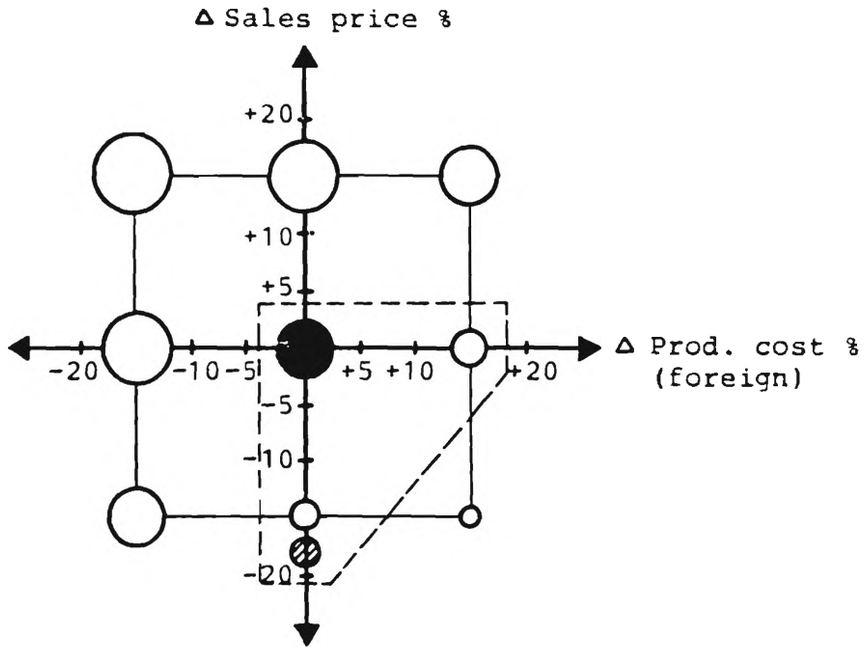
- Breakeven (base case)

In the fourth year of production, breakeven is at 65 %. At full production, in the seventh year, breakeven is at 49 %.

- Sensitivity (base case)

Considering the very pessimistic assumptions (price/quantity) of the reference program which is given a very high probability and the lower probability of the base case (final program), we are able to define a very realistic area in which the most probable IRR would be located. This is shown in Figure 9.

Figure 9: Sensitivity graph



● : base case of final program; circle dimension indicates value of IRR = 14.2 %

◍ : approximate IRR of reference program

○ : other values of the IRR, corresponding to Table 7

[ ] : most probable area for possible IRR's

1. Project concept and summary

- National economic evaluation

1. Foreign exchange gain incl. import substitution in year 7

1.a	Foreign exchange gain generated by project (see table 5)		747.0
1.b	Value of import substitution 1)		
	(A) Foundry products	517.7	
	(B) Metal forming products	220.4	
	(C) Corrugated iron sheets 2)	1'472.6	
	Sub-Total		2'210.7
			2'957.7

2. Foreign currency costs

2.a	Foreign currency manufacturing costs 3)		
	(A) Foundry products	266.5	
	(B) Metal forming products	176.5	
	(C) Corrugated iron sheets	1'291.7	
	Sub-Total		- 1'734.7
2.b	Foreign currency financial costs		- 110.9

3. Net foreign exchange gain 1'112.1

. Other benefits

The project conserves more workplaces than any other alternative considered. In general, higher skills are required than for alternative projects. Adequate provision has been made for training.

- Project financing

Three foreign currency loans are assumed:

. $ 1'500'000 at 8.5 %, 15 years: to pay for new machinery and equipment and auxiliary services and equipment. The terms are those typical for loans made by a national development bank under the relending conditions of a development loan sponsored by a single developed country. (For example, the Swiss "mixed-credit" loan to Egypt)

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1) The values for import substitution are considerably lower than sales levels, because not all of the products manufactured would be imported otherwise.
2) It is assumed that the government would otherwise allow the importation of C-I-sheets, a product essential for building.
3) From COMFAR calculations of manufacturing costs by product group; not included in present report.

- $ 190'000 at 5 %, 10 years: to pay for pre-production capital costs.

- $ 750'000 at 5 %, 10 years: to pay for the four foreign experts for three years, starting with the first year of production.

The 5 % rate for the two latter loans can be considered an average rate as some of the costs may be covered by grants, or through assistance or soft loans from international organizations.

It is assumed that the Government, as a 40 % partner in the new company, would be willing and able to guarantee local currency loans to the enterprise at about 10 % (considerably less than the commercial rate). The equivalent of $ 250'000 would be made available in the first year.

1.13 Conclusions

- Soundness of project

The project appears to be sound on all counts, and its implementation merits serious consideration by the government and private business. Lenders are likely to be attracted to the project based on the results of the present study.

The internal rate of return of 14.2 % is a good return considering that all project costs are financed by the project, including costs for the four foreign experts on whom the success of the project depends.

The project is not so sensitive to price decreases, because the larger part of revenue would come from C-I-sheets for which prices are attractive and are not at all likely to be decreased during the life of the project.

Imported raw materials are mostly steel sheet and are not likely to undergo significant price increases other than for inflation in producer countries.

1. Project concept and summary

The success of the project depends on a steady source of foreign currency at about $ 1'200'000/year to pay for imported galvanized sheet for C-I-sheets production, but it is assumed that C-I-sheets would be imported without the project. The substitution of these imports and the expected exports of over $ 600'000 (only C-I-sheets) would benefit the national economy.

We encourage the government of Sierra Leone to seriously consider implementing this project for the national economic benefits as well. There is likely to be a positive net foreign exchange gain, skills of workers would be improved, and higher wages could be paid. Moreover, the project would make a significant contribution to industrialization in Sierra Leone.

- Further action needed

The next step must be careful detailed planning. If it is not done seriously and conscientiously, the project would propably not achieve the results shown in the financial analysis. Moreover, the detailed planning and implementation should have at least some of the same key personnel involved (chief engineer; industrial engineer, production, capable of finalizing product designs) to ensure continuity.

- The technological and industrial potential of a reorganized Workshop

Former studies, like that by TESCO, have tried to push the National Workshop into the role of the most vital technological center of Sierra Leone. Indeed, one might be tempted to argue for the creation of a real technological and industrial center, because of some of the favourable existing conditions:

. very big works area; the utilizable surface of workshop buildings alone is more than 10'000 m2.

. good possibilities to enlarge existing buildings or to erect new buildings

. good exploitability in terms of transport (internal/external), and factory utilities (water, steam, electricity, etc.)

. good physical national and international connections (harbour and airport).

However, there are some important restrictions to creating a proper technologically leading position for the Workshop. Some basic preconditions are lacking:

- need for a technological leader in the industry; no real reason to centralize exists, and, in fact, the existing competitive structure is appropriate for the industry's development
- skill levels: much upgrading is required
- financial resources: investments should be kept in line with the country's ability to pay back loans
- local market size: the market is small
- regional integration: the prospects for exporting to neighbors under favourable conditions must be tested on a case by case basis.

Therefore, it seems to us more realistic to consider the reorganized Workshop as one of the more important metalworking industries of the country.

For these reasons we have chosen a "step by step" strategy. When the Workshop has become profitable, the owners and financing institutions can discuss a further upgrading.

2. PROJECT BACKGROUND AND HISTORY

2.1 Background of the National Workshop

The workshop of the abandoned Sierra Leone Railway was taken over by a committee attached to the Ministry of Transport and Communication in 1977. The Chairman of the committee ran the workshop as an industrial facility along three main lines of business:

- Manufacture of hand tools, simple agricultural machines, and simple consumer products
- Repair jobbing for local industrial establishments, the shipyard, and the mining industry
- Metal fabrication (welded vessels, roof trusses, window and door frames, etc.).

The existing facilities lent themselves well to repair jobbing, and this became the dominant business line, generating about 80 % of turnover. However, the new enterprise, called the National Workshop, did not have a legal status which would permit it to import raw materials. Consequently, it was obliged to buy at local retail prices and to pass on the costs in the prices of finished goods.

In each of its three main lines of business, the National Workshop encountered at least some competition, the strongest of which was in the fabrication of metal window and door frames.

For various reasons, the Workshop's foundry - the only one in the country - was used very little.

2. Project background and history

2.2 Government's current role in the National Workshop

The National Workshop was obliged by its governmental charter to try to preserve and develop the skills of its experienced workers and to pass on these skills to a large number of apprentices.

This imposed burden resulted in a heavy wage bill which the Workshop could not afford. The government covered the wages, recognizing that most of the bill was a training cost which could not be charged to production.

The government has made a general policy decision which would limit its support to public sector enterprises. The National Workshop would be affected, and there is no longer a guarantee of government's coverage of the "training component" of the Workshop's wage bill.

2.3 Development of the metal working industry

The industry has an organized sector concentrated in Freetown and composed mainly of the Workshop and:

- a galvanized bucket factory
- a nail factory
- a small shovel factory

as well as several fabricators of diverse metal products such as:

- metal furniture and cabinets
- small tank trailers, crop storage bins, refuse dumpsters
- diamond and gold ore washing plants
- safes and strongboxes.

Some refuse dumpsters have been exported to Liberia.

Except for the National Workshop, the organized sector has abandoned the manufacture of metal door and window frames. The latter has been taken over by small, independent fabricators scattered all over Freetown.

Other products of the informal sector are:

- measuring cans, funnels, buckets
- cast aluminium cooking pots.

In addition, the local blacksmiths produce some goods - mainly hoes and simple tools - and do mostly repair work.

The motor vehicle repair branch counts many competitors to the National Workshop, while in the branch of repairs for industry the workshop has only a few competitors.

The National Workshop is the only public-sector enterprise in the industry, and its turnover is small compared to the industry total. 1)

2.4 Government's policy for the Workshop and the Industry

The government has no plans or intentions to try to remake the National Workshop into a key institution for the development of the industry. Instead, it plans to grant a legal status to the workshop which would permit it to become a mixed sector enterprise with a majority share in private ownership.

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1) Information from "Review of Industrial Development in Sierra Leone", UNIDO/IO.496, April 2, 1982 and information gathered in the field by ICME shows that the National Workshop's turnover is about one-tenth of the "Light Engineering and Metal Products" Industry total.

No special plans or measures to encourage the industry have been developed. Thus, it is likely that the industry will continue to be plagued by its predominate problem, lack of raw materials.

2.5 Background of the project

A prior UNIDO-sponsored study (1982) concerned itself primarily with establishing a universal foundry at the Workshop. This study was done by the Hungarian firm "TESCO".

Two studies done in 1982, by two Danish companies, investigated the feasibility of entering into joint ventures with the National Workshop to manufacture wheelbarrows and corrugated iron roofing sheets.

Prior to these studies, UNIDO sponsored several missions of experts who made recommendations on possible manufacturing programs for the Workshop, on the utilization of scrap, and on the development of the metalworking industry. The "TESCO" study used some of the market information developed in the principal UNIDO study of possible manufacturing programs.

The present study made use of some of the information developed in the "TESCO" study:

- value of land
- technical state of existing machines and equipment.

2.6 Evaluation of prior studies

Prior UNIDO-sponsored studies made recommendations only and were not feasibility studies. The "TESCO" study and the present study have taken the recommendations into consideration.

The "TESCO" study appears to the authors of the present study to concentrate, in its concept, too much on the foundry. The study was weak in marketing in both the estimates of some quantities of products as well as in pricing, generally. Moreover, the great number of different products recommended would make the Workshop very difficult to manage. In such conditions, workers would not be able to make enough units of most of the products to learn how to make them well. The investment is the highest proposed by any study to date on the Workshop.

The "Danish" study on wheelbarrows was perhaps too optimistic on the quantities of the product that could be sold. The ICME study estimated the local market for wheelbarrows at only 67 % of that in the "Danish" study. The export targets of the "Danish" study are probably realizable, but only under expert management. The technology chosen appears to be entirely appropriate and was chosen for the present study as well.

> It is interesting to note that these two prior studies and the present study all have wheelbarrows as a major product.

The "Danish" study on corrugated iron sheets was restrained in its export targets, and with good management the targets could probably be realized. Pricing was conservative, and discounts were offered on exports. The local sales targets are easily realizable. In fact, the total target sales (local and export) could most likely be sold in the local market. The present study used the quantities of this study with no changes (although alternatives were tested).

The technology chosen for the sheets is semi-automatic and cannot be made any less automated. A line of special products such as roof ridges is included and is entirely manual. The present study retains this concept as well.

2.7 Alternatives to the project

Given the relatively high profitability of corrugated iron sheets, repair jobbing, and metal fabrication, they are retained in all alternatives. The other two are:

- Produce only corrugated iron sheets and retain repair jobbing and metal fabrication [no foundry and no metalforming (wheelbarrows, etc.)]
- Produce corrugated iron sheets, retain repair jobbing and metal fabrication, and produce metal-forming products (wheelbarrows, etc.) [no foundry].

The other alternatives have not been taken through a full financial analysis, because they do not satisfy so well as the chosen alternative, the economic and social criteria specified for the present study.

3. MARKET ANALYSIS, PRODUCTS FOR MANUFACTURE

3.1 Method of analysis

The method of analysis had the following steps:

1. Develop criteria for selecting products
2. Examine degree to which products already made at the Workshop meet the criteria; choose a preliminary list of "best" products
3. Analyze market reports developed by the Workshop and apply the same criteria to the products studied; add the more suitable products to the list.
4. Add other potentially suitable products chosen from products for which a satisfactorily large demand probably exists.
5. Test the preliminary list to obtain information on market size and market penetration, mainly by conducting interviews first with importers, wholesalers, and retailers in Freetown, and then with project officers (of I.A.D.P., PLAN, CARE, etc.) [1] and with proprietors of metal working establishments in Freetown.
6. Simultaneously with step 5, collect supplemental information from:
   - statistics
   - sectoral studies and household survey
   - studies and reports made available by UNDP in Freetown
   - UNIDO studies such as "Review of Industrial Development in Sierra Leone", UNIDO/I0.496, April 2, 1982.

   Modify the preliminary list as necessary.

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1) I.A.D.P.: "Integrated Agriculture Development Project"
PLAN, CARE: Private international aid organizations

3. Market analysis, products for manufacture

7. Test preliminary list in the provinces by conducting interviews with wholesalers and retailers, various project officers, and contacts of the National Workshop.

8. Refine preliminary list and re-contact, as necessary, the sources in Freetown found to provide the most useful information.

9. Define a preliminary sales/manufacturing program and present it to key business and government contacts; consider their reactions. This program takes into account a preliminary costing of the products to determine whether they could be produced at a significant margin under the target sales prices.

10. Define, from reviewing all information gathered from steps 1 to 9, a "reference" sales and production program to be taken through a complete financial analysis 1) in the feasibility study.

3.2 Import statistics

A three-man team from the Workshop collected import statistics on raw materials, finished goods, and spare parts from the Central Statistical Organization.

ICME collected the import statistics from Liberia using the computerized system at the International Trade Centre in Geneva, Switzerland. No recent statistics were available for Guinea.

In general, the statistical information was helpful but not detailed or meaningful enough for using for any more than a control for the market information collected from other sources. A special note concerning the information from statistics is given for each product of the chosen mix in Table 2, a series of "Market Size Estimates" which are presented later in this chapter.

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1) Calculated by UNIDO's COMFAR computer program

3. Market analysis, products for manufacture

3.3 Preliminary choice of products

The starting point was the products already produced by the Workshop. After applying steps 1 to 4 of the method of 3.1, above, a preliminary list of evaluated products was made and is presented in Table 1b.

Each product is evaluated against the criteria for selection, given across the top of the table. For the eleven products rejected, the reasons are given (mainly small market and too much competition).

The ten retained reference products are numbered, 1 through 7 in Group A, foundry products; 8 and 9 in Group B, metal forming products; and 10 for Group C, corrugated iron sheets. Of these, four (marked with asterisks) have been produced already by the Workshop in satisfactory quality.

3.4 Retained reference products

The ten products retained are called "reference" products, because alternatives (for most of them) could be produced just as well. The alternatives are given below:

- Foundry products (Group A)
  - . universal mincer/maize mill (no alternative)
  - . charcoal iron/cast-iron cooking pot (alternative products: fresh air inlet, "Dutch" oven)
  - . castings for the Guma Valley Water Authority (alternative products: castings for Sugar Mill, other users)
  - . rakes (alternative products: digging fork, mattock, pick axe, hammers)
  - . palm oil press (alternative products: vises for carpentry and metal working)
  - . dispensing pump, semi-rotary (no alternative)
  - . palm nut cracking machine (no alternative)
  - . rice huller (alternative product: coffee huller).

3. Market analysis, products for manufacture

Table 1b: Preliminary list of products by group; criteria for selection; reasons for rejection

	Product	Criteria for selection										reasons for rejection				
		Uses foundry (and largely scrap material)	Adequate local market size	Product no longer/not available in market	Important for rural development/agriculture	Requires skilled workers	Relatively high labour content	Uses existing facilities/ machines (largely)	Uses existing skills	Significant import savings possible		Small market compared to alternative products	Costly technology	Too much local competition	High consumption of electricity	
Group A Products for which all or many parts can be cast in foundry	1. Universal mincer/ maize mill	X	X	X		X		X	X							
	2. Simple castings: - charcoal iron	X	X			X		X	X							
	- cast iron * cooking pots	X	X	X		X		X	X							
	- casting for Guma Valley Water Auth.	X	X			X		X	X	X						
	3. Rakes, digging * forks, hammers etc.	X	X		X	X		X	X	X						
	4. Palmoil press *	X	X	X	X	X	X	X	X							
	5. Semi-rotary pump	X	X	X		X	X	X	X							
	6. Palm nut cracker	X	X		X	X	X	X	X							
	7. Rice huller	X	X		X	X	X	X	X							
	Pliers	X				X	X	X	X			X				
	Building hardware	X				X			X			X				
	Block moulding machine	X				X	X		X			X				
Group B Metal forming products	8. Wheelbarrow		X	X	X	X	X	X	X	X						
	9. Rice winnower *		X		X	X	X	X	X							
	Gold/diamond washing rigs					X	X	X	X						X	
	Plows (for oxen)					X	X	X	X			X			X	
	Wood-burning cooking ovens					X	X	X	X			X				
Group C	Shovels, spades		X		X			X	X						X	
	Hoes		X		X				X						X	
	Round head-pans				X				X			X	X			
	10. Corrugated iron sheets		X		X				X	X						
	Vitreous-enamel hoilowware		X						X				X		X	
	Wire mesh		X						X			X			X	

* Indicates products which have been produced already by the Workshop in satisfactory quality.

3. Market analysis, products for manufacture

- Metal forming products (Group B)

  . wheelbarrow (alternative products: carts, simple materials handling equipment)

  . rice winnower (alternative products: rice thresher, cassava grater, groundnut sheller).

3.5 Market size

For each of the reference products, a "Market Size Estimate" is given in a separate page of Table 2. For each product, eight possible sources of market size information are given with estimates given for those sources providing useable information. The right-hand column gives the figure taken as the valid one for the study for the estimate of total market size (units/year). In brackets is shown the annual target sales figure and its percentage of the total annual market size.

3. Market analysis, products for manufacture

Table 2: Market size estimates

Universal mincer/maize mill

Local (Sierra Leone)	Various estimates Units/year	To use as total market
a] Wholesalers (Freetown)	2000 (F.only)	
b] Wholesalers (Provinces)	2000 (P.only)	
c] Statistics (CSO (1979 to 1981)	-	
d] National Workshop (Marketing Department)	minimum 4000	
e] "Project" officers (e.g., I.A.D.P.)	-	4000
f] Household purchasing power calculation (ICME)	6000	[Target sales: 4000
g] Sectoral studies	-	(100 % of
h] Other	-	local market)]
Foreign		
Liberia		
a] Wholesalers (Freetown, S.L.)	-	
b] Wholesalers (Provinces, S.L.)	-	
c] Statistics (ITC, Geneva; 1978 to 1981)	2000	4000 min.
d] ICME estimate	1750	[Target sales:
Guinea		2000
- Wholesalers (Provinces, S.L.)	-	(50 % of export
- ICME estimate	3875	market)]
IMPLICATIONS FOR MARKETING		8000
- Distribution in Liberia is a key factor		Target sales:
- Liberian distributors should be consulted on:		6000 = 75 % of total market
. design - nationality of technology source		
. mix, mincer/maize mill		

3. Market analysis, products for manufacture

Table 2: Market size estimates

Charcoal iron

Local (Sierra Leone)	Various estimates Units/year	To use as total market
a] Wholesalers (Freetown)	5000	
b] Wholesalers (Provinces)	5000	
c] Statistics (CSO (1979 to 1981)	4200 (avg.)	
d] National Workshop (Marketing Department)	-	
e] "Project" officers (e.g., I.A.D.P.)	-	5000
f] Household purchasing power calculation (ICME)	4000	[Target sales: 4000
g] Sectoral studies		(90 % of
h] Other	-	local market)]
Foreign		
Wholesalers (Provinces, S.L.)	5000 max. (Lib. + Guin.)	
Liberia		
a] Wholesalers (Freetown, S.L.)	-	
b] Wholesalers (Provinces, S.L.)	-	
c] Statistics (ITC, Geneva; 1978 to 1981)	unuseable	
d] ICME estimate	1500	4500
*		
Guinea		[Target sales:
- Wholesalers (Provinces, S.L.)		- 0 -]
- ICME estimate	3200	
IMPLICATIONS FOR MARKETING		9500
Some of the 4000 units will probably be exported by wholesalers in the provinces.		Target sales: 4000 (42 % of total market)

* No recent statistics available

3. Market analysis, products for manufacture

Table 2: Market size estimates

Cooking pot (cast iron)

Local (Sierra Leone)	Various estimates Units/year	To use as total market
a] Wholesalers (Freetown)	-	
b] Wholesalers (Provinces)	-	
c] Statistics (CSO (1979 to 1981)	no imports	
d] National Workshop (Marketing Department)	-	
e] "Project" officers (e.g., I.A.D.P.)	-	6000 [Target sales:
f] Household purchasing power calculation (ICME)	6000 min	
g] Sectoral studies	-	5000
h] Other: Interviews with distributors of alu.pots and with users	qualitative information only	(83% of local market)]
Foreign		
Liberia		
a] Wholesalers (Freetown, S.L.)		
b] Wholesalers (Provinces, S.L.)		
c] Statistics (ITC, Geneva; 1978 to 1981)		
d] ICME estimate	3500	
*		7000
Guinea		[Target sales:
- Wholesalers (Provinces, S.L.)		
- ICME estimate	3875	- 0 -]
IMPLICATIONS FOR MARKETING		13000
Distributors in the provinces will probably export some pots; the target production should be easily absorbed.		[Target sales: 5000 (38 % of total market)]

* No recent statistics available

3. Market analysis, products for manufacture

Table 2: Market size estimates

Rakes (Cast steel, Agricultural hand tools)

Local (Sierra Leone)	Various estimates Units/year	To use as total market
a] Wholesalers (Freetown)	3000	
b] Wholesalers (Provinces)	3000	
c] Statistics (CSO (1979 to 1981)	unuseable	
d] National Workshop (Marketing Department)	-	12000
e] "Project" officers (e.g., I.A.D.P.)	6000	[Target sales:
f] Household purchasing power calculation (ICME)	N.A.	3000
g] Sectoral studies	-	(25 % of total
h] Other	-	market)]
	12000	
Foreign		
Liberia		
a] Wholesalers (Freetown, S.L.)	-	
b] Wholesalers (Provinces, S.L.)	-	
c] Statistics (ITC, Geneva; 1978 to 1981)	unuseable	
d] ICME estimate	10000 min.	14000
*		
Guinea		[Target sales:
- Wholesalers (Provinces, S.L.)	-	
- ICME estimate	3875	- 0 -]
IMPLICATIONS FOR MARKETING		26000
Sales could be increased if management finds that it is advantageous to expand production of this product group.		[Target sales: 3000 (12 % of total market)]

* No recent statistics available

3. Market analysis, products for manufacture

Table 2: Market size estimates

Palm oil press

Local (Sierra Leone)	Various estimates Units/year	To use as total market
a] Wholesalers (Freetown)	-	
b] Wholesalers (Provinces)	-	
c] Statistics (CSO (1979 to 1981)	unuseable	
d] National Workshop (Marketing Department)	-	
e] "Project" officers (e.g., I.A.D.P.)	200 - 400	350
f] Household purchasing power calculation (ICME)	-	[Target sales: 330
g] Sectoral studies	no quantitat. estimates	(94 % of local market)]
h] Other		
- interv. with potential distr.	300 - 500	
- ICME estimate	350	
Foreign		
Liberia		
a] Wholesalers (Freetown, S.L.)	-	
b] Wholesalers (Provinces, S.L.)	-	
c] Statistics (ITC, Geneva; 1978 to 1981)	-	No export planned
*		
Guinea		
- Wholesalers (Provinces, S.L.)	-	

IMPLICATIONS FOR MARKETING

Some project officials are concerned that palm oil presses should be sold only outside the trading radius of the palm oil pressing companies.

* No recent statistics available

3. Market analysis, products for manufacture

Table 2: Market size estimates

Semi-rotary pump

Local (Sierra Leone)	Various estimates Units/year	To use as total market
a] Wholesalers (Freetown)	300	
b] Wholesalers (Provinces)	300	
c] Statistics (CSO (1979 to 1981)	-	
d] National Workshop (Marketing Department)	-	350
e] "Project" officers (e.g., I.A.D.P.)	-	
f] Household purchasing power calculation (ICME)	400	[Target sales: 330
g] Sectoral studies	-	(94 % of local
h] Other	-	market)]
Foreign		
Liberia		
a] Wholesalers (Freetown, S.L.)	-	
b] Wholesalers (Provinces, S.L.)	100 (exportable from Sierra Leone)	
c] Statistics (ITC, Geneva; 1978 to 1981)	-	250
*		[Target sales:
Guinea		220
- Wholesalers (Provinces, S.L.)	150 (exportable from Sierra Leone)	(88 % of total estimated potential)]

IMPLICATIONS FOR MARKETING

Export arrangements should be made by foreign expert and his counterpart as early as possible after design is finalized.

* No recent statistics available

3. Market analysis, products for manufacture

Table 2: Market size estimates

Palm nut cracker

Local (Sierra Leone)	Various estimates Units/year	To use as total market
a] Wholesalers (Freetown)	-	
b] Wholesalers (Provinces)	-	
c] Statistics (CSO (1979 to 1981)	-	
d] National Workshop (Marketing Department)	-	375
e] "Project" officers (e.g., I.A.D.P.)	-	
f] Household purchasing power calculation (ICME)	-	[Target sales: 330
g] Sectoral studies	no quantitat. estimates	(88 % of local market)]
h] Other (ICME estimate)	375	
Foreign		
Liberia		
a] Wholesalers (Freetown, S.L.)	-	
b] Wholesalers (Provinces, S.L.)	-	
c] Statistics (ITC, Geneva; 1978 to 1981)	-	No export planned
*		
Guinea		
- Wholesalers (Provinces, S.L.)	-	

IMPLICATIONS FOR MARKETING

Careful preparation of demonstrations in field and selection of distributors is necessary.

* No recent statistics available

3. Market analysis, products for manufacture

Table 2: Market size estimates

Rice huller

Local (Sierra Leone)	Various estimates Units/year	To use as total market
a] Wholesalers (Freetown)	-	
b] Wholesalers (Provinces)	-	
c] Statistics (CSO (1979 to 1981)	-	
d] National Workshop (Marketing Department)	-	
e] "Project" officers (e.g., I.A.D.P.)	-	250
f] Household purchasing power calculation (ICME)	-	[Target sales: 220
g] Sectoral studies	-	(88 % of local market)]
h] Other (Interviews with potential distributors	200 - 350	
Foreign		
Liberia		
a] Wholesalers (Freetown, S.L.)	-	
b] Wholesalers (Provinces, S.L.)	-	
c] Statistics (ITC, Geneva; 1978 to 1981)	-	No export planned
*		
Guinea		
- Wholesalers (Provinces, S.L.)	-	

IMPLICATIONS FOR MARKETING

Distribution might be done best through some independent agents who know the farmers/village lenders and who can help to secure financing from the Industrial Development Bank. The same agents should market the rice winnower. This market may prove to be very difficult but should be attacked. It may also be possible to export.

* No recent statistics available

3. Market analysis, products for manufacture

Table 2: Market size estimates

Wheelbarrow

Local (Sierra Leone)	Various estimates Units/year	To use as total market size (units/year)
a] Wholesalers (Freetown)	2000	
b] Wholesalers (Provinces)	4000	
c] Statistics (CSO (1979 to 1981)	2000	
d] National Workshop (Marketing Department)	-	
e] "Project" officers (e.g., I.A.D.P.)	-	4000
f] Household purchasing power calculation (ICME)	N.A.	[Target sales: 4000
g] Sectoral studies	-	(100 % of
h] Other: Danish feasibility study	6000	local market)]
Foreign		
Liberia		
a] Wholesalers (Freetown, S.L.)	-	
b] Wholesalers (Provinces, S.L.)	-	
c] Statistics (ITC, Geneva; 1978 to 1981)		
d] ICME estimate	3000-4000	
*		
Guinea		4000
- Wholesalers (Provinces, S.L.)	1000-2000	[Target sales: 2000
	=========	(50 % of
	4000-6000	export market)]
IMPLICATIONS FOR MARKETING		8000
- Distribution in Liberia and Guinea is very important		Target sales:
- Liberian distributors should be consulted on design of the wheelbarrow!		6000 (75 % of total market)

* No recent statistics available

3. Market analysis, products for manufacture

Table 2: Market size estimates

Rice winnower

Local (Sierra Leone)	Various estimates Units/year	To use as total market size (units/year)
a] Wholesalers (Freetown)	-	
b] Wholesalers (Provinces)	-	
c] Statistics (CSO (1979 to 1981)	-	
d] National Workshop (Marketing Department)	-	
e] "Project" officers (e.g., I.A.D.P.)	-	350
f] Household purchasing power calculation (ICME)	-	[Target sales: 300
g] Sectoral studies	no quantitat. estimates	(86 % of local market)]
h] Other (Interviews with potential distributors)	350	
Foreign		
Liberia		
a] Wholesalers (Freetown, S.L.)	-	
b] Wholesalers (Provinces, S.L.)	-	
c] Statistics (ITC, Geneva; 1978 to 1981)	-	No export planned
*		
Guinea		
- Wholesalers (Provinces, S.L.)	-	

IMPLICATIONS FOR MARKETING

Careful preparation of demonstrations in field and selection of distributors is necessary.

* No recent statistics available

3. Market analysis, products for manufacture

Table 2: Market size estimates

Corrugated iron sheets

Local (Sierra Leone)	Various estimates Units/year (tons)	To use as total market
a] Wholesalers (Freetown)	2000	
b] Wholesalers (Provinces)	-	
c] Statistics (CSO (1979 to 1981)	1250 (avg.)	
d] National Workshop (Marketing Department)	-	2000
e] "Project" officers (e.g., I.A.D.P.)	-	
f] Household purchasing power calculation (ICME)	-	[Target sales: 1800
g] Sectoral studies	-	(90 % of
h] Other: Danish feasibility study	1300	local market)]
Foreign		
Liberia		
a] Wholesalers (Freetown, S.L.)	-	
b] Wholesalers (Provinces, S.L.)	-	
c] Statistics (ITC, Geneva; 1978 to 1981)	600 min. (in 1981)	
d] ICME estimate	730	
*		1200 min.
Guinea		[Target sales:
- Wholesalers (Provinces, S.L.)	-	700
- ICME estimate	800	(58 % of export market)]
IMPLICATIONS FOR MARKETING		3200
The export market is not essential to the project, but the export sales would generate significant foreign exchange to pay for raw materials.		Target sales: 2500 (78 % of total market)

* No recent statistics available

3. Market analysis, products for manufacture

3.6 Export sales adapted to the project

The export market size for Liberia is also estimated, as is that for Guinea in the cases where some information was available. No other export markets were evaluated.

The analysis reveals that the following manufactured products (of Group A and B) could be exported in the 5th year with the following values (see page 55):

- universal mincer/maize mill 28'000
- wheelbarrow 82'000
- semi-rotary pump 24'000

Of these, the wheelbarrow would generate about 70 % of the export earnings.

Corrugated iron sheets could also be exported in large quantity: 610'000

Export success would depend on the quality of the products, competitive pricing, and management's knowledge of the export market. The future owners of the workshop will be largely (60 %) from the private sector, which has some excellent business contacts in Liberia and other nearby countries.

Thus export success will depend mainly on quality and price. Quality can start with choosing good products to copy. Thus, the universal mincer/maize mill should be based on English, German, American, or Swiss models; the wheelbarrow on Danish or French designs (the latter is very strong and very popular in West Africa); and the semi-rotary pump on a French model (as this is the preferred type).

Pricing, of course, should be competitive, offering dealers interesting introductory discounts. Suggested prices are shown in the Reference Sales and Production Program, Table 3.

Other, indirect exporting would likely be done by some of the wholesalers in Sierra Leone for:

- wheelbarrows
- semi-rotary pumps
- charcoal irons and cooking pots.

3.7 Reference sales and production program

Completing steps 5 through 10 of the method of analysis, the reference sales and production program was established and is shown in Table 3.

This table is called the "Reference program", because the prices and quantities are those used determined in the field as "ideal" for marketing and production. That is, the prices are very conservative respectively pessimistic and calculated to facilitate market penetration. The production quantities would not strain the workers, the facilities, or the management.

Thus, the "Reference program" is conservative in prices and production quantities. The consultants left working margins of 10 - 20 % over the reference program's prices and 10 - 30 %, depending on the product group, for production quantities. Ideally, however, the Reference program would have given an acceptable IRR.

The first calculations (without COMFAR) gave an IRR of about 7 % for the Reference program. In the next step, and respecting the working margins described above, multipliers of 1.0 to 1.2 were used for reference prices and 1.0 to 1.3 for reference production quantities for different trials of the financial analysis in order to arrive at a program which would offer a satisfactory return at price/quantity-levels that market would certainly absorb.

3. Market analysis, products for manufacture

These multipliers for the reference program are further explained in Table 4. The COMPAR program calculated the final sales/production program, which is also called the "base case". Final sales are given in Figure 2, in Table 5 for the fifth year of production, and in the output tables of Chapter 10.4.

We emphasize that the probability to fulfill this base case by the realized project is still high enough to be considered as a serious concept for the National Workshop.

The unit prices were checked for coverage of manufacturing costs plus a margin in the field and again in the consultant's home office during the detailed analysis (which yielded several increases).

The production quantities are limited more by the market and by the learning required by workers and management much more than by the technical capacity of the plant.

It should be stressed again that for the interim year, 1984, production is done on the existing facilities of the Workshop. New machines and equipment would be installed the following year.

Table 3: Reference sales/production program

		Product	Unit price $ export	Unit price $ local	interim year 1984, 1985 quantity (pieces) export	interim year 1984, 1985 quantity (pieces) local	interim year 1984, 1985 ($) sales export	interim year 1984, 1985 ($) sales local	production 1st year 1986 quantity (pieces) export	production 1st year 1986 quantity (pieces) local	production 1st year 1986 ($) sales export	production 1st year 1986 ($) sales local	production 2nd year 1987 quantity (pieces) export	production 2nd year 1987 quantity (pieces) local	production 2nd year 1987 ($) sales export	production 2nd year 1987 ($) sales local
Part 1	Group A	Universal mincer/ maize mill	11.7	13	-	-	-	-	-	2 000	-	26 000	-	3 000	-	39 000
		Charcoal iron/ cooking pot	-	5.6	-	4 000	-	22 400	-	4 000	-	22 400	-	6 000	-	33 600
		Castings for GVWA	-	15	-	1 000	-	15 000	-	2 000	-	30 000	-	2 000	-	45 000
		Rakes, etc.	-	3.8	-	2 000	-	7 600	-	2 000	-	7 600	-	3 000	-	11 400
		Palm oil press	-	131	-	150	-	19 650	-	150	-	19 650	-	200	-	26 200
		Semi-rotary pump	100	112	-	-	-	-	-	-	-	-	-	200	-	20 000
		Palm nut cracker	-	150	-	-	-	-	-	-	-	-	-	-	-	-
		Rice huller	-	750	-	-	-	-	-	-	-	-	-	-	-	-
		Subtotal						64 650				105 650				175 200
	Group B	Wheelbarrow	34.2	38	-	-	-	-	-	2 000	-	76 000	2 000	2 000	68 400	76 000
		Rice winnower	-	140	-	100	-	14 000	-	100	-	14 000	-	200	-	28 000
		Subtotal						14 000				90 000			68 400	104 000
Part 2	Group C	C-I-sheet 34	688	702	- (tons)	-	-	-	- (tons)	450	-	315 900	100 (tons)	800	68 800	561 600
		C-I-sheet 28	629	747	-	-	-	-	-	200	-	149 400	100	300	62 900	224 100
		Subtotal						-		650		465 300	200	1 100	131 700	785 700
Part 1	Group D	Repair jobbing						130 600				149 250				161 940
		Metal fabrication						18 660				37 320				46 480
		Total Sales						227 910				847 520				1 473 420

Table 3: Reference sales/production program

		Product	Unit price $ export	Unit price $ local	production 3rd year 1988 quantity (pieces) export	3rd year 1988 quantity (pieces) local	3rd year 1988 ($) sales export	3rd year 1988 ($) sales local	4th year 1989 quantity (pieces) export	4th year 1989 quantity (pieces) local	4th year 1989 ($) sales export	4th year 1989 ($) sales local	full production 5th year 1990 quantity (pieces) export	full production 5th year 1990 quantity (pieces) local	full production 5th year 1990 ($) sales export	full production 5th year 1990 ($) sales local
Part 1	Group A	Universal mincer/ maize mill	11.7	13	-	4 000	-	52 000	2 000	4 000	23 400	52 000	2 000	4 000	23 400	52 000
		Charcoal iron/ cooking pot	-	5.6	-	6 000	-	33 600	-	9 000	-	50 400	-	9 000	-	50 400
		Castings for GVWA	-	15	-	3 000	-	45 000	-	3 000	-	45 000	-	3 000	-	45 000
		Rakes, etc.	-	3.8	-	3 000	-	11 400	-	3 000	-	11 400	-	3 000	-	11 400
		Palm oil press	-	131	-	250	-	32 750	-	300	-	39 300	-	300	-	39 300
		Semi-rotary pump	100	112	-	200	-	22 400	100	300	10 000	33 600	200	300	20 000	33 600
		Palm nut cracker	-	150	-	200	-	30 000	-	300	-	45 000	-	300	-	45 000
		Rice huller	-	750	-	-	-	-	-	200	-	150 000	-	200	-	150 000
		Subtotal						227 150			33 400	426 700			43 400	426 700
	Group B	Wheelbarrow	34.2	38	2 000	4 000	68 400	152 000	2 000	4 000	68 400	152 000	2 000	4 000	68 400	152 000
		Rice winnower	-	140	-	200	-	28 000	-	300	-	42 000	-	300	-	42 000
		Subtotal					68 400	180 000			68 400	194 000			68 400	194 000
Part 2	Group C	C-I-sheet 34	688	702	200 (tons)	900	137 600	631 800	300 (tons)	900	206 400	631 800	400 (tons)	900	275 200	631 800
		C-I-sheet 28	629	747	200	350	125 800	261 450	250	400	157 250	298 800	300	400	188 700	298 800
		Subtotal			400	1 250	263 400	893 250	550	1 300	363 650	930 600	700	1 300	463 900	930 600
Part 1	Group D	Repair jobbing						175 370				190 300				223 880
		Metal fabrication						57 910				72 135				111 940
		Total Sales						1 865 480				2 279 185				2 462 820

Table 3: Reference sales/production program

		Product	Unit price $ export	Unit price $ local	full production 6th year 1991 quantity (pieces) export	6th year 1991 quantity (pieces) local	6th year 1991 ($) sales export	6th year 1991 ($) sales local	7th year 1992 quantity (pieces) export	7th year 1992 quantity (pieces) local	7th year 1992 ($) sales export	7th year 1992 ($) sales local	8th year 1993 quantity (pieces) export	8th year 1993 quantity (pieces) local	8th year 1993 ($) sales export	8th year 1993 ($) sales local
Part 1	Group A	Universal mincer/ maize mill	11.7	13	2 000	4 000	23 400	52 000								
		Charcoal iron/ cooking pot	-	5.6	-	9 000	-	50 400	-		-		-		-	
		Castings for GVWA	-	15	-	3 000	-	45 000	-		-		-		-	
		Rakes, etc.	-	3.8	-	3 000	-	11 400	-		-		-		-	
		Palm oil press	-	131	-	300	-	39 300	-		-		-		-	
		Semi-rotary pump	100	112	200	300	20 000	33 600								
		Palm nut cracker	-	150	-	300	-	45 000	-		-		-		-	
		Rice huller	-	750	-	200	-	150 000	-		-		-		-	
		Subtotal					43 400	426 700								
	Group B	Wheelbarrow	34.2	38	2 000	4 000	68 400	152 000								
		Rice winnower	-	140	-	300	-	42 000	-		-		-		-	
		Subtotal					68 400	194 000								
Part 2	Group C	C-I-sheet 34	688	702	400 (tons)	900	275 200	631 800	(tons)				(tons)			
		C-I-sheet 28	629	747	300	400	188 700	298 800								
		Subtotal			700	1 300	463 900	930 600								
Part 1	Group D	Repair jobbing						223 880								
		Metal fabrication						111 940								
		Total Sales						2 462 820			2 462 820				2 462 820	

3. Market analysis, products for manufacture

3.8 Marketing strategy

- Products

A key element of the strategy is to immediately produce two products for which demand is high but which have virtually disappeared from the local market place:

. wheelbarrow

. universal mincer/maize mill.

At the same time, the two products have excellent export potential.

Together, they would generate about 40 % of sales of manufactured products (Group A and B), with the wheelbarrow at 30 % and the mincer/mill at 10 % of sales. Thus, the wheelbarrow is the key product.

Simple foundry products would also be launched immediately, and the products chosen have a high demand. Moreover, there are ample alternative foundry products which could be substituted to meet new market opportunities.

The strategy also takes advantage of the demand for some agricultural products developed at the Workshop, namely:

. rice winnower, and

. palm oil press,

for which only minor improvements are necessary.

3. Market analysis, products for manufacture

Additional products would be introduced later in order to allow the Workshop adequate development time, and sufficient learning time on both using the new machines and equipment and in working in a factory environment. The introduction of additional products would be as shown below:

Product	Year of introduction
Semi-rotary pump	2nd
Palm nut cracker	3rd
Rice huller	4th

Corrugated iron sheets would be produced and sold immediately in order to make the maximum possible contribution to cash flow.

- General strategy

The strategies for pricing, production, and distribution are related, because in Sierra Leone -- as in other countries where shortages sometimes occur -- care must be taken to avoid a situation where retail prices rise so high as to impede the final sales of the products. Therefore:

. Prices are aimed at giving both Workshop and the sellers adequate margins

. Production quantities are set high enough to keep the market supplied regularly.

. Distributors are chosen so that no one has an interest in arbitrarily withholding products from the market.

- Pricing

Prices are calculated to give the Workshop an adequate margin while still resulting in ex-works prices which permit sellers to earn a good profit on very reasonable prices to customers. By "very reasonable" is meant prices much more in line with those in other West African and Central African countries than those currently found in the marketplace in Sierra Leone.

3. Market analysis, products for manufacture

In fact, the pricing was done in the following steps:

- estimate prices for each product based on European and American prices (which are generally lower than in Africa)
- determine whether manufacturing costs plus margin could be covered by such prices
- retain those products and prices for which coverage is adequate
- for the remaining products, determine the prices which provide adequate coverage and then determine how the market would react to the prices (quantities likely to be bought)
- where the quantities are still suitable for production, retain the product and price; reject any other products.

In applying this procedure, no products were dropped from the list. One can conclude that all the prices are conservative and would allow relatively easy penetration of the products. A ten percent discount would be offered on export products. Corrugated iron sheets would also have a discount for export.

- Distribution

The policy of the new Workshop would be to grant no exclusive distributorships either in Freetown or in the provinces. The Workshop would not sell directly to final users in Sierra Leone. It would sell its export products directly to foreign wholesalers.

3. Market analysis, products for manufacture

3.9 Recommended sales/production program based on financial analysis

The final program was reached after four trials of analysis using UNIDO's "COMFAR" computer model. Table 4 shows for each trial the different "multipliers" used to increase prices and production quantities over those of the "Reference program". Table 5 presents the unit prices, production quantities, and sales for the final program, trial 4, compared to those of the reference program.

Table 5 shows that total sales of the final program in the 5th year are about 24 % higher than those of the reference program. In the 7th year of production (and all following years) total sales would be about 31 % higher.

Up to the 5th year of production, the nine reference products of Group A and B would be produced at the quantities indicated and sold at the indicated final unit prices.

In the 6th and 7th years, total foundry production would increase by 30 % over the level for the 5th year, in one of two ways:

- the reference products of Groups A and B would be retained and additional products would be chosen for production among the alternatives
- some of the reference products and alternatives would be retained and some new products would be chosen for production.

The choice would have to be made during the 5th year of production.

3. Market analysis, products for manufacture

Table 4: Multipliers of price and production quantity used in the four trials of financial analysis

Product Group	Increase in unit price over reference unit price ( ): multiplier				Increase in production quantity over reference quantity ( ): multiplier			
	trial 1	trial 2	trial 3	trial 4	trial 1	trial 2	trial 3	trial 4
A] Foundry products	10 % (1.10)	10 % (1.10)	10 % (1.10)	10 % (1.10)	0 (1.00)	10 % (1.10)	10 % (1.10)	10 % to year 5 * (1.10)
B] Metalforming products	10 % (1.10)	20 % (1.20)	20 % (1.20)	20 % (1.20)	10 % (1.10)	0 (1.00)	0 (1.00)	0 (1.00)
C] Corrugated iron sheets	20 % (1.20)	0 (1.00)	20 % (1.20)	20 % (1.20)	25 % (1.25)	0 (1.00)	0 (1.00)	10 % (1.10)
D] Metal fabrication and repair	10 % (1.10)	0 (1.00)	0 (1.00)	0 (1.00)	15 % (1.15)	0 (1.00)	0 (1.00)	0 (1.00)

* From year 5 to year 7, production of foundry products is increased by 30 % from the new level of year 5.
In year 6 the production quantity is 15 % higher than for year 5, and the multiplier of the reference quantity is 1.10 x 1.15.
In year 7, at full production, the production quantity is 30 % higher than for year 5, and the multiplier of the reference quantity is 1.10 x 1.30.

Table 5: Comparison of final sales/production program to the reference program, Trial 4

		Product	Unit prices, production and sales in 5th year (1990)												8th year (1993)	
			Reference program						Final program (Trial 4)							
			Unit price		quantity (pieces)		($) sales		Unit price		quantity (pieces)		($) sales		($) sales	
			export	local	export	local	export	local	export	local	export	local	export	local	export	local
Part 1	Group A	Universal mincer/ maize mill	11.7	13	2 000	4 000	23 400	52 000	12.9	14.3	2 200	4 400	28 314	52 920		
		Charcoal iron/ cooking pot	-	5.6	-	9 000	-	50 400	-	6.2	-	9 900	-	60 984	Total output	
		Castings for GVWA	-	15	-	3 000	-	45 000	-	16.5	-	3 300	-	54 450	increased by	
		Rakes, etc.	-	3.8	-	3 000	-	11 400	-	4.2	-	3 300	-	13 794	30 % over	
		Palm oil press	-	131	-	300	-	39 300	-	144.1	-	330	-	47 553	that of	
		Semi-rotary pump	100	112	200	300	20 000	33 600	110	123.2	220	330	24 200	40 656	year 5	
		Palm nut cracker	-	150	-	300	-	45 000	-	165.0	-	330	-	54 450		
		Rice huller	-	750	-	200	-	150 000	-	825.0	-	220	-	181 500		
		Subtotal					43 400	426 700					52 514	516 307	739 467	
	Group B	Wheelbarrow	34.2	38	2 000	4 000	68 400	152 000	41.0	45.6	2 000	4 000	82 080	182 400	82 080	182 400
		Rice winnower	-	140	-	300	-	42 000	-	168.0	-	300	-	50 400	-	50 400
		Subtotal					68 400	194 000					82 080	232 800	82 080	232 800
Part 2	Group C	C-I-sheet 34	688	702	400 (tons)	900	275 200	631 800	825.6	842.4	440 (tons)	990	363 264	833 976	363 264	833 976
		C-I-sheet 28	629	747	300	400	188 700	298 800	754.8	896.4	330	440	249 084	394 416	249 084	394 416
		Subtotal			700	1 300	463 900	930 600			770	1 430	612 348	1 228 392	612 348	1 228 392
Part 1	Group D	Repair jobbing						223 880						223 880		223 880
		Metal fabrication						111 940						111 940		111 940
		Total Sales					2 462 820						3 060 261		3 230 907	

3. Market analysis, products for manufacture

3.10 Plant capacity

The required new machines and equipment were determined and costed for meeting the "Final Program".

The nominal normal capacity (possible units at 100 % capacity) always refers to the capacity of the "bottle-neck" unit of the particular production process. Explanations of foundry capacity are given in Chapter 6.

Table 6 shows production capacity for the three product groups A, B, and C and the capacity utilization at full production (year 5 of final program).

For product group D, repair jobbing and metal fabrication, the following rough estimates of existing and future capacity utilization are given below:

	Utilization in % of existing facilities	
	Repair jobbing division	Metal fabrication division
Actual situation	45 %	15 %
At full production of reorganized Workshop	90 %	80 %

Since the program for the other product groups is the focus of the present study, a more detailed examination of production capacity and utilization for repair jobbing and metal fabrication is not warranted.

3. Market analysis, products for manufacture

Table 6: Production capacity and capacity utilization

Products	Percentage of steel	Percentage of cast iron	Possible units at 100 % capacity	Year 5 units	Year 5 % capacity	Year 7 units	Year 7 % capacity
1. Universal mincer/ maize mill	19	21 *	7 500	6 600	88 %		
2. Charcoal iron/ cooking pots	5	95	43 420	9 990	23 %	Total output of foundry	
Castings for Guma Valley	-	100	14 440	3 330	23 %	increased by 30 %	
3. Rakes, digging forks etc.	15	85 *	6 420	3 300	51 %	over that of year 5	
4. Palm oil press	40	60	350	330	94 %		
5. Pump	20	80	550	550	100 %		
6. Palm nut cracker	12	88	350	330	94 %		
7. Rice huller	8	92	220	220	100 %		
8. Wheelbarrow	83	17	6 600	6 000	91 %	6 000	91 %
9. Rice winnover	83	17	350	300	86 %	300	86 %
10. Corrugated iron sheets	100	-	3 000	2 200	73 %	2 200	73 %

* steel casting

Notes:

- Full production for "Final Program" (for reference products) reached in year 5.
- In years 6 and 7, output of foundry increased by 30 %, and reference products of Group A may be no longer valid (see chapter 3.9).

4. MATERIALS AND INPUTS

4.1 Quantitative supply program and annual costs

The Workshop is and will be able to produce goods of steel, cast iron, several alloys, and wood.

The program recommended in the present study avoids, as much as possible, the use of:

- foreign semi-processed raw materials
- processed industrial materials (intermediates)
- sub-assemblies.

Capacity of storage is sufficient for all materials, and no special buildings have to be erected.

To store and deliver the wheelbarrows, some special facilities have been provided and are explained in chapter 6.4.

Schedule 4.1 gives the required materials and inputs for product Groups A, B, and C and full production of the "Reference Program". The material and input costs as well as the entire production costs of the "Final Program" are slightly higher in relation to the increased quantities of the base case. The calculated material, inputs and production costs for this case - done by COMFAR - are shown in the output tables of Chapter 10.4.

A detailed calculation of needed materials especially for the foundry is shown in Annex 1.

Schedule 4-1: Materials and inputs for entire workshop (Prod. group A, B, C and D) at full production of "Reference program"

Item description	unit	PRODUCT GROUPS A, B and C						PRODUCT GROUP D				ENTIRE WORKSHOP		
					$ 1000				$ 1000			$ 1000		
		quantity	source	unit cost $ c.i.f. + duty	for.	local	total	quant.	for.	local	total	for.	local	total
1. Raw mat. (unprocessed and semi-processed)					53,3	4,1	57,4	div.	4) 5,0	4) 0,4	5,4	58,3	4,5	62,8
- grey iron scrap	t	100,0	local	2) 19		1,9	1,9							
- steel scrap	t	81,0	local	2) 19		1,6	1,6							
- pig iron	t	90,0	Braz/Nig 1)	303	27,3		27,3							
- alloys	t	4,2	Braz/Nig 1)	1200	5,0		5,0							
- coke	t	54,0	Braz/Nig 1)	237	12,8		12,8		4)	4)	4)	4)	4)	4)
- charcoal	t	0,5	local	45		0,1	0,1							
- limestone and scorifier	t	10,9	loc/for	19/500	0,1	0,2	0,3							
- Timber (mangrove)	t	24,0	local	12		0,3	0,3							
- new sand	t	111,0	local (?) Braz/Nig	73	8,1		8,1							
2. Processed mat. + compon.					1275,3		1275,3	-	-	-	-	1330,3	-	1330,3
- steel sheets SWG 34 delivered in 5t coils	t	1300,0	Europe (Brazil)	592	769,6		769,6	-	-	-	-	769,6	-	769,6
- steel sheets SWG 28 delivered in 5t coils	t	700,0	Europe (Brazil)	540	378,0		378,0	-	-	-	-	378,0	-	378,0
- steel plates st 1203 1100 x 1200 x 1,5	t	102,0	Europe (Brazil)	455	46,4		46,4	59,5	27,1	-	27,1	73,5	-	73,5
- steel tubes 30 x 2, 4 angle irons 30x30x3, other dim., steel bars	t	68,8	Europe (Brazil)	578	39,8		39,8	31,1	17,9	-	17,9	57,7	-	57,7
- others: paint, rubber, div. types, plastics, bearings, welding mat., foundry material, etc.	div.	div.	mostly foreign: Europe	div.	41,5		41,5	div.	10,0	-	10,0	51,5	-	51,5
Total raw material					1328,6	4,1	1332,7	-	60,0	0,4	60,4	1388,6	4,5	1393,1
3. Auxiliary materials 3)	div.	div.	mostly foreign	div.	15,0	-	15,0	div.	2,0	-	2,0	17,0	-	17,0
4. Spares	div.	div.	mostly foreign		5,4	4,1	9,5	div.	4,6	2,1	6,7	10,0	6,3	16,3
5. Utilities/Energy: electr., water, steam, compressed air, fuel, lubrication, etc.	div.	div.	local	div.		70,8	70,8	div.	-	6,2	6,2	-	77,0	77,0

1) Transport costs from Brazil are about 50 % of cost from Europe
2) Only costs for breaking and sorting scrap
3) This value was inadvertently omitted from the to the COMFAR program
4) ICME-estimation for product group D, no breakdown

Generally: no specific storage measures are necessary; the existing facilities are satisfactory.

4. Materials and inputs

4.2 Characteristics of materials and inputs, seasonal variations, and supply sources

Grey iron scrap, steel scrap, timber and charcoal are the most important locally available materials. The estimated unit costs include transport, clearing charges, local insurance and, for scrap, breaking and sorting.

The critical element among the utilities is electricity, and a generator would be provided for the foundry. The existing transformer (300 KVA) is satisfactory for the remaining facilities such as machine shop, corrugated iron sheets facilities, metalworking shop, repair jobbing, and metal fabrication.

No seasonal restrictions are seen as affecting the procurement of materials and inputs.

For the foundry and metalworking shops, sources of supply are already established, but steel plate would have to be imported directly. The sources listed in Schedule 4.1 are recommended for the various materials.

4.3 Inventory of existing materials, spare parts, tools

- Foreign raw material, raw material for machine shop	. Approximately 30 t of bars, angle irons, semi-round bars . Satisfactory for more than 1 year of the proposed production program
- Foundry raw material	. Only grey iron scrap, steel scrap and charcoal are locally available in quantities sufficient for more than 10 years. . The first two items are situated just within the works area or nearby.

4. Materials and inputs

- Metalworking raw material including iron sheets	. Only a small quantity of mild steel plates is in stock: about 400 plates (1,5 mm) or 6,4 tons. . For corrugated iron sheets there is no raw material stored.
- Spare parts for machinery and equipment	. Generally, there are no spare parts existing. Most imported items will be provided under machinery investment, chapter 6.14
- Tools and jigs, handtools, machine accessories	. A complete list was made at the end of August 1983 by the supervisors of the machine shop, the tool making stop and the stores. It is available at the machine shop. . Conclusion: a suitable range of different kind of mills, twist drills, taps and dies has to be purchased. Metric dimensions are especially needed. There is also noticeable a lack of suitable handtools, machine accessories . The value of all these items is about $ 4000.

Details of additional equipment investments are given in Chapter 6.14

5. LOCATION AND SITE CONDITIONS

The existing works area, located in the Cline Town district of Freetown, has enough unused space to accomodate the proposed manufacturing units. Some of the existing buildings are vacant as well.

The general layout, existing and proposed, is shown in Annex 2.

The Government of Sierra Leone owns the entire works area and its improvements which were built as the National Railway Workshop.

Local conditions and environmental impacts

- Investments for location and site	The new company would buy most of the land and buildings
- Annual payments (rent or mortgage)	None
- Transport facilities	- macadamized roads connect the main towns; quality generally good - no railways - harbour less than 1 km from the site - Airport: Lunghi, about 25 km from Freetown, reachable by ferry, which is suitable for transporting 6m-containers
- Water supply	Satisfactory; hookup in September 1983 to municipal supply
- Power supply	Frequent interruptions of electricity. The purchase of a 800 kva-generation is strongly recommended. This generation will not be subject of machinery and equipment investments.
- Waste disposal	Singular problem is the storage of scoria of the foundry. However, there is much unused place to deposit scoria just within the work area.

5. Location and site conditions

- Manpower	Freetown has more than 400'000 people. Actually there is considerable unemployment, so that enough manpower is available.
- Living conditions	Freetown and its environs have a complete infrastructure. The city's road network lacks a principal through-artery, and traffic is very often congested. Adequate public transportation is available, and there is a bus stop in front of the Workshop.
- Fiscal and legal regulations; foreign exchange position	Tax treatment must be negotiated for each new project, as must be eligibility for import duty exemptions. Generally, new projects for import substitution are encouraged, and priority is given to projects which export. The foreign exchange position of the country is difficult, to the point that little is available from the Central Bank to finance imports of raw materials.
- Environmental impacts of proposed project	Social environment: the project would provide much more employment than all alternatives considered, and would pay slightly higher wages than the current practice. More opportunities for skill development would be provided than with alternative projects. Natural environment: No change from the existing situation (National Workshop) is seen. Negative effects are negligible.

6. PROJECT ENGINEERING

The functional lines of the new Workshop would be as follows:

- Manufacturing:
  - . Foundry products (all products except: wheelbarrows, rice winnower, C-I- sheets)
  - . Metal forming products (rice winnover, wheelbarrows)
- Corrugated iron sheets (C-I-sheets)
- Metal fabrication and repair jobbing
- Apprentices' shop (1st, 2nd, 3rd year-apprentices).

Annex 2 shows the general plan of the site and buildings in the works area. The existing and proposed use of each building is indicated, as well as possible extensions for production and storage. The building code-numbers of the plan are those used throughout the study for reference to the plan.

The various shops, production areas, technologies, and equipment are shown treated below.

6.1 Machine shop (building 14) including tool making shop (building 09 and 10)

A list of existing machines showing pertinent data, current utilization and utilization under the proposed project is given in Annex 3. The layout is shown in Annex 4.

6. Project engineering

The existing machine shop has a rather wide range of cutting machines, most of them in acceptable condition. It is obvious that the "backbone" of the shop is the lathes, because it was formerly the repair center of railway shop.

For the needs of the proposed production program, most of the machines can be used except some heavy machines (indicated on plan). These latter, however, could be activated for the repair jobbing division.

The toolmaking shop would be upgraded on a smaller scale, using the existing toolmaking shop (building 09) and additional building 10, which is actually only used at about 20 % of available space.

The necessary additional machinery for the toolmaking shop is shown in schedule 6-1 (under "machine shop"). The new machinery will be placed in building 10.

Annex 5 shows the whole toolmaking room.

The existing arrangement of tools, accessories, equipment, tool lockers, etc., in the entire machine shop is very poor. A comprehensive clean-up is necessary.

In most cases the lighting is satisfactory, but some workplaces need better light.

The other infrastructure (power, water, compressed air, cranes, etc.) is appropriate for the proposed project.

6.2 New metal forming shop (buildings 17 and 18)

At present, these shops are used for welding and for the fabrication and assembly of frames, doors and windows.

As mentioned in chapters 1 and 3, this fabrication would be terminated, and buildings 17 and 18 would be used for the new "metal forming shop".

6. Project engineering

The layout of this shop is shown in Annex 6. The following activities would be executed there:

- pressing
- cutting off of plates, tubes, angle irons
- bending of tubes, plates, etc.
- sawing
- folding
- welding
- assembling of all products (except C-I-sheets) of the new production program
- painting of all products for the new production program.

The halls are very suitable for this kind of fabrication. Lighting has to be improved, but the other infrastructure needs no additional upgrading.

Corrugated iron sheets would not be produced in this building, so there is enough space for all of the equipment of the metal forming shop.

6.3 Production of wheelbarrows

The main fabrication activity in the metal forming shop would be the production of wheelbarrows. In its study of March/April 1983, the Danish firm Ravendo recommended that the Workshop enter into a joint venture with the former for producing wheelbarrows.

In our opinion it is not necessary to have a joint venture for such a simple product, if adequate management is provided. (Detailed recommendations on management are given in Chapter 7).

The detailed steps to manufacture this product are also set out in the Ravendo study, and are retained for the present study.

The pan of the wheelbarrows is cut from flat plate, bent, and spot welded. This method is more labour intensive and requires less costly equipment than the preferred method (for better market acceptance) of pressing the pan so that there are no seams.

The most important steps for manufacturing wheelbarrows are shown in the Danish study.

6. Project engineering

6.4 Storage and transport of wheelbarrows

The semi-finished parts of the wheelbarrows would be moved in special aluminium containers (l x w x h = 700 x 400 x 400 mm) and standardized stepable pallets. For short distances in the work area, pallet-rollers would be provided and diesel forklifts for longer distances.

The work reserves at every workstation/workplace can be sufficient for a month's production by using these means.

Final storage should not be larger than a week's production, because larger stores would tie up too much financial means.

The space needed for a week's storage of finished wheelbarrows is a surface of 20 x 5 m, and would be situated in the same buildings (17 and 18, see Annex 2). For the final storage and transport by lorry, it is proposed to keep the pan separate from the body.

Transportation to customers would be executed by a new 7,0 t lorry, which is mainly needed for the wheelbarrows alone.

Details on storage and transport are shown in Annex 7.

6.5 Production of foundry products and rice winnower

All the remaining nine products (except C-I-sheets and rice winnower) are made entirely or mostly from castings. The technology of grey-iron- and steel-castings is described in Attachment 1.

For all of the products except C-I-sheets, at least some development work has to be done, even for those products with which the National Workshop has some experience (rakes, palm oil press, rice huller).

The development work required is mainly arriving at good quality copies of existing designs, some of which must still be chosen (universal mincer/maize mill, semi-rotary pump, rice huller). For the palmnut cracker, some hard development effort is needed to make the existing motor-driven model appropriate for manual use (by adapting a fly-wheel).

6. Project engineering

The importance of adequate design time is stressed here, because it is often underestimated. The following schedule gives approximate design times required.

Production phase		Product	> 75 % steel	> 75 % grey iron c.	> 75 % steel cast.	actual stat. of design: prototyp. or model	unproven design	proven design	production phase	needed time (man months) for fully designed product ready for lauching into market	Remarks
	1	1. Universal mincer/ maize mill			X	X			1,2,3	3	traditional British product exists
		2. Charcoal iron/ cooking pot		X		X			1,2,3	1,5	
		3. Castings for Guma Valley Water Auth.		X		X			1,2,3	1,5	
		4. Rakes			X	X			1,2,3	1	
		5. Palmoil		X			X		1,2,3	5	
		6. Rice Winnower	X				X		1,2,3	8	Chinese product exists
	2	7. Semi-rotary pump		X		X			2,3	10	French product exists
		8. Palmnut cracker		X		X			2,3	14	fly-wheel technology
	3	9. Rice huller		X		X			3	18	joint venture possible; a traditional British product exists

1) steel casting would be possible, as well, but our calculations are for grey iron.

The first four products could be produced in a short time with the existing resources of the Workshop and are recommended for production starting in the year before installing new equipment.

In order to properly develop products, the new Workshop's Marketing and Engineering Departments must cooperate effectively and receive feedback from production. The creation of a group called "Production support" (see chapter 7) is recommended and plays a vital role here.

Product development would be supervised in most cases by the Chief Engineer, according to a set of steps set out by the General Manager. Annex 8 provides a model for the development steps.

6. Project engineering

6.6 Storage and transport of the remaining products (excluding C-I-sheets)

Storage and transport of the other products (Nos. 1 to 9 in the schedule below) would be executed in the same way as the wheelbarrows; use of aluminium containers, pallets, pallet rollers and forklifts for intermediate storage, final storage and internal transport.

These storage and transport means are not currently used by the National Workshop. Their use is necessary for the material flow of the proposed program. In any case, a manufacturing company should attempt to follow the following guideline:

> unit of production = unit of transport = unit of intermediate and final storage.

6. Project engineering

The relationships between the capacities of working reserves of parts at every work station per product and the final storage of the finished product are as follows:

Product	possible capacity of mean storage at every workstation in buildings 17/18		proposed capacity of final storage in buildings 17/18		surface for mean storage at every workstation	surface for final storage - No of pallets/ container - m x m
	pieces	prod.time in weeks	pieces	prod.time in weeks	m x m	
1. Universal mincer, maize mill	160	1	320	1	1,5 x 1	- 6 pallets of each 9 container - 8 x 1,5
2. Charcoal iron, cooking pots	48	0,2 (1day)				
3. Castings for Guma Valley Water Auth.	16	0,2 (1day)	60 - 80	4 - 5	1,5 x 1	2 p, 8 c 2,5 x 1,5
4. Rakes	80	4	80	4	2,5 x 1,5	2 p, 0 c 2,5 x 1,5
5. Palmoil press	8	1	8	1	4,0 x 1,5	4 p, 0 c 4,0 x 1,5
6. Rice winnower	25	4	8	1	2,5 x 1,5	4 p, 0 c 4,0 x 1,5
7. Semi-rotary pump	42	4	42	4	4,0 x 1,5	4 p, 10 c 4,0 x 1,5
8. Palmnut cracker	8	1	8	1	4,0 x 1,5	4 p, 0 c 4,0 x 1,5
9. Rice huller	indiv.	indiv.	6 - 8	3 - 4	5,0 x 1,5	6 p, 0 c 5,0 x 1,5

p = pallets 1000 x 800

c = container 700 x 400 x 400 mm

For further details see layout of Metal forming Shop, Annex 6. For the road transport of products 1 to 9, the existing 7,0 t lorry would be adequate.

6. Project engineering

6.7 Layout and description of the forging shop (building 15)

The layout is shown in Annex 9. The existing blacksmith shop (building 15) can be used. However, some additional equipment, as shown in Chapter 6.14, is needed.

In the recommended production program, the forging shop has an auxiliary function, as most of the parts fabricated there are parts for finished products.

6.8 Layout and description of the foundry, pattern making shop, and materials testing laboratory (building 16)

The core of the job-creating part of the production program is the foundry.

Although the main part (about $ 500'000) of the investment package would be for the foundry, it is not our intention to establish a full-fledged universal foundry (up to 2000 t capacity per year) as a former study had suggested.

The production program would provide 185 t good casting per year. With reserves included, annual production would be about 200 t. For this capacity, the minimum possible size of equipment was selected, especially for the bottleneck items like the cupola furnace and the electric oven.

This small size permits the utilization of the location of the existing foundry which is favourably located in building 16.

It is proposed to upgrade the existing foundry with equipment and machinery shown in Chapter 6.14.

The layout of the upgraded foundry, pattern making shop and materials testing laboratory is shown in Annex 10. The breaking tower and the place for classified scrap appears in Annex 2, General Layout.

An exact description of all foundry activities, technologies, and preporatory work to be done especially for the requirements of the Workshop is given in Attachment 1.

6. Project engineering

While the selected equipment is of the minimum size, an increase in capacity to about 1000 t good castings per year could be obtained on an additional investment of about $ 80'000 and by increasing the number of workers by 17.

The material testing laboratory and the pattern making shop can be integrated in the same building No 16. For some additional equipment such as storage racks for dies, patterns, tables for the test facilities, an improvement of lighting is required.

In the foundry itself a minimum of civil engineering work, such as a floor and some foundations, has to be done.

It is beyond the scope of this study to describe the work process of every foundry product or semi-finished product, especially since much development work still remains to be done.

6.9 Layout and description of apprentices' shop (part of buildings 03 and 04)

Annex 11 shows the layout of this shop.

A separate apprentices' shop does not currently exist. The 87 apprentices are distributed over all existing shops, and this is one of the reasons for the poor productivity of the National Workshop.

The training of apprentices must be completely reorganized. For this purpose, we provide a separate shop for the apprentices of the 1st, 2nd and 3rd years. The 4th and 5th year apprentices are considered as nearly fully productive skilled workers.

At the same time, we propose a reduction to 25 apprentices. More details on apprentices' training are given in Chapter 8.

The necessary machines and equipment could be taken from among residual machines of the machine shop, which would have to be relocated to buildings 03 and 04. Nevertheless, some new investment is necessary. After reorganization, the new apprentices' shop would not be a "training center" for the whole country, but would bring a considerable contribution to the education of apprentices for the metal working industry.

6. Project engineering

6.10 Layout and description of C-I-sheet fabrication (buildings 03 and 04)

At present, the two required buildings are not in use. They are very suitable for massproduced products like corrugated iron sheets.

With relatively modest investments a profitable production unit could be installed. The direct labour force would be about 8 to 10 workers. The layout for C-I-sheet fabrication is shown in Annex 11.

Production of two qualities is proposed:

- SWG 28: 0,37 mm; 1820 x 660 mm; 1,2 m2; 4,56 kg/sheet
- SWG 34: 0,23 mm; 1820 x 660 mm; 1,2 m2; 2,88 kg/sheet.

Both are from galvanized iron sheet delivered in 5 t-coils. The production process is shown in the Danish study. Quantities at full production would be: 1430 t SWG 34 and 770 t SWG 28. In a later phase, the equipment could be added to produce trapezoidal sheets as well, but required investments are not included in the present study.

It is proposed to install the appropriate facilities for custom (individual) orders in the first phase (at the start of production).

The buildings 03 and 04 are also suitable to store the finished products of 1 to 2 week's production.

The existing cranes must be made operational.

6. Project engineering

6.11 Layout of Repair jobbing and Metal fabrication divisions

As these divisions are not specially analysed in this study and since neither important investments nor modifications have to be done, no detailed layouts are provided. The general location can be seen on the General Layout, Annex 2.

Repair jobbing would be in existing buildings 05, 06, 07, 08. (Existing vehicle repair, electric shop, millwright shop and coopersmith shop.)

Metal fabrication would be located at the existing plating and assembly shop, building 25. The facilities there are very suitable for the proposed activities.

6.12 Nominal feasible and effective production hours at the different workshops of reorganized Workshop

This schedule is shown in Annex 12.

6.13 Technologies

All proposed technologies have been proven over a long period. The products of the program are available on the international market and have proven their usefulness for years.

All manufacturing methods were chosen in such a way that they coincide with the capabilities, technical possibilities, and raw materials available to a reorganized Workshop.

The existing levels of technology, know-how, and skills are rather low at the existing National Workshop. Even simple jobs like turning, milling, and cutting threads are often executed improperly.

6. Project engineering

An important condition for all products except C-I-sheets was the job-creating attribute of the chosen technology. This is one reason why the pan of the wheelbarrow would not be pressed from one piece, but would be spot-welded along cut seams.

The technology for corrugated iron sheet production was chosen from few available alternatives, because it must be at least semi-automated in order to produce the relatively large quantities required to generate enough profit on this low-margin product. It is specifically the cash and profit generating potential of this product which led to its inclusion in the production program.

Therefore, a semi-automated line was chosen. The associated special products such as roof ridgings would be made by simple hand-operated machines.

In product technology, hand-power has been chosen over electric motor or diesel-engine power for the palmnut cracker and the rice huller, because of the high cost of the power-production units, the lack of electricity, and the lack of spare parts for small diesel engines.

However, no manual models of these two products were found during the field work, and appropriate designs must still be found. It appears that at least two companies manufacture hand-operated rice hullers: John Gordon and Co, of the U.K. and CECOCO of Japan.

A large part of the proposed products are made of mainly or entirely cast parts. In Attachment 1, our foundry expert has described in detail the entire foundry procedure especially for the conditions of the Workshop.

6.14 Equipment and machinery

The required additional equipment and machinery was chosen after careful consideration of:

- plant capacity, production, quantities (Chapter 3)
- technology requirements
- existing equipment (Annex 3).

6. Project engineering

On the next pages are given schedules for the necessary additional equipment for the following shops or departments:

- metal forming shop
- machine shop
- foundry and forging (including pattern making, materials testing laboratory)

} product groups A and B

- corrugated iron sheets production

} product group C

- apprentices' shop
- repair jobbing
- metal fabrication

} product group D

- auxiliary and service equipment

A summary of capital requirements of investments is also given.

The production equipment also includes the required additional spare parts, tools, machine accessories, dies, etc. Since only modest investments in buildings and civil works are required, these costs are incorporated in the equipment cost schedule for each of the different shops or departments.

The cost schedules include descriptions of equipment with main technical data, the estimated investment costs, the estimated costs for transport, packing, delivery, duty and insurance.

Although the indicated investment costs for machinery are generally based on new machines, it is emphasized that in most cases second hand machines are very suitable. Since the availability of second hand machines is not certain, prices for new equipment have been used.

The prices in the schedules are average values from different suppliers, except for C-I-sheets, where the costs have been taken from the study by the Danish company Saxton.

In Annex 13, some recommendations on suitable, well-established suppliers are given.

6. Project engineering

Schedule 6-1: Capital requirements (all estimates are in 1000 US $)

DEPARTMENT: FOUNDRY (including wood working/pattern making, forging, material testing laboratory)

	Foreign Currency							Local curr.
Denomination of equipment	Machines	Spareparts	Reserve Fund	Packing, Trsp., duty, insurance	Total New machinery and equipment	Technical drawings	Pattern, dies, tools	Buildings
1. Pattern making and wood working shop								
(existing buildings 16/02)								
1 wood working lathe (or existing lathe adapted for wood working purpose)	3,0							
1 vertical saw with table	1,5							
- renovating exhaust system at wood working shop	1,5							
- diverse hand tools (drilling/milling)	1,0							
- diverse auxiliary instruments for making patterns	2,0							
- improvement of lighting in the existing pattern making shop								1,0
Subtotal 1	9,0							1,0
2. Forging								
(existing building 15, Blacksmith)								
1 air hammer, capacity approx. 140 kpm	8,1							1,4
1 oil heated furnace, inner dim. approx. 700x500x500	11,2							
1 excentric press (existing, to be built)	0,8							
- building existing air hammer	0,9							
1 salt bath furnace	6,6							
1 blower	2,0							
- building existing air hammer	0,5							
2 quenching vats	1,7							
1 grinding machine	2,6							
3 metal hoods, tubes 500x3	0,9							
- various tools for forging (additional to existing tools)	4,0							
- renovating the existing furnace								2,3
- protection equipment for workers							0,7	
- renovation of roof (transparent panels)						0,5		1,8
- improvement of lighting						0,5		1,0
- repair of floor								4,5
Subtotal 2	39,3					1,0	0,7	11,0

6. Project engineering

Schedule 6-1 (cont'd)

DEPARTMENT: FOUNDRY (including wood working/pattern making, forging, material testing laboratory)

Denomination of equipment	Foreign Currency							Local curr.
	Machines	Spareparts	Reserve Fund	Packing, Trsp., duty, insurance	Total New machinery and equipment	Technical drawings	Pattern, dies, tools	Buildings
3. Foundry and material testing laboratory (building 16)								
Laboratory:								
equipment for chemical analysis, sand control, mechanical testing, metallographic tests, temperature control (minimum equipment!)	40,0							5,0
Charge-material preparation:								
1 breaking tower with hand operated cable winder (using existing 520 kg breaking ball)	9,3							2,0
1 repair of existing shear	0,4							
1 oxyacethylene cutting device	0,7							
- various tools, protection equipment							2,3	
Melting and pouring:								
1 induction furnace unit, 130 kW; 0,5 t; Type JTO (Russ Electroofen GmbH, Köln, West-Germany) with: 1 operating crucible - PB gas station - ladle preheater - ladles - closed water cooling system with heat exchanger	158,2					2,0		10,0
rebuilding of existing cupola furnace	17,7					1,0		5,0
Sand preparation:								
1 sand drying drum	12,6							1,0
1 moulding sand mixer unit, 6 kW, complete with container, press control, dosage	12,5							
1 wheeled sand dressing machine, 2 kW	4,5							
1 sand dressing machine (aerator), 2 kW	6,8							
1 core sand mixer machine, 4 kW, complete with iron-oxide dosage, sand, process control	9,1							
Core making:								
CO2 cylinders with electric heating, work benches, core and corebox shelves	6,8							
	278,6					3,0	2,3	23,0

6. Project engineering

Schedule 6-1 (cont'd)

DEPARTMENT: FOUNDRY (including wood working/pattern making, forging, material testing laboratory)

Denomination of equipment	Foreign Currency							Local curr.
	Machines	Spareparts	Reserve Fund	Packing, Trsp., duty, insurance	Total New machinery and equipment	Technical drawings	Pattern, dies, tools	Buildings
3. Foundry and material testing laboratory	278,6					3,0	2,3	23,0
Moulding:								
1 jolt-squeeze moulding machine (e. g. Künkel Wagner, West-Germany)	27,2					2,0		0,4
- inline roller conveyors (approx. 30 m)	9,2					0,5		0,3
3 console cranes	5,1							0,4
- core and pattern plate shelves	0,9							
- hand operated pneumatic rammers	0,9							
10 sand containers with fish-mouth closure	7,0							
50 pcs. casting/charge material containers	4,4							
40-50 flasks in various dimensions	11,3							
1 shake out grid	5,1							1,0
1 transfer cart with rails	3,7							0,2
1 drying chamber	5,9							1,0
Heat treatment:								
1 standard chamber heat treatment oven, 20 kW	13,0					0,5		0,5
1 oil quenching vat, 1 water quenching vat, 1 dipping vat	5,6							0,2
- different tables, shelves, tanks + baskets	4,5							
Fettling:								
1 intermittent turning table; shot blasting cabin with dust exhaust, filter	7,0							0,2
2 grinding machines	2,7							
- building existing grinders	0,5							
1 band saw (existing, to be rebuilt)	0,7							
2 fettling workplaces	6,5							0,1
1 oxyacetylene cutting device	0,8							
- diverse pneumatic hammers, cutters, grinders	3,5							
	404,1					6,0	2,3	27,3

6. Project engineering

Schedule 6-1 (cont'd)

DEPARTMENT: FOUNDRY (including wood working/pattern making, forging, material testing laboratory)

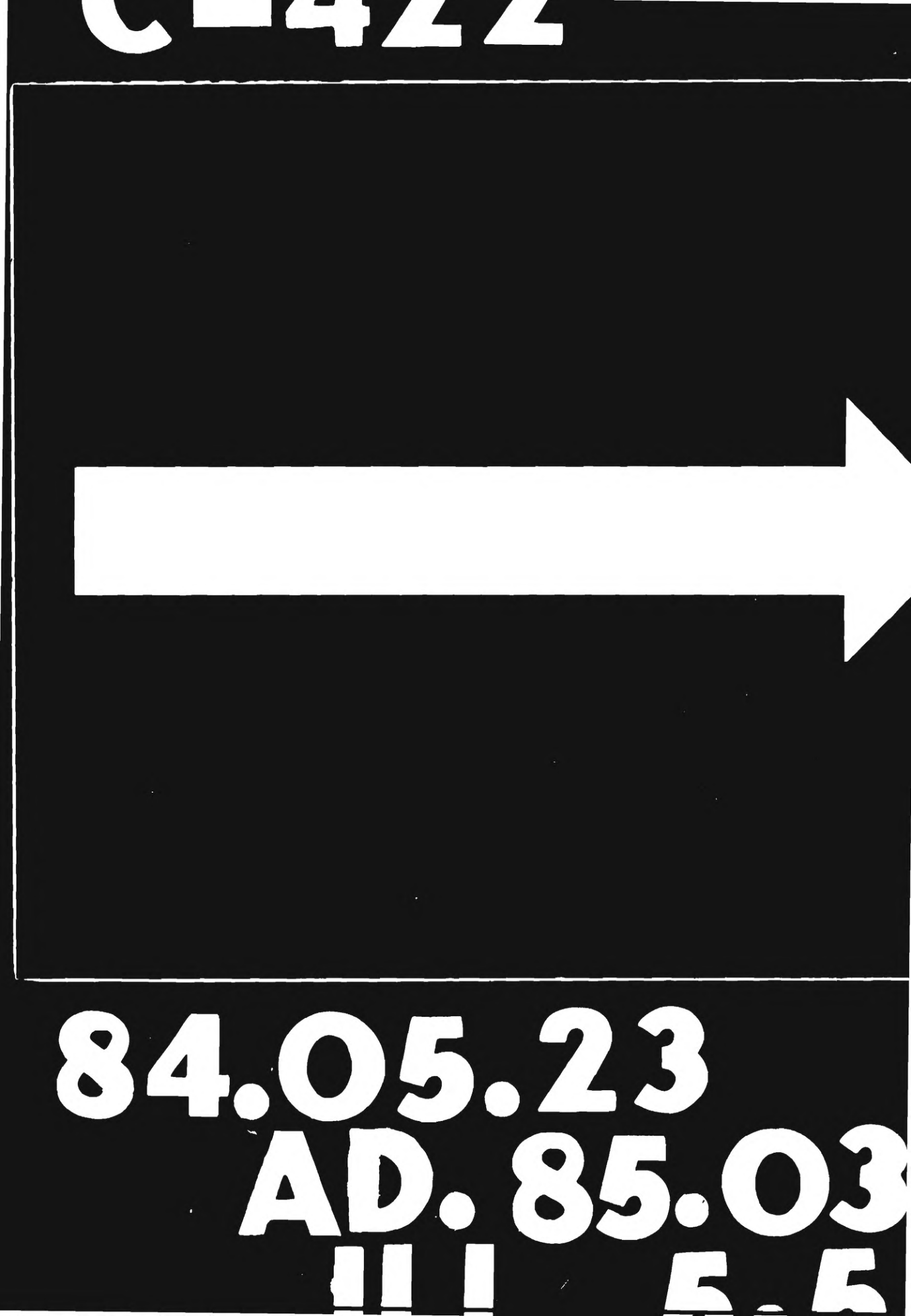
	Foreign Currency							Local curr.
Denomination of equipment	Machines	Spareparts	Reserve Fund	Packing, trsp., duty, insurance	Total New machinery and equipment	Technical drawings	Pattern, dies, tools	Buildings
3. Foundry and material testing laboratory	404,1					6,0	2,3	27,3
Exhaust and arrestor system equipment; auxiliary material:								
chimneys with self ventilation for sand drying drum, moulding sand mixer, sand dressing machine	2,3							0,2
exhaustors with wet arrestors for following facilities (20 kW, 10 m3/h water) - shake out grid - oil quenching vat - sand blasting equipment - grinding machines fetting workplaces	16,0							5,0
protection equipment for ca. 20 workers							2,0	
diverse material							10,0	
Subtotal 3	422,4					6,0	14,3	32,5
Subtotal 2	39,3					1,0	0,7	11,0
Subtotal 1	9,0							1,0
Total	470,7		91,8	117,6	680,1	7,0	15,0	44,5

6. Project engineering

Schedule 6-1 (cont'd)

DEPARTMENT: METAL WORKING-SHOP

Denomination of equipment	Foreign Currency							Local curr.
	Machines	Spareparts	Reserve Fund	Packing, Trsp., duty, insurance	Total New machinery and equipment	Technical drawings	Pattern, dies, tools	Buildings
1. Section cutting/tube bending/plate bending (buildings 17/18)								
4 universal cutting machines (electric) (shearing machine)	30,0							
1 plate shear	3,5							
1 folding machine (for wheelbarrows)	3,2							
1 pneumatic folding machine for pans (wheelbarrows)	7,7							
2 tube bending machines, manual								
1 pillar drilling machine	3,0							
1 autogene welding including 2 cyl. oxygene + acetylene	2,0							
1 universal plate bending machine (2nd hand)	1,0							
- relocation of existing equipment of building 17+18 (General layout)	10,0							5,0
2. Section pressing/welding/sawing/painting (building 17/18)								
1 spray painting box dry	6,0					0,3		0,5
2 spray painters (air dry painting)	2,6							
1 pneumatic plant including 350 l tank	4,2					0,3		0,5
1 conveyer system	8,1					0,8		1,0
3 AC/DC-welding machines	6,0							
1 circular saw	3,5							
2 standard fly press 9,5 t	1,5							
1 excentric press	12,0							1,0
1 spot welding machine	9,0							
3. Miscellaneous								
pneumatic/lubrification/cooling equipment								3,0
machine installation								5,0
electric/hand tools							2,5	
machine tools							1,0	
jigs/machine attachments							2,0	
spare parts		2,5						
auxiliary material/accessories							3,5	
Total	113,3	2,5	23,2	28,3	167,3	1,4	9,0	16,0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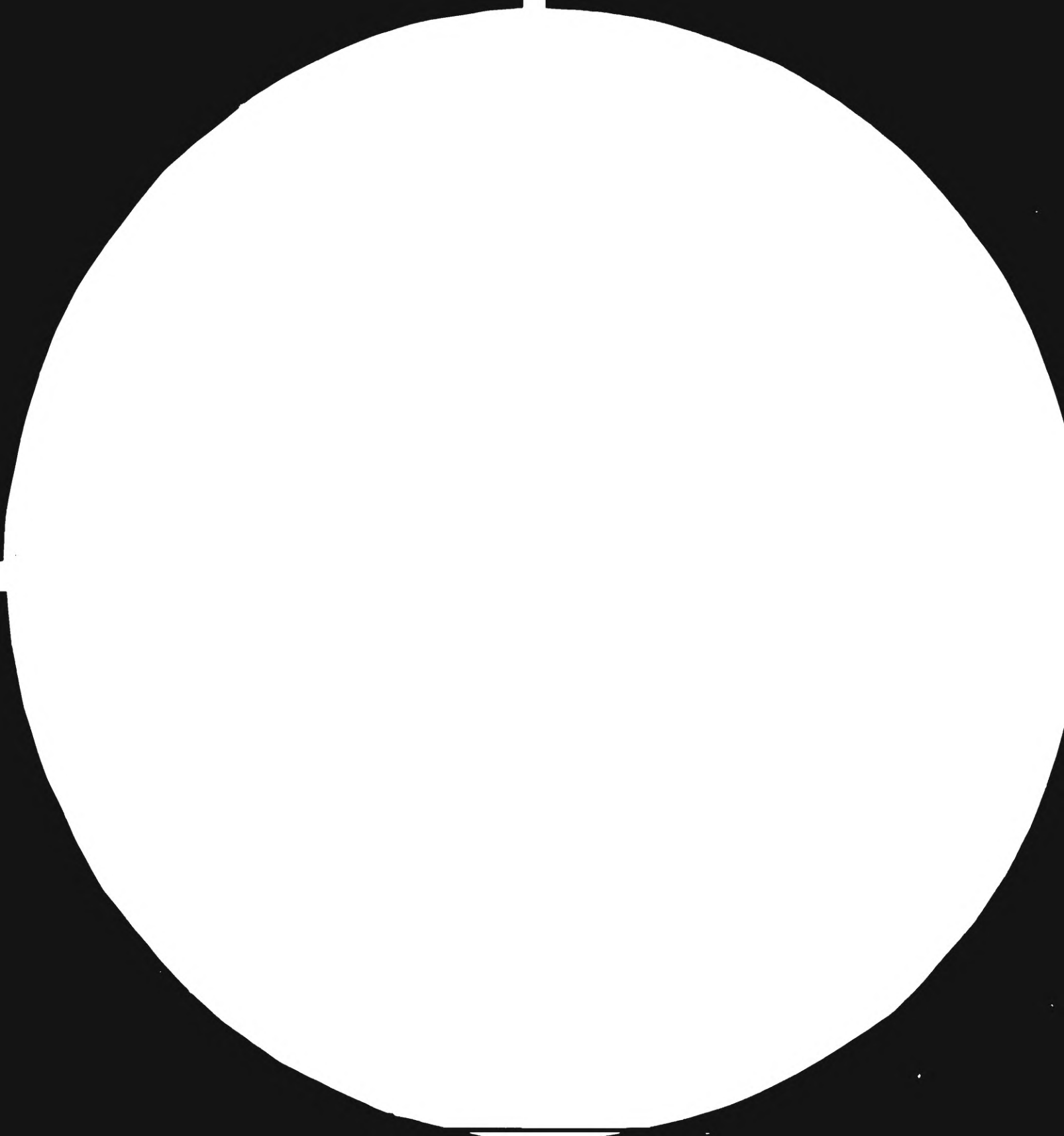

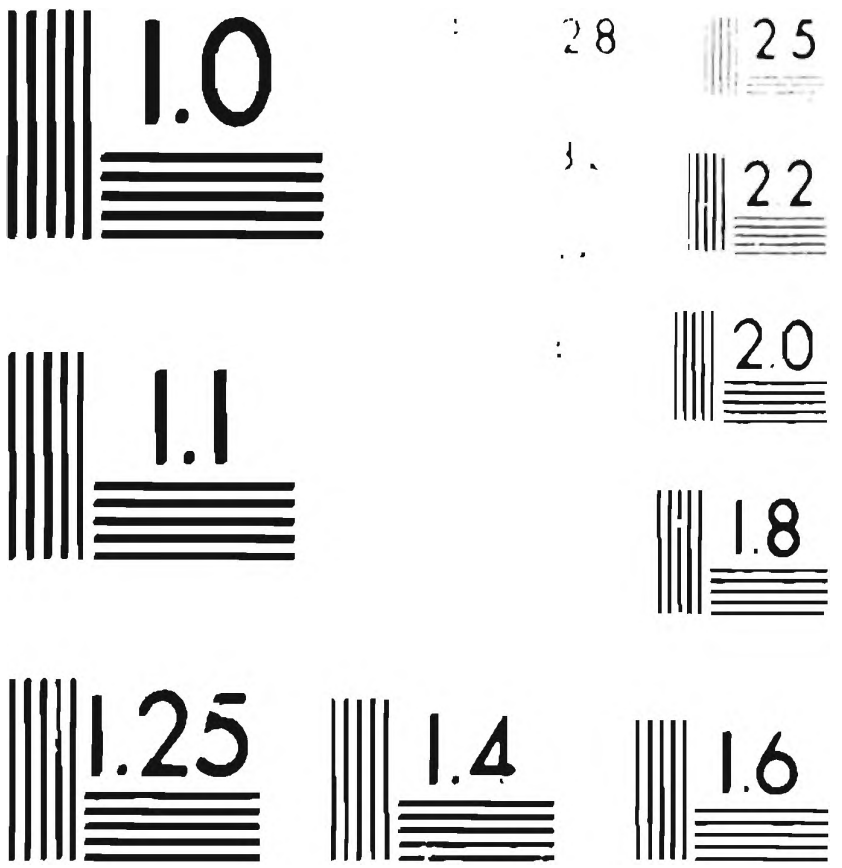
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2.8

6. Project engineering

Schedule 6-1 (cont'd)

DEPARTMENT: MACHINE SHOP

Denomination of equipment	Foreign Currency							Local curr.
	Machines	Spareparts	Reserve Fund	Packing, Trsp., duty, insurance	Total New machinery and equipment	Technical drawings	Pattern, dies, tools	Buildings
1. Section: turning/shaping/milling/drilling (building 14)								
general renovation of 6 lathes, 4 milling machines, 3 drilling machines, 1 shaping machine (all existing)	28,0							
2 pillar drilling machines (all indicated in annexe 3)	14,0							
2. Section: grinding/tool making shop (building 09/10)								
1 surface grinder (2nd hand)	15,0							
- renovation of existing centre grinder	3,0							
- relocation of parts of equipment for toolmaking shop; preparing building 10 for upgraded tool making shop								4,0
- general renovation of existing tool making facilities	10,0							
- relocation and renovation of 2 existing lathes of machine shop	4,0							2,0
1 precision toolroom lathe Ø 200/350	18,0							
1 universal toolroom milling machine 400x850	25,0							
1 centre grinder Ø 100x500 (2nd hand)	15,0							
1 pantog aph milling machine	12,0							
1 copying-wire erosion machine	10,0							
1 power saw Ø 200	8,0							
1 pillar drilling machine Ø 40	5,0							0,4
3. Miscellaneous								
pneumatic/lubrification/cooling equipment								2,0
machine installation								10,0
electric/hand tools/measuring instruments							12,0	
machine tools							5,0	
jigs/machine attachments							4,0	
spare parts		4,0						
auxiliary material/ accessories							3,7	
technical drawings						5,0		
Total	167,0	4,0	33,4	40,8	245,2	5,0	24,7	18,4

6. Project engineering

Schedule 6-1 (cont'd)

DEPARTMENT: FABRICATION OF CORRUGATED IRON SHEETS (C-I-SHEETS)
(buildings 03/04, partially)

	Foreign Currency							Local curr.
Dencmination of equipment	Machines	Spareparts	Reserve Fund	Packing, Trsp., duty, insurance	Total New machinery and equipment	Technical drawings	Pattern, dies, tools	Buildings
1. Production equipment								
1 plate rolling mill including profile quillotine shear utilizable width = 760 mm = with of unprocessed sheets 0,37/0,23 mm	75,0							
1 distribution table for rolling mill	0,5							
2 reeling machines for 5t coils	8,5							
2 lifting yokes	1,0							
2 straps for lifting coils	0,7							
1 bending machines, manual	3,8							
2 carts	0,9							
1 splitting and working table	3,6							
1 binding tool for packaging, manual	1,4							
2. Miscellanous								
machine installation (buildings; costs for mounting, travelling, lodging)								15,3
technical drawings						6,0		
various hand tools: grinders, drilling machine, nippling machine							2,9	
spare parts		3,4						
Total	95,4	3,4	9,0	7,0	114,8	6,0	2,9	15,3

6. Project engineering

Schedule 6-1 (cont'd)

DEPARTMENT: APPRENTICES' SHOP
(buildings 03/04, partially)

Denomination of equipment	Foreign Currency							Local curr.
	Machines	Spareparts	Reserve Fund	Packing, Trsp., duty, insurance	Total New machinery and equipment	Technical drawings	Pattern, dies, tools	Buildings
- relocation of the following existing machines of machine shop to the new apprentices shop: 2 lathes, 2 AC/DC-welding machines, 1 shaper; rebuilding the machines	4,0							1,0
- appropriate machines for apprentices shop (2nd hand)								
1 horizontal milling machine	15,0							
1 vertical milling machine	15,0							
1 pillar drilling machine Ø 30	5,0							
1 bench drilling machine	2,0							
1 surface grinding machine (2nd hand)	15,0							
1 centre grinding machine (2nd hand)	15,0							
Miscellaneous								
pneumatic/lubrification/controlling equipment								1,0
machine installation								4,0
electric/hand tools/measuring instruments							4,0	
machine tools							2.0	
jips, machine attachments							1,5	
spare parts		2,0						
auxiliary material, accessories							2,5	
technical drawings						2,0		
work benches with vises (15)	6,0							
Total	77,0	2,0	14,9	19,3	113,2	2,0	10,0	6,0

6. Project engineering

Schedule 6-1 (cont'd)

DEPARTMENT: AUXILIARY INVESTMENTS AND SERVICE EQUIPMENTS
(diverse buildings)

	Local currency					Foreign Currency		Local curr.
Denomination of equipment	Machines	Spareparts	Reserve Fund	Packing, Trsp., duty, insurance	Total New machinery and equipment	Technical drawings	Pattern, dies, tools	Buildings
- upgrading engineering/desing office	5,0							
- transformer (existing 300 kVA) to be extended to 500 kVA *	3,0							
1 truck with 6 m load ramp	50,0	5,0						
2 fork lifts, diesel	20,0							
40 pallets							2,0	
120 alu-containers (20 x 40 x 40 cm)							6,0	
- storage racks							3,0	
2 binding machines for the stores	2,0							
- civil engineering of the work area (macadamizing paths)						2,0		10,0
- measuring and control instruments for quality control							4,0	
- improvement of illumination in the workshops (machine and metal forming)						1,0		5,0
- general office equipment for additional offices (furniture, office machines)							6,0	
- telex (2nd hand) (Siemens)	1,5							
- miscellaneous: hand rollers for pallets, etc.	3,5						4,0	2,0
Total	85,0	5,0	18,8	21,3	130,1	3,0	25,0	17,0

* It is assumed that uninterrupted electric current will be guaranteed by authorities.

6. Project engineering

Schedule 6-1 (cont'd)

DEPARTMENT: REPAIR JOBBING
(except: vehicles repair) (buildings 05/06/07, existing)

Denomination of equipment	Foreign Currency							Local curr.
	Machines	Spareparts	Reserve Fund	Packing, Trsp., duty, insurance	Total New machinery and equipment	Technical drawings	Pattern, dies, tools	Buildings
2 bench drilling machines	2,0							
1 pillar drilling machine	5,0							
1 double bench grinder	0,5							
- electrical hand tools	0,5							
8 tool boxes	2,0							
- installation								
- auxiliary material							1,0	
Total	10,0		2,2	2,5	14,7	-	1,0	-

DEPARTMENT: METAL FABRICATION

The former "Plating" shop (building 25) is used for metal fabrication and remains as it exists today	-	-	-	-	-	-	-	-

6. Project engineering

Schedule 6-2: Summary of schedule 6-1, Capital Requirements

Denomination of equipment	Foreign Currency: Machines	Spareparts	Reserve Fund	Packing, Trsp., duty, insurance	Total New machinery and equipment	Technical drawings	Pattern, dies, tools	Local curr.: Site preparation, building, modification
MANUFACTURING DIVISION								
A Foundry								
- Pattern making/wood working shop	9,0							1,0
- Forging shop	39,3					1,0	0,7	11,0
- Material testing laboratory	40,0							5,0
- Foundry	382,4					6,0	14,3	27,5
Total Foundry	470,7	-	91,8	117,6	680,1	7,0	15,0	44,5
B Metal forming								
- Metal working shop	113,3	2,5	23,2	28,3	167,3	1,4	9,0	16,0
- Machine shop (including tool making shop)	167,0	4,0	33,4	40,8	245,2	5,0	24,7	18,4
C C-I-sheet fabrication	95,4	3,4	9,0	7,0	114,8	6,0	2,9	15,3
Apprentices shop	77,0	2,0	14,9	19,3	113,2	2,0	10,0	6,0
Auxiliary investments and service equipment (for manufacturing division)	-	-	-	-	-	3,0	25,0	17,0
Total Manufacturing division (including Apprentices' shop)	923,4	11,9	172,3	213,0	1320,6	24,4	86,6	117,2
Total Manufacturing division (without Apprentices's shop)	846,4	9,9	157,4	193,7	1207,4	22,4	76,6	111,2
D Repair jobbing and metal fabrication								
- Repair jobbing	10,0	-	2,2	2,5	14,7	-	1,0	2,9
- Metal fabrication	-	-	-	-	-	-	-	-
TOTAL WORKSHOP (including Apprentices' shop)	933,4	11,9	174,5	215,5	1335,3	24,4	87,6	120,1*
						112,0		
TOTAL WORKSHOP (without Apprentices' shop)	856,4	9,9	159,6	196,2	1222,1	22,4	77,6	114,1
						100,0		
	Local currency							
Auxiliary investments and service equipment (for manufacturing division)	85,0	5,0	18,8	21,3	130,1			

Notes: : Indicates a subtotal or total which is used in the worksheet of Schedule 6-2

* : "Site preparation, building modifications" has the following components:

Local currency	: Site preparation, building modification	106,2
Local currency	: New building	2,2
Foreign currency	: Building modification	11,7
	Total	120,1

6. Project engineering

Schedule 6-3: Worksheet for input table on total initial investment costs

All figures are from Schedule 6-2 and are expressed in thousand US dollars.

- Fixed investment costs, foreign currency

. building modifications		11.7
. new machinery and equipment		
- foundry	680.1	
- metal forming (167.3 + 245.2)	412.5	
- corrugated iron sheets	114.8	
- repair jobbing and metal fabrication	14.7	
- apprentices' shop	113.2	
	1'335.3	1'335.5
. auxiliary services and equipment		112.0
SUB-TOTAL		1'459.0

- Fixed investment costs, local currency

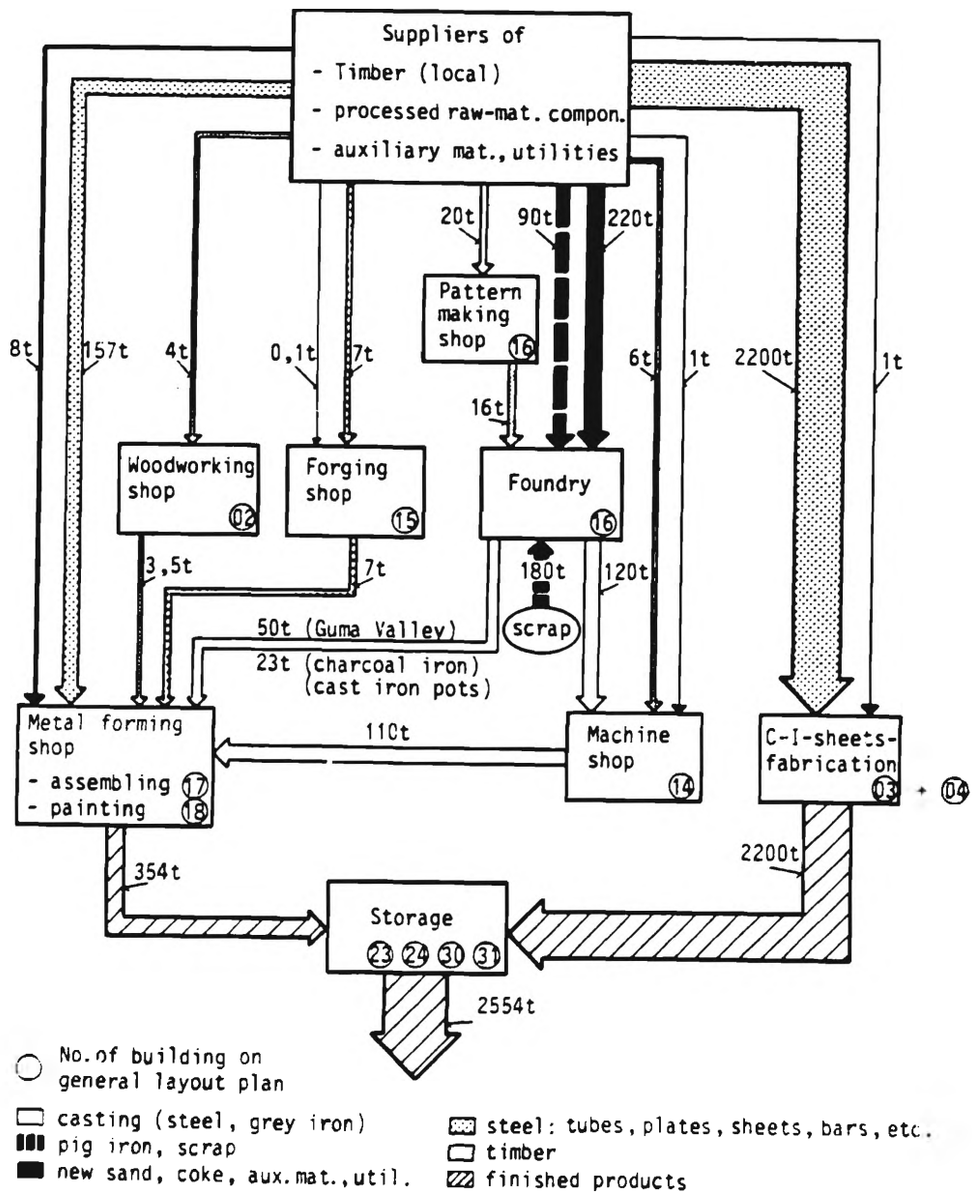
. site preparation, building modification	106.2
. new buildings	2.2
. auxiliary services and new equipment	130.1
SUB-TOTAL	238.5

6. Project engineering

6.15 Material- and quantity flow

Flows for manufactured products (product groups A, B, and C) from supply through the various shops to storage and to customers are shown in Figure 3.

Figure 3: Material- and quantity-flow diagram of manufacturing division (product groups A, B, and C)



7. COMPANY AND PLANT ORGANIZATION

The proposed production program requires a new manufacturing-oriented and market-oriented organization. The existing organization is not at all suitable.

7.1 Company organization

The recommended form for the new company is shown graphically in Figure 4 and is explained below.

- Board of directors and general management

  The 5 to 7 directors would represent the private and governmental shareholders. The board of directors is, in the largest sense, the highest control organ.

  The role of the existing Top Management will be further explained in Chapter 8.2.

  The general manager can be a member of the board, but in any case, he is directly responsible to the board of directors and is also recruited and elected by them.

- Divisional organization and cost centers

  There are three divisions directly put under control of the general manager.

  As has been done for the financial analysis of the present study, four production cost centers are distinguished.

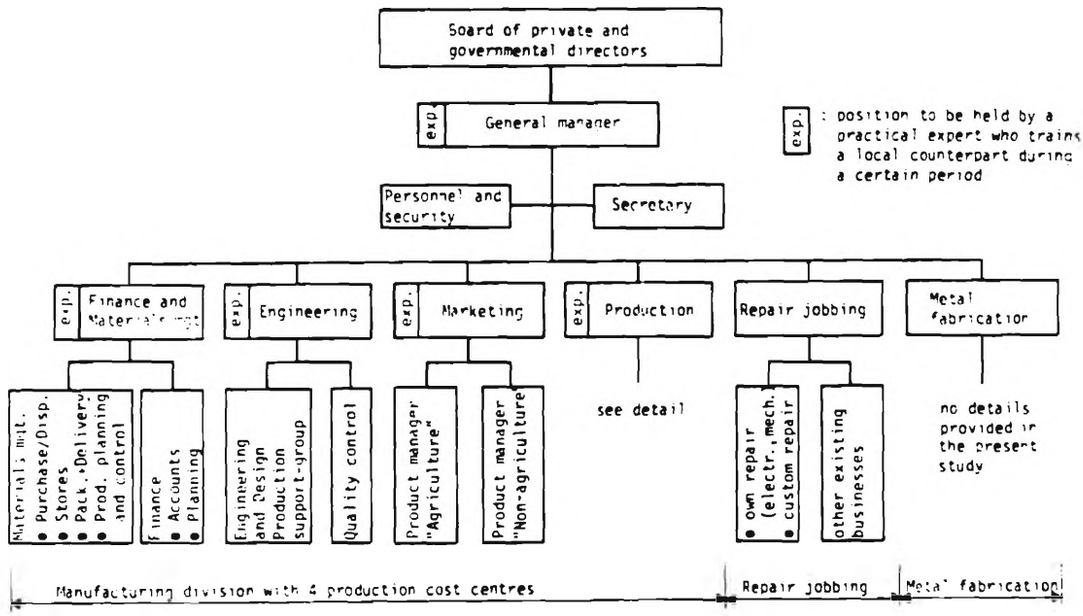
  . A, foundry products
  . B, metal forming products (wheelbarrow and rice winnower)
  . C, corrugated iron sheets
  . D, metal fabrication and repair jobbing.

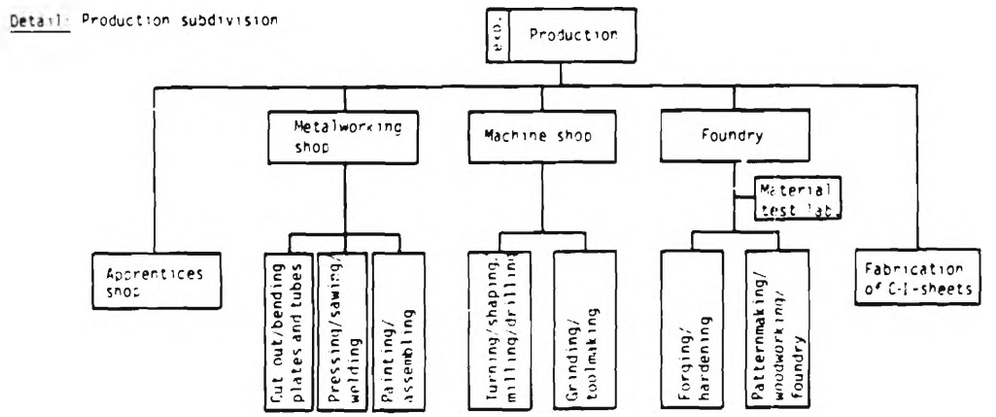
  Cost centers A, B, and C are part of the manufacturing division.

  The administrative cost centers include the apprentices' shop as it is non-productive.

7. Company and plant organization

Figure 4: Organization chart of the reorganized Workshop





7. Company and plant organization

- Manufacturing division

This division is the most important element and, at the same time, the main subject of this study. It would be responsible for manufacturing the production program.

The division consists of three production cost centers: A, B, and C as shown above, and four administrative/finance cost centers ("Personnel and Security", "Finance and Material Management", "Engineering", and "Marketing").

About 80 % of the annual revenues at full production would be realized in this division.

Another characteristic of this division is the serial production of goods in quantities of 300 to 6000 pieces per year.

Proper organization of this division presupposes the use of appropriate means and measures as, for example:

. management guideline manual (management philosophy)

. job descriptions for key positions

. resolute on-the-job training.

Especially important, moreover, is efficient cooperation between the 4 to 5 experts who would hold the key positions and their local counterparts.

Chapter 8, "Manpower", gives details on this cooperation.

The personnel requirements (number and skills) of every division, subdivision and section are also given in Chapter 8.

7. Company and plant organization

- Repair jobbing [1]

A manager runs this division as a cost center with the following activities:

. execute own repair and maintenance of electrical and mechanical machines and devices, execute simple civil engineering works.

. execute repairs by custom order, using the machinery of the manufacturing division if necessary. The manager of the repair jobbing division should try to get those custom orders, among others, which allow an additional utilization of the residual machines.

Examples: orders where lathes are used: repair of wheels, axles, disc-brakes, etc.

. execute the other currently existing service-businesses at the Workshop [2]

- woodworking furniture [3]
- coppersmith shop
- repair of vehicles
- refrigerator shop [3]
- upholstery shop.

- Metal fabrication [4]

This division, would also be a production cost center and would make custom-ordered, bulky welded-plate items such as

. vats

. vessels and tanks

. storage bins and hoppers.

1, 4) The repair jobbing and metal fabrication division, which would generate about 20 % of revenues, are not further treated in this study. Nevertheless, we emphasize the importance of these units, from the interim period until start-up of the Workshop. The activities to be increased during the interim period are described in Chapter 9.

2) Other existing businesses are not part of the financial analysis of the present study.

3) To be phased out.

7. Company and plant organization

7.2 Role of the experts

In our opinion, a successful reorganization of the Workshop and implementation of a new production program by using additional new machinery can only be done, if the key positions mentioned in the organization chart are held by appropriate experts.

These experts would have executive functions in the project organization, which has to be set up before start-up (see Chapter 7.3).

Each expert would train a local counterpart who would study every decision the expert makes. After a certain introduction time, the expert should delegate some selected jobs to the counterpart. It is obvious that close cooperation between the experts and counterpart is essential.

The experts must have proven, practical experience in:

- similar executive management jobs
- working in developing countries.

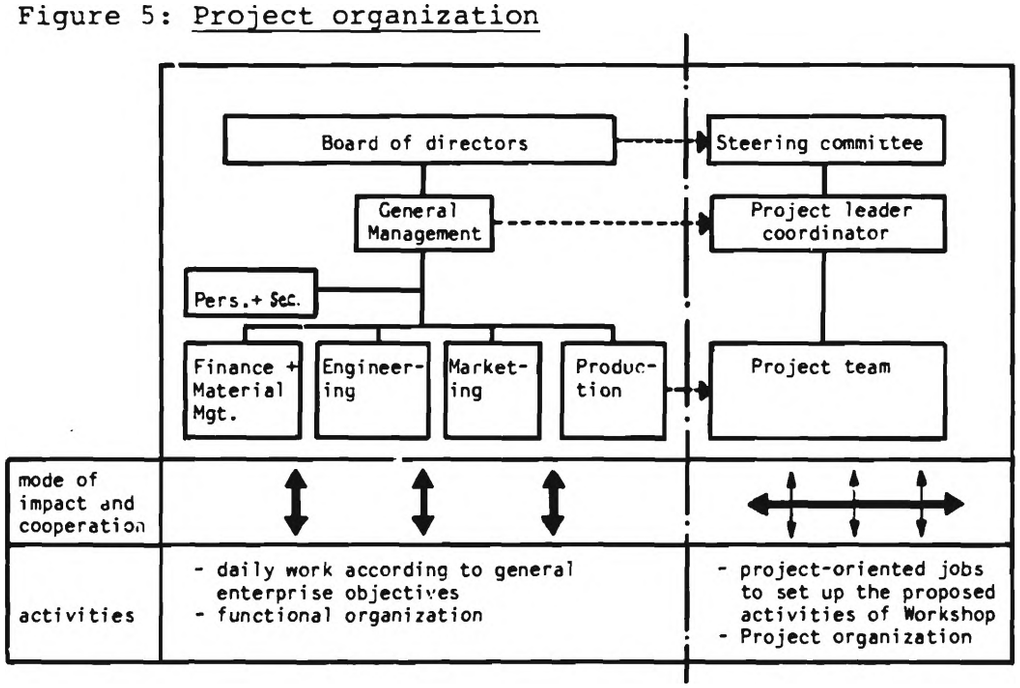
The expert must not be a theoretician. It is not even necessary, in our opinion, that he hold a university degree.

The recommended profiles for the experts are given in Chapter 8 in the job descriptions for the important managerial positions.

7. Company and plant organization

7.3 Project organization

Figure 5: Project organization



This matrix project organization should be set up as soon as:

- the legal status of the Workshop is defined (see Chapter 9)
- governmental- and private shareholders are named
- all financial arrangements are finalized.

7. Company and plant organization

All individual steps are further explained in Chapter 9, "Implementation scheduling".

> We strongly emphasize that no activity to reorganize the Workshop should be undertaken unless the 3 elements of project organization are constituted as described below.

(1) Steering committee

This committee would have about 3 members, all recruited from the board of directors. Their functions are of supervisional and decisive nature. The project leader would make a progress report to the committee at least every 3 months. The committee also would have a consulting function.

(2) Project leader, coordinator

In this case, the project leader should be the general manager. Results will depend on his skills and on his ability to cooperate with the project team.

(3) Project team

The project team should consist the managers of finance, engineering, marketing, and production, who are all experts. Some representatives of the middle management should also be included.

The project team has planning and executive functions, including the following:

- to conceive, evaluate and supervise the detailed plan for installing the proposed machinery and equipment (mainly the task of the production manager)
- to work out final product designs and marketing plan for the entire production program (mainly the tasks of the marketing and engineering managers)
- to set up the new functional organization; to hire the appropriate middle and low management positions
- to take all required measures to fulfill the entreprenurial objectives.

7. Company and plant organization

7.4 Plant organization

Some new functions appear in the organization chart as shown in Chapter 7.1. They are described below.

- Material management

  This subdivision consists of the following components:

  . Purchasing:

  Selection of suppliers, quantities, purchase prices, delivery conditions

  . Disposition:

  Ensuring that the optimum quantities and qualities of required materials are in stock. Shortages are to be avoided. Too large stocks give high rates of capitalization which should be avoided. Disposition tells purchasing when it has to order and specifies the optimum order-quantity.

  . Packaging and delivery:

  (part of the stores)

  . Production planning and control:

  Serial production (like the recommended program) is usually produced in (monthly) lots. For every product there are lots for the different subassembly groups and final assembly groups. Consequently, the different lots of different products overlap each other.

  In order to get a homogeneous utilization of machinery and labour, the group "production planning and control" has to work out appropriate planning tables where the mutual interdependency of the individual lots are indicated. In this sense, the group has a process control function.

7. Company and plant organization

- Engineering and design; product support

  . Engineering and design:

  Responsible for the function, design, reliability, and quality of a product. Industrial experience has shown that quality, factory costs, and reliability are more than 60 % determined by the design of a product.

  . Production support group:

  The design office specifies the product's features, but it does not specify how to produce a product with given machinery and equipment. Here, the group "production support" creates the link between engineering and manufacturing. The drafts of an assembly-group of a product or of the entire product have to be examined by the production support group. They tell the engineering and design group whether existing means are sufficient. For this reason, very tight cooperation of both groups is required.

  The production support group also elaborates, by using the job master cards described in Chapter 7.5, the detailed work plans for manufacture of the products.

- Marketing

  . Product manager, "agricultural" products

  Agriculture-related machines and equipment are important to the production program, and will probably find an important place in it over the long term. Moreover, much development work is needed for the products of the recommended program and for products which might be added later. Thus, a separate product manager, having some agricultural experience, would be required. He would have a key role in product development, and would be responsible for finding the most appropriate distribution system, for pricing, selling, and the sales performance of the products.

7. Company and plant organization

. Product manager, "non-agricultural" products

This manager would have less development work to look after, but would have the same types of responsibilities as the other product manager. He would have a particularly important task in pricing, because sales of many of his products may turn out to be very price-sensitive. He would also have to be good at selling to export markets, because his products include all those planned for export.

- Production

No special comments on production organization are required for the recommended production program.

- Apprentices' shop

This is a new element in the organization structure. Here, the apprentices of 1st, 2nd, and 3rd year are trained by the shop supervisor, a man who must have a wide experience in training apprentices.

One of his very first jobs will be to elaborate, together with the personnel manager, a detailed training plan, which would indicate the timing and length of each activity. For each activity should be indicated:

. year of apprenticeship
. theory and practice
. time duration and order of every activity.

7. Company and plant organization

7.5 Special organizational measures

To arrive at smooth and trouble-free production runs, it is necessary to introduce a package of special organizational measures, which can only be finalized in a detailed planning study, which must be undertaken by the production support group. One of the more important measures is the establishing of job cards, where the kind and order of every single operation on a part or product assembly is described. This will be one of the first responsibilities of the newly created group. These job cards also promote correct material-flow and the proper identification of material.

Annex 14 shows an example of a job card and an explanation for its use.

8. MANPOWER

8.0 Fundamental statements

A summary of the manpower requirements is presented in Schedule 8-1a. The estimates for direct labour were based on the calculations of the times needed to produce the quantities of products given in the reference program.

The requirements for indirect labour and staff for handling, stores, packaging, transport, delivery, and administration were estimated using experience with similar manufacturing companies in developing countries as a reference.

Schedule 8-1a shows that, compared to European standards, the numbers of supervising and managing personnel, as well as administrative an technical staff, are high. Indirect labour is also great compared to direct labour.

These manpower requirements are necessary for the conditions in Sierra Leone.

In our opinion one of the most important preconditions for a successful production run is that all staff without managerial or supervising functions have to be led, instructed and controlled very carefully. For efficient supervision, the range of control of one leading person must not be too extensive. European standards can not be applied.

A verification for key positions or departments is given in Chapter 7.4 "Plant organization".

The reasons for the apparently large number of administrative and technical staff are the following:

8. Manpower

- Well-qualified management would be able to correct the existing poor performance of the National Workshop. However, more manpower is needed for a particular job in the workshop than for a comparable job done in a European country.

- There is actually a considerable lack of planning, engineering and designing capacity at the workshop. To equalize this gap, the workshop needs a well endowed number of adequate qualified personnel. When the workshop has improved this capacity, some reductions in manpower could be provided.

In referring to the National Workshop after reorganization two terms are used:

- "new company" includes all the business lines (263 people)

- "Workshop" includes Product Groups A, B, C, and D as well as the Apprentices' shop (237 people).

The analysis of the needs for manpower gives the following main results:

- The new company would employ 263 people, as compared to 341 now employed by the National Workshop.

- Production-related personnel would number 118 in the manufacturing division (product groups A, B, and C) and 31 in the repair jobbing and metal fabrication division (product group D).

- In the other existing lines of business 26 people would be employed; fresh management techniques might result in a significant expansion of these lines and, thus, more employment.

- Management and related administrative personnel would number 69.

- The Apprentices'shop would count 19 people, 15 of it are apprentices in 1st, 2nd, 3rd year.

- The largest decrease is among apprentices who would be reduced from 87 to 25; the 62 redundant apprentices could be laid off gradually over two years.

8. Manpower

Schedule 8-1a: Manning table: manpower for reorganized Workshop, Product Groups A, B, C, and D and Apprentices' shop

Note: This schedule is used in the financial analysis

		Managers	Chief supervisors	Supervisor	Foremen	Secretaries	Admin.+technical staff *	Skilled workers	Unskilled workers	Apprentices 4, 5 yr.	Apprentices 1, 2, 3 yr.	Experts	Totals
Product Groups A and B **													
Foundry	hot and cold forging			1	1			5		1			
	harcening							1					
	pattern making							3					
	woodwork products			1	1			4	1	2			
	preparing founding							6					
	founding and rough casting			1	1			8	3				
	material testing						1						
Machine Shop	turning				1			6					
	shaping							1					
	milling			1	1			4	2	2			
	drilling				1			3					
	grinding			1	1			1	1	1			
	toolmaking							6					
Metal Forming Shop	Cut out				1			4					
	bending tubes, profiles			1				1	2	1			
	bending plates				1			2					
	pressing				1			2					
	welding							5					
	sawing			1	1			1	3	1			
	painting							2					
	assembling				1			5					
Product group C	Fabrication of C-I-sheets			1			1	5	3				
Subtotal 1:	Manufacturing Division			7	11		2	75	15	8			118
Product group D	Repair jobbing division		1	2			2	5	8	1			
	Metal fabrication division		1	1			2	4	3	1			
Subtotal 2:	Product Group D		2	3			4	9	11	2			31
1	Total non-management production related personnel (Subtotal 1 and Subtotal 2)		2	10	11		6	84	26	10			149
Management Overhead	General Manager	1				1						1	
	Personnel and security	1					13 a						
	Finance and material	1	2				17 b						
	Chief Engineer	1	2			2	14 c					1	
	Marketing	1	2				2					1	
	Production	1	3				1 d					1	
2	Total management related personnel	6	9			3	47					4	69
3	Apprentices' shop			1	3						15		19
	Total personnel of reorganized Workshop (sum, lines 1+2+3)	6	11	11	14	3	53	84	26	10	15	4	237
	Workers							110					
	Apprentices									25			

* Administration and technical staff:
a = pers assist.: 1 / tel.: 1 / post: 1 / security: 6 / auxiliary jobs: 4
b = stores, packing, delivery: 6 / forklift: 2 / chauff.: 3 / purchase: 1 / PPC: 2 / fin. + acc.: 3
c = quality control: 6 / prod. support: 2 / engineering and design: 3 / draughtsmen: 3
d = assistant

** Distribution of workers of machine shop and metal forming shop:
2/3 for product group A, 1/3 for product group B

8. Manpower

Schedule 8-1b: Manning table: entire new company including other existing business

		Managers	Chief supervisor	Supervisor	Foremen	Secretaries	Admin. + technical staff	Skilled workers	Unskilled workers	Apprentices 4, 5 yr.	Apprentices 1, 2, 3 yr.	Experts	Totals
Other existing business	woodworking furniture			1				4	1				
	coopersmith shop			1				3	3				
	repair vehicles			1				4	2				
	refrigeration shop				1			2					
	unholstery				1			1	1				
Total personnel, other existing business				3	2			14	7				26
Total personnel Product Groups A, B, C, D and Apprentices' shop													237
Total personnel, entire new company													263

Note: In the present study, no revenues or costs are estimated for the "other existing business". This schedule is presented to show the suggested reorganization of "other existing business" and the total number of personnel at the Workshop.

The total of 26 people in "other existing business" is valid immediately after reorganization; new management techniques would provide the opportunity for these business lines to flourish, and thus for the number of personnel to increase.

8. Manpower

- For most, if not all of, the residual 16 employees [(341 - 263) - 62 = 16], temporary work at the Workshop could be provided to:

  . clean up the works area: work for 5 to 8 people for one year.

  . separate and sort scrap iron and steel: work for 8 to 10 people for more than one year.

  Any of the residual employees reaching retirement age should not be retained.

The schedule below shows some indications of manpower performance, with the proposed new workshop compared to the existing National Workshop.

	US $ turnover (revenue) per employee	
	existing N.W.	new workshop
Workshop including apprentices' shop	$\frac{138,060}{341} = 405$	$\frac{3'231'000}{237} = 13'633$
Workshop without apprentices' shop	$\frac{138,060}{254} = 544$	$\frac{3'231'000}{218} = 14'821$

Some details of the analysis are given below.

8.1 Direct labour (134)

About half (110) of the workforce (237) of the new workshop would be skilled and unskilled workers. Total direct labour is these workers plus the fourth and fifth year apprentices (10) and the foreman (14) for a total of 134. They would be required to work in a much more intensive way and under a completely different kind of management than exists at the National Workshop. The required performance can be achieved under good management, which must include suitable incentives to stimulate output. The appropriate incentive system would be determined by the production- and personnel managers together.

In the new company, 60 % private, an employee would be fired for persistantly poor performance.

A competitive wage would also be an incentive. The existing wages (National Workshop) are too low for workers at the proposed new company. Suggestions are made in Chapter 8.4

The skilled workers at the National Workshop should have no problems in mastering the production technologies recommended for the new company. However, instruction would have to be provided by suppliers of new equipment to the operators. The new foundry is a good example: at least five skilled workers must be specially trained.

8.2 Managerial staff and experts (10)

As stated earlier in this study, the success of the proposed new company depends on managerial skill. For this reason, it is proposed that counterparts recruited locally be coached by the following internationally recruited top- and middle management experts:

- General manager
- Chief engineer
- Marketing manager
- Production manager.

The Finance/Materials manager could also be an expert coaching a counterpart.

Great care must also be used in making the selections for the following positions:

- Product managers "agriculture" and "non-agricultrue"
- Chief supervisor material management
- Chief supervisor production support group
- Chief supervisor quality control
- Chief supervisor apprentices' shop
- Chief supervisor metal forming shop
- Chief supervisor foundry (including forge).

8. Manpower

In addition to adequate remuneration, bonuses should be paid to all of the managers and supervisors on the basis of performance.

The experts should be selected according to the job profiles provided in Annex 15. In order to perform well, they must have the full authority stated in the job description, including the power to hire and fire their subordinates.

At this stage, it is not possible to specify exactly the period required for each expert to work at the new company. The period will be a function of the:

- quality of cooperation between the expert and counterpart
- receptiveness of the counterpart
- scope of problems encountered by the expert in his division or department
- skills of the expert himself.

One can estimate, however, an average period of 2.5 years for the experts' work.

The national origins of the experts are not generally, so important, but it is felt that the general manager should be a European.

For the existing Top Management we provide two options:

a] (partially) incorporate in the Board of Directors

b] accept the role to be the local counterpart

8.3 Other staff (93)

Factory supervisors would number 14, and there would be 15 first-, second- and third year apprentices.

8. Manpower

The remaining staff would consist of 64 administrative and technical personnel, most of whom would be in the departments:

- Material management
- Engineering and design
- Production support
- Quality control.

The key positions in the above departments and the corresponding education/experience requirements are:

- 1 purchaser:
  commercial education with good technical knowledge
- 2 technicians for production planning and control:
  experience as mechanical apprentice with later progresson into production organization and engineering; education at technical school
- 3 industrial engineers for engineering and design:
  completion of industrial engineering education; some experience
- 3 draughtsmen for engineering and design:
  completion of technical education; some experience
- 2 technicians for product support:
  (similar requirements as for production planning and control, above)
- 6 technicians for quality control:
  some technical education and some experience.

All of the above positions should be filled with very carefully chosen people. Considering the lot of engineering work to be done, the proposed numbers are not exaggerated.

A remark to the department "personnel and security": the need to secure the works area is obvious in a developing country. With 6 people for security and 4 for auxiliary jobs, we even decreased the actual number. The latter are provided, if critical jobs cannot be done because of lack of workers (sickness, absent).

8. Manpower

8.4 Labour norms and manpower cost

The effective working time would be 1600 hours/year or 185 days/year.

The manpower costs used in the present study were calculated by taking the existing wages at the National Workshop and increasing them by 40 % to arrive at a salary more in line with the private sector. Since allowances for social costs, etc., amount to about 80 % of salaries in the private sector in Sierra Leone, the formula used for manpower cost in the study is:

new salary = existing salary x 1.4

manpower cost = new salary x 1.8

or

manpower cost = existing salary x 1.4 x 1.8.

The cost of the experts would be covered by the proposed project and would be taken as investments in technology amortized over 5 years. These costs (total manpower cost and all fringe benefits) are:

- General manager: $ 100'000 per year
- other experts (3): $ 50'000 per year, each.

Thus the total cost of the four experts would be $ 250'000 per year for three years.

A breakdown of manpower cost at full production for the entire Workshop is shown in Schedule 8-2.

Management overhead and Apprentice shop overhead and their distribution by product group are shown in Schedule 8-3.

Breakdowns of manpower cost at full production for product groups A, B, C, and D are shown in Schedule 8-4.

Schedule 8-2: Manpower cost at full production
for the entire Workshop

Functions		unit cost per year $ 1000		cost per year																	
				direct manpower labour and staff $ 1000				factory overhead manpower cost $ 1000				administr. overhead manpower cost $ 1000				sales/distr. overhead manpower cost $ 1000					
		loc.	for.	No.	loc.	for.	tot.	No.	loc.	for.	tot.	No.	loc.	for.	tot.	No.	loc.	for.	tot.		
General Mgr (expert)			100									1		100	100						
Local counterpart		7,8										1	7,8		7,8						
Managers (experts)			50					1		50,0	50,0	1		50	50,0	1		50,0	50,0		
(local)		6,2										2	12,4		12,4						
Local counterparts to expert managers		5,5						1	5,5		5,5	1	5,5		5,5	1	5,5		5,5		
Chief supervisors		4,9						2	9,8		9,3	7	34,3		34,3	2	9,8		9,8		
Supervisors		4,5						10	45,0		45,0	1	4,5		4,5						
Foremen		2,5		11	27,5		27,5					3	7,5		7,5						
Skilled workers		1,5		84	126,0		126,0														
Unskilled workers		0,9		26	23,4		23,4														
Apprentices (4,5 yr.)		0,8		10	8,0		8,0														
Apprentices (1,2,3yr.)		0,8										15	12,0		12,0						
Admini.+ techn. staff including secretaries		1,6						6	9,6		9,6	47	75,2		75,2	3	4,8		4,8		
Total with experts	No. personnel			131				20				79				7				237	
	Cost				184,9		184,9		69,9	50,0	119,9		159,2		309,2		20,1	50,0	70,1		684,1
Total without experts	No. personnel			131				19				77				6				233	
	Cost						184,9				69,9				159,2				20,1		434,1

Schedule 8-3: Manpower cost: Management overhead and Apprentices' Shop; Distribution by Product Group

Functions	unit cost per year $ 1000		cost per year: direct manpower labour and staff $ 1000				factory overhead manpower cost $ 1000				administr. overhead manpower cost $ 1000				sales/distr. overhead manpower cost $ 1000					
	loc.	for.	No.	loc.	for.	tot.	No.	loc.	for.	tot.	No.	loc.	for.	tot.	No.	loc.	for.	tot.		
General Mgr (expert)		100									1		100	100						
Local counterpart to general manager	7,8										1	7,8		7,8						
Managers (experts)		50					1		50,0	50,0	1		50	50,0	1		50,0	50,0		
(local)	6,2										2	12,4		12,4						
Local counterparts to expert managers	5,5						1	5,5		5,5	1	5,5		5,5	1	5,5		5,5		
Chief supervisors	4,9										7	34,3		34,3	2	9,8		9,8		
Apprentices' shop																				
- Supervisors	4,5										1	4,5		4,5						
- Foremen	2,5										3	7,5		7,5						
- Apprent. (1,2,3yr.)	0,8										15	12,0		12,0						
Admini.+ techn. staff including secretaries	1,6										47	75,2		75,2	3	4,8		4,8		
Total with experts — No. personnel							2				79				7				88	
Total with experts — Cost								5,5	50,0	55,5		159,2	150,0	309,2		20,1	50,0	70,1		434,8
Total without experts — No. personnel							1				77				6				84	
Total without experts — Cost										5,5				159,2				20,1		184,8
Distribution of overhead cost by product group — A: Foundry									40 %	2,2			40 %	63,7			40 %	8,1		
B: Metal Forming									15 %	0,8			15 %	23,9			30 %	6,0		
C: C-I-Sheets									20 %	1,1			20 %	31,8			15 %	3,0		
D: Repair jobbing and Metal Fabrication									25 %	1,4			25 %	39,8			15 %	3,0		

Schedule 8-4: Manpower cost at full production by Product Group:
A) Foundry

Functions	unit cost per year $ 1000	cost per year																
		direct manpower labour and staff $ 1000				factory overhead manpower cost $ 1000				administr. overhead manpower cost $ 1000				sales/distr. overhead manpower cost $ 1000				
	loc. for.	No.	loc.	for.	tot.	No.	loc.	for.	tot.	No.	loc.	for.	tot.	No.	loc.	for.	tot.	
Chief supervisors	4,9																	
Supervisors	4,5					4	18,0		18,0									
Foremen	2,5	6	15,0		15,0													
Skilled workers	1,5	49	73,5		73,5													
Unskilled workers	0,9	8	7,2		7,2													
Apprentices (4,5 yr.)	0,8	5	4,0		4,0													
Admini.+ techn. staff including secretaries	1,6					1	1,6		1,6									
Total No. personnel		68				5												73,0
Cost			99,7		99,7		19,6		19,6									
Distributed overhead costs (Schedule 8-3)									2,2				63,7				8,1	
Total Costs					99,7				21,8				63,7				8,1	193,3

Schedule 8-4: Manpower cost at full production by Product Group: F) Metal forming

Functions	unit cost per year $ 1000		cost per year															
			direct manpower labour and staff $ 1000				factory overhead manpower cost $ 1000				administr. overhead manpower cost $ 1000				sales/distr. overhead manpower cost $ 1000			
	loc.	for.	No.	loc.	for.	tot.	No.	loc.	for.	tot.	No.	loc.	for.	tot.	No.	loc.	for.	tot.
Chief supervisors	4,9																	
Supervisors	4,5						2	9,0		9,0								
Foremen	2,5		5	12,5		12,5												
Skilled workers	1,5		21	31,5		31,5												
Unskilled workers	0,9		4	3,6		3,6												
Apprentices (4,5 yr.)	0,8		3	2,4		2,4												
Admini.+ techn. staff including secretaries	1,6																	
Total No. personnel			33				2											35,0
Cost				50,0		50,0		9,0		9,0								
Distributed overhead costs (Schedule 8-3)										0,8				23,9			6,0	
Total Costs						50,0				9,8				23,9			6,0	89,7

Schedule 8-4: Manpower cost at full production by Product Group: C) Corr. Iron Sheets

Functions	unit cost per year $ 1000		cost per year															
			direct manpower labour and staff $ 1000				factory overhead manpower cost $ 1000				administr. overhead manpower cost $ 1000				sales/distr. overhead manpower cost $ 1000			
	loc.	for.	No.	loc.	for.	tot.	No.	loc.	for.	tot.	No.	loc.	for.	tot.	No.	loc.	for.	tot.
Chief supervisors	4,9																	
Supervisors	4,5						1	4,5		4,5								
Foremen	2,5																	
Skilled workers	1,5		5	7,5		7,5												
Unskilled workers	0,9		3	2,7		2,7												
Apprentices (4,5 yr.)	0,8																	
Admini.+ techn. staff including secretaries	1,6						1	1,6		1,6								
Total No. personnel			8				2											
Cost				10,2		10,2		6,1		6,1								
Distributed overhead costs (Schedule 8-3)						-				1,1				31,8			3,0	
Total Costs						10,2				7,2				31,8			3,0	

Total No. personnel	10,0
	52,2

Schedule 8-4: Manpower cost at full production by Product Group: Dj Reg. Jobb/Met. Fab

Functions	unit cost per year $ 1000		cost per year															
			direct manpower labour and staff $ 1000				factory overhead manpower cost $ 1000				administr. overhead manpower cost $ 1000				sales/distr. overhead manpower cost $ 1000			
	loc.	for.	No.	loc.	for.	tot.	No.	loc.	for.	tot.	No.	loc.	for.	tot.	No.	loc.	for.	tot.
Chief supervisors	4,9						2	9,8		9,8								
Supervisors	4,5						3	13,5		13,5								
Foremen	2,5																	
Skilled workers	1,5		9	13,5		13,5												
Unskilled workers	0,9		11	9,9		9,9												
Apprentices (4,5 yr.)	0,8		2	1,6		1,6												
Admini.+ techn. staff including secretaries	1,6						4	6,4		6,4								
Total No. personnel			22				9											31,0
Cost				25,0		25,0		29,7		29,7								
Distributed overhead costs (Schedule 8-3)						-				1,4				39,8			3,0	
Total Costs						25,0				31,1				39,8			3,0	98,9

9. IMPLEMENTATION SCHEDULING

Figure 6 shows a plan for implementing the proposed project. From it can be seen that much time and effort is required to launch the new company. In particular, it would be necessary to have the assets of the existing National Workshop formally appraised by an international expert and to incorporate a new company to take over the assets (less the Railway Museum and its contents).

A General manager should be hired as soon as possible after the new company is formed, because he will have the responsibility of:

- specifying of equipment
- commissioning detailed ccnstruction drawings
- ordering equipment
- supervising installation
- supervising the hiring of other key personnel
- supervising start-up.

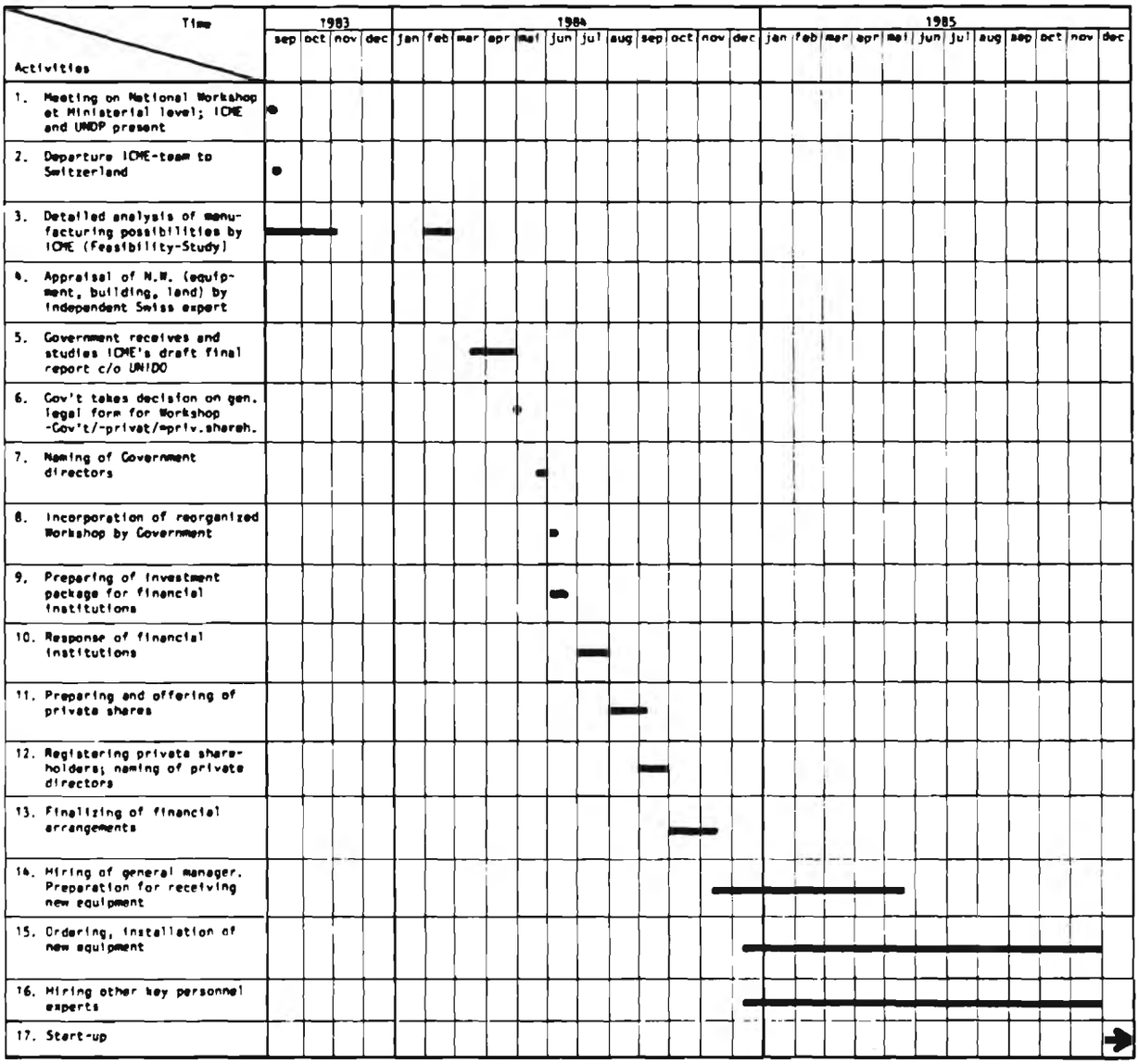
The other key managerial and supervisory personnel should be at work at least three months before start-up.

The following points are emphasized:

- No machines must be ordered before the General manager has started work.
- The delivery time for most machines is likely to be 6 to 12 months.
- For the equipment for C-I-sheets, 9 to 12 months is probable for delivery.

9. Implementation scheduling

Figure 6: Project timing



10. FINANCIAL AND ECONOMIC ANALYSIS

10.0 The "base case"

Four variants on the reference production and sales program were tested using the COMFAR computer program to arrive at a final case which provided the best possible return on investment while staying within the marketing constraints of each of the four product groups.

This final program is called the "base case" in this report, and the financial and economic analyses treat this case.

Finally, a set of sensitivity analyses were made also using the COMFAR computer program. These analyses varied separately and combined the price levels and foreign production costs by 15 % above and below the base case.

10.1 Production costs by product group

Costs by product group for materials, inputs, and manpower have been given in Chapters 4 and 8 respectively. A summary table of manufacturing costs by product group is given in Schedule 10-1a, below. This schedule shows costs for the reference program. Data from the schedule have been taken as input data for the calculation of the base case (final program).

Schedule 10-1a: Production cost for entire workshop at full production of "Reference program"

Cost item	Schedule	Product group A $ 1000			Product group B $ 1000			Product group C $ 1000			Product group D $ 1000			Entire workshop $ 1000		
		local	for.	total	local	for.	total	local	for.	total	local	for.	total	local	for.	total
Raw material 1)	4-1	4,10	87,0	91,10	-	94,0	94,0	-	1147,6	1147,6	0,4	60,0	60,4	4,5	1388,6	1393,1
Direct labour (page 105-110)	8-4	99,70	-	99,70	50,0	-	50,0	10,2	-	10,2	25,0	-	25,0	184,9	-	134,9
Utilities, energy	4-1	38,50	-	38,50	22,3	-	22,3	10,0	-	10,0	6,2	-	6,2	77,0	-	77,0
Factory overheads (labour)	8-2	21,80	-	21,80	9,8	-	9,8	7,2	-	7,2	31,1	-	31,1	69,9	-	69,9
Factory overheads 2) (non-labour)		5,00	-	5,00	3,0	-	3,0	2,0	-	2,0	1,0	-	1,0	11,0	-	11,0
Spares	4-1	2,10	0,5	2,60	2,1	2,0	4,1	-	2,9	2,9	2.1	4,6	6,7	6,3	10,0	16,6
Factory costs	-	171,20	87,5	258,70	87,2	96,0	183,2	29,4	1150,5	1179,9	65,8	64,6	130,4	353,6	1398,6	1752,2
Administration overheads (labour)	8-2	63,70	-	63,70	23,90	-	23,90	31,80	-	31,8	39,8	-	39,8	159,2	-	159,2
Administration overheads 2) (non-labour)		11,55	2,0	13,55	4,62	2,0	6,62	6,93	1,0	7,9	3,2	1,0	4,2	26,3	6,0	32,3
Sales/marketing distribution overheads (labour)	8-2	8,10	-	8,10	6,00	-	6,00	3,00	-	3,0	3,0	-	3,0	20,1	-	20,1
Sales/management distrib. 2) overheads (non-labour)		5,00	-	5,00	3,00	-	3,00	1,00	-	1,0	1,0	-	1,0	10,0	-	10,0
Operation costs	-	259,55	89,5	349,05	124,72	98,0	222,72	72,13	1151,5	1223,6	112,8	65,6	178,4	569,2	1404,6	1973,8
Financial costs														15,3	110,9	126,2
Depreciation 1)		-	145,3 (50 %)	145,3	-	75,6 (26 %)	75,6	-	23,2 (8 %)	23,2	-	46,5 (16 %)	46,5	-	290,6	290,6
Manufacturing costs														584,5	1806,1	2390,6

1) Distribution of the 4 product groups is an ICME-estimation. This "artificial" breakdown was necessary to satisfy the COMFAR program. For project concept, we started with the calculated cost of the manufacturing division, respectively the entire workshop.

2) Total value and distribution of non-labour overheads of Product groups A, B, C and D is an ICME-estimation.

10.2 Notes on the COMFAR Input tables

- Initial fixed investment (foreign and local)

  New and existing buildings and site preparation is depreciated over 30 years.

  New and existing machinery is depreciated over 10 years.

  Preproducton expenditures are amortized over 20 years.

- Current fixed investment (foreign)

  This schedule has only one entry, that for the cost of four foreign experts. In keeping with usual practice for charging acquisition of know-how, these costs are included as investments instead of costs of manufacturing. The amortization rate is 20 % (5 years).

- Production costs (foreign)

  The percent of total depreciation covered by each product group is given in line 78. The percentages correspond to the approximate share of each group in the total investment.

  The percentages of costs which are variable are estimates based on similar manufacturing conditions.

- Production costs (local)

  The data given for "Administration, non-labour" (line 105) and "Marketing, distribution, non-labour" (line 107) for each product group are for costs such as office supplies, communications, etc. In the case of "Marketing", they include travel costs within the country for sales and general marketing work.

- Production program and sales "foreign"

These data are the only data in the input tables that are different from the data for the reference program. They represent the production quantities and sales prices for the fourth variant of the reference program, and are given in the form used to make the three other variants. The "quantity per annum" times the "unit price" gives the sales volume for a given product in a given year.

"Quantity per annum" is actually a sales volume: production x unit price; values are the "reference" sales from Table 3 multiplied by the "multipliers" of Table 4, trial 4, for "increase in production quantity over reference quantity".

Unit price is actually the "multiplier" of Table 4, trail 4, for "increase in unit price over reference unit price".

As an example, for product group C in the fifth year of production:

1) Table 3 (Reference program) gives $ 930'600 for local sales.

2) Table 4 (Multipliers) gives 1.10 as the multiplier for quantity.

3) 1.10 x $ 930'600 gives $ 1'023'700 or 1'023.7 on line 158, column 5 of the input table.

4) Table 4 (Multipliers) gives 1.20 as the multiplier for unit price. Line 159, column 5 gives the same value.

5) 1.20 x 1'023.7 = 1'228.4, the local sales for product C in the firfth year of production.

6) COMFAR makes this calculation and adds it to the value for export sales for product C for year 5 to yield total sales.

7) Total sales are calculated for each product group and then summed by COMFAR to give the total sales for the project. These totals are given in the output tables of COMFAR in the tables for cash flow and net income statement.

The "reference capacity" is the production volume (total, exports and local) for which the production costs are valid. This capacity is the sales at full capacity for each product as given in Table 3.

- Working capital requirements

  Data for minimum days coverage and cash in hand are given for foreign and local currency. It is assumed that there are to be no sales on credit.

- Source of finance (foreign)

  The terms of the three foreign currency loans are fully specified in this subtable.

- Source of finance (local)

  An approximate level for a line of credit was estimated at the equivalent of $ 250'000 for 15 years at 10 percent. This rate is a special rate which is lower than the normal commercial rate and reflects the government's participation in the project.

- Income, tax, cashflow

  Only the tax rate for income is given. The 40 % rate is an estimated rate based on the consultants' findings in the field that such a rate would be probable for a development project of high priority. Likewise, the five-year tax holiday was assumed probable.

10.3 Complete input data for calculating the base case from the reference program

In order to facilitate cross-referencing of data in the COMFAR input tables and data shown elsewhere in the report, Schedule 10-1b is provided. It shows for each line of the COMFAR input tables, the corresponding table, schedule or text in the report where the data are first introduced.

Schedule 10-1b: "Bridge" to the COMFAR input lines L1 to L213 with text in the report

```
L   3 : Schedule 6-2, page 87; foot note
L   6 : Directly given in the input tables; no further explanation in the report
L   8 : Schedule 6-2, page 87; repair jobbing and metal fabrication
L   9 :     "       ,   "   ; total manufacturing division (Product group A, B, C)
L  10 : Schedule 6-2: page 87; technical drawings, pattern, dies, tools
L  11 : Schedule 10-2, page 131
L  13 : Chapter 10.5, page 132; total investment costs, land
L  14 : Schedule 6-2, page 87; site preparation, foot note
L  15 : Chapter 10.5, page 132; total investment costs, existing buildings
L  16 :      "      ,   "    ;            "          , new buildings
L  21 :      "      ,   "    ;            "          , existing machines and equipment
L  22 :      "      ,   "    ;            "          , aux. services and new equipment
L  23 : Chapter 10.5, page 132; total investment costs, pre-production capital costs
L  30 : Chapter 8.4, page 109; labour norms and manpower cost
L64/65: Schedule 10-1a, page 119; production cost
        Detailed: Schedule 4-1: page 59; materials and inputs
L  72 : Schedule 10-1a, page 119 or Schedule 4-1, page 59
L  73 : Schedule 10-1a, page 119; production cost
L  75 :      "      ,   "    ;       "
L  78 :      "      ,   "    ;       "
L94/95: Schedule 10-1a, page 119; production cost
        Detailed: Schedule 4-1, page 59; materials and inputs
L  98 : Schedule 4-1, page 59; materials and inputs
        Note: utilities include energy
L 100 : Schedules 8-4, page 112 ff; manpower cost by product group
L 102 : Schedule 10-1a, page 119; production cost
L 103 : Schedule 8-2, page 110; manpower cost for entire workshop
L 104 : Schedule 8-3, page 111; mangement overhead
L 105 : Schedule 10-1a, page 119; production cost
L 106 : Schedule 8-3, page 111; management overhead
L 107 : Schedule 10-1a, page 119; production cost
L 110 : Table 3, page 47; reference sales/prod. program; export sales Prod. A times 1.1
L 111 : Table 4, page 54; multipliers
L 116 : Table 3, page 47; reference sales; export sales Prod. B times 1.0
L 117 : Table 4, page 54; multipliers
L 122 : Table 3, page 47; reference sales; export sales Prod. C times 1.1
L 123 : Table 4, page 54; multipliers
L 128 : Table 3, page 47/48; reference sales; no export!
L 129 : Table 4, page 54; multipliers
L 146 : Table 3, page 47/48; reference sales; local sales Prod. A times 1.1
L 147 : Table 4, page 54; multipliers
L 152 : Table 3, page 47/48; reference sales; local sales Prod. B times 1.0
L 153 : Table 4, page 54; multipliers
L 158 : Table 3, page 47/48; reference sales; local sales Prod. C times 1.1
L 159 : Table 4, page 54; multipliers
L 164 : Tabel 3, page 47/48; reference sales; local sales Prod. D times 1.0
L 165 : Table 4, page 54; multipliers
L 182-190 : The necessary data and statement are directly given in
            the COMFAR input table, no further comment in the report
L 191-204 : Chapter 10.12, page 145; project financing
L 205-213 : Tax rate: explained in Chapter 10.2, page 120, notes on
            to COMFAR input tables
```

Schedule 10-1: Input tables

Contents of **TABI** named **NSL5A**

Text Variables

********** COMFAR 1.0 - UNIDO Vienna *****

Project Name:	SIERRA LEONE , NATIONAL PROJECT
Date:	MAR01,1984
Name of Alternative:	FOURTH TRIAL, REVISED INV. EXIST. BUILDINGS, MACHINES
Accounting currency:	US-dollar
Currency units:	thousand
Name of Product (A):	FOUNDRY PRODUCTS
Name of Product (B):	METAL FORMING
Name of Product (C):	C.I. SHEETS
Name of Product (D):	METAL FABRICATION AND REPAIR
Name of Product (E):	++++++++++
Name of Product (F):	++++++++++

General Variables

********** COMFAR 1.0 - UNIDO Vienna *****

Multiplier to compute foreign into accounting currency:	1.000
Multiplier to compute local into accounting currency:	1.000
Initial fixed investment - each column represents 1/KIIP years,	KIIP: 1
Preproduction phase in years,	KIIY: 1
Interest rate for computation of future values in % p.a.:	0.0
Percent rate for CF-Discounting:	10.000

Schedule 10-1: Input tables

Contents of **TABI** named **NSL5**

Subtable **Initial Fixed Investment - "foreign"**

********** COMFAR 1.0 - UNIDO Vienna **********

Col		Depreciation rate	Salvage value (%)	Depreciation period (years)	1	2	3	4 (Investmen
L 1	Land	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 2	Site preperation and development	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 3	Structures and civil (a)	3.33	0.0	30.00	11.70	0.0	0.0	0.0
L 4	Structures and civil (b)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 5	Incorporated fixed assets (a) Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 6	Incorporated fixed assets (b) Technology	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 7	Incorporated fixed assets (c) Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 8	Plant machinery and equipment (a)	10.00	0.0	10.00	14.70	0.0	0.0	0.0
L 9	Plant machinery and equipment (b)	10.00	0.0	10.00	1320.60	0.0	0.0	0.0
L 10	Auxiliary and service facilities	10.00	0.0	10.00	112.00	0.0	0.0	0.0
L 11	Pre-production expenditures	20.00	0.0	5.00	188.00	0.0	0.0	0.0
L 12	Inventory , working capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Subtable **Initial Fixed Investment - "local"**

********** COMFAR 1.0 - UNIDO Vienna **********

Col

L 13	Land	0.0	100.00	50.00	174.00	0.0	0.0	0.0
L 14	Site preperation and development	3.33	0.0	30.00	106.20	0.0	0.0	0.0
L 15	Structures and civil (a)	3.33	0.0	30.00	403.00	0.0	0.0	0.0
L 16	Structures and civil (b)	3.33	0.0	30.00	2.20	0.0	0.0	0.0
L 17	Incorporated fixed assets (a) Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 18	Incorporated fixed assets (b) Technology	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 19	Incorporated fixed assets (c) Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 20	Plant machinery and equipment (a)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 21	Plant machinery and equipment (b)	10.00	0.0	10.00	150.00	0.0	0.0	0.0
L 22	Auxiliary and service facilities	10.00	0.0	10.00	130.10	0.0	0.0	0.0
L 23	Pre-production expenditures	20.00	0.0	5.00	28.00	0.0	0.0	0.0
L 24	Inventory , working capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Subtable **Current Fixed Investment - "foreign"**

********** COMFAR 1.0 - UNIDO Vienna **********

Col

L 25	Land	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 26	Site preperation and development	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 27	Structures and civil (a)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 28	Structures and civil (b)	0.0	0.0	0.0				0.0
L 29	Incorporated fixed assets (a) Construction	0.0	0.0	0.0				0.0
L 30	Incorporated fixed assets (b) Technology	20.00	0.0	0.0	250.00	250.00	250.00	0.0
L 31	Incorporated fixed assets (c) Other	0.0	0.0	0.0				0.0
L 32	Plant machinery and equipment (a)	0.0	0.0	0.0				0.0
L 33	Plant machinery and equipment (b)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 34	Auxiliary and service facilities	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 35	Pre-production expenditures	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 36	Inventory , working capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Cost of four foreign experts

SECTION 1

.0 - UNIDO Vienna ********** COMFAR 1.0 - UNIDO Vienna *****

Investment in year

1	2	3	4	5	6	7	8	9	10	11	12
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

.0 - UNIDO Vienna ********** COMFAR 1.0 - UNIDO Vienna *****

4.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

.0 - UNIDO Vienna ********** COMFAR 1.0 - UNIDO Vienna *****

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cost of four			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50.00	250.00	250.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
foreign	experts		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SECTION 2

Schedule 10-1: Input tables

Subtable **Current Fixed Investment - "local"**

COMFAR 1.0 - UNIDO Vienna

Col		Depreciation time	Salvage value (%)	Depreciation period	1	2	3	4
L 37	Land	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 38	Site preperation and developent	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 39	Structures and civil (a)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 40	Structures and civil (b)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 41	Incorporated fixed assets (a) Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 42	Incorporated fixed assets (b) Technology	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 43	Incorporated fixed assets (c) Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 44	Plant machinery and equipment (a)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 45	Plant machinery and equipment (b)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 46	Auxiliary and service facilities	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 47	Pre-production expenditures	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 48	Inventory , working capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Subtable **Production Costs - "foreign"**

COMFAR 1.0 - UNIDO Vienna

Col	Production year :	1	2	3	4	5	6	7	8
L 51	Inflators in %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 52	Product A; Annual cost adjustment, labour	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 53	Product A; Annual cost adjustment, non-l	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 54	Product B; Annual cost adjustment, labour	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 55	Product B; Annual cost adjustment, non-l	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 56	Product C; Annual cost adjustment, labour	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 57	Product C; Annual cost adjustment, non-l	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 58	Product D; Annual cost adjustment, labour	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 59	Product D; Annual cost adjustment, non-l	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

		Cost for product A	% of cost variable	Cost for product B	% of cost variable	Cost for product C	% of cost variable	Cost for product D	% of cost variable
L 64	Raw material: quantity per annum 1)	100.00	100.00	100.00	100.00	1.00	100.00	10.00	100.00
L 65	Raw material: price per unit 2)	0.87	100.00	0.94	100.00	1147.60	100.00	6.00	100.00
L 66	Raw material (others):quantity per annum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 67	Raw material (others):price per unit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 68	Utilities: Value per annum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 69	Energy: Value per annum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 70	Labour(direct,factory): Value per annum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 71	Maintenance, repair: per annum (except)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 72	Spare-parts: per annum	0.50	50.00	2.00	50.00	2.90	50.00	4.60	50.00
L 73	Factory overheads: per annum (non-labour)	5.00	15.00	3.00	15.00	2.00	15.00	1.00	15.00
L 74	Administration, labour: per annum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 75	Administration, non-labour: per annum	2.00	2.00	2.00	10.00	1.00	10.00	1.00	10.00
L 76	Marketing, distribution, labour: per ann	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 77	Marketing, distribution, non-labour: per	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 78	% of total depreciation, covered by each	50.00	26.00	8.00	16.00	0.0	0.0	0.0	0.0
	product group for line 72	A	B	C	D				

SECTION 1

-AR 1.0 - UNIDO Vienna ## COMFAR 1.0 - UNIDO Vienna #####

Investment in year

1	2	3	4	5	6	7	8	9	10	11	12
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

-AR 1.0 - UNIDO Vienna ## COMFAR 1.0 - UNIDO Vienna #####

5	6	7	8	9	10	11	12	13	14	15
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Cost per product C	% of cost variable	Cost per product D	% of cost variable
1.00	100.00	10.00	100.00
1147.60	100.00	6.00	100.00
0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0
2.90	50.00	4.60	50.00
2.00	15.00	1.00	15.00
0.0	0.0	0.0	0.0
1.00	10.00	1.00	10.00
0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0

Notes

1) "Quantity per annum" (raw material): expressed in "artificial" units which, when multiplied by the price per unit, give the total cost for the product group.

2) "Price per unit" (raw material): calculated cost divided by the "quantity per annum", above.

SECTION 2

Schedule 10-1: Input tables

Subtable Production Costs - "local"

COMFAR 1.0 - UNIDO Vienna

Col	Production year :	1	2	3	4	5	6	7	8
L 81	Inflators in %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 82	Product A; Annual cost adjustment, labour	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 83	Product A; Annual cost adjustment, non-l	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 84	Product B; Annual cost adjustment, labour	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 85	Product B; Annual cost adjustment, non-l	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 86	Product C; Annual cost adjustment, labour	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 87	Product C; Annual cost adjustment, non-l	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 88	Product D; Annual cost adjustment, labour	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 89	Product D; Annual cost adjustment, non-l	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

		Cost for product A	% of cost variable	Cost for product B	% of cost variable	Cost for product C	% of cost variable	Cost for product D	% of cost variable
L 94	Raw material: quantity per annum 1)	10.00	90.00	0.0	0.0	0.0	0.0	1.00	90.0
L 95	Raw material: price per unit 2)	0.41	100.00	0.0	0.0	0.0	0.0	0.41	100.0
L 96	Raw material (others):quantity per annum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 97	Raw material (others):price per unit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 98	Utilities: Value per annum	38.50	35.00	22.30	35.00	10.00	35.00	6.20	35.0
L 99	Energy: Value per annum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 100	Labour(direct,factory): Value per annu	99.70	10.00	50.00	10.00	10.20	10.00	25.00	10.00
L 101	Maintenance, repair: per annum (except l	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 102	Spare-parts: per annum	2.07	0.0	2.07	0.0	0.0	0.0	2.07	0.0
L 103	Factory overheads: per annum (labour)	21.80	0.0	9.80	0.0	7.20	0.0	31.10	0.0
L 104	Administration, labour: per annum	63.70	10.00	23.90	10.00	31.80	10.00	39.80	10.0
L 105	Administration, non-labour: per annum	11.55	10.00	4.62	10.00	6.93	10.00	3.2	10.0
L 106	Marketing, distribution, labour: per ann	8.10	20.00	6.00	20.00	3.00	20.00	3.0	20.0
L 107	Marketing, distribution, non-labour: per	5.00	20.00	3.00	20.00	1.00	20.00	1.00	20.0

SECTION 1

COMFAR 1.0 - UNIDO Vienna ******************** COMFAR 1.0 - UNIDO Vienna *****

4	5	6	7	8	9	10	11	12	13	14	15
.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

...iable	Cost for product C	% of cost variable	Cost for product D	% of cost variable
.0	0.0	0.0	1.00	90.00
.0	0.0	0.0	0.40	100.00
.0	0.0	0.0	0.0	0.0
.0	0.0	0.0	0.0	0.0
[illegible]	10.00	35.00	6.20	35.00
.	0.0	0.0	0.0	0.0
.00	10.20	10.00	25.00	10.00
.0	0.0	0.0	0.0	0.0
.0	0.0	0.0	2.07	0.0
.0	7.20	0.0	31.10	0.0
.00	31.80	10.00	39.80	10.00
.00	6.93	10.00	3.20	10.00
.00	3.00	20.00	3.00	20.00
.00	1.00	20.00	1.00	20.00

Notes

1) "Quantity per annum" (raw material): expressed in "artificial" units which, when multiplied by the price per unit, give the total cost for the product group.

2) "Price per unit" (raw material): calculated cost divided by the "quantity per annum", above.

SECTION 2

Schedule 10-1: Input tables

Subtable **Production Program and Sales "foreign"**

COMFAR 1.0 - UNIDO Vienna

Col		Initial rate	Production year 1	2	3	4	5	6	7
L 110	Product A ..... Quantity per annum 1)	0.0	0.0	0.0	0.0	36.70	47.70	54.90	62.00
L 111	Product A ..... Unit price 2)	0.0	0.0	1.10	1.10	1.10	1.10	1.10	1.10
L 112	Product A ..... Sales tax	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 113	Product A ..... Other direct variable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 114	Product A ..... Direct, non-variable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 115	Product A ..... of 4&5 labour cost (i	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 116	Product B ..... Quantity per annum 1)	0.0	0.0	68.40	68.40	68.40	68.40	68.40	68.40
L 117	Product B ..... Unit price 2)	0.0	0.0	1.20	1.20	1.20	1.20	1.20	1.20
L 118	Product B ..... Sales Tax	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 119	Product B ..... Other direct variable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 120	Product B ..... Direct, non-variable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 121	Product B ..... of 4&5 labour cost (i	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 122	Product C ..... Quantity per annum 1)	0.0	0.0	144.87	289.74	400.02	510.29	510.30	510.30
L 123	Product C ..... Unit price 2)	0.0	0.0	1.20	1.20	1.20	1.20	1.20	1.20
L 124	Product C ..... Sales Tax	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 125	Product C ..... Other direct variable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 126	Product C ..... Direct, non-variable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 127	Product C ..... of 4&5 labour cost (i	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 128	Product D ..... Quantity per annum 1)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 129	Product D ..... Unit price 2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 130	Product D ..... Sales Tax	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 131	Product D ..... Other direct variable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 132	Product D ..... Direct, non-variable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 133	Product D ..... of 4&5 labour cost (i	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Notes: 1) "Quantity per annum": this is actually sales volume: production x unit price; values are the "reference" sales from Table 3 multiplied by the "multipliers" of Table 4, trial 4, for "increase in production quantity over reference quanity"

2) "Unit price": this is actually the "multiplier" of Table 4, trial 4, for increase in unit price over reference unit price".

SECTION 1

4	5	6	7	8	9	10	11	12	13	14	15
36.70	47.70	54.90	62.00	62.00	62.00	62.00	62.00	62.00	62.00	62.00	62.00
1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
68.40	68.40	68.40	68.40	68.40	68.40	68.40	68.40	68.40	68.40	68.40	68.40
1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
400.02	510.29	510.30	510.30	510.30	510.30	510.30	510.30	510.30	510.30	510.30	510.30
1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SECTION 2

Schedule 10-1: Input tables

Subtable **Production Program and Sales "local"**

COMFAR 1.0 - UNIDO Vienna

Col		Reference capacity *	Production year 1	2	3	4	5	6	7
L 146	Product A ..... Quantity per annum 1)	470.10	116.22	192.72	249.87	469.37	469.37	539.79	610.20
L 147	Product A ..... Unit price 2)	0.0	1.10	1.10	1.10	1.10	1.10	1.10	1.10
L 148	Product A ..... Sales tax	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 149	Product A ..... Other direct variable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 150	Product A ..... Direct, non-variable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 151	Product A ..... of 4&5 labour cost (i	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 152	Product B ..... Quantity per annum 1)	262.40	90.00	104.00	180.00	194.00	194.00	194.00	194.00
L 153	Product B ..... Unit price 2)	0.0	1.20	1.20	1.20	1.20	1.20	1.20	1.20
L 154	Product B ..... Sales Tax	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 155	Product B ..... Other direct variable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 156	Product B ..... Direct, non-variable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 157	Product B ..... of 4&5 labour cost (i	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 158	Product C ..... Quantity per annum 1)	1394.50	511.83	864.27	982.58	1023.66	1023.70	1023.70	1023.70
L 159	Product C ..... Unit price 2)	0.0	1.20	1.20	1.20	1.20	1.20	1.20	1.20
L 160	Product C ..... Sales Tax	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 161	Product C ..... Other direct variable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 162	Product C ..... Direct, non-variable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 163	Product C ..... of 4&5 labour cost (i	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 164	Product D ..... Quantity per annum 1)	335.80	186.57	208.42	233.28	262.44	335.80	335.80	335.80
L 165	Product D ..... Unit price 2)	0.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00
L 166	Product D ..... Sales Tax	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 167	Product D ..... Other direct variable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 168	Product D ..... Direct, non-variable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L 169	Product D ..... of 4&5 labour cost (i	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Notes: * "Reference capacity" is the production volume (total, exports and local) for which the production and sales are valid. This production volume was established for the "reference productin and saies program" given in Table 3.

1) "Quantity per annum": this is actually sales volume: production x unit price; values are the "reference" sales from Table 3 multiplied by the "multipliers" of Table 4, trial 4, for "increase in production quantity over reference quanity"

2) "Unit price": this is actually the "multiplier" of Table 4, trial 4, for increase in unit price over reference unit price".

..OMFAR 1.0 - UNIDO Vienna ## COMFAR 1.0 - UNIDO Vienna #####

year

4	5	6	7	8	9	10	11	12	13	14	15
469.37	469.37	539.79	610.20	610.20	610.20	610.20	610.20	610.20	610.20	610.20	610.20
1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
194.00	194.00	194.00	194.00	194.00	194.00	194.00	194.00	194.00	194.00	194.00	194.00
1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1023.66	1023.70	1023.70	1023.70	1023.70	1023.70	1023.70	1023.70	1023.70	1023.70	1023.70	1023.70
1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
262.44	335.80	335.80	335.80	335.80	335.80	335.80	335.80	335.80	335.80	335.80	335.80
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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SECTION 2

Schedule 10-1: Input tables

Subtable **Working Capital Requirements "f/l"**

********** COMFAR 1.0 - UNIDO Vienna

Col		Minimum Days Coverage Foreign	local
L 182 Accounts receivable :	cash in hand	1.00	1.00
L 183 Inventory, raw material		90.00	60.00
L 184 Inventory, other raw materials		1.00	1.00
L 185 Inventory, utilities		1.00	20.00
L 186 Inventory, energy		1.00	1.00
L 187 Inventory, spare parts		180.00	30.00
L 188 Inventory, work-in-progress		10.00	10.00
L 189 Inventory, finished products		30.00	30.00
L 190 Accounts payable		1.00	20.00

Subtable **Source of Finance - "foreign"**

********** COMFAR 1.0 - UNIDO Vienna

Col	Year available	Amount available	Interest rate pre-production	production	Grace period	Term
L 191 Equity-O (ordinary shares)	1.00	0.0	0.0	0.0	0.0	0.0
L 192 Equity-P (preference shares)	1.00	0.0	0.0	0.0	0.0	0.0
L 193 Subsidies, grants	1.00	0.0	0.0	0.0	0.0	0.0
L 194 Loan AF (to finance machinery / equipment)	1.00	1500.00	8.50	8.50	1.00	15.00
L 195 Loan BF (to finance pre-production)	1.00	190.00	5.00	5.00	1.00	10.00
L 196 Loan CF (to finance four foreign experts)	2.00	750.00	5.00	5.00	1.00	10.00
L 197 Current liabilities	0.0	0.0	0.0	0.0	1.00	1.00

Subtable **Source of Finance - "local"**

********** COMFAR 1.0 - UNIDO Vienna

Col						
L 198 Equity-O (ordinary shares)	1.00	0.0	0.0	0.0	0.0	0.0
L 199 Equity-P (preference shares)	1.00	0.0	0.0	0.0	0.0	0.0
L 200 Subsidies, grants	1.00	0.0	0.0	0.0	0.0	0.0
L 201 Loan AL (equipment)	1.00	250.00	10.00	10.00	1.00	15.00
L 202 Loan BL	1.00	0.0	0.0	0.0	1.00	1.00
L 203 Loan CL	1.00	0.0	0.0	0.0	1.00	1.00
L 204 Current liabilities	1.00	0.0	0.0	0.0	1.00	1.00

Subtable **Income, Tax, Cashflow**

********** COMFAR 1.0 - UNIDO Vienna

Col	Tax rate %	Tax holiday years	Years losses carried forward
L 205 Income tax	40.00	5.00	2.00
L 206 Investment allowance, NO depreciation !!	0.0	0.0	0.0
L 207 Initial allowance; to be written-off (d	0.0	0.0	0.0
L 208 Annual allowances (fiscal)	0.0	0.0	0.0
L 209 Tax rate in % , if rate is variable	0.0	0.0	0.0
L 210 Profit distributed, Equity-P-foreign(sum	0.0	0.0	0.0
L 211 Profit distributed, Equity-P-local	0.0	0.0	0.0
L 212 Profit distributed, Equity-O-foreign	0.0	0.0	0.0
L 213 Profit distributed, Equity-O-local	0.0	0.0	0.0

10. Financial and economic analysis

10.4 Preproduction capital expenditures

Schedule 10-2, below, shows the expenditures for preproduction. Included are the costs of the present study. The remaining major expenditures are for detailed planning and tendering and management of the project implementation by foreign experts.

Schedule 10-2: Preproduction capital expenditures (in 1000 US$)

	Foreign currency	Local currency	Total
Pre-investment studies 1)	65	-	
Preparatory investigations 2)	10	-	
Management of project implementation 3)	50	5	
Detail planning, tendering	35	5	
Supervision, co-ordination, test-run and take-over of civil works, equipment and plant 4)	16	-	
Build-up of administration, recruitment and training of staff and labour	-	2	
Arrangements for supplies	-	1	
Arrangements for marketing 5)	12	5	
Build-up of connections	-	-	
Preliminary and capital issue expenditure	-	10	
Totals	188	28	216

1) Present UNIDO study executed by ICME

2) Appraisal of existing assets of National Workshop

3) One half year of General Managers' time

4) One month General Manager: 8'000
One month Production Manager: 4'000
One month Chief Engineer: 4'000
Total 16'000

5) Three months Marketing Manager: 12'000

10. Financial and economic analysis

10.5 Total investment costs

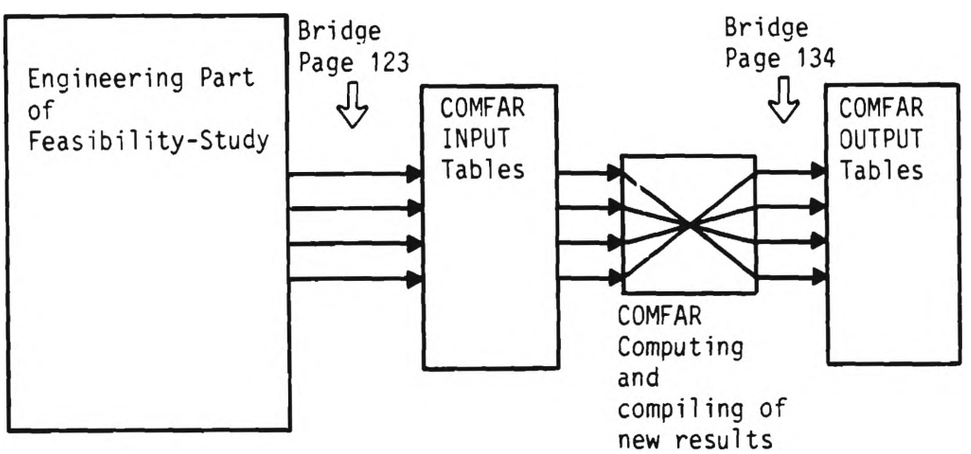
All figures are expressed in thousand US dollars.

- Investment costs, foreign currency			
. buildings modifications			11.7
. new machinery and equipment			
- foundry	680.1		
- metal forming	412.5		
- corrugated iron sheets	114.8		
- repair jobbing and metal fabrication	14.7		
- apprentices' shop	113.2		
			1'335.3
. auxiliary services and equipment			112.0
. pre-production capital costs			188.0
. working capital (1986)			189.8
SUB-TOTAL			1'836.8
- Investment costs, local currency			
. land (acquisition by the new company)			174.0 1)
. site preparation, building, modification			106.2
. new buildings			2.2
. existing buildings (acquisition by the new company)			403.0 2)
. existing machines and equipment (acquisition by the new company)			150.0 3)
. auxiliary services and new equipment			130.1
. pre-production capital costs			28.0
. working capital (1986)			76.5
SUB-TOTAL			1'070.0
TOTAL INVESTMENT COST			2'906.8

1, 2): Source: "National Workshop of Sierra Leone, Balance Sheet as at March 31, 1981"
3): ICME estimate

10. Financial and economic analysis

The following charts show the input data flow in effect during software processing and should support the understanding of the calculated results.



Schedule 10-3a: COMFAR OUTPUT: VALUE FLOAT AND GAIN OF RESULTS (IRR)

Example: Year 1990, Value in $ 1000

Total production costs

Year	1990
% of nom. capacity (single product only)	0.0
Raw material 1	1507.99
Other raw materials	0.0
Energy	0.0
Utilities	77.35
Labour, direct	185.00
Repair	0.0
Spares	16.36
Factory overheads	80.93
Factory costs	1867.62
Administrative overheads + Marketing	222.08
Indir. costs, sales and distribution	0.0
Direct costs, sales and distribution	0.0
Depreciation	383.82
Financial costs	149.65
Total manufacturing costs	2623.17
Costs per unit (single product)	0.0
Of it foreign, %	77.99
Of it variable,%	60.45
Of it direct, %	71.20
Total labour	364.68

60% → Less: variable costs, including sales tax

40% - Fin. costs → Non-variable costs, including depreciation

- Depr. - Fin. costs → Cost of finance

Net income statement

Year	1990
Total sales, including sales tax	3060.25
Less: variable costs, including sales tax	1585.74
Variable margin	1474.51
As % of total sales	48.18
Non-variable costs, including depreciation	887.78
Operational margin	586.72
As % of total sales	19.17
Cost of finance	149.65
Gross profit	437.08
Allowances	0.0
Taxable profit	437.08
Tax	0.0
Net profit	437.08
Dividends paid	0.0
Undistributed profit	437.08
Accumulated undistributed profit	260.97
Gross profit, % of total sales	14.28
Net profit, % of total sales	14.29
Net profit, % of equity	62.40
Net profit + interest, % of investment	14.24

Projected balance sheet

Year	1990
Total assets	2752.89
Fixed assets, net of depreciation	1866.38
Construction in progress	0.0
Current assets	618.33
Cash, bank	40.90
Cash surplus, finance available	227.28
Total liabilities	2752.89
Equity capital	700.50
Reserves, retained profit	-176.10
Profit,(loss)	437.08
Long and medium term debt	1768.12
Current liabilities	23.29
Bank overdraft, finance required	0.0
Total debt	1791.41
Equity, % of liabilities	25.45

Cashflow

a) interest pay

b) interest pay

Cashflow

Year

Total CF-inflow

. Financial res

. Sales

Total CF-outflo

. Total assets

. Operating cos

. Debt service

. Repayment

. Corporate tax

. Dividends pai

Surplus (defic

Cumulated cash

Inflow local c

Outflow local c

Surplus (defic

Inflow foreign

Outflow foreign

Surplus (defic

Source

Year

Equity, ordinar

Equity, prefere

Subsidies, gra

Loan AF

Loan BF

Loan CF

Loan AL

Loan BL

Loan CL

Total loan

Current liabil

Bank overdraft

Total funds av

SECTION 1

Cashflow Discountings

a) interest payable on loan = cash-outflow:

Net present value at	10.00 % =	160.17
Internal Rate of Return	10.57 %	

b) interest payable on loan added back to net-cashflow:

Net present value at	10.00 % =	1139.03
Internal Rate of Return	14.23 %	

Cashflow tables

Year	1990
Total CF-inflow	3060.25
. Financial resources	0.0
. Sales	3060.25
Total CF-outflow	2439.20
. Total assets	39.57
. Operating costs	2089.70
. Debt service and interest	149.65
. Repayment	160.28
. Corporate tax	0.0
. Dividends paid	0.0
Surplus (deficit)	621.04
Cumulated cash balance	203.99
Inflow local currency	2296.68
Outflow local currency	1341.60
Surplus (deficit) local currency	955.08
Inflow foreign currency	746.90
Outflow foreign currency	1097.60
Surplus (deficit) foreign currency	-350.71

	1990
	3060.25
	1585.74
	1474.51
	48.18
	887.78
	586.72
	19.17
	149.65
	437.08
	0.0
	437.08
	0.0
	437.08
	0.0
	437.08
	260.97
	14.28
	14.28
	62.40
	14.24

Source of finance

Year	1990
Equity, ordinary	0.0
Equity, preference	0.0
Subsidies, grants	0.0
Loan AF	-73.63
Loan BF	-18.36
Loan CF	-51.62
Loan AL	-16.67
Loan BL	0.0
Loan CL	0.0
Total loan	-160.28
Current liabilities	0.41
Bank overdraft	-394.17
Total funds available	-554.05

SECTION 2

Total current investment costs

Year	1990
Fixed investment costs:	
Land, site preparation and developement	0.0
Buildings and civil works	0.0
Auxiliary and service facilities	0.0
Incorporated fixed assets	0.0
Plant, machinery and equipment	0.0
Total fixed investment costs	0.0
Preproduction capitals expend's	0.0
Working capital's increase	39.17
Total current investment costs	39.17
Of it foreign, %	98.57

Net working capital

Year	1990
Coverage:	
Current assets &	
Accounts receivable	5.80
Inventory and materials	380.92
Energy	0.0
Spares	5.59
Work in progress	51.88
Finished products	174.14
Cash in hand	40.90
Total current assets	659.23
Current liabilities and	
Accounts payable	23.29
Net working capital	635.94
Increase in working capital	39.17
Net working capital, local currency	83.94
Net working capital, foreign currency	552.00

10. Financial and economic analysis

The investments in local currency include costs for acquisition by the new company of the existing land, buildings, and some of the existing machines of the National Workshop.

The values for existing land and buildings are taken as those in the National Workshop's balance sheet.

No true market values were available for the present study. However, it seems that the value of buildings is not likely to be higher than the given value, because the market for industrial real estate in Sierra Leone is not so active.

10.6 Financial calculations

With interest payable on loans taken as cash outflow:

. Net present value (cash flow, in constant dollars on inflows and outflows, discounted at 10 %)	160.2
. Internal rate of return	10.6

With interest payable on loans added back to net cash flow:

. Net present value (cash flow, in constant dollars on inflows and outflows, discounted at 10 %)	1'139.0
. Internal rate of return	14.2

The discount rate of 10 % is considered adequately high given that all the cash flows are in constant dollars and that the maximum interest rate used in financing the investments is 8.5 % (for imported machinery and equipment).

This rate yields a positive net present value for the project in both cases above.

The two streams of cash flows used in the calculations of internal rate of return are given in Schedule 10-3, lines 233 and 240. This schedule was calculated by the COMFAR program.

Schedule 10-3: Cash flow table

Subtable **funds income, cashflows - consolidated**

********** COMFAR 1.0 - UNIDO Vienna *****

Columns are:

col 1: free for intermediate results
col 2: represents 1.st year of production
col 3: represents 2.nd year of production
col 4: represents 3.rd year of production
col 5: represents 4.th year of production
col 6: represents 5.th year of production
col 7: represents 6.th year of production
col 8: represents 7.th year of production
col 9: represents 8.th year of production
col 10: represents 9.th year of production
col 11: represents 10.th year of production
col 12: represents 11.th year of production
col 13: represents 12.th year of production
col 14: represents 13.th year of production
col 15: represents 14.th year of production

Line 233 used for calculation of IRR with interest payable on loans taken as cash out-flows.

Line 240 used for calculation of IRR with interest payable on loans added back to net cash-flow.

Col	1	2	3	4	5	6
L 233 current net CF production	-2721.50	-691.11	-268.55	37.53	634.56	781.74
L 234 accumulated current net-CF, pre-producti	-2735.50	-3426.61	-3695.16	-3657.63	-3023.08	-2241.34
L 235 DCF at rate GNPV (rate for CF - discoun	0.0	160.17	10.57	0.0	0.0	0.0
L 236 current net cashflow in % of total sales	0.0	-66.67	-14.61	1.61	22.32	25.54
L 237 current net cashflow in % of total inves	0.0	-21.25	-7.32	0.93	15.54	18.97
L 238 current net cashflow , accumulated, row	-2654.50	-516.21	-87.68	208.46	795.09	931.38
L 239 DCF at rate GNPV (rate for CF - discoun	0.0	1139.03	14.23	0.0	0.0	0.0
L 240 U S E D F O R I N T E R M E D I A T	-2721.50	-516.21	-87.68	208.46	795.09	931.38

7	8	9	10	11	12	13	14	15
669.98	697.06	690.22	678.20	686.62	626.43	635.10	642.75	650.96
-1571.37	-874.31	-184.09	494.11	1180.73	1807.16	2442.26	3085.01	3735.97
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21.30	21.57	21.36	20.99	21.25	19.39	19.66	19.89	20.15
16.23	16.87	16.70	16.41	16.61	15.16	15.37	15.55	15.75
808.20	823.27	803.81	778.49	772.87	697.84	692.06	686.96	681.49
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
808.20	823.27	803.81	778.49	772.87	697.84	692.06	686.96	681.49

16	17	18	
659.79	1089.94	0.0	L 233
4395.76	0.0	0.0	L 234
0.0	0.0	0.0	L 235
20.42	0.0	0.0	L 236
15.97	0.0	0.0	L 237
675.61	0.0	0.0	L 238
0.0	0.0	0.0	L 239
675.61	1089.94	0.0	L 240

col 16: represents 15.th year of production
col 17: for cash-flow discounting and for residual values
col 18: for cash-flow discounting and for residual values

The IRR of 14.2 % is considered a good return considering that all project costs are financed by the project. There are no grants. The project merits very serious consideration on this basis.

The simple rate of return, net profit/investment, is 18.2 % for the last year where depreciation is taken on machines, 1995.

Net profit on sales for the same year is 15.4 %.

The "Cash flow tables, production" of Schedule 10-4 show deficit cash positions for the first three years, but the financing of these deficits would have no significant affect on the financial calculations given above.

10.7 Payback

The cash flows of line 240, Schedule 10-3, show that payback is in about 7.7 years. With the life of the project taken as 16 years the number of paybacks is 3.6.

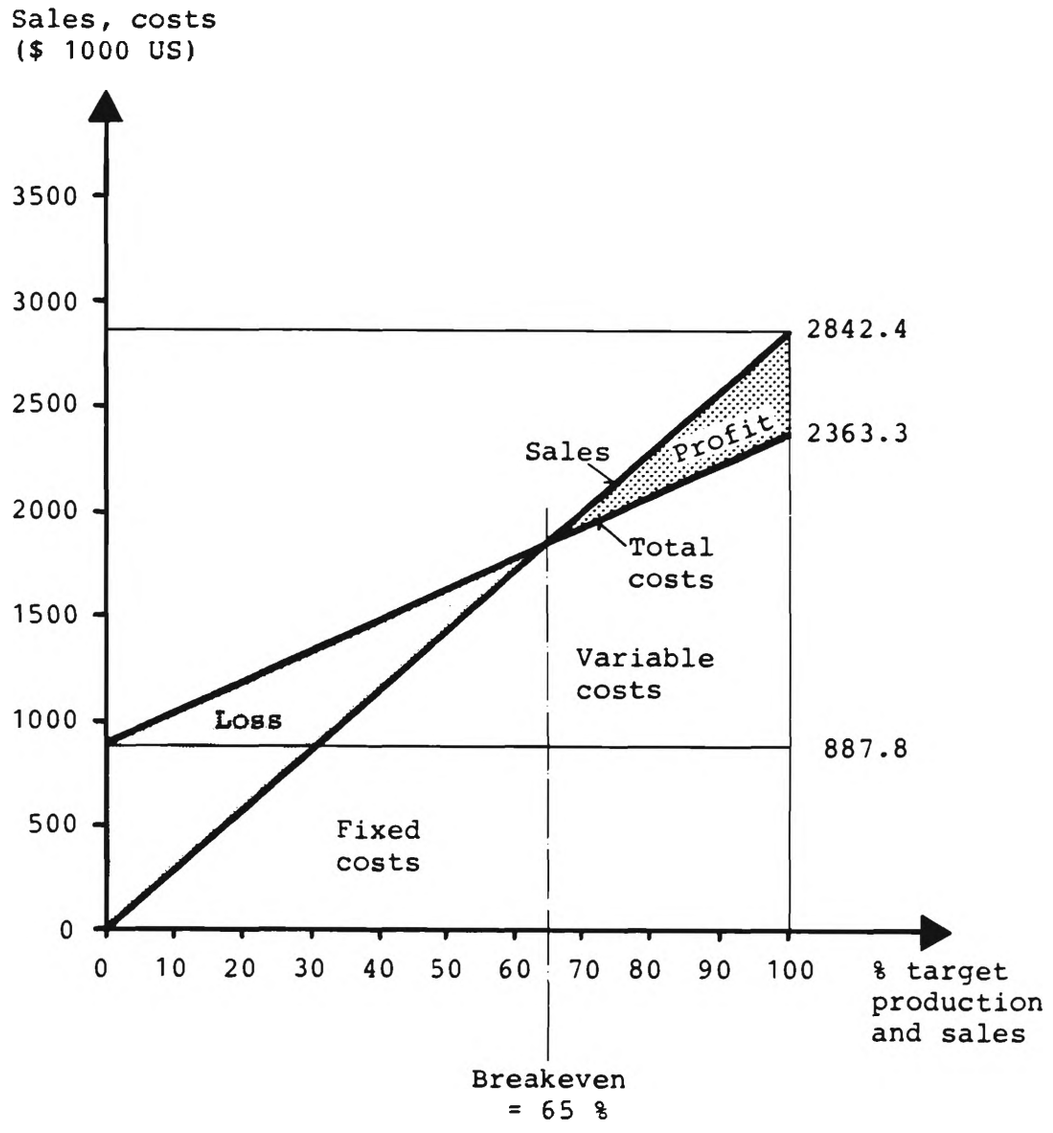
10.8 Breakeven analysis

Figure 7 shows a breakeven graph for the base case in the fourth year of production (1989). The breakeven point is 65 %. Breakeven for the seventh year of production, when full production is reached, is 49.4 % as shown in Figure 8.

The sales and fixed and variable costs for these analyses are taken from the COMFAR output table for Net Income given in Schedule 10-4.

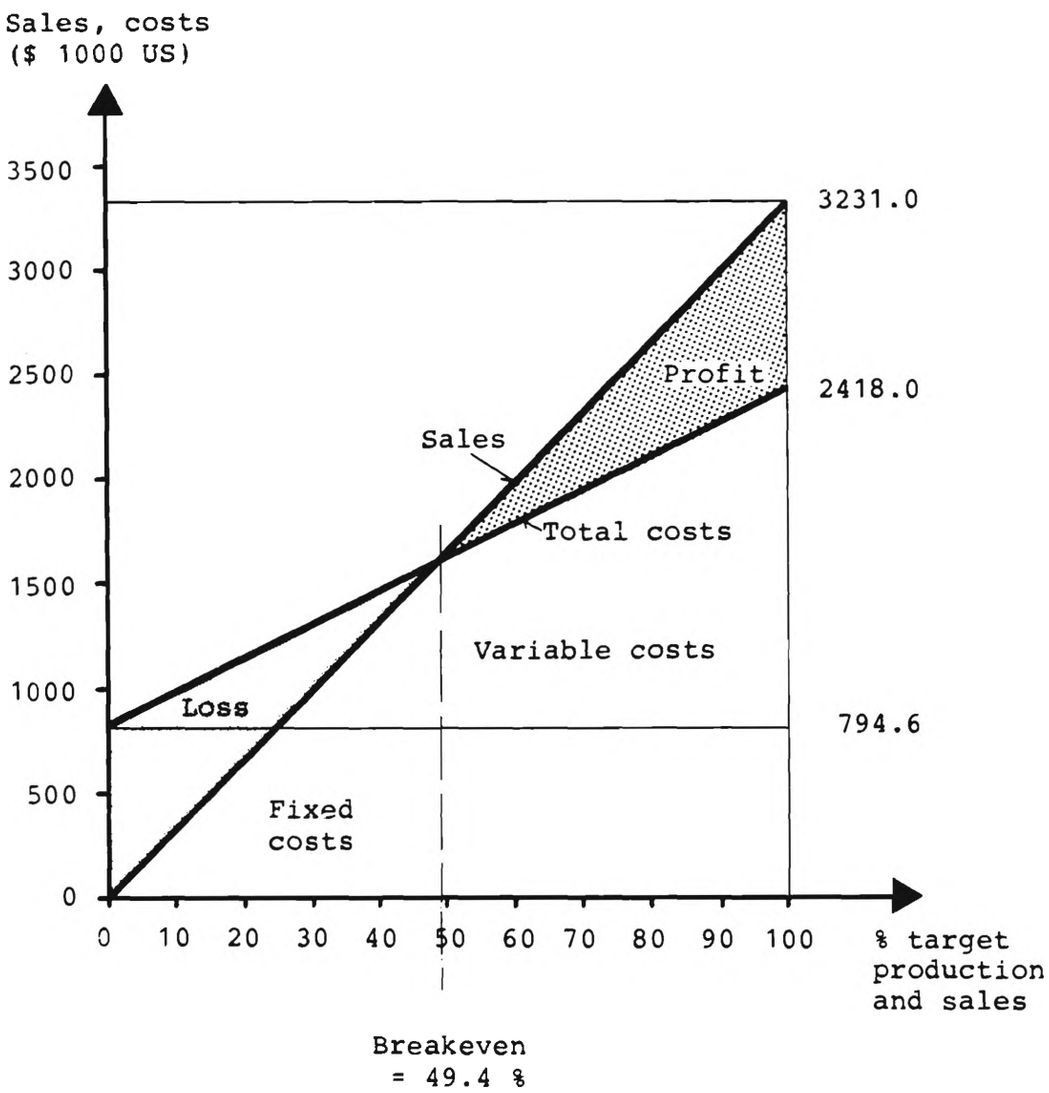
10. Financial and economic analysis

Figure 7: Breakeven graph for base case, fourth year of production



10. Financial and economic analysis

Figure 8: Breakeven graph, seventh year, full production reached



10. Financial and economic analysis

10.9 Sensitivity analysis

Table 7 shows the results of varying separately and combined the sales prices and foreign production costs by 15 % lower and higher than the base case. In varying sales prices, the decrease of 15 % was applied to all products, while the increase of 15 % was applied only to product C, C-I-sheets. This brings the element of probability into the analysis. The consultants believe that it is much more likely for the project to fail to reach target prices for product groups A, B, and D than for product group C, C-I-sheets.

However, for the sake of conservativeness, the price C-I-sheets was decreased as well for the sensitivity analysis. This yielded a dramatic result on IRR and gross profit, but the reader is cautioned to disregard the results of the decrease in sales: they are too heavily dependent on the decrease in sales price of C-I-sheets, and this is not at all likely to be necessary. On the contrary, the market does appear capable of absorbing increases in the C-I-sheet price.

Considering the very pessimistic assumptions (price/quantity) of the reference program which is given a very high probability and the lower probability of the base case (final program), we are able to define a very realistic area in which the most probable IRR would be located. This is shown in Figure 9.

10. Financial and economic analysis

Table 7: Sensitivity analysis

Internal Rate of Return (IRR, interest payable on loans added back)

	Foreign prod. costs up 15 %	Foreign prod. costs unchanged	Foreign prod. costs down 15 %
Sales prices down 15 %	3.0	7.7	12.3
Sales prices unchanged	9.8	14.2 *	18.7
Sales prices up 15 %	14.8	19.4	23.7

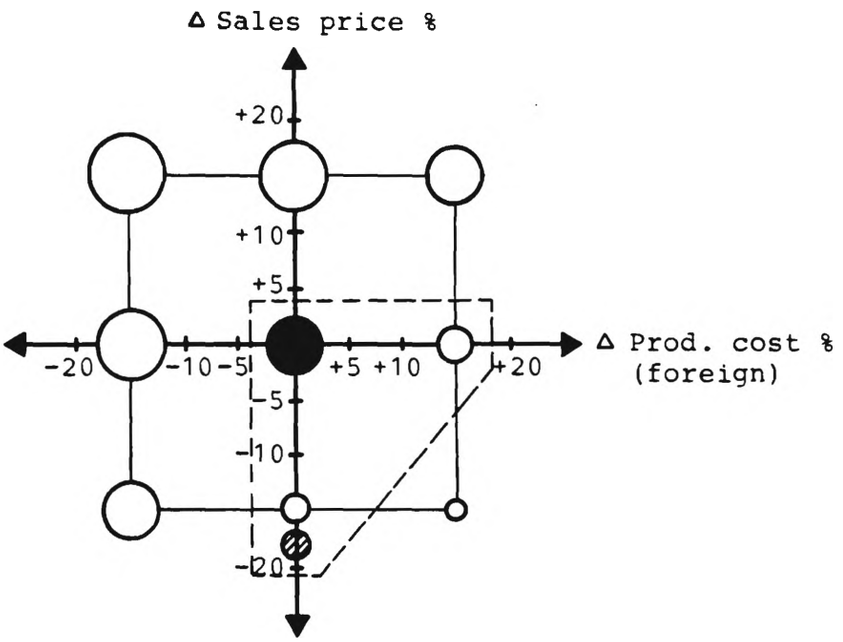
Gross profit ($ 1000) fourth year of production

	Foreign prod. costs up 15 %	Foreign prod. costs unchanged	Foreign prod. costs down 15 %
Sales prices down 15 %	- 224.0	- 10.3	204.9
Sales prices unchanged	104.8	318.6 *	533.7
Sales prices up 15 %	361.1	574.8	790.0

* When only new investments are considered (no investment in existing land, buildings, and machines), the IRR is 16.9, and the gross profit in the fourth year of production is 347.4.

10. Financial and economic analysis

Figure 9: Sensitivity graph



● : base case of final program; circle dimension indicates value of IRR = 14.2 %

⊘ : approximate IRR of reference program

○ : other values of the IRR, corresponding to Table 7

[ ] : most probable area for possible IRR's

10.10 Operating margins of the four cost centers of the new company

Each of the cost centers has a positive operating margin.

The schedule of operating margins from the first chapter is repeated below. The values are for the year 1995, the tenth year of production and the last year where depreciation is taken on machines.

10. Financial and economic analysis

- Operating margins of cost centers at full production in 1995 1)

All figures in thousand US $

(A)	Foundry products			
	Sales			739.5
	- Manufacturing costs	foreign	216.5	
		local	265.7	
		total		-482.2
	Operating margin			257.3
(B)	Metal forming products			
	Sales			314.9
	- Manufacturing costs	foreign	150.5	
		local	121.7	
		total		-272.2
	Operating margin			42.7
(C)	Corrugated iron sheets			
	Sales			1841.0
	- Manufacturing costs	foreign	1'283.7	
		local	71.7	
		total		-1355.4
	Operating margin			485.6
(D)	Repair jobbing and Metal fabrication (all local sales)			
	Sales			335.8
	- Production cost	foreign	97 1	
		local	111.8	
		total		-208.9
	Operating margin			126.9
	TOTAL OPERATING MARGIN (see output tables page 160)			912.5
	TOTAL MANUFACTURING COSTS 1995			2'404.2

1) Last year in which depreciation is taken on machines (10th year of production). These figures are taken the COMFAR calculations of manufacturing costs by product group, not included in present report.

10. Financial and economic analysis

10.11 National economic evaluation

1.	Foreign exchange gain incl. import substitution in year 7		
1.a	Foreign exchange gain generated by project (see table 5)		747.0
1.b	Value of import substitution 1)		
	(A) Foundry products	517.7	
	(B) Metal forming products	220.4	
	(C) Corrugated iron sheets 2)	1'472.6	
	Sub-Total		2'210.7
			2'957.7
2.	Foreign currency costs		
2.a	Foreign currency manufacturing costs 3)		
	(A) Foundry products	266.5	
	(B) Metal forming products	176.5	
	(C) Corrugated iron sheets	1'291.7	
	Sub-Total		- 1'734.7
2.b	Foreign currency financial costs		- 110.9
3.	Net foreign exchange gain		1'112.1

- Number of workplaces

The project conserves more workplaces than any other alternative considered.

The workplaces of the present study are very carefully defined and are those which would be appropriate for a rational, re-organized Workshop.

- Skill levels

In general, higher skills are required than for alternative projects.

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1) The values for import substitution are considerably lower than sales levels, because not all of the products manufactured would be imported otherwise.
2) It is assumed that the government would otherwise allow the importation of C-I-sheets, a product essential for building.
3) From COMFAR calculations of manufacturing costs by product group; not included in present report.

10. Financial and economic analysis

- Training

Adequate provision has been made for training which is self-financed by the project.

- Workers wages

Wages under the present study would be more in line with existing wages in the private sector. They would be about 40 % higher than those at the existing National Workshop.

10.12 Project financing

Three foreign currency loans are assumed:

. $ 1'500'000 at 8.5 %, 15 years: to pay for new machinery and equipment and auxiliary services and equipment. The terms are those typical for loans made by a national development bank under the relending conditions of a development loan sponsored by a single developed country. (For example, the Swiss "mixed-credit" loan to Egypt)

. $ 190'000 at 5 %, 10 years: to pay for pre-production capital costs.

. $ 750'000 at 5 %, 10 years: to pay for the four foreign experts for three years, starting with the first year of production.

The 5 % rate for the two latter loans can be considered an average rate as some of the costs may be covered by grants, or through assistance or soft loans from international organizations.

It is assumed that the Government, as a 40 % partner in the new company, would be willing and able to guarantee local currency loans to the enterprise at about 10 % (considerably less than the commercial rate). The equivalent of $ 250'000 would be made available in the first year.

10. Financial and economic analysis

10.13 Output tables from the computerized financial analysis

The output tables for the base case follow in Schedule 10-4 and include:

- initial investment costs
- current investment costs
- cashflow tables
- cashflow discounting results (IRR)
- net working capital
- total production costs
- projected balance-sheet, pre-production
- projected balance-sheet, production
- net income statement, production
- source of finance, pre-production
- source of finance, production.

10.14 Conclusions: Financial and economic analysis

All the financial calculations yield values which are favourable enough for the government and private business to give very serious consideration to the project.

The project pays for all costs including those for the four foreign experts needed to realize the project and the costs to a private business of acquiring the existing assets of the National Workshop. There are no grants included. Training is also self-financed by the project.

Lenders as well would probably take an interest in the project based on the financial calculations.

10. Financial and economic analysis

The project is not so sensitive to price decreases, because the larger part of revenue would come from C-I-sheets for which prices are attractive and are not at all likely to be decreased during the life of the project.

Imported raw materials are mostly steel sheet and are not likely to undergo significant price increases other than for inflation in producer countries.

The success of the project depends on a steady source of foreign currency at about $ 1'200'000/year to pay for imported galvanized sheet for C-I-sheets production, but it is assumed that C-I-sheets would be imported without the project.

* * *

The next step must be careful detailed planning. If it is not done seriously and conscientiously, the project would probably not achieve the results shown in the financial analysis. Moreover, the detailed planning and implementation should have at least some of the same key personnel involved (chief engineer; industrial engineer, production, capable of finalizing product designs) to ensure continuity.

We encourage the government of Sierra Leone to seriously consider implementing this project for the national economic benefits as well. There is likely to be a positive net foreign exchange gain, skills of workers would be improved, and higher wages could be paid. Moreover, the project would make a significant contribution to industrialization in Sierra Leone.

Schedule 10-4: Output tables

---------- COMFAR 1.0 - UNIDO Vienna ---

Total initial investment costs in thousand US-dollar

Year	1985	0	
Fixed investment costs			
Land site preparation and development	280.20	0.0	
Buildings and civil works	416.90	14.00	*
Auxiliary and service facilities	242.10	0.0	
Incorporated fixed assets	0.0	0.0	
Plant machinery and equipment	1485.30	0.0	
Total fixed investment costs	2424.50	14.00	
Pre-production capital expendit	297.00	0.0	
Working capital	0.0	0.0	
Total initial investment costs	2721.50	14.00	
Of it foreign, in %	63.04	0.0	

SIERRA LEONE , NATIONAL PROJECT --- MAR01,1984

* : Input error; there are no initial investment costs other than those for 1985

Schedule 10-4: Output tables

---------- COMFAR 1.0 - UNIDO Vienna ---

Total current investment costs in thousand US-dollar

Year	1986	1987	1988	1989	1990	1991
Fixed investment costs:						
Land, site preparation and developement	0.0	0.0	0.0	0.0	0.0	0.0
Buildings and civil works	0.0	0.0	0.0	0.0	0.0	0.0
Auxiliary and service facilities	0.0	0.0	0.0	0.0	0.0	0.0
Incorporated fixed assets	250.00	250.00	250.00	0.0	0.0	0.0
Plant, machinery and equipment	0.0	0.0	0.0	0.0	0.0	0.0
Total fixed investment costs	250.00	250.00	250.00	0.0	0.0	0.0
Preproduction capitals expend's	0.0	0.0	0.0	0.0	0.0	0.0
Working capital	266.24	167.38	95.33	67.82	39.17	5.60
Total current investment costs	516.24	417.38	345.33	67.82	39.17	5.60
Of it foreign, %	85.19	99.49	99.52	95.39	98.57	85.26

SIERRA LEONE , NATIONAL PROJECT --- MAR01,1984

---------- COMFAR 1.0 - UNIDO Vienna ---

Total current investment costs in thousand US-dollar

Year	1992
Fixed investment costs:	
Land, site preparation and developement	0.0
Buildings and civil works	0.0
Auxiliary and service facilities	0.0
Incorporated fixed assets	0.0
Plant, machinery and equipment	0.0
Total fixed investment costs	0.0
Preproduction capitals expend's	0.0
Working capital	5.59
Total current investment costs	5.59
Of it foreign, %	85.25

SIERRA LEONE , NATIONAL PROJECT --- MAR01,1984

Schedule 10-4: Output tables

COMFAR 1.0 - UNIDO Vienna

Cashflow tables, construction in thousand US-dollar

Year	1985	0
Total CF-inflow	2640.50	0.0
. Financial resources	2640.50	0.0
. Sales	0.0	0.0
Total CF-outflow	2721.50	14.00 *
. Total assets	2640.50	14.00
. Operating costs	0.0	0.0
. Debt service and interest	81.00	0.0
. Repayment	0.0	0.0
. Corporate tax	0.0	0.0
. Dividends paid	0.0	0.0
Surplus (deficit)	-81.00	-14.00
Cumulated cash balance	-81.00	0.0
Inflow local currency	950.50	0.0
Outflow local currency	1006.00	14.00
Surplus (deficit) local currency	-55.50	-14.00
Inflow foreign currency	1690.00	0.0
Outflow foreign currency	1715.50	0.0
Surplus (deficit) foreign currency	-25.50	0.0

SIERRA LEONE , NATIONAL PROJECT --- MAR01,1984

* : Input error; there are no other initial investments than those for 1985.

Schedule 10-4: Output tables

---------- COMFAR 1.0 - UNIDO Vienna ---

Cashflow tables, production in thousandUS-dollar

Year	1986	1987	1988	1989	1990	1991	1992
Total CF-inflow	1552.85	1838.26	2333.00	2842.41	3060.25	3145.64	3230.90
. Financial resources	516.24	0.0	0.0	0.0	0.0	0.0	0.0
. Sales	1036.61	1838.26	2333.00	2842.41	3060.25	3145.64	3230.90
Total CF-outflow	1831.19	2250.43	2444.12	2362.83	2439.20	2643.39	2709.32
. Total assets	534.80	419.20	346.49	69.16	39.57	5.86	5.85
. Operating costs	1036.57	1508.56	1779.21	1979.50	2089.70	2108.55	2127.36
. Debt service and interest	174.91	180.87	170.93	160.54	149.65	138.22	126.22
. Repayment	84.90	141.80	147.49	153.64	160.28	167.46	175.22
. Corporate tax	0.0	0.0	0.0	0.0	0.0	223.3.	274.68
. Dividends paid	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Surplus (deficit)	-278.34	-412.17	-111.12	479.58	621.04	502.25	521.58
Cumulated cash balance	-373.34	-785.51	-896.63	-417.05	203.99	706.24	1227.82
Inflow local currency	1428.20	1716.78	1886.57	2223.27	2296.68	2374.14	2451.59
Outflow local currency	642.64	820.97	1004.22	1198.40	1341.60	1577.14	1640.25
Surplus (deficit) local currency	785.55	895.81	882.35	1024.87	955.08	797.01	811.35
Inflow foreign currency	516.24	255.92	429.77	602.47	746.90	754.83	762.64
Outflow foreign currency	1188.55	1429.46	1439.90	1164.43	1097.60	1066.25	1069.08
Surplus (deficit) foreign currency	-672.30	-1173.54	-1010.14	-561.96	-350.71	-311.42	-306.44

SIERRA LEONE , NATIONAL PROJECT --- MAR01,1984

---------- COMFAR 1.0 - UNIDO Vienna ---

Cashflow tables, production in thousandUS-dollar

Year	1993	1994	1995	1996	1997	1998	1999
Total CF-inflow	3230.90	3230.90	3230.90	3230.90	3230.90	3230.90	3230.90
. Financial resources	0.0	0.0	0.0	0.0	0.0	0.0	0.0
. Sales	3230.90	3230.90	3230.90	3230.90	3230.90	3230.90	3230.90
Total CF-outflow	2724.28	2745.35	2746.72	2792.89	2742.80	2746.23	2750.04
. Total assets	0.0	0.0	0.0	0.0	0.0	0.0	0.0
. Operating costs	2127.36	2127.36	2127.36	2127.36	2127.36	2127.36	2127.36
. Debt service and interest	113.59	100.29	86.25	71.42	56.96	44.21	30.53
. Repayment	183.60	192.65	202.44	188.42	147.00	158.08	170.10
. Corporate tax	299.73	325.05	330.67	405.69	411.48	416.58	422.05
. Dividends paid	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Surplus (deficit)	506.62	485.55	484.18	438.01	488.10	484.67	480.86
Cumulated cash balance	1734.45	2220.00	2704.18	3142.19	3630.28	4114.95	4595.81
Inflow local currency	2451.59	2451.59	2451.59	2451.59	2451.59	2451.59	2451.59
Outflow local currency	1662.58	1686.24	1690.18	1763.54	1767.66	1771.09	1774.90
Surplus (deficit) local currency	789.01	765.36	761.41	688.05	683.93	680.50	676.69
Inflow foreign currency	762.64	762.64	762.64	762.64	762.64	762.64	762.64
Outflow foreign currency	1061.70	1059.11	1056.53	1029.35	975.14	975.14	975.14
Surplus (deficit) foreign currency	-299.06	-296.47	-293.89	-266.71	-212.50	-212.50	-212.50

SIERRA LEONE , NATIONAL PROJECT --- MAR01,1984

Schedule 10-4: Output tables

---------- COMFAR 1.0 - UNIDO Vienna ---

Cashflow tables, production in thousandUS-dollar

Year	2000
Total CF-inflow	3230.90
. Financial resources	0.0
. Sales	3230.90
Total CF-outflow	2754.26
. Total assets	0.0
. Operating costs	2127.36
. Debt service and interest	15.82
. Repayment	183.15
. Corporate tax	427.93
. Dividends paid	0.0
Surplus (deficit)	476.64
Cumulated cash balance	5072.45
Inflow local currency	2451.59
Outflow local currency	1779.12
Surplus (deficit) local currency	672.48
Inflow foreign currency	762.64
Outflow foreign currency	975.14
Surplus (deficit) foreign currency	-212.50

Schedule: Output tables

Cashflow Discounting:

a) interest payable on loan = cash-outflow:

Net present value at	10.00 % =	160.17
Internal Rate of Return	10.57 %	

b) interest payable on loan added back to net-cashflow:

Net present value at	10.00 % =	1139.03
Internal Rate of Return	14.23 %	

Note: NPV is computed for the year before production starts, using the Future Value of cashflows during pre-production.

c) Future Value of cashflow during pre-production:

Total cash-outflow at	0.0 % , FVAL =	2721.50
Total cash-outflow, Nominal value	NVAL =	2735.50

COMFAR 1.0 - UNIDO Vienna

Total production costs in thousand US-dollar

Year	1986	1987	1988	1989	1990	1991	1992
% of nom. capacity (single product only).	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Raw material 1	507.83	963.95	1222.24	1402.09	1507.99	1521.64	1535.26
Other raw materials	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Utilities	58.25	64.08	68.65	76.31	77.35	79.37	81.39
Labour, direct	172.13	175.70	178.63	184.16	185.00	186.50	187.99
Repair	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spares	13.42	14.44	15.20	15.73	16.36	16.39	16.43
Factory overheads	79.77	80.14	80.42	80.86	80.93	81.04	81.15
Factory costs	831.39	1298.30	1565.14	1759.15	1867.62	1884.94	1902.23
Administrative overheads	205.18	210.26	214.07	220.35	222.08	223.61	225.13
Indir. costs, sales and distribution	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct costs, sales and distribution	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Depreciation	233.82	283.83	333.83	383.82	383.82	340.62	290.62
Financial costs	174.91	180.87	170.93	160.54	149.65	138.22	126.22
Total manufacturing costs	1445.30	1973.26	2283.97	2523.86	2623.17	2587.39	2544.20
Costs per unit (single product)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Of it foreign, %	63.16	72.35	75.67	77.21	77.99	77.53	77.00
Of it variable,%	36.85	50.91	55.83	58.46	60.45	62.02	63.81
Of it direct, %	57.52	65.79	68.53	69.70	71.20	72.85	74.77
Total labour	338.45	345.98	351.88	362.37	364.68	367.37	370.07

SIERRA LEONE , NATIONAL PROJECT --- MAR01,1984

COMFAR 1.0 - UNIDO Vienna

Total production costs in thousand US-dollar

Year	1993	1994	1995	1996	1997	1998	1999
% of nom. capacity (single product only).	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Raw material 1	1535.26	1535.26	1535.26	1535.26	1535.26	1535.26	1535.26
Other raw materials	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Utilities	81.39	81.39	81.39	81.39	81.39	81.39	81.39
Labour, direct	187.99	187.99	187.99	187.99	187.99	187.99	187.99
Repair	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spares	16.43	16.43	16.43	16.43	16.43	16.43	16.43
Factory overheads	81.15	81.15	81.15	81.15	81.15	81.15	81.15
Factory costs	1902.23	1902.23	1902.23	1902.23	1902.23	1902.23	1902.23
Administrative overheads	225.13	225.13	225.13	225.13	225.13	225.13	225.13
Indir. costs, sales and distribution	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct costs, sales and distribution	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Depreciation	240.62	190.62	190.62	17.88	17.88	17.88	17.88
Financial costs	113.59	100.29	86.25	71.42	56.96	44.21	30.53
Total manufacturing costs	2481.58	2418.27	2404.23	2216.66	2202.21	2189.46	2175.77
Costs per unit (single product)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Of it foreign, %	76.48	75.94	75.87	73.90	73.80	73.73	73.64
Of it variable,%	65.42	67.13	67.52	73.24	73.72	74.15	74.61
Of it direct, %	76.65	78.66	79.12	85.81	86.38	86.88	87.43
Total labour	370.07	370.07	370.07	370.07	370.07	370.07	370.07

SIERRA LEONE , NATIONAL PROJECT --- MAR01,1984

Schedule 10-4: Output tables

---------- COMFAR 1.0 - UNIDO Vienna ---

Total production costs in thousand US-dollar

Year.....	2000
% of nom. capacity (single product only).	0.0
Raw material 1.....	1535.26
Other raw materials.....	0.0
Energy	0.0
Utilities	81.39
Labour, direct	187.99
Repair	0.0
Spares	16.43
Factory overheads	81.15
Factory costs	1902.23
Administrative overheads	225.13
Indir. costs, sales and distribution	0.0
Direct costs, sales and distribution	0.0
Depreciation	17.89
Financial costs	15.82
Total manufacturing costs	2161.07
Costs per unit (single product)	0.0
Of it foreign, %	73.54
Of it variable,%	75.12
Of it direct, %	88.02
Total labour	370.07

Schedule 10-4: Output tables

COMFAR 1.0 - UNIDO Vienna

Projected balance sheets, construction in thousand US-dollar

Year	1985	0
Total assets	2721.50	14.00
Fixed assets, net of depreciation	0.0	0.0
Construction in progress	2721.50	14.00
Current assets	0.0	0.0
Cash, bank	0.0	0.0
Cash surplus, finance available	0.0	0.0
Total liabilities	2721.50	14.00
Equity capital	700.50	0.0
Reserves, retained profit	0.0	0.0
Profit,(loss)	0.0	0.0
Long and medium term debt	1940.00	0.0
Current liabilities	0.0	0.0
Bank overdraft, finance required	81.00	14.00
Total debt	2021.00	14.00
Equity, % of liabilities	26.53	0.0

Schedule 10-4: Output tables

---------- COMFAR 1.0 - UNIDO Vienna ---

Projected balance sheet, production in thousand US-dollar

Year	1986	1987	1988	1989	1990	1991	1992
Total assets	3036.48	3171.86	3184.52	2869.86	2752.89	2920.64	3157.70
Fixed assets, net of depreciation	2501.68	2467.85	2384.03	2250.20	1866.38	1525.75	1235.13
Construction in progress	250.00	250.00	250.00	0.0	0.0	0.0	0.0
Current assets	246.55	414.98	510.86	579.00	618.33	623.94	629.53
Cash, bank	38.26	39.03	39.63	40.66	40.90	41.16	41.41
Cash surplus, finance available	0.0	0.0	0.0	0.0	227.28	729.80	1251.64
Total liabilities	3036.48	3171.86	3184.52	2869.86	2752.89	2920.64	3157.70
Equity capital	700.50	700.50	700.50	700.50	700.50	700.50	700.50
Reserves, retained profit	0.0	-408.70	-543.69	-494.66	-176.10	260.97	595.92
Profit,(loss)	-408.70	-135.00	49.04	318.56	437.08	334.95	412.02
Long and medium term debt	2371.34	2229.54	2082.05	1928.41	1768.12	1600.66	1425.45
Current liabilities	18.56	20.39	21.55	22.88	23.29	23.55	23.81
Bank overdraft, finance required	354.78	765.12	875.09	394.17	0.0	0.0	0.0
Total debt	2744.68	3015.05	2978.68	2345.46	1791.41	1624.21	1449.26
Equity, % of liabilities	26.12	29.11	30.33	28.30	25.45	23.98	22.18

SIERRA LEONE , NATIONAL PROJECT --- MAR01,1984

---------- COMFAR 1.0 - UNIDO Vienna ---

Projected balance sheet, production in thousand US-dollar

Year	1993	1994	1995	1996	1997	1998	1999
Total assets	3423.70	3718.63	4012.18	4432.31	4902.52	5369.30	5832.27
Fixed assets, net of depreciation	994.50	803.88	613.25	595.37	577.48	559.60	541.71
Construction in progress	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Current assets	629.53	629.53	629.53	629.53	629.53	629.53	629.53
Cash, bank	41.41	41.41	41.41	41.41	41.41	41.41	41.41
Cash surplus, finance available	1758.26	2243.81	2727.99	3166.00	3654.10	4138.76	4619.62
Total liabilities	3423.70	3718.63	4012.18	4432.31	4902.52	5369.30	5832.27
Equity capital	700.50	700.50	700.50	700.50	700.50	700.50	700.50
Reserves, retained profit	1007.94	1457.53	1945.11	2441.11	3049.65	3666.87	4291.73
Profit,(loss)	449.59	487.58	496.00	608.54	617.22	624.86	633.08
Long and medium term debt	1241.85	1049.20	846.76	658.34	511.34	353.25	183.15
Current liabilities	23.81	23.81	23.81	23.81	23.81	23.81	23.81
Bank overdraft, finance required	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total debt	1265.67	1073.02	870.57	682.16	535.15	377.07	206.96
Equity, % of liabilities	20.46	18.84	17.46	15.80	14.29	13.05	12.01

SIERRA LEONE , NATIONAL PROJECT --- MAR01,1984

Schedule 10-4: Output tables

---------- COMFAR 1.0 - UNIDO Vienna ---

Projected balance sheet, production in thousand US-dollar

Year	2000
Total assets	6291.02
Fixed assets, net of depreciation	523.82
Construction in progress	0.0
Current assets	629.53
Cash, bank	41.41
Cash surplus, finance available	5096.26
Total liabilities	6291.02
Equity capital	700.50
Reserves, retained profit	4924.81
Profit,(loss)	641.90
Long and medium term debt	0.00
Current liabilities	23.81
Bank overdraft, finance required	0.0
Total debt	23.82
Equity, % of liabilities	11.13

Schedule 10-4: Output tables

COMFAR 1.0 - UNIDO Vienna

Net income statement in thousand US-dollar

Year	1986	1987	1988	1989	1990	1991
Total sales, including sales tax	1036.61	1838.26	2333.00	2842.41	3060.25	3145.64
Less: variable costs, including sales tax	532.61	1004.60	1275.25	1475.54	1585.74	1604.59
Variable margin	503.99	833.66	1057.75	1366.88	1474.51	1541.05
As % of total sales	48.62	45.35	45.34	48.09	48.18	48.99
Non-variable costs, including depreciation	737.79	787.78	837.79	887.78	887.78	844.59
Operational margin	-233.79	45.88	219.97	479.09	586.72	696.47
As % of total sales	-22.55	2.50	9.43	16.86	19.17	22.14
Cost of finance	174.91	180.87	170.93	160.54	149.65	138.22
Gross profit	-408.70	-135.00	49.04	318.56	437.08	558.25
Allowances	0.0	0.0	0.0	0.0	0.0	0.0
Taxable profit	-408.70	-135.00	49.04	318.56	437.08	558.25
Tax	0.0	0.0	0.0	0.0	0.0	223.30
Net profit	-408.70	-135.00	49.04	318.56	437.08	334.95
Dividends paid	0.0	0.0	0.0	0.0	0.0	0.0
Undistributed profit	-408.70	-135.00	49.04	318.56	437.08	334.95
Accumulated undistributed profit	-408.70	-543.69	-494.66	-176.10	260.97	595.92
Gross profit, % of total sales	-39.43	-7.34	2.10	11.21	14.28	17.75
Net profit, % of total sales	-39.43	-7.34	2.10	11.21	14.28	10.65
Net profit, % of equity	-58.34	-19.27	7.00	45.48	62.40	47.82
Net profit + interest, % of investment	-7.19	1.25	5.48	11.74	14.24	11.47

Schedule 10-4: Output tables

---------- COMFAR 1.0 - UNIDO Vienna ---

Net income statement in thousand US-dollar

Year	1992	1993	1994	1995	1996	1997
Total sales, including sales tax	3230.90	3230.90	3230.90	3230.90	3230.90	3230.90
Less: variable costs, including sales tax	1623.40	1623.40	1623.40	1623.40	1623.40	1623.40
Variable margin	1607.50	1607.50	1607.50	1607.50	1607.50	1607.50
As % of total sales	49.75	49.75	49.75	49.75	49.75	49.75
Non-variable costs, including depreciation	794.58	744.58	694.58	694.58	521.84	521.84
Operational margin	812.91	862.91	912.91	912.91	1085.65	1085.65
As % of total sales	25.16	26.71	28.26	28.26	33.60	33.60
Cost of finance	126.22	113.59	100.29	86.25	71.42	56.96
Gross profit	686.70	749.32	812.63	826.67	1014.24	1028.69
Allowances	0.0	0.0	0.0	0.0	0.0	0.0
Taxable profit	686.70	749.32	812.63	826.67	1014.24	1028.69
Tax	274.68	299.73	325.05	330.67	405.69	411.48
Net profit	412.02	449.59	487.58	496.00	608.54	617.22
Dividends paid	0.0	0.0	0.0	0.0	0.0	0.0
Undistributed profit	412.02	449.59	487.58	496.00	608.54	617.22
Accumulated undistributed profit	1007.94	1457.53	1945.11	2441.11	3049.65	3666.87
Gross profit, % of total sales	21.25	23.19	25.15	25.59	31.39	31.84
Net profit, % of total sales	12.75	13.92	15.09	15.35	18.84	19.10
Net profit, % of equity	58.82	64.18	69.60	70.81	86.87	88.11
Net profit + interest, % of investment	13.02	13.63	14.22	14.09	16.45	16.31

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Schedule 10-4: Output tables

COMFAR 1.0 - UNIDO Vienna

Net income statement in thousand US-dollar

Year	1998	1999	2000
Total sales, including sales tax	3230.90	3230.90	3230.90
Less: variable costs, including sales tax	1623.40	1623.40	1623.40
Variable margin	1607.50	1607.50	1607.50
As % of total sales	49.75	49.75	49.75
Non-variable costs, including depreciation	521.84	521.84	521.85
Operational margin	1085.65	1085.65	1085.65
As % of total sales	33.60	33.60	33.60
Cost of finance	44.21	30.53	15.82
Gross profit	1041.44	1055.13	1069.83
Allowances	0.0	0.0	0.0
Taxable profit	1041.44	1055.13	1069.83
Tax	416.58	422.05	427.93
Net profit	624.86	633.08	641.90
Dividends paid	0.0	0.0	0.0
Undistributed profit	624.86	633.08	641.90
Accumulated undistributed profit	4291.73	4924.81	5566.71
Gross profit, % of total sales	32.23	32.66	33.11
Net profit, % of total sales	19.34	19.59	19.87
Net profit, % of equity	89.20	90.37	91.63
Net profit + interest, % of investment	16.19	16.06	15.92

Schedule 10-4: Output tables

---------- COMFAR 1.0 - UNIDO Vienna ---

Source of finance, construction in thousand US-dollar

Year	1985
Equity, ordinary	700.50
Equity, preference	0.0
Subsidies, grants	0.0
Loan AF	1500.00
Loan BF	190.00
Loan CF	0.0
Loan AL	250.00
Loan BL	0.0
Loan CL	0.0
Total loan	1940.00
Current liabilities	0.0
Bank overdraft	81.00
Total funds available ...	2721.50

SIERRA LEONE , NATIONAL PROJECT --- MAR01,1984

Schedule 10-4: Output tables

COMFAR 1.0 - UNIDO Vienna

Source of finance, production in thousand US-dollar

Year	1986	1987	1988	1989	1990	1991	1992	1993
Equity, ordinary	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Equity, preference	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subsidies, grants	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loan AF	-53.13	-57.65	-62.55	-67.86	-73.63	-79.89	-86.68	-94.05
Loan BF	-15.11	-15.86	-16.65	-17.49	-18.36	-19.28	-20.24	-21.26
Loan CF	516.24	-51.62	-51.62	-51.62	-51.62	-51.62	-51.62	-51.62
Loan AL	-16.67	-16.67	-16.67	-16.67	-16.67	-16.67	-16.67	-16.67
Loan BL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loan CL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total loan	431.34	-141.80	-147.49	-153.64	-160.28	-167.46	-175.22	-183.60
Current liabilities	18.56	1.82	1.16	1.33	0.41	0.26	0.26	0.0
Bank overdraft	354.78	410.35	109.96	-480.92	-394.17	0.0	0.0	0.0
Total funds available	804.68	270.37	-36.37	-633.22	-554.05	-167.20	-174.95	-183.60

COMFAR 1.0 - UNIDO Vienna

Source of finance, production in thousand US-dollar

Year	1994	1995	1996	1997	1998	1999	2000
Equity, ordinary	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Equity, preference	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subsidies, grants	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loan AF	-102.04	-110.72	-120.13	-130.34	-141.42	-153.44	-166.48
Loan BF	-22.32	-23.43	0.0	0.0	0.0	0.0	0.0
Loan CF	-51.62	-51.62	-51.62	0.0	0.0	0.0	0.0
Loan AL	-16.67	-16.67	-16.67	-16.67	-16.67	-16.67	-16.67
Loan BL	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loan CL	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total loan	-192.65	-202.44	-188.42	-147.00	-158.08	-170.10	-183.15
Current liabilities	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bank overdraft	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total funds available	-192.65	-202.44	-188.42	-147.00	-158.08	-170.10	-183.15

SIERRA LEONE , NATIONAL PROJECT --- MAR01,1984

COMFAR 1.0 - UNIDO Vienna

Net working capital in thousand US-dollar

Year			1986	1987	1988	1989	1990	1991
Coverage:	mdc	coto						
Current assets &								
Accounts receivable	1	360.0	2.88	4.19	4.94	5.50	5.80	5.86
Inventory and materials	82	4.4	130.07	244.38	309.17	354.40	380.92	384.40
Energy	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spares	110	3.3	4.12	4.63	5.01	5.28	5.59	5.61
Work in progress	10	36.0	23.09	36.06	43.48	48.87	51.88	52.36
Finished products	30	12.0	86.38	125.71	148.27	164.96	174.14	175.71
Cash in hand	29	12.3	38.26	39.03	39.63	40.66	40.90	41.16
Total current assets			284.80	454.01	550.50	619.66	659.23	665.09
Current liabilities and								
Accounts payable	8	44.8	18.56	20.39	21.55	22.88	23.29	23.55
Net working capital			266.24	433.62	528.95	596.78	635.94	641.54
Increase in working capital			266.24	167.38	95.33	67.82	39.17	5.60
Net working capital, local currency			76.45	78.59	80.25	83.38	83.94	84.77
Net working capital, foreign currency			189.79	355.03	448.70	513.40	552.00	556.77

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

SIERRA LEONE , NATIONAL PROJECT --- MAR01,1984

COMFAR 1.0 - UNIDO Vienna

Net working capital in thousand US-dollar

Year			1992	1993	1994	1995	1996	1997
Coverage:	mdc	coto						
Current assets &								
Accounts receivable	1	360.0	5.91	5.91	5.91	5.91	5.91	5.91
Inventory and materials	82	4.4	387.87	387.87	387.87	387.87	387.87	387.87
Energy	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spares	110	3.3	5.63	5.63	5.63	5.63	5.63	5.63
Work in progress	10	36.0	52.84	52.84	52.84	52.84	52.84	52.84
Finished products	30	12.0	177.28	177.28	177.28	177.28	177.28	177.28
Cash in hand	29	12.3	41.41	41.41	41.41	41.41	41.41	41.41
Total current assets			670.94	670.94	670.94	670.94	670.94	670.94
Current liabilities and								
Accounts payable	8	44.8	23.81	23.81	23.81	23.81	23.81	23.81
Net working capital			647.13	647.13	647.13	647.13	647.13	647.13
Increase in working capital			5.59	0.0	0.0	0.0	0.0	0.0
Net working capital, local currency			85.59	85.59	85.59	85.59	85.59	85.59
Net working capital, foreign currency			561.54	561.54	561.54	561.54	561.54	561.54

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Schedule 10-4: Output tables

---------- COMFAR 1.0 - UNIDO Vienna ---

Net working capital in thousand US-dollar

Year			1998	1999	2000
Coverage:.....	mdc	coto			
Current assets &					
Accounts receivable	1	360.0	5.91	5.91	5.91
Inventory and materials.....	82	4.4	387.87	387.87	387.87
Energy	0	0.0	0.0	0.0	0.0
Spares	110	3.3	5.63	5.63	5.63
Work in progress	10	36.0	52.84	52.84	52.84
Finished products	30	12.0	177.28	177.28	177.28
Cash in hand	29	12.3	41.41	41.41	41.41
Total current assets			670.94	670.94	670.94
Current liabilities and					
Accounts payable	8	44.8	23.81	23.81	23.81
Net working capital			647.13	647.13	647.13
Increase in working capital			0.0	0.0	0.0
Net working capital, local currency ...			85.59	85.59	85.59
Net working capital, foreign currency ...			561.54	561.54	561.54

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

SIERRA LEONE , NATIONAL PROJECT --- MAR01,1984

ANNEXES

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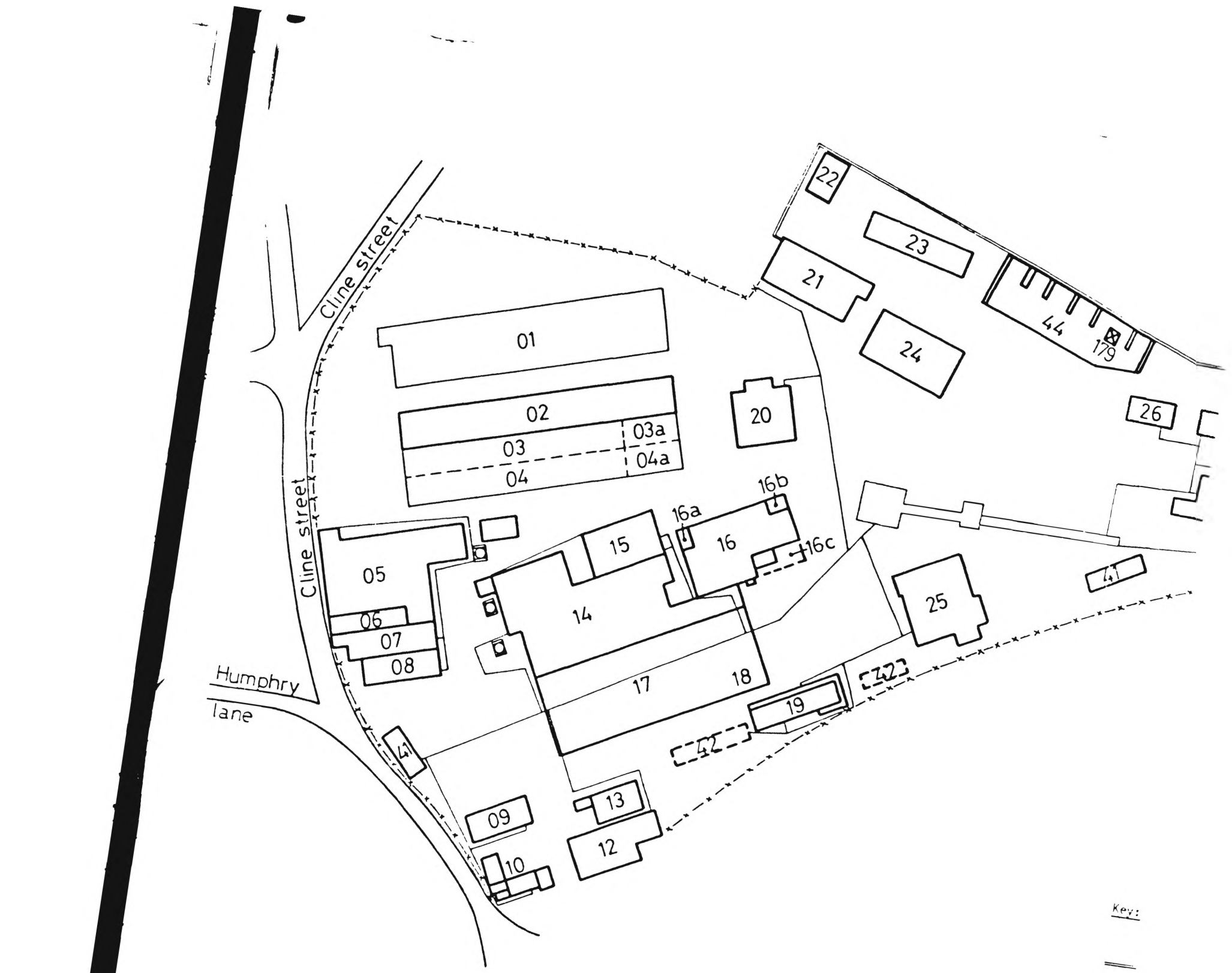
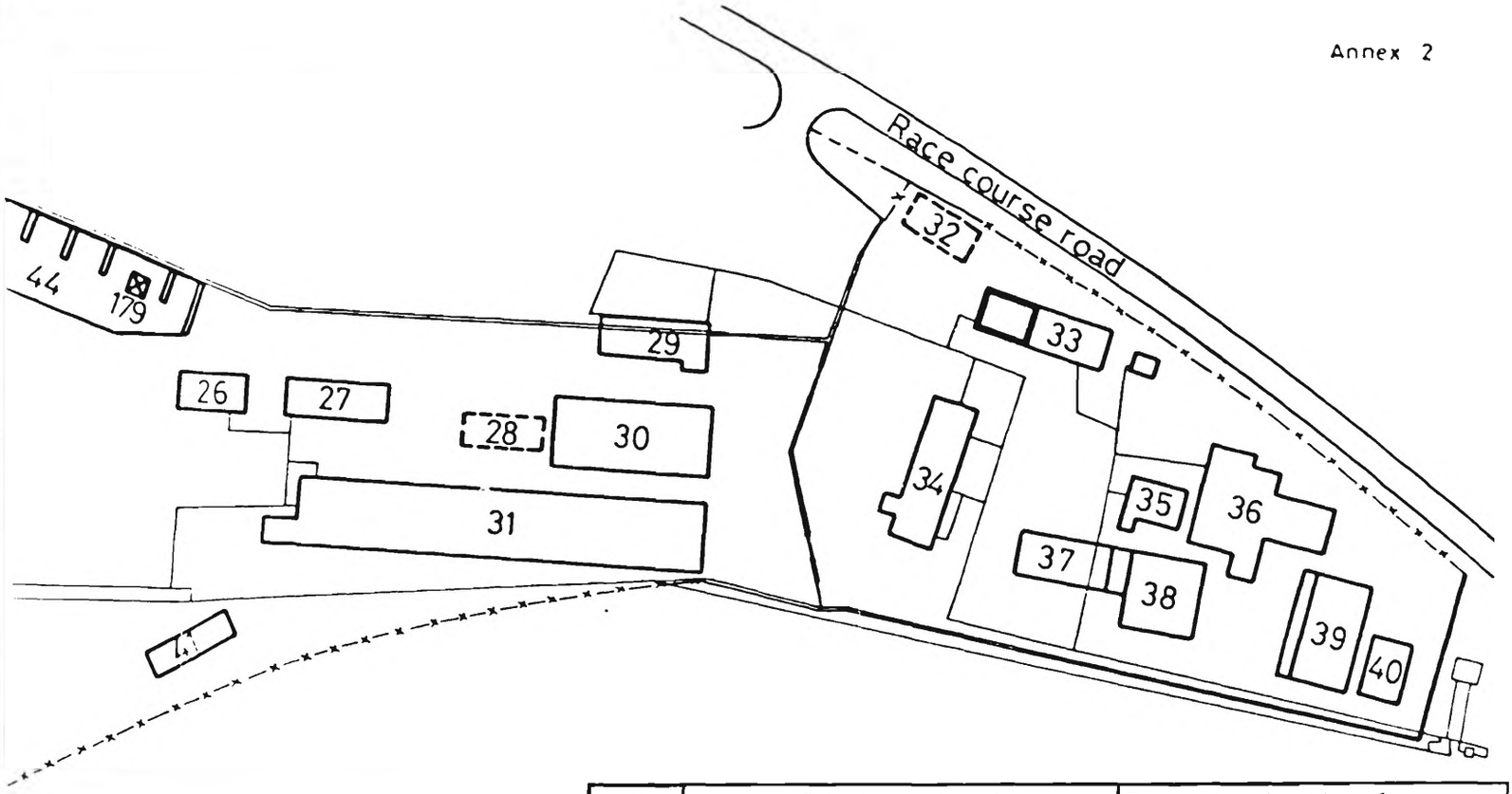
Annex 1: Materials and inputs for the new foundry at full production

to produce 180 t good grey-iron castings (cupola furnace)	to produce 30 t good steel castings (electric furnace)

	item description	source loc	source for	qty t	item description	source loc	source for	qty t
raw material	molten iron total	x		390	molten steel total	x		78
	pig iron		x	90	steel scrap	x		27
	grey iron scrap	x		99	ferro-alloys		x	1,1
	steel scrap	x		54	charcoal	x		0,5
	ferro-alloys		x	3,1	scorifier		x	0,1
	coke		x	54				
	limestone	x		10,8				
auxiliary material	recycling material	-	-	145,8	recycling material	-	-	36,3
	losses (10 %)	-	-	3,6	losses (10 %)	-	-	0,8
	moulding sand		x	72	moulding sand		x	15
	core sand		x	18	core sand		x	6
	sea coal		x	9	bentonite		x	0,9
	bentonite		x	3,6	sodium silicate		x	0,36
	sodium silicate		x	1,08	C02	x		0,36
	C02	x		1,08	iron oxide		x	0,06
	iron-oxide		x	0,18	water	x		3,6
	water	x		14,4	starch	x		1,8
utilities and other material	fire reserve material		x	-	fire reserve material		x	-
	separating agent	x		0,2	mould agent	x		-
	radiated marcasite		x	1	radiated marcasite		x	-
	cutting wheels		x	0,1	grinding wheels		x	-
	grinding wheels		x	0,19	tools		x	-
	tools		x	-	patterns (wood)	x		-
	patterns (wood)	x		120 pcs	lacquers, colour		x	-
	lacquers, colour		x	0,1	cement		x	-
	cement		x	-	protection measures	x		-
	protection measures	x		-	electricity	x		-
	electricity	x		-	water	x		-
	water	x		-	wages (15 %)	x		-
	wages (85 %)	x		-				

if no qty-number is stated, qty is very to small (< 0,01 t) or dimension is not ton


Cline street
Cline street
Humphry
lane
01
02
03
04
03a
04a
05
06
07
08
09
10
12
13
14
15
16
16a
16b
16c
17
18
19
20
21
22
23
24
25
26
41
42
42
44
179
Key:
100 50 0 100 200 300
NATIONAL WORKSHOP, SIERR
General layout
ICME
Bellariastrasse 51, 8038 Züri
SECTION 1



Key:

- Block fence
- Building
- Temporary structure
- C-I-sheet fence
- Water supply

feet
200 300 400 500

No	Existing designation	Proposed designation after reorg.
01	not in use (Museum)	not used (Museum)
02	Wood working shop(carpenter/saw mill)	Wood working shop
03+04	not in use	C-I-sheet fabrication (only 04)
03a+04a	not in use	Apprentices shop
05	Spraying and vehicle repair shop	Spraying/vehicle rep. shop
06	Electrical shop	Electrical shop repair-
07	Millwright shop	Millwright shop jobbing
08	Coppersmith shop	Coppersmith shop
09	Tool room	Tool room Part 1
10	Partially used (Post, Security)	Tool making shop Part 2
11	Time keeper's office	Time keeper's office
12	Canteen	Canteen
13	Show room	Show room
14	Machine shop	Machine shop
15	Blacksmith shop	Forging shop
16	Foundry	Foundry
16a	Foundry (part)	Material testing laboratory
16b	Pattern making shop	Pattern making shop
16c	not existing	Shelter for cupola furnace
17	Welding shop	Metal forming shop
18	Metal assembly shop (doors, frames)	Metal forming shop
19	Administrative offices	Administrative offices
20	Block making shop	Block making shop
21	Upholstery shop	Upholstery shop
22	Vacant	Vacant
23	Store	Store
24	Store	Store
25	Plating shop	Plating shop
26	Refrigeration	Refrigeration
27	Plumbing shed	Plumbing shed
28	Fuel shelter	Fuel shelter
29	Office stores	Office stores
30	Warehouse 2	Warehouse 2 stores for
31	Warehouse 1	Warehouse 1 raw material

	Rented area, buildings / proposed auxiliary facilities
32	Proposed scrap reception
33	Former blacksmith shop
34	Existing training school
35	Former welding shop
36	Former carpentry shop
37	Former railmotor shed
38	Former plant shop and rail motor shed
39	Former general store
40	Former cement store
41	Toilet
42	Car port
43	Transformer
44	Classified scrap with braking tower (179)

RKSHOP, SIERRA LEONE

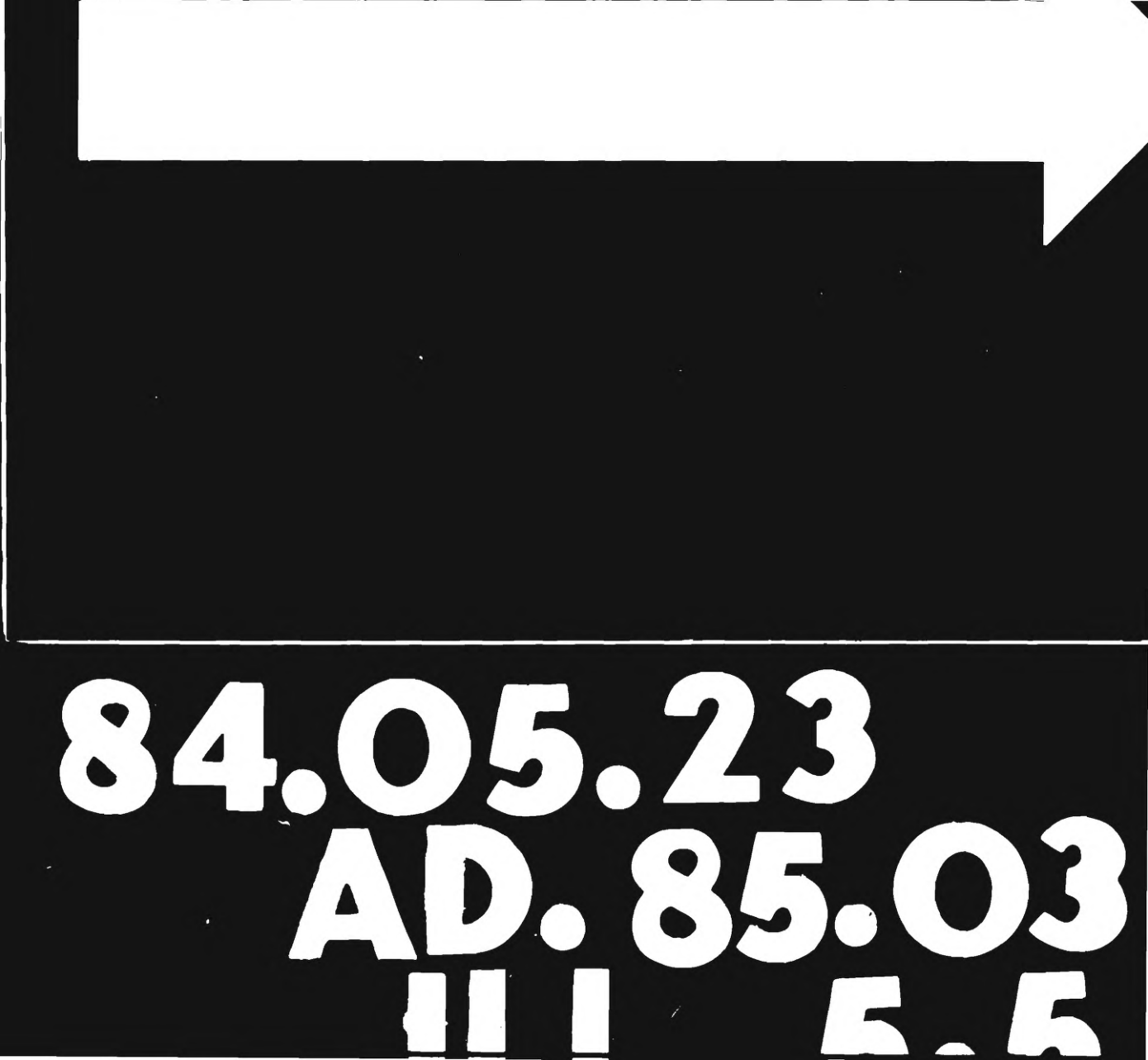
trasse 51, 8038 Zurich | 28 10 83

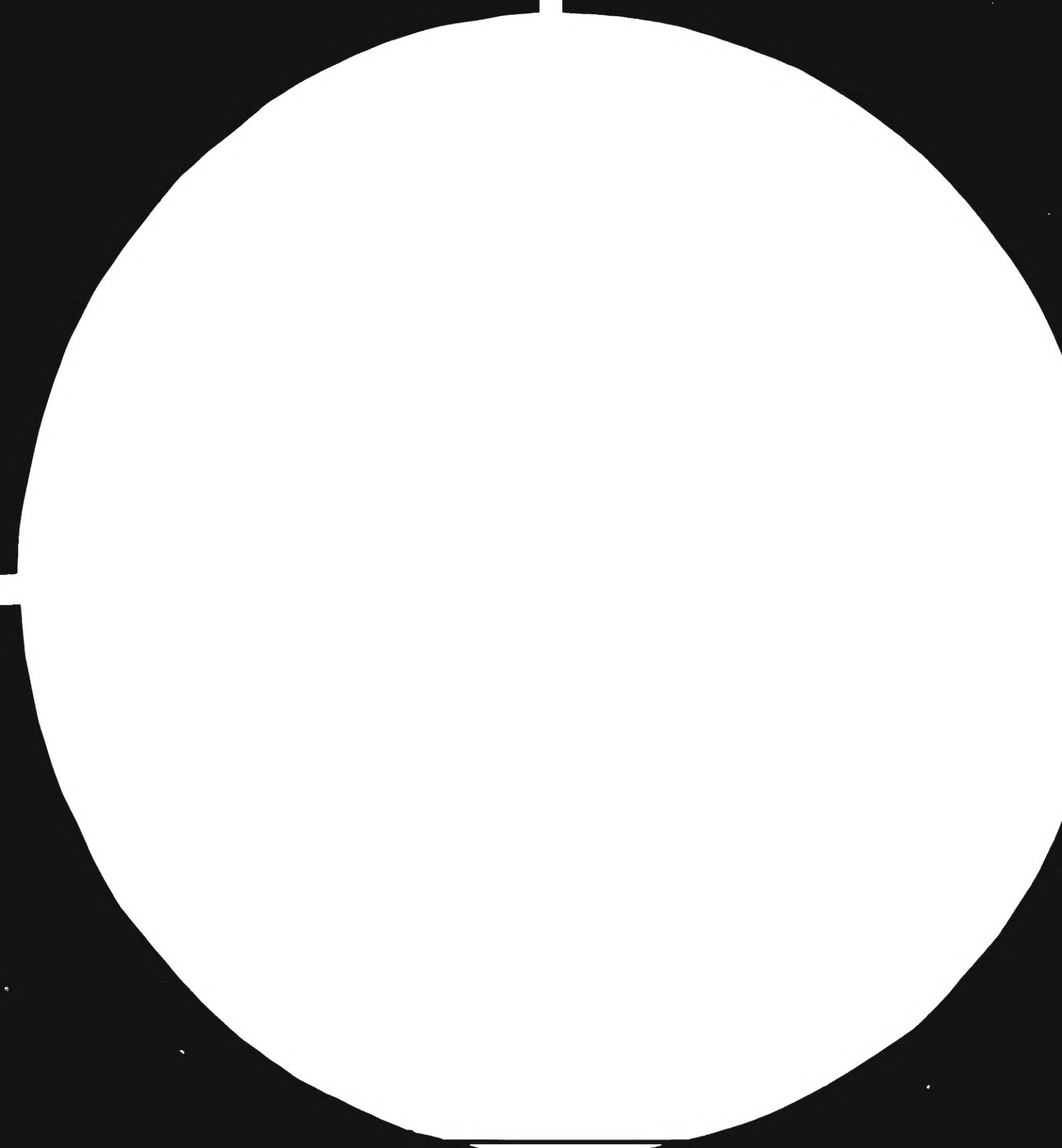
SECTION 2

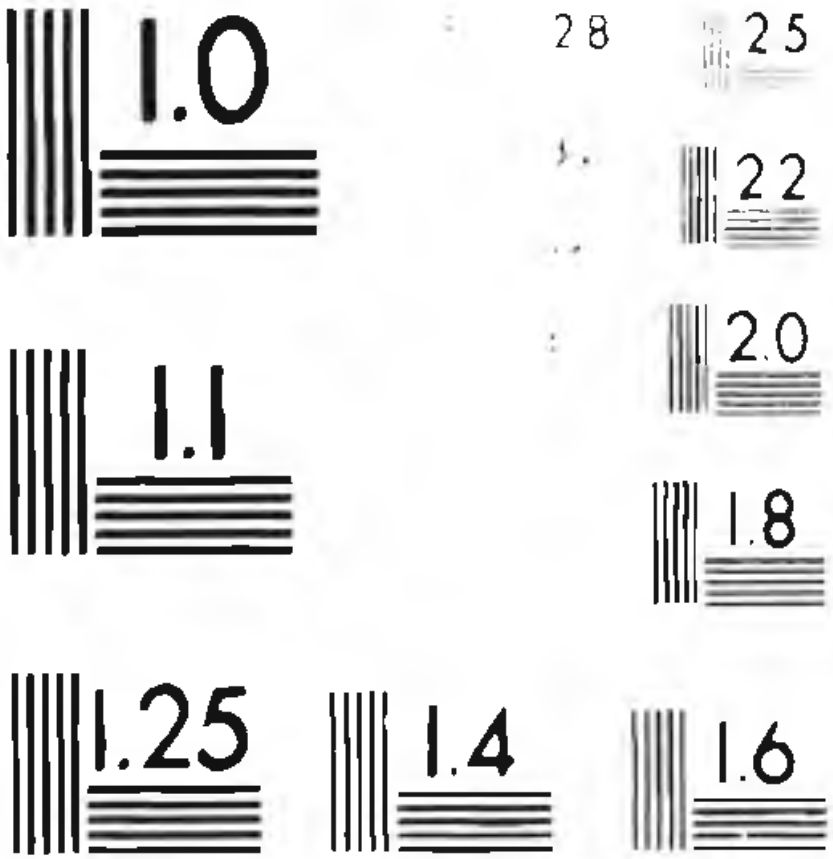
Annex 3: List of machines in machine shop

Item	Code No.	Description	Make	Year	Techn. Features	Cond. %	utiliz.[4] a]	utiliz.[4] b]	Remarks
406	08-01-01	Capstan Lathe	Herbert	-	Ø 5/8"x10" 7.5HP	10	-	-	
405	08-01-02	Capstan Lathe	Herbert	-	Ø15/8"x10" 7.5HP	30	80	80*	to be renovated
404	08-01-03	Capstan Lathe	Herbert	1950	Ø1 3/8"x10" 7.5HP	40	80	85*	to be renovated
403	08-01-04	Capstan Lathe	Ward	-	Ø2 5/8"x4' 7.5HP	30	10	85*	to be renovated
402	08-01-05	Capstan Lathe	Gisholt	1943	Ø2 1/2"x10" 7.5HP	30	-	-	
410	08-01-06	Centre Lathe	Mitchell	1956	Ø16" x 4' 5HP	30	-	-	no motor
411	08-01-07	Centre Lathe	Denhams	-	Ø16" x 4' 7.5HP	20	-	85*	to be renovated
412	08-01-08	Multi purpose Machine tool	Witchen and Wade	-	5HP	20	-	-	
413	08-01-09	Capstan Lathe	Herbert	1963	Ø2" x 10" 7.5HP	50	-	-	
409	08-01-10	Centre Lathe	Oldfield	1942	Ø30" x 8' 15HP	40	30	-	
439	08-01-11	Centre Lathe	Oldfield	1944	Ø24" x B' 10HP	40	30	-	
450	08-01-12	Centre Lathe	Mitchell	1956	Ø16" x 4' 5HP	50	80	90*	to be renovated
449	08-01-13	Centre Lathe	Mitchell	1952	Ø16" x 4' 5HP	50	80	90*	to be renovated
448	08-01-14	Centre Lathe	Swift	-	Ø24" x 5' 10HP	20	-	-	
447	08-01-15	Centre Lathe	Dean and Smith	1957	Ø24" x 4' 12.5HP	60	80	95*	to be renovated
441	08-01-18	Centre Lathe	Mitchell	1952	Ø16" x 4' 5HP	40	-	95*	to be renovated
442	08-01-19	Centre Lathe	Mitchell	1956	Ø16" x 4' 5HP	30	-	-	
443	08-01-20	Centre Lathe			2.5HP		-	-	
452	08-01-21	Centre Lathe	Churchill	1951	Ø12" x 2' 3HP	30	10	-	
453	08-01-22	Centre Lathe	Mitchell	1956	Ø16" x 4' 5HP	40	60	85*	to be renovated
454	08-01-23	Centre Lathe	Dean and Smith		-	20	-	-	no motor
455	08-01-24	Centre Lathe	Mitchell	1964	Ø16" x 4' 5HP	60	80	90*	to be renovated
456	08-01-25	Centre Lathe	Mitchell	1963	Ø16" x 4' 5HP	40	10	-	clutch defect
458	08-01-27	Centre Lathe	Mitchell	1956	Ø16" x 4' 5HP	40	80	80	
459	08-01-28	Centre Lathe	Mitchell	-	Ø18" x 4' 7.5HP	-	-	-	
460	08-01-29	Centre Lathe	Denhams	-	Ø12" x 40" 5HP	30	40	-	
417	08-01-3A	Centre Lathe	Mitchell	1956	Ø16" x 4' 5HP	40	20	-	
416	08-01-30	Capstan Lathe	Ward	-	Ø 2" x 18" 5HP	20	-	-	
418	08-01-32	Capstan Lathe	Herbert	1953	Ø1 5/8"x12" 5HP	10	5	-	
423	08-02-01	Universal Milling Mach.	Cincinnati	1957	10"x 54 table 5HP	50	20	95*	to be renovated
426	08-02-02	Horizontal Milling Mach.	Kearney	1943	9"x 48"table 1HP	30	10	95*	to be renovated
427	08-02-03	Vertical Milling Mach.	Cincinnati	-	8"x 24"table 1HP	30	10	95*	to be renovated
422	08-02-04	Vertical Milling Mach.	Cincinnati	1956	10"x 54"table 5HP	50	20	95*	to be renovated

4: utilization
a] existing
b] after reorganization


84.05.23
AD. 85.03
III 1 5.5



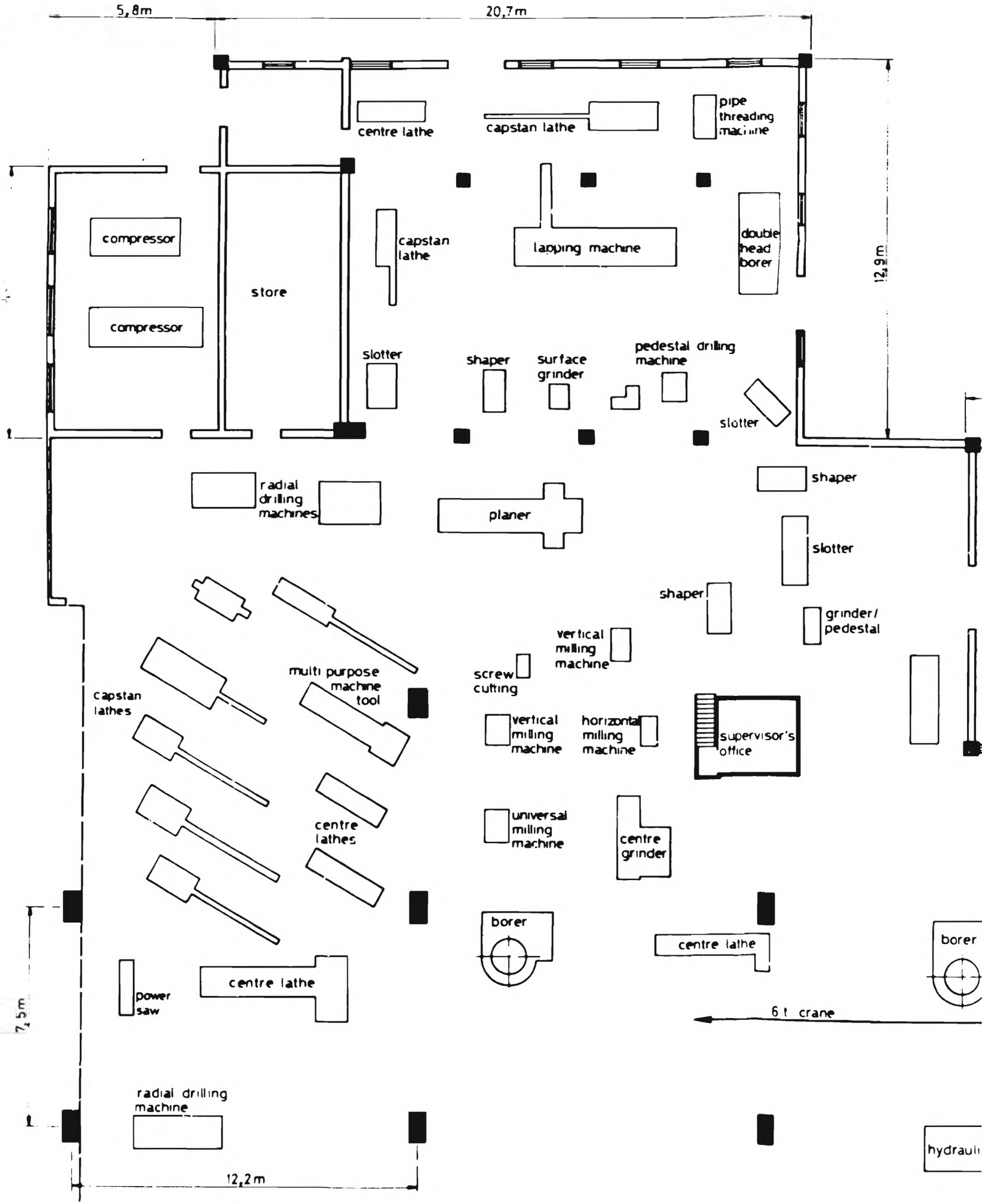

1.0
2.8
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

Item	Code No.	Description	Make	Year	Techn. Features	Cond. %	utiliz.[1] a]	utiliz.[1] b]	Remarks
438	08-03-01	Shaper	Buller	1963	26" stroke 10HP	60	30	85*	to be renovated
435	08-03-02	Shaper	Elliott	1956	24" stroke 7.5HP	50	-	-	
419	08-03-03	Shaper	Smith and Mills	1943	25" stroke 7.5HP	50	-	85*	to be renovated
436	08-04-01	Slotter	Ormerod	1943	12" stroke	60	-	-	no belt
434	08-04-02	Slotter	Edgwick	1956	10" stroke 7.5HP	40	10	-	
415	08-04-03	Slotter	Horey	1942	8" stroke 7.5HP	40	10	-	
437	08-05-01	Grinder/ Pedestal	-	-	Ø12" wheel 2.5HP	30	20	-	belt defect
425	08-06-02	Centre Grinder	Churchill	1958	Ø12" x 36" 7.5HP	50	5	-	
428	08-05-05	Surface Grinder	Cincinnati	-	9" x 36" 3HP	30	-	-	no motor
492	08-05-04	Lapping mach.	Churchill	1950	11HP	30	5	5	
424	08-06-01	Borer	Webber & Bennett	1953	Ø 3' table 18HP	30	70	75*	to be renovated
440	08-06-02	Borer	do.	1942	Ø 4' table	30	10	75*	to be renovated
	08-06-03	Borer	do.	1958	Ø 3' table	30	-	-	not installed
408	08-07-01	Radial drilling machine	Asquit	1943	6' arm 5HP	30	5	-	
401	08-07-02	do.	Archdale	1956	3' arm 5HP	30	80	80	
414	08-07-03	do.	Archdale	1956	3' arm 5HP	50	60	-	
433	08-07-04	Pedestal drilling machine	Cleereman	-	1" drill 1.5HP	30	-	-	
407	08-08-01	Power saw	Herbert	-	6" 3HP	10	80	60	
444	08-09-01	Hydraulic press	-	-	400 t 12HP	30	5	-	
420	08-12-01	Planer	Werd	-	42"x112"x48" 48HP	30	-	-	
421	08-13-01	Screw cutting	Waiden	1943	2" thread	30	5	20	
430	08-13-02	Pipe threading machine	Landis	-	1" thread	20	-	-	no motor
431	08-06-04	Double head borer	Kitchen and Warde	-	20HP	30	5	-	
461	-	Compressor			30HP	70	-	-	
462	-	-			35HP	70	-	-	

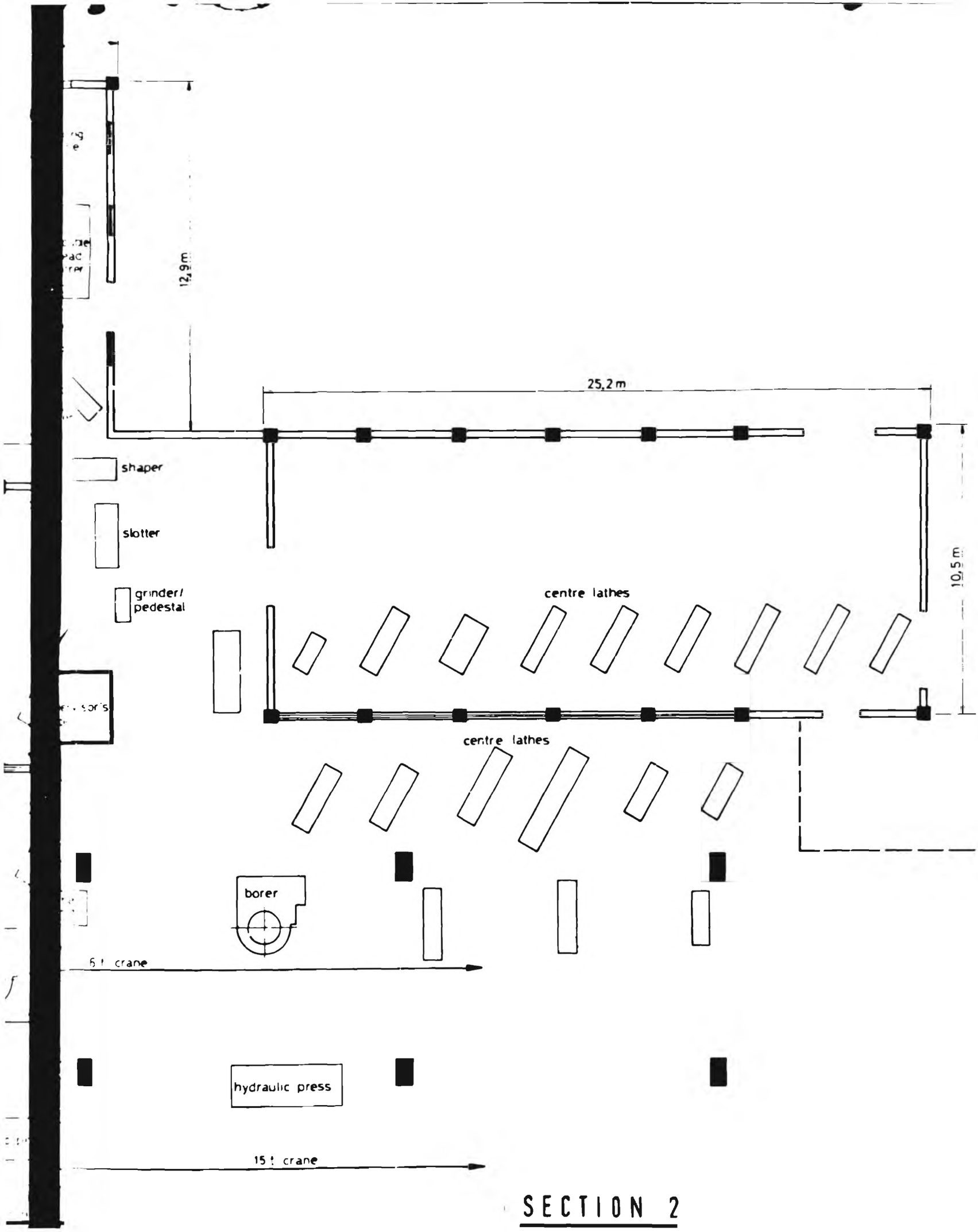
explanations:

- machines with a * are used for the manufacturing division (machine shop, tool making shop, apprentices); the other machines for the repair and metal fabrication division
- "-": not used

1: utilization
a] existing
b] after reorganization


5,8m
20,7m
centre lathe
capstan lathe
pipe threading machine
compressor
compressor
store
capstan lathe
lapping machine
double head borer
12,9m
slotter
shaper
surface grinder
pedestal drilling machine
slotter
radial drilling machines
planer
shaper
slotter
shaper
grinder/ pedestal
vertical milling machine
screw cutting
multi purpose machine tool
capstan lathes
vertical milling machine
horizontal milling machine
supervisor's office
universal milling machine
centre grinder
centre lathes
borer
centre lathe
borer
power saw
centre lathe
6 t crane
7,5m
radial drilling machine
hydrauli
12,2m

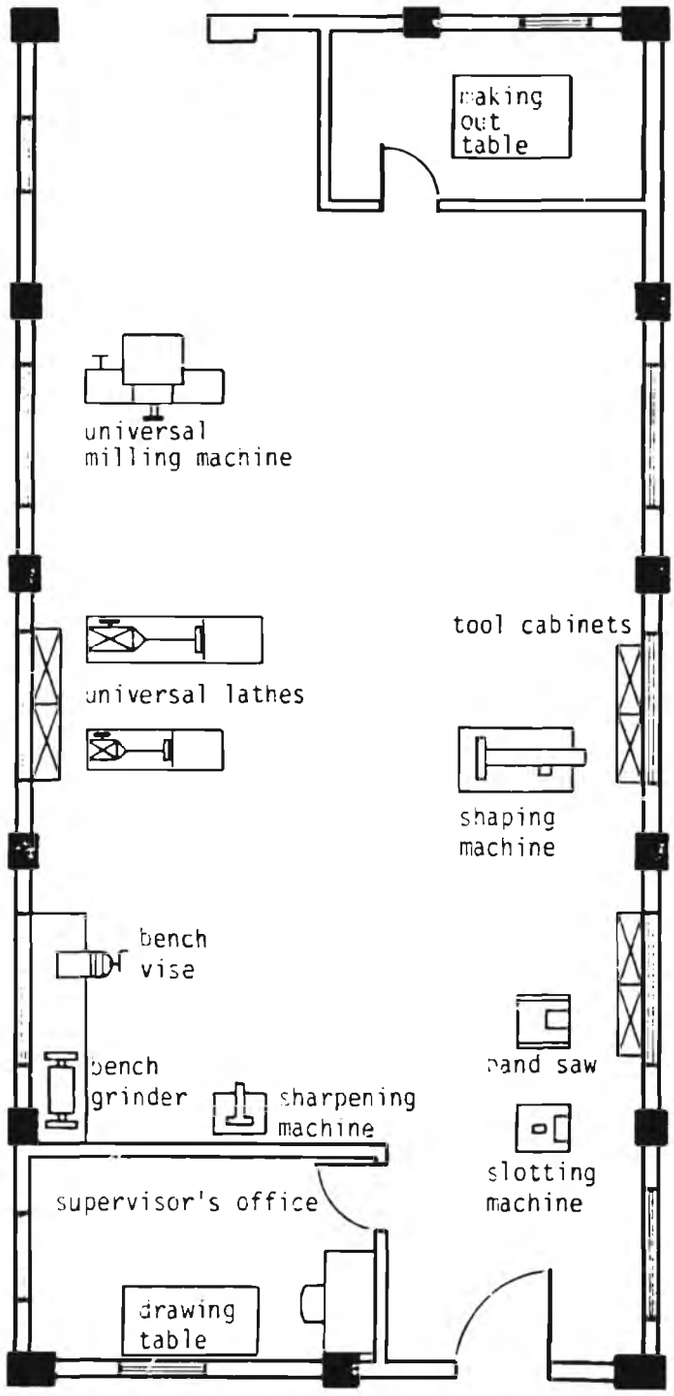
SECTION 1


12,9 m
25,2 m
shaper
slotter
grinder/
pedestal
centre lathes
10,5 m
centre lathes
borer
6 t crane
hydraulic press
15 t crane

SECTION 2

SECTION 3

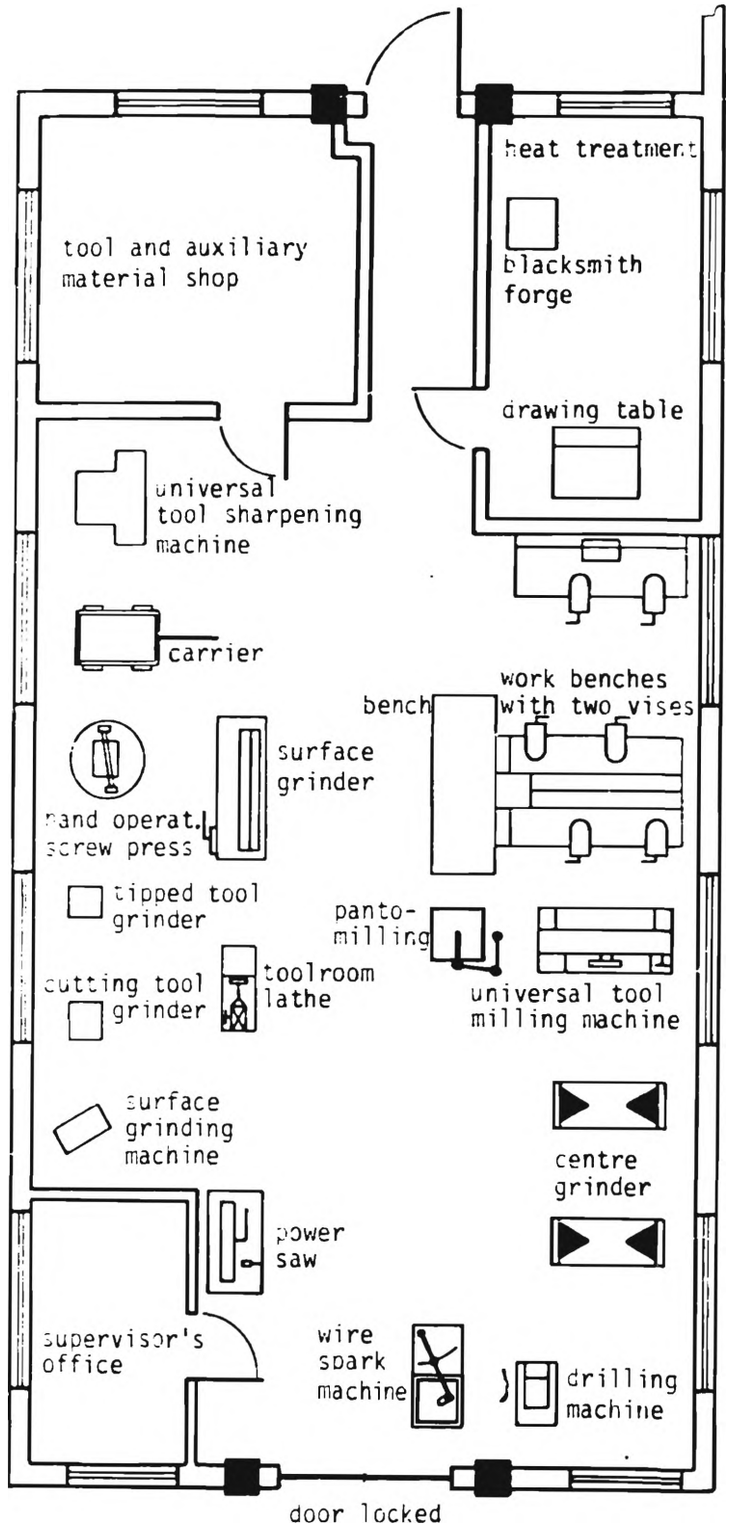
NATIONAL WORKSHOP, SIERRA LEONE		
Layout Machine shop (building 14)		
ICME	Bellariastrasse 51, 8038 Zurich	28 10 83



Tool making shop: machinery
(building 10)

Tool makin
(building 09

SECTION 1

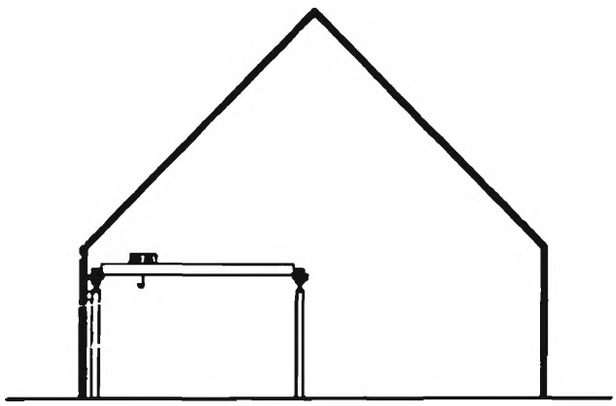


Tool making shop: tool room
(building 09)

0 5 10 15 feet

NATIONAL WORKSHOP, SIERRA LEONE		
Layout		
Tool making shops: machinery/tool room		
ICME	Bellariastrasse 51, 8038 Zurich	28.10.83

SECTION 2



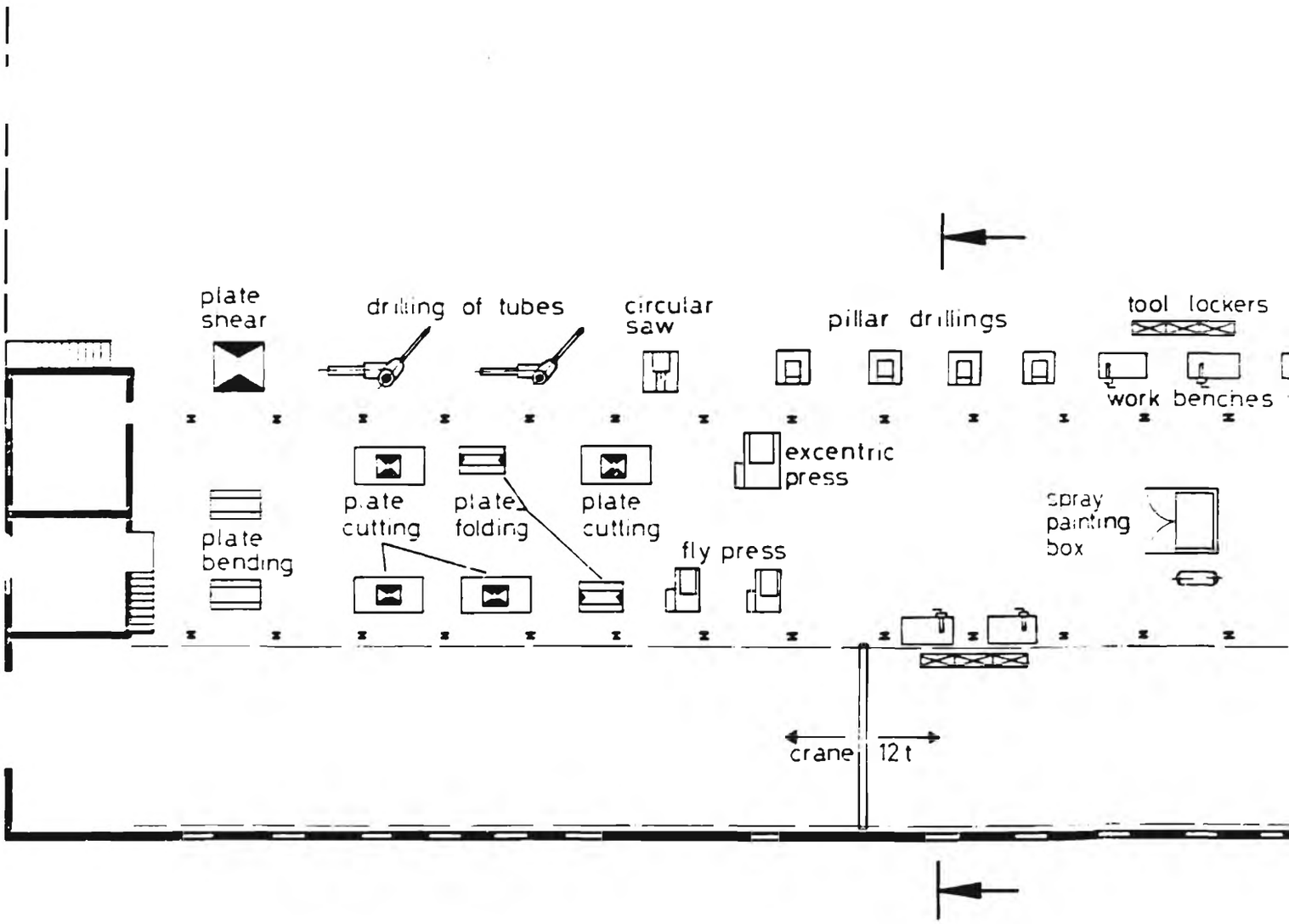
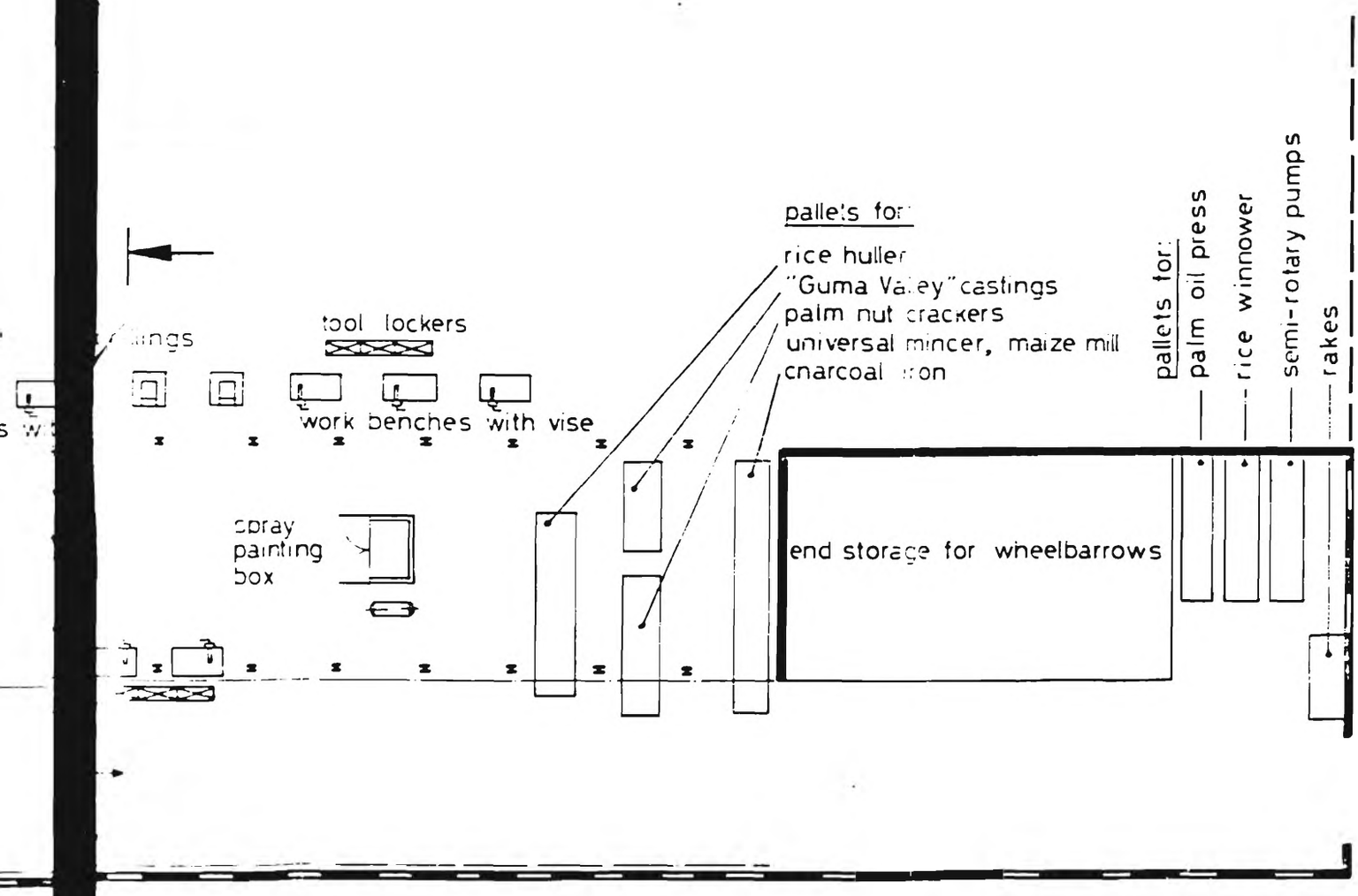


plate
snear
drilling of tubes
circular
saw
pillar drillings
tool lockers
work benches
excentric
press
plate
bending
plate
cutting
plate
folding
plate
cutting
fly press
spray
painting
box
crane 12 t

SECTION 1



SECTION 2

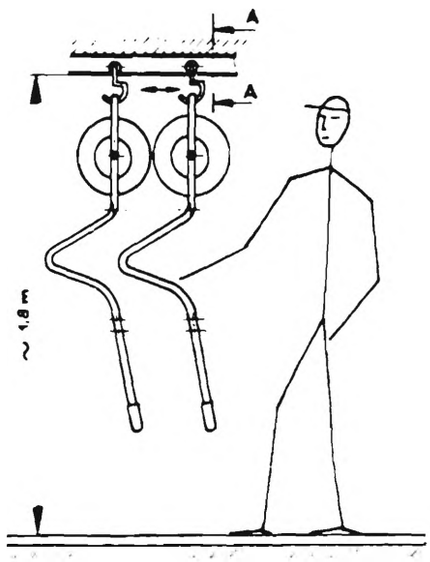
NATIONAL WORKSHOP, SIERRA LEONE		
Layout Welding and metal forming shop (building 17/18)		
ICME	Bellariastrasse 51, 8038 Zurich	28 10 83

icme

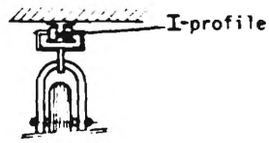
Annex 7: Storage and transport of wheelbarrows

The ready assembled wheelbarrows will be stored and transported by larry without pan for better utilization of space. The pan has to be attached with 6 bolts by the customer. Bolts and nuts are delivered in a small transparent plastic bag attached at the pan with strong scotch tape. Every customer receives a suitable tool to fasten the pan at the chassis.

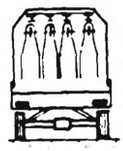
a] Storage at the Workshop and transport by lorry



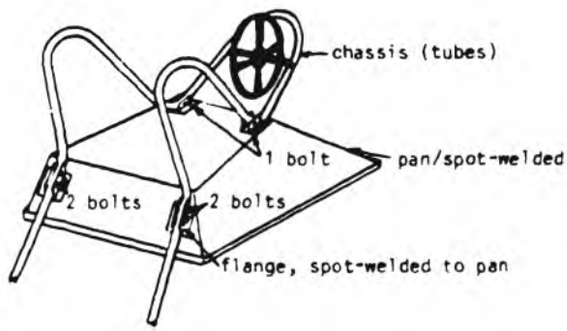
Section A-A:



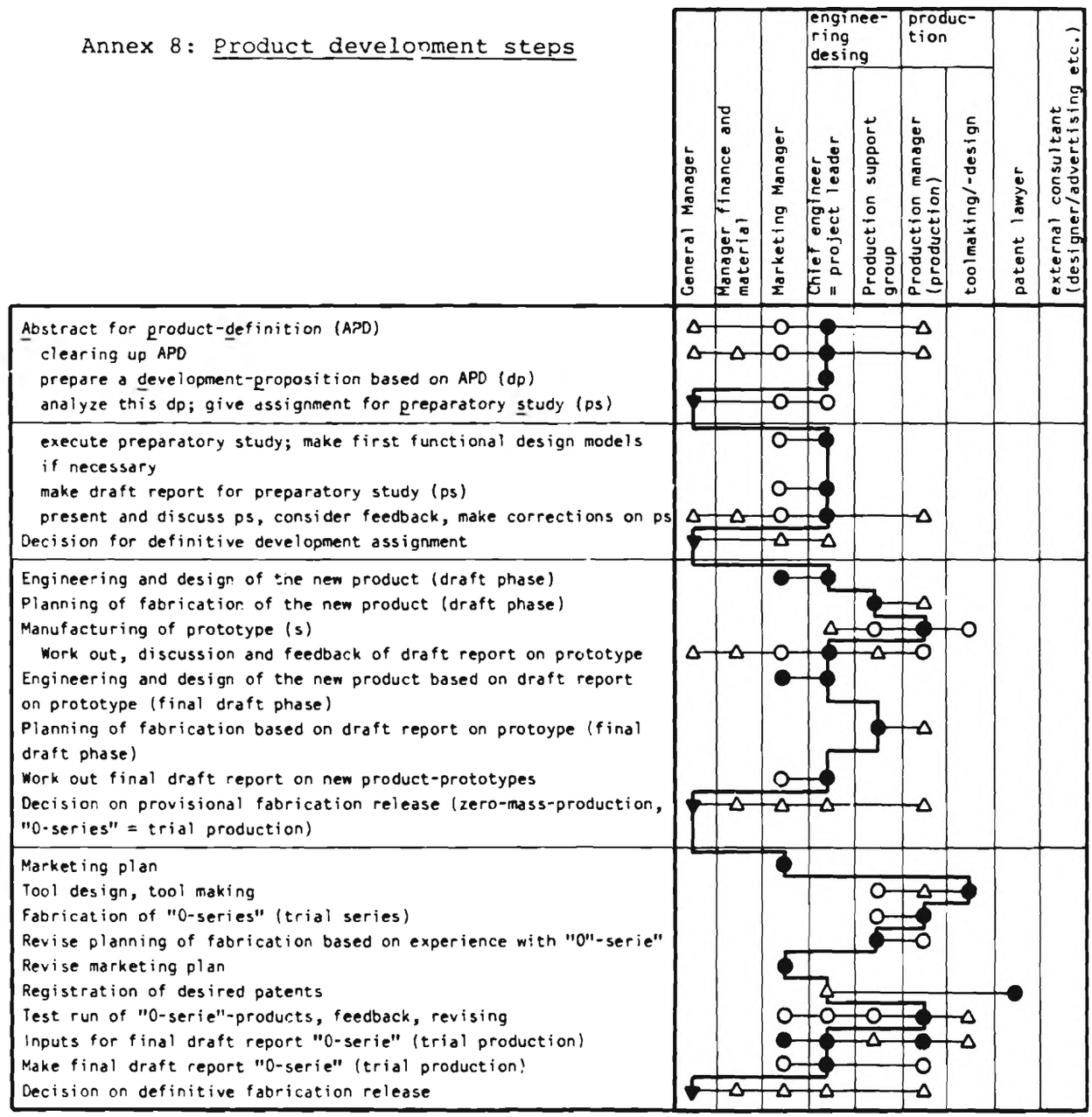
I-profile is attached at a height of 1,8 m in the storage place of fabrication hall and also to the ceiling of the larry.



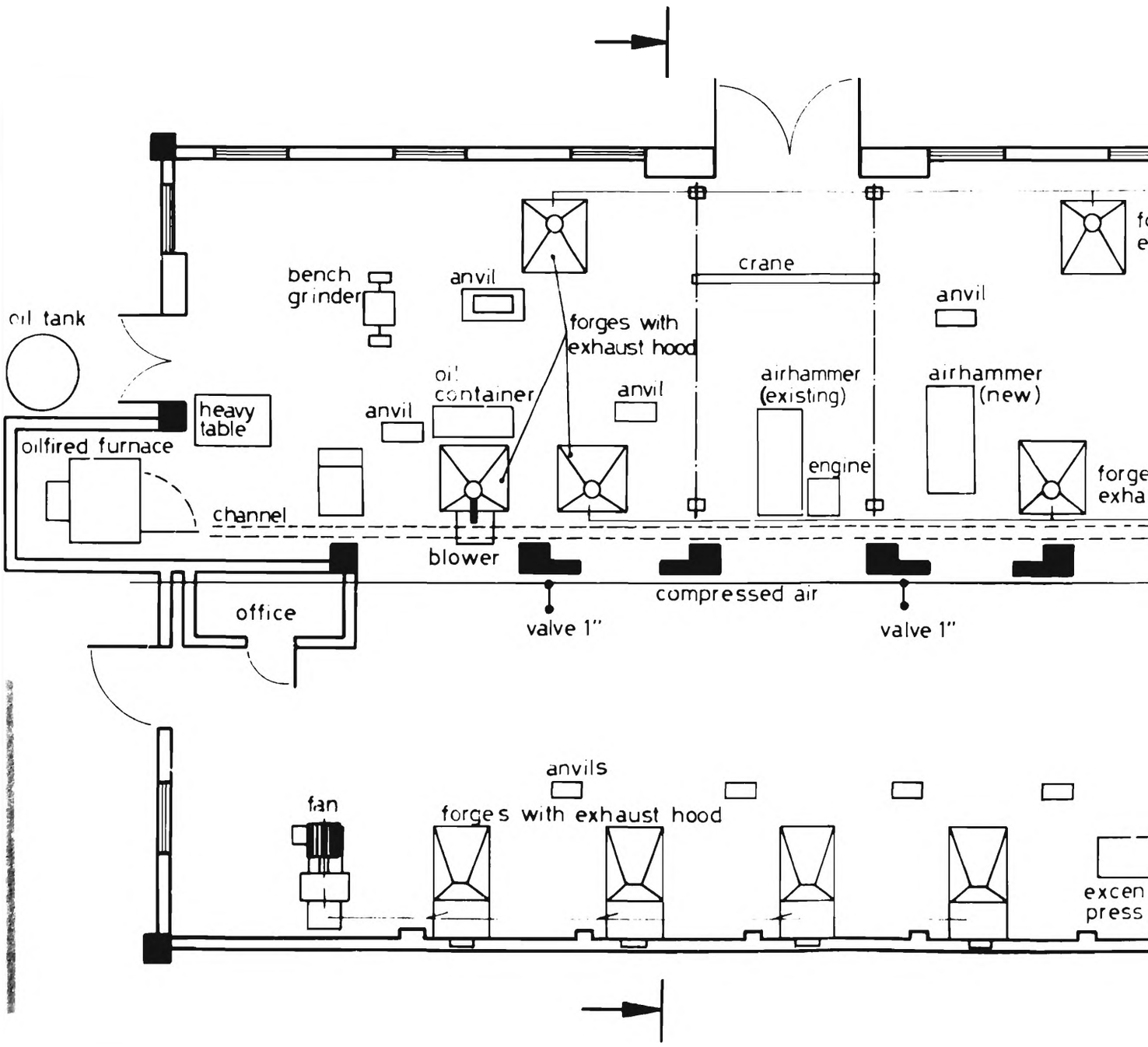
b] Location of bolts for fastening pan to the chassis



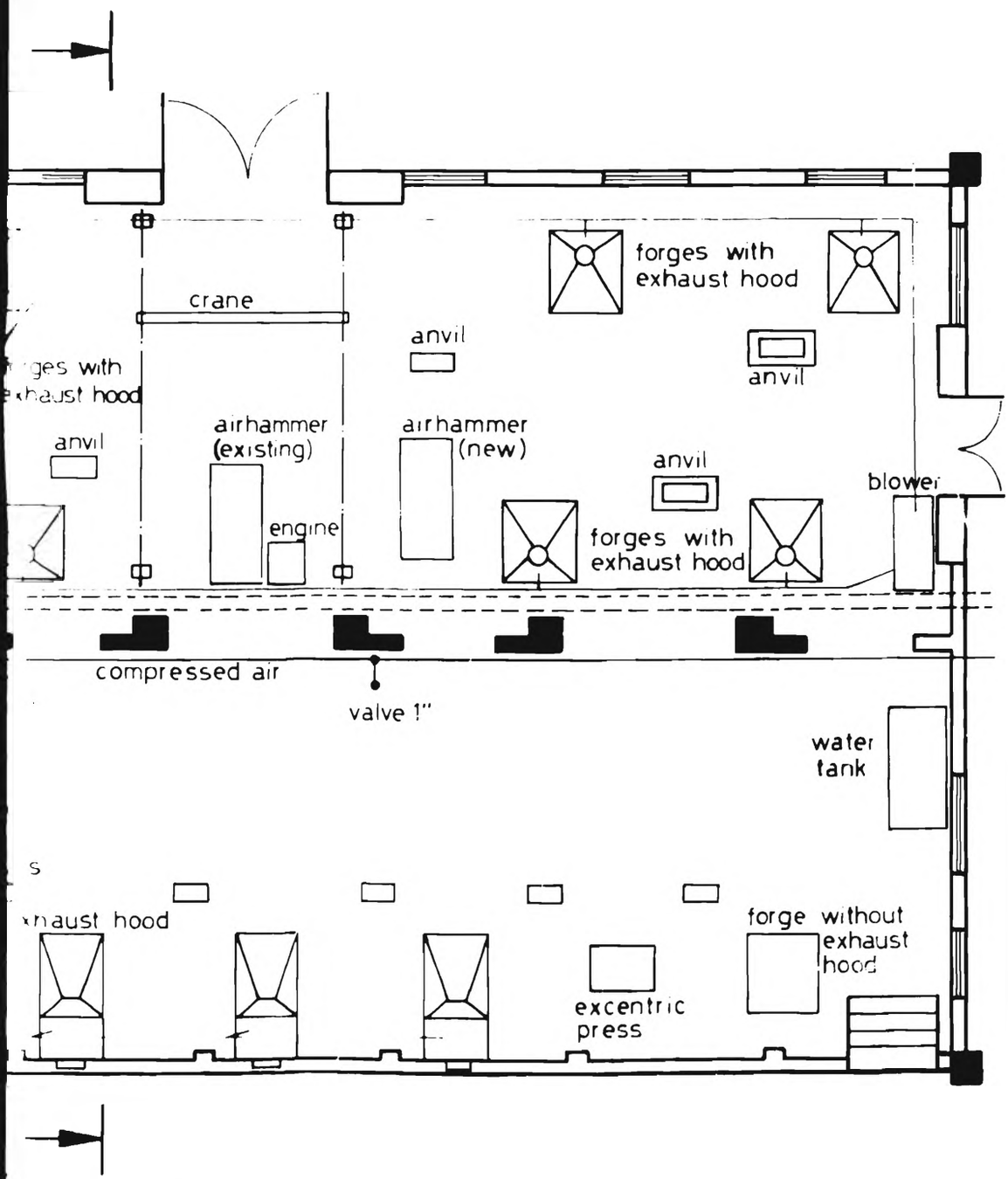
Annex 8: Product development steps

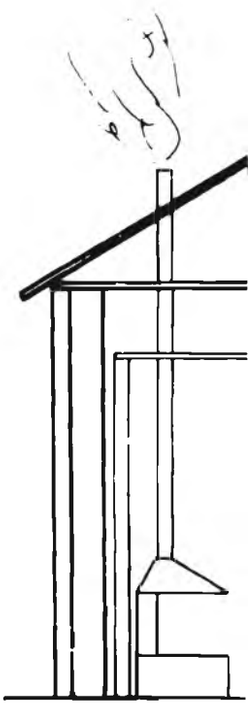


▼ = decision
● = conception and execution
o = execution (cooperation)
Δ = consulting, information
— = main run

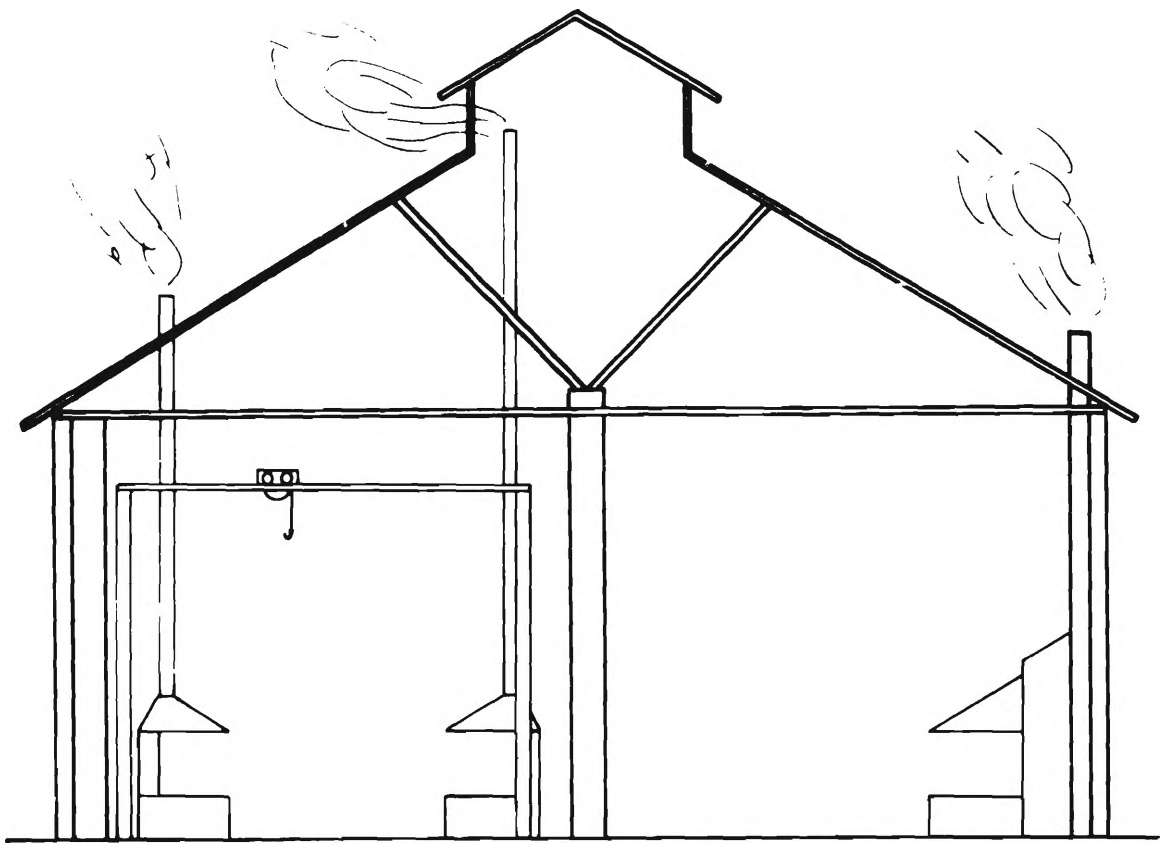

bench grinder
anvil
crane
anvil
oil tank
forges with exhaust hood
oil container
anvil
anvil
airhammer (existing)
airhammer (new)
heavy table
oilfired furnace
engine
channel
blower
compressed air
office
valve 1"
valve 1"
anvils
fan
forges with exhaust hood

SECTION 1


crane
forges with
exhaust hood
anvil
anvil
airhammer
(existing)
airhammer
(new)
anvil
anvil
blower
engine
forges with
exhaust hood
compressed air
valve 1"
water
tank
forge without
exhaust
hood
excentric
press



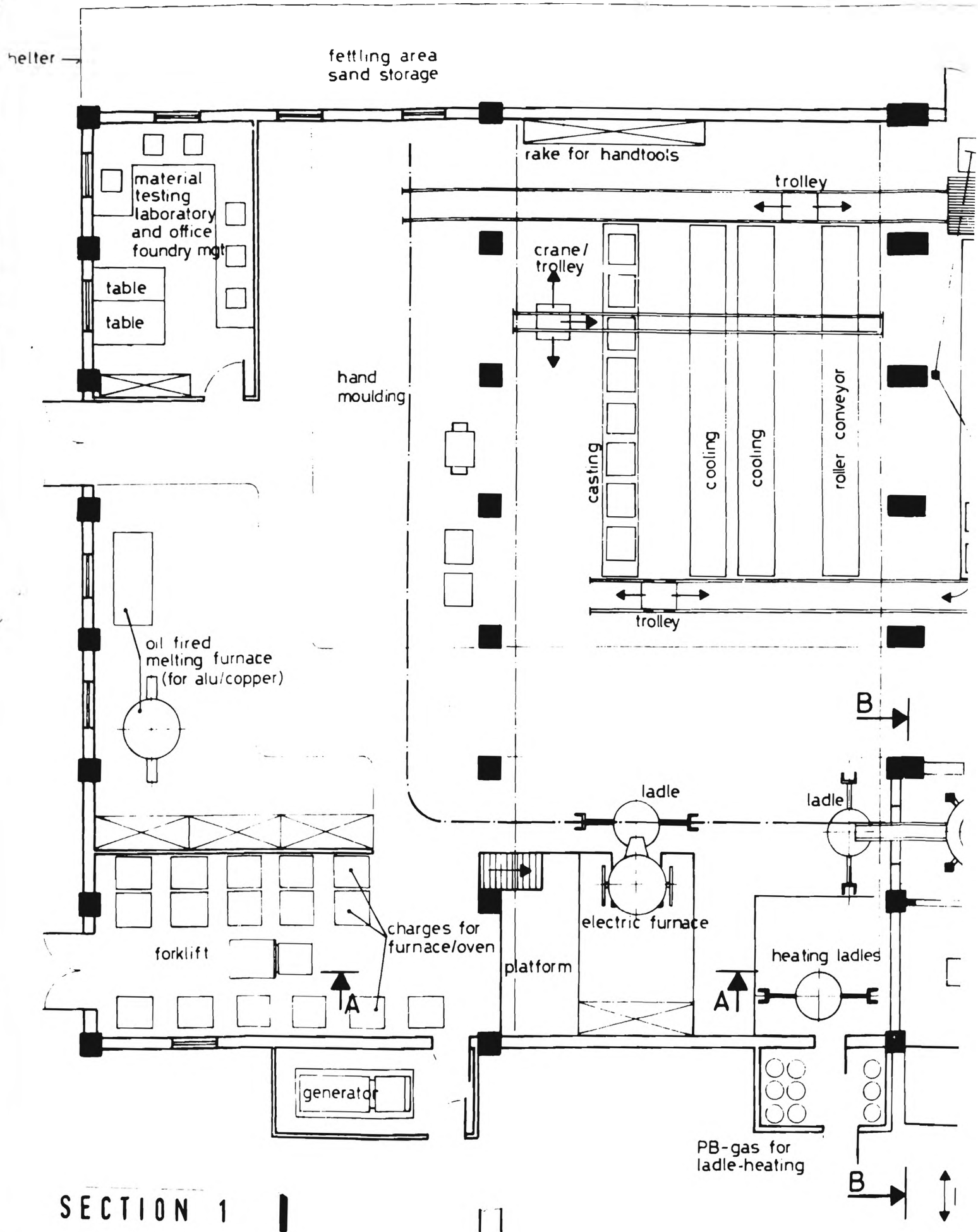
SECTION 2



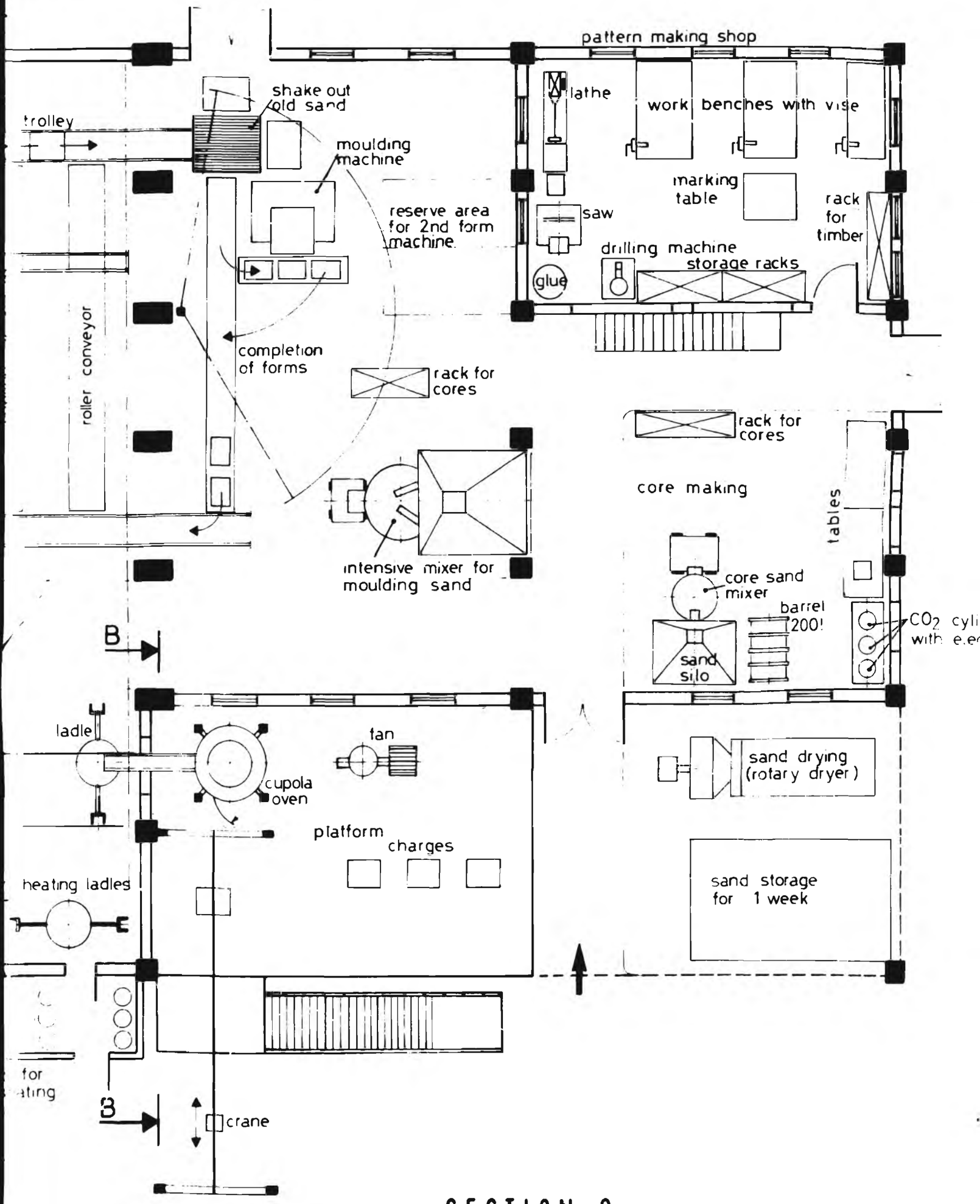
SECTION 3

0 5 10 15 feet

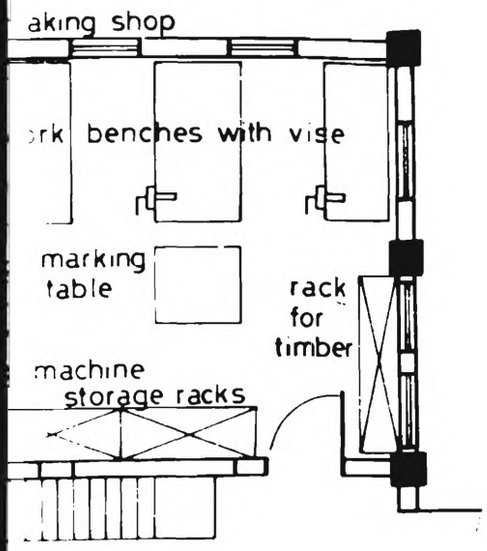
NATIONAL WORKSHOP, SIERRA LEONE		
Layout Forging shop (building 15)		
I C M E	Bellariastrasse 51, 8038 Zürich	28.10.83

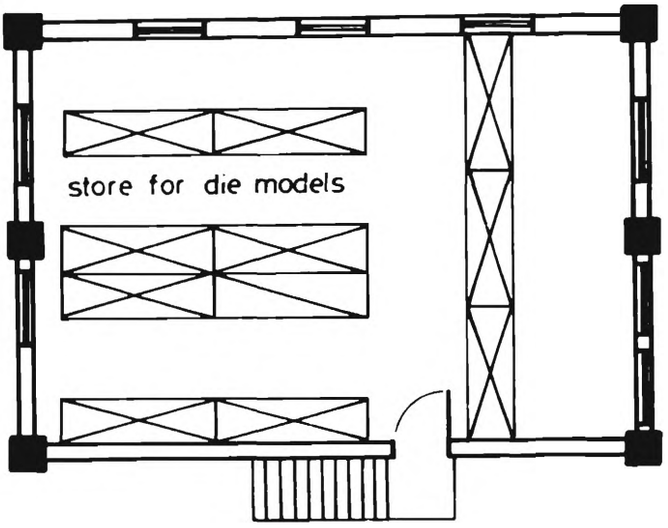

helter
fettling area
sand storage
rake for handtools
material testing laboratory and office foundry mgt
table
table
trolley
crane/ trolley
hand moulding
casting
cooling
cooling
roller conveyor
trolley
oil fired melting furnace (for alu/copper)
B
ladle
ladle
electric furnace
charges for furnace/oven
forklift
platform
heating ladles
A
A
generator
PB-gas for ladle-heating
B

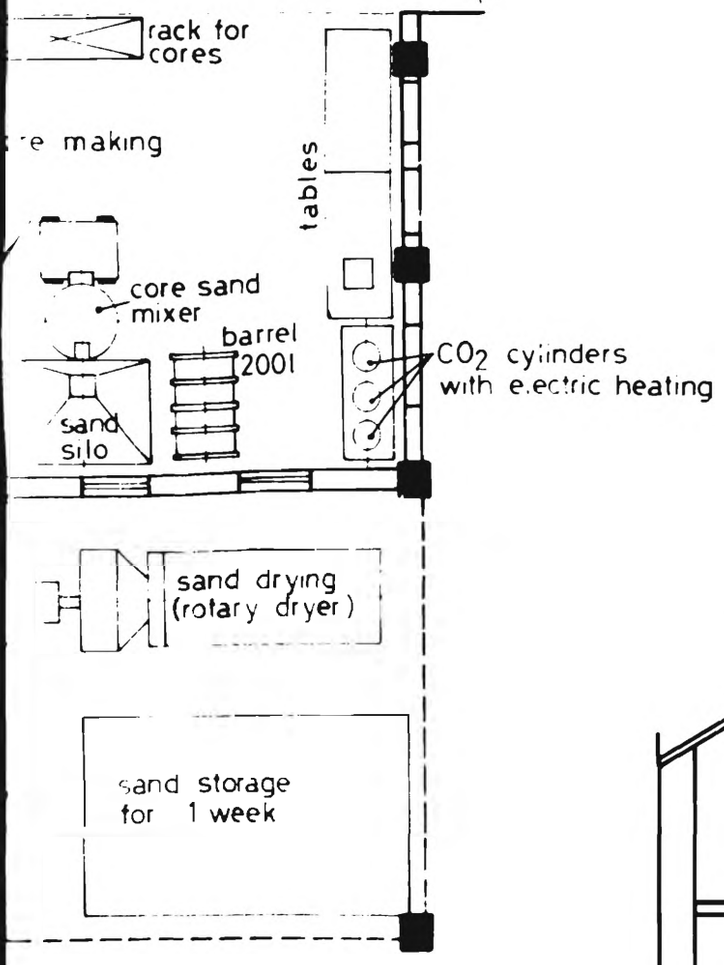
SECTION 1


pattern making shop
lathe
work benches with vise
shake out old sand
trolley
moulding machine
marking table
rack for timber
saw
reserve area for 2nd form machine
drilling machine
storage racks
glue
roller conveyor
completion of forms
rack for cores
rack for cores
core making
tables
intensive mixer for moulding sand
core sand mixer
barrel 200l
CO_2 cyli
with e.e
sand silo
B
ladle
fan
cupola oven
sand drying (rotary dryer)
platform
charges
heating ladles
sand storage for 1 week
for ating
B
crane

SECTION 2

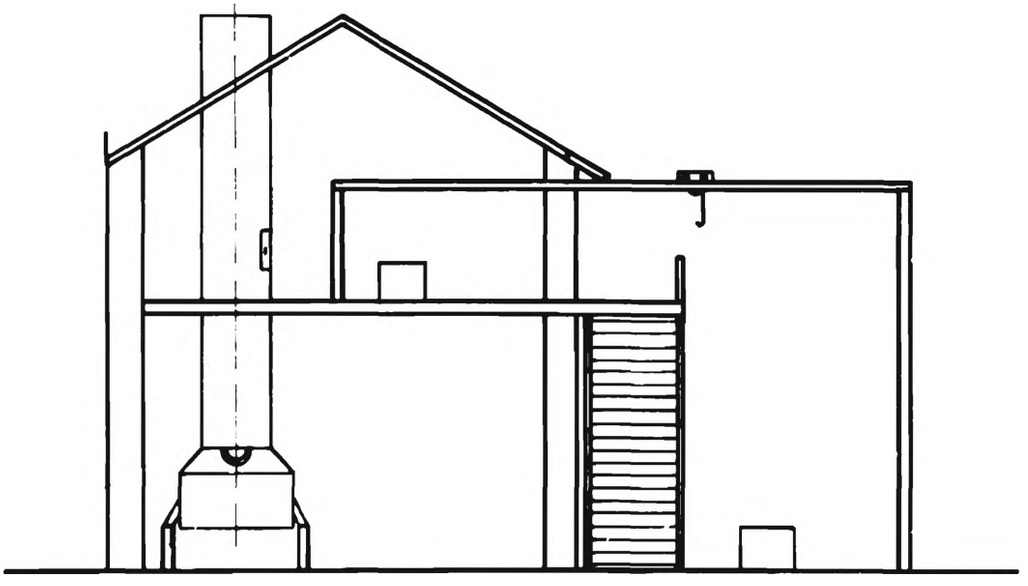




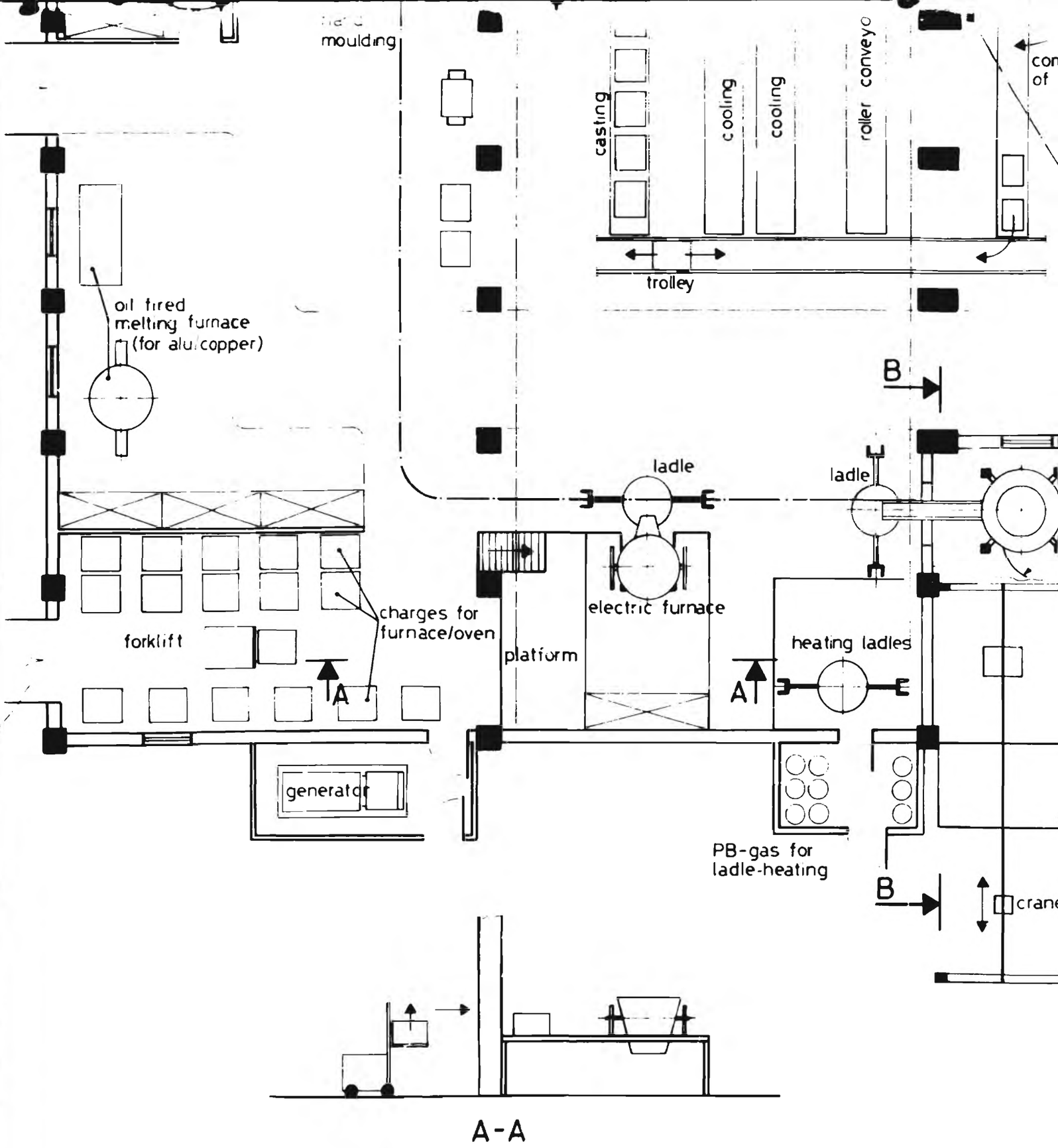


Annex 10

SECTION 3

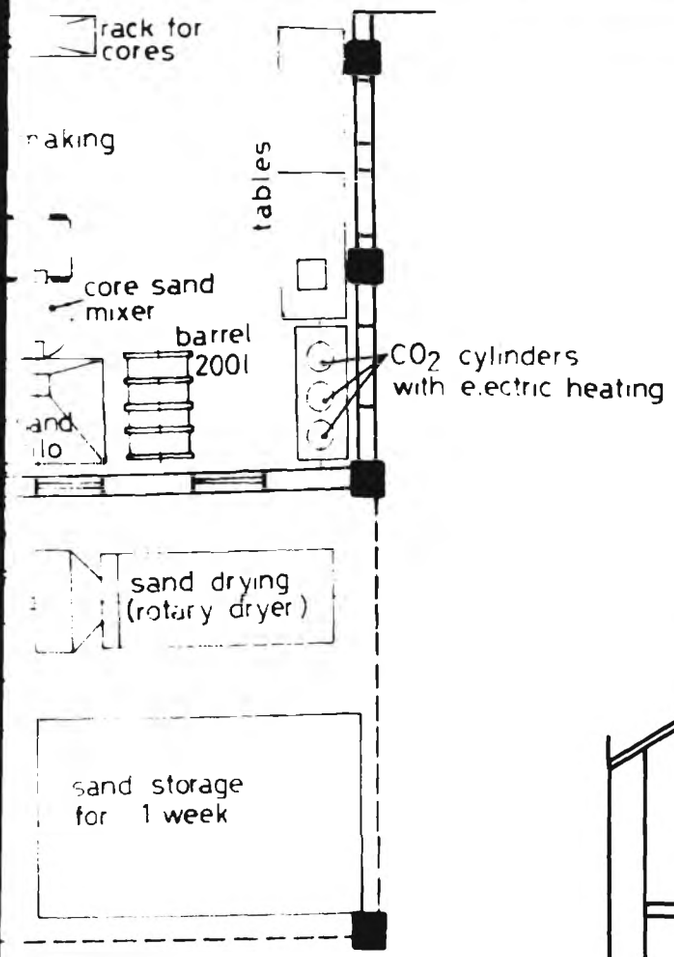


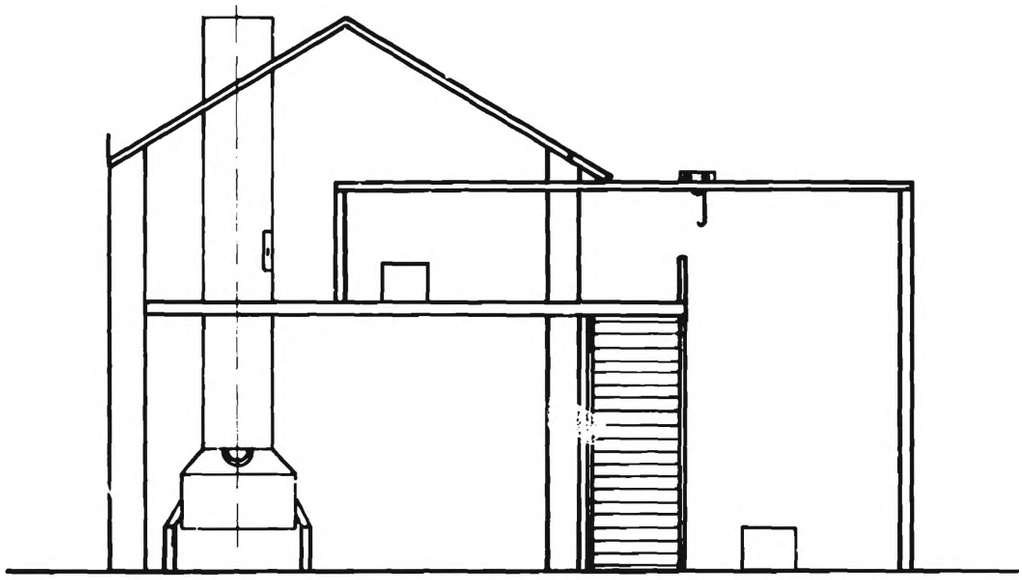
B-B


moulding
casting
cooling
cooling
roller conveyo
trolley
oil fired
melting furnace
(for alu/copper)
ladle
ladle
B
charges for
furnace/oven
forklift
electric furnace
platform
heating ladles
A
A
generator
PB-gas for
ladle-heating
B
crane

A-A

SECTION 4



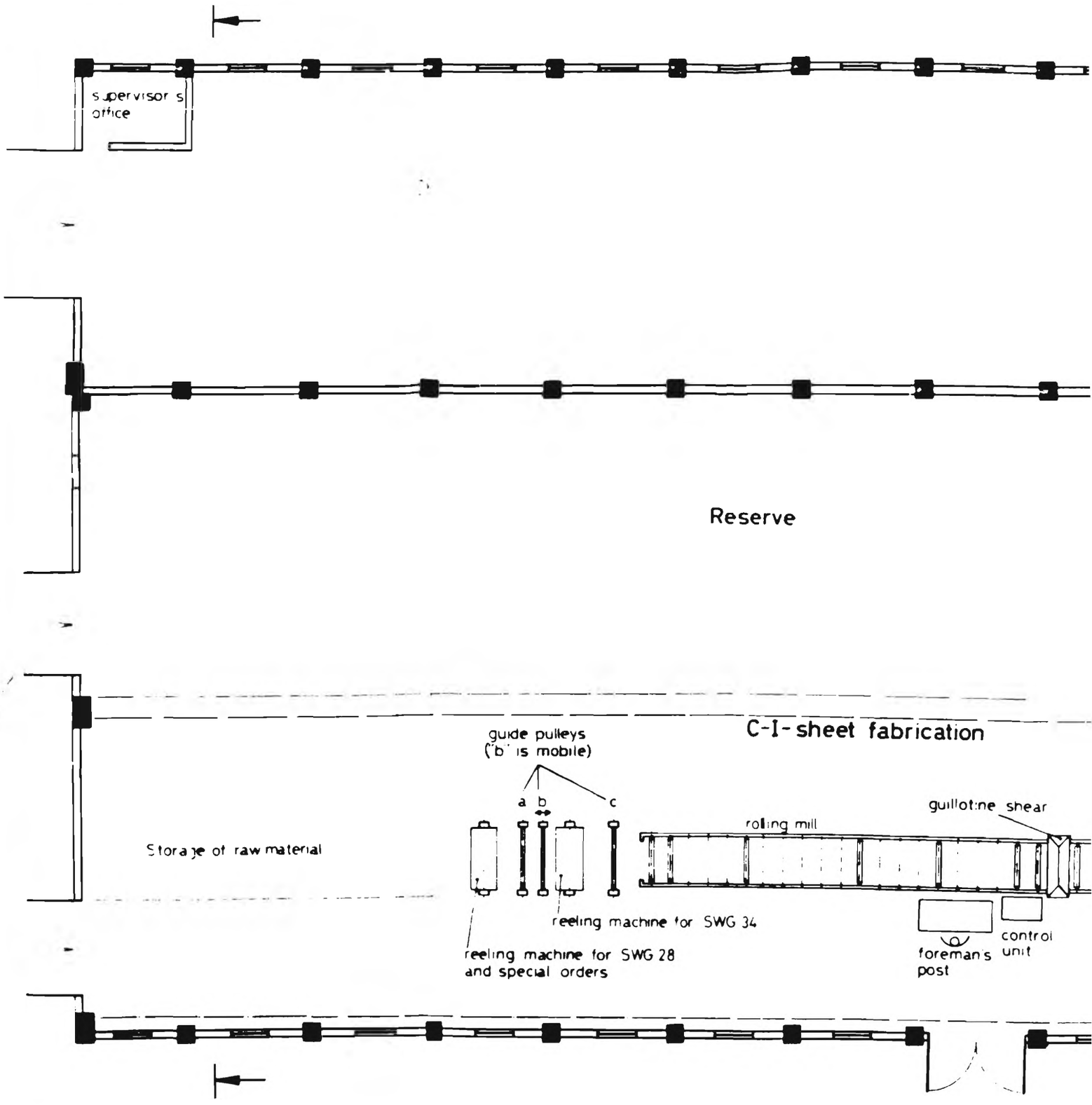


B-B

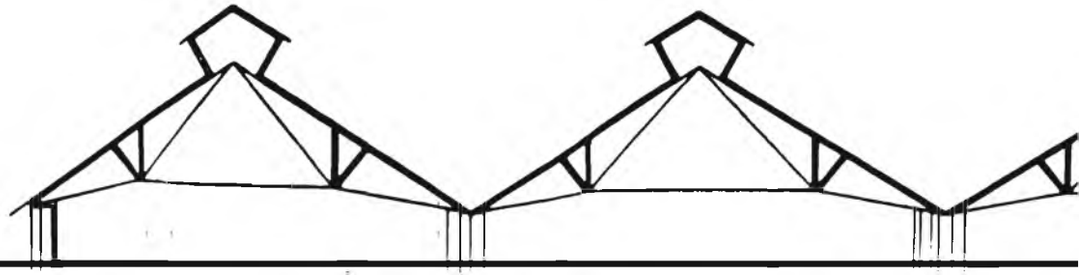
SECTION 5

0 5 10 15 feet

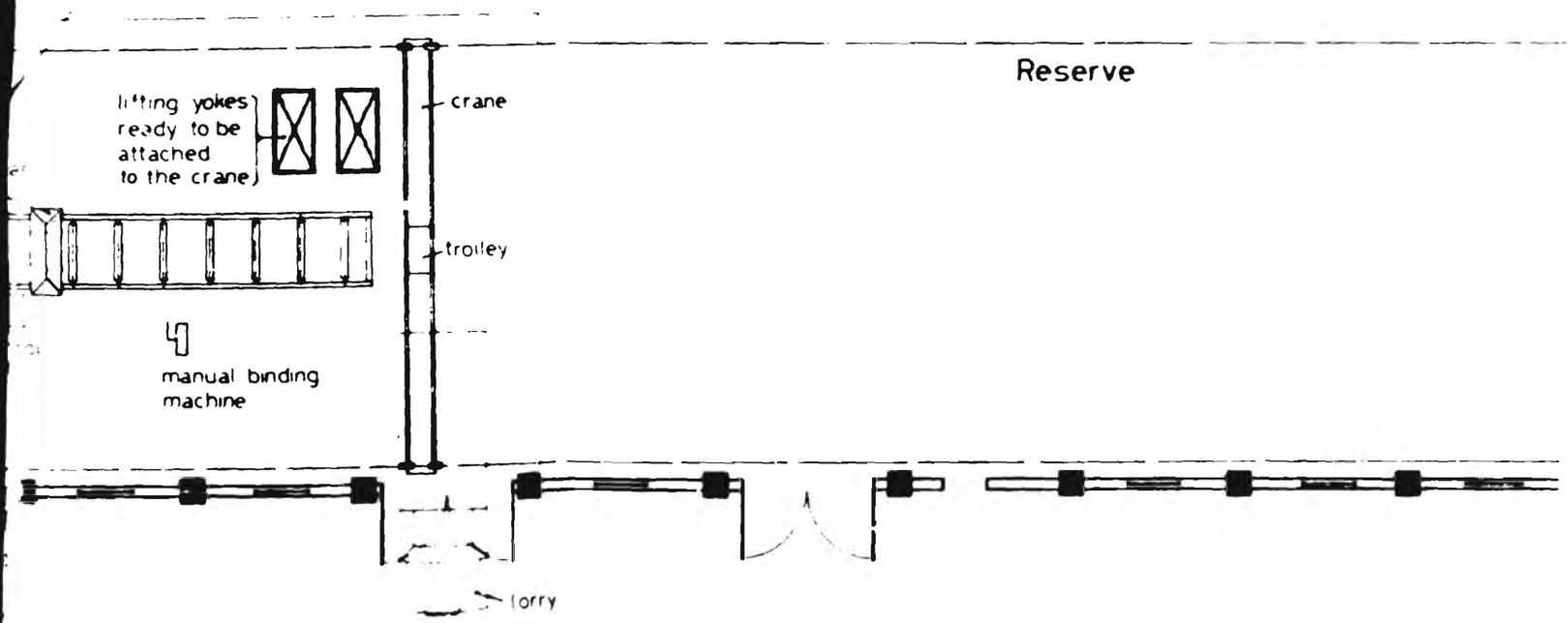
NATIONAL WORKSHOP, SIERRA LEONE		
Layout Foundry (building 16) Patter making shop(16b), Material testing laboratory(16a)		
ICME	Bellariastrasse 51, 8038 Zürich	28.10.83


supervisor s
office
Reserve
C-I-sheet fabrication
guide pulleys
('b' is mobile)
a b c
Storage of raw material
rolling mill
guillotine shear
reeling machine for SWG 34
reeling machine for SWG 28
and special orders
foreman's
post
control
unit

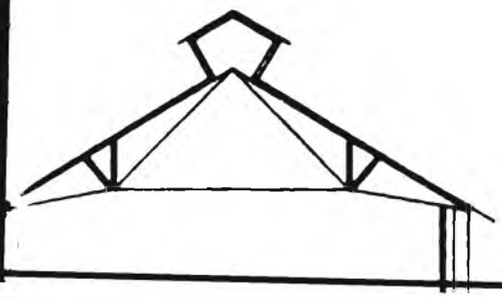
SECTION 1

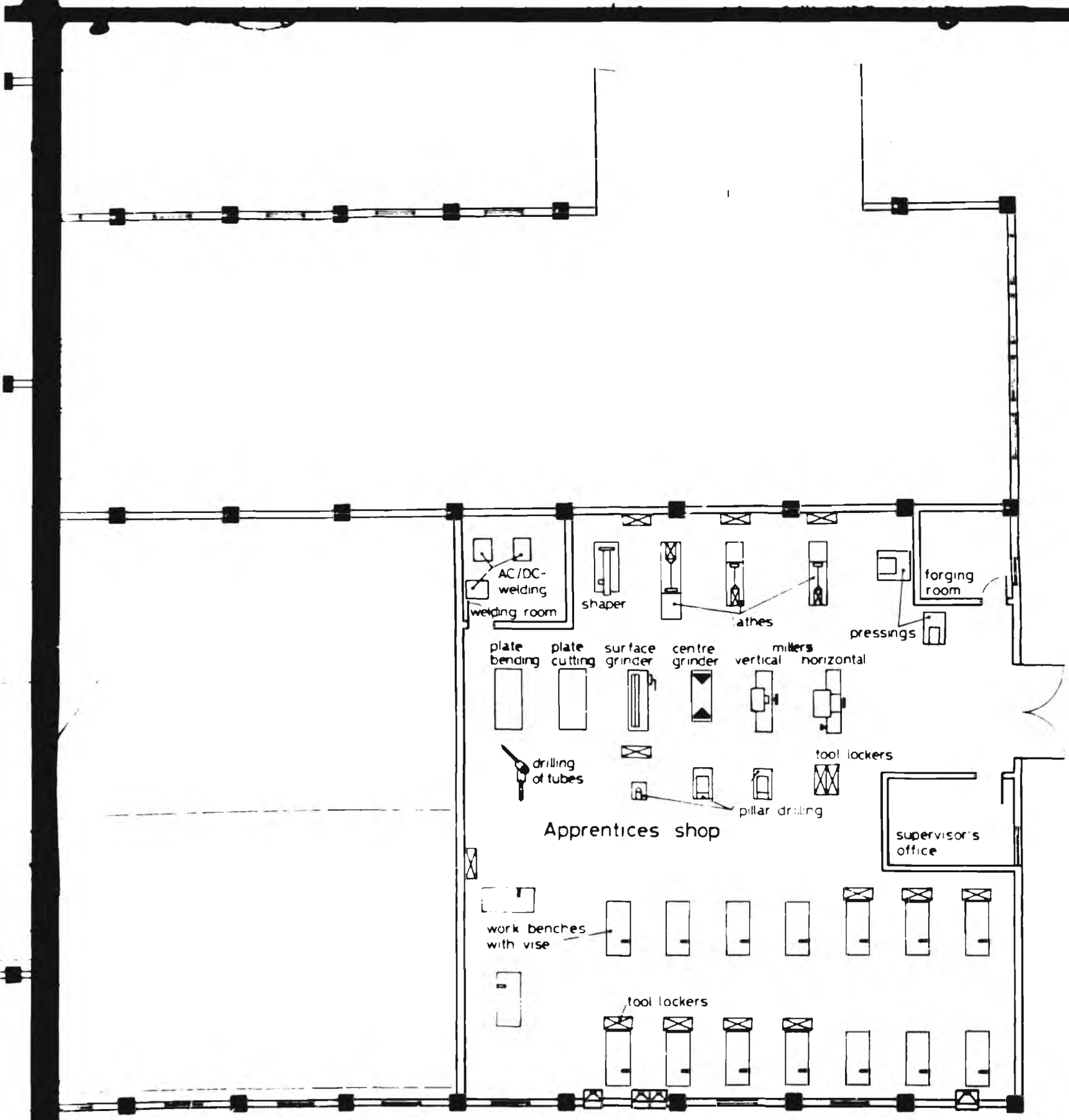


Woodworking/carpenter shop



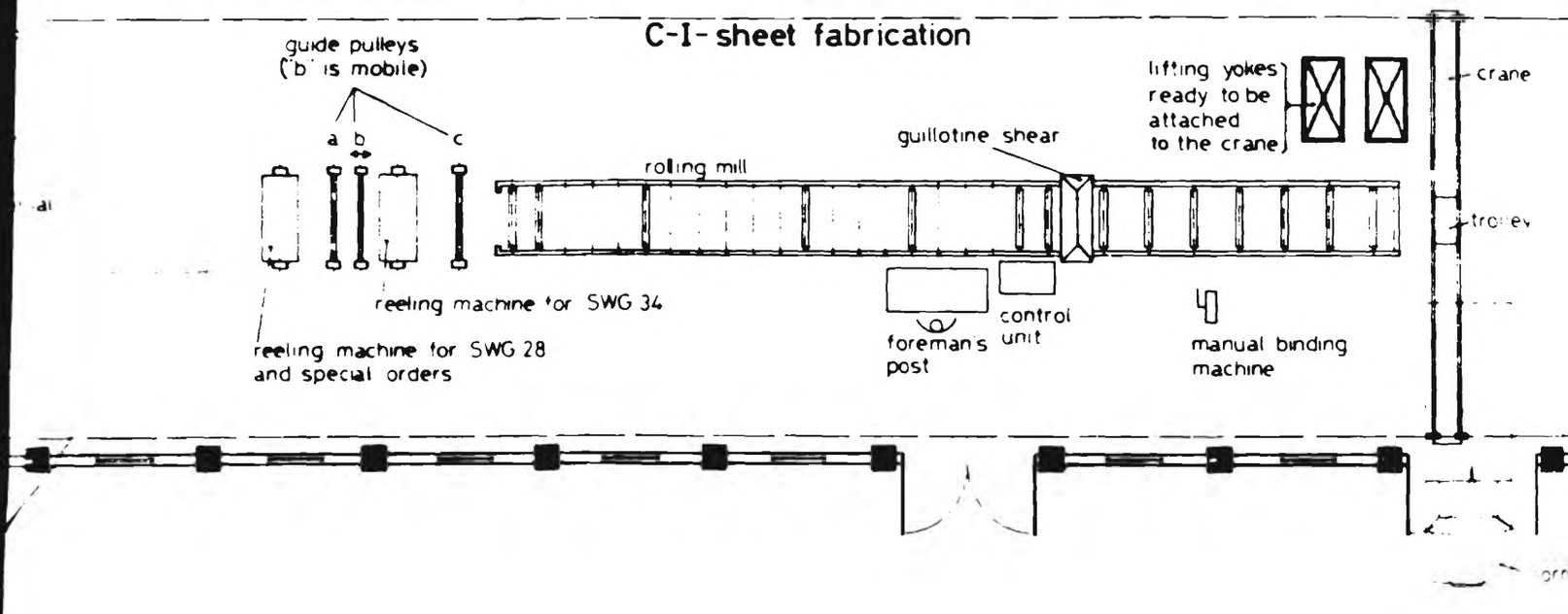
SECTION 2

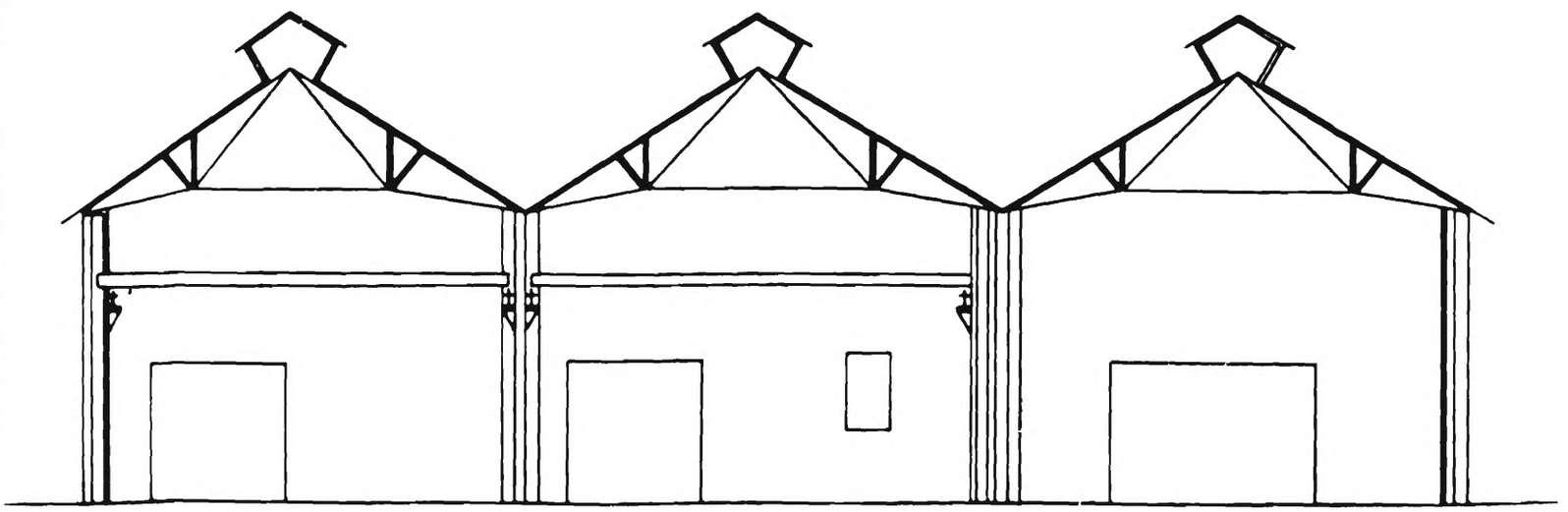



AC/DC-
welding
welding room
shaper
lathes
forging
room
pressings
plate
bending
plate
cutting
surface
grinder
centre
grinder
millers
vertical
horizontal
drilling
of tubes
tool lockers
pillar drilling
Apprentices shop
supervisor's
office
work benches
with vise
tool lockers

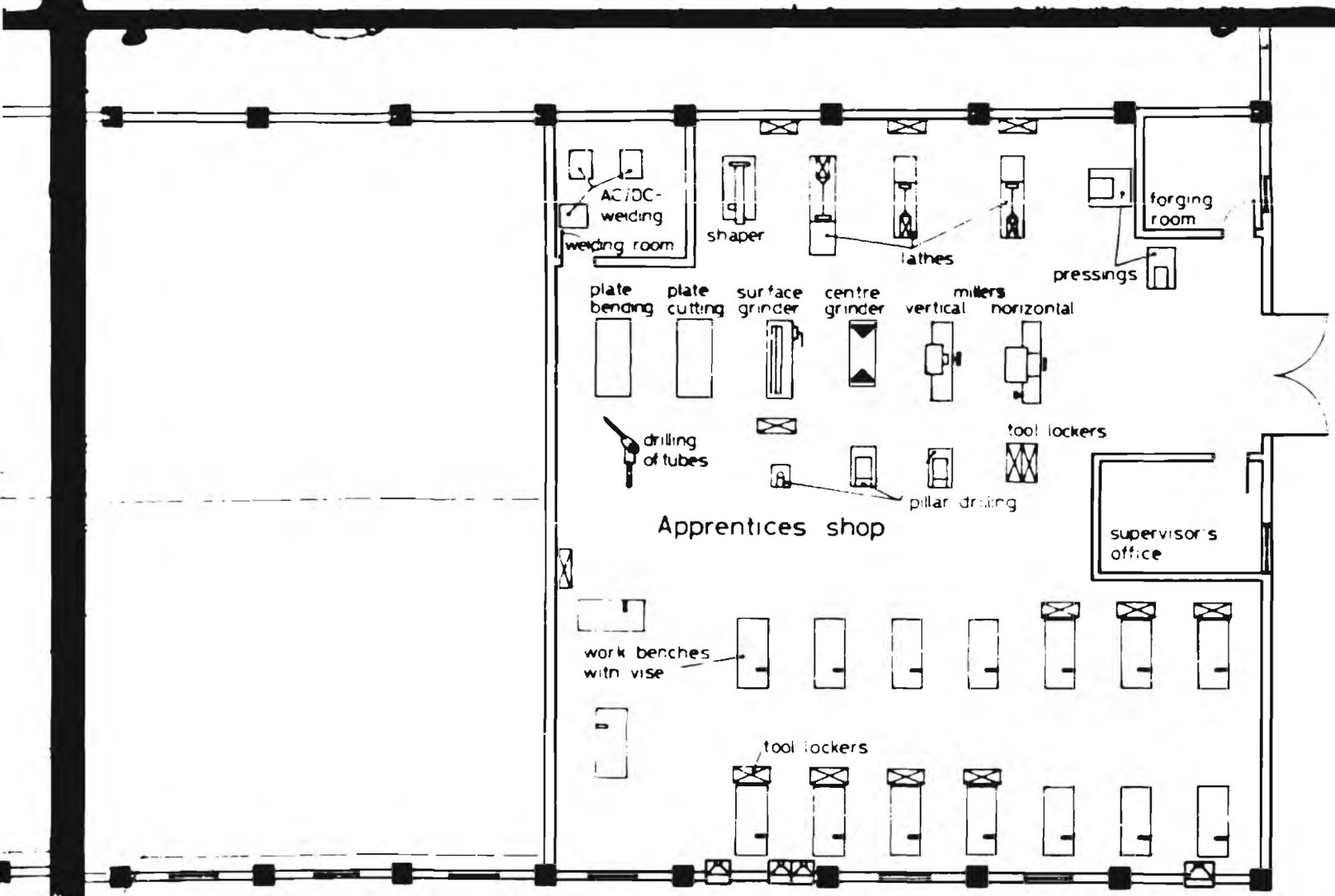
SECTION 3

Reserve





SECTION 4



Annex 11

SECTION 5

0 5 10 15 feet

NATIONAL WORKSHOP, SIERRA LEONE		
Layout C-I-sheet fabrication (building 03) Apprentices shop (building 03a+04a)		
ICME	Bellariastrasse 51, 8038 Zurich	28 10 83

Annex 12: Nominal feasible and effective production hours at the different workshops of new company at full production

	Workshop	Bottle-neck-machine/ equipment/working place	No of direct labour	nominal feasible production hours in year	effective production hours in year	% utilization
manufacturing division	metal forming shop	cut off machinery	5,5	6'400	6'300	98
		bending tubes, profiles	3,0	3'200	3'000	93
		bending tubes, folding	3,5	3'200	2'250	70
		pressing	2,5	3'200	1'900	60
		welding	6,5	9'600	8'700	90
		sawing	1,5	1'600	1'350	84
		painting	4,0	6'400	6'000	93
		assembling	6,5	10'400	10'400	100
	machine shop (without tool making)	turning	8,5	9'600	9'380	97
		milling	6,0	8'000	7'250	90
		shaping	1,5	1'600	1'320	83
		drilling	5,0	6'400	5'150	80
		grinding	2,0	1'600	1'250	78
	C-I-sheets	C-I-sheets fabrication	8,0	1'600	1'500	93
	foundry	cupola furnace	1,0	1'000	215	21
		electric furnace	1,0	1'000	460	46
		forging	8,0	12'800	11'500	90
repair		diverse handtools	34,0	Ø 54'400	43'520	80
jobbing div.		lathes	3,0	4'800	3'360	70
metal fabr.		diverse work places	8,0	Ø 12'800	10'240	80

Annex 13: Possible suppliers for machinery, equipment and material

No.	Supply item	Name of suppliers	Address
1	Machine tools turning, drilling, milling, shaping, grinding	a] Hahn + Kolb, Toolmachines + Tools b] MAHO, Toolmachine-design c] Pittler Toolmachines d] Walter Meier AG e] drilling: Alzmetall GmbH	D-7000 Stuttgart, Königstr. 14 D-8962 Ptronten, POBox 1280 D-6070 Langen b. Frankfurt/M CH-8024 Zürich, PO Box D-8226 Altenmarkt, POBox 1169
2.	Toolmaking machines (high precision)	see 1a, 1b	
3.	Other machines bending plates and tubes, cut off, folding, pressing	a] Trumpf GmbH + Co b] IRLE KG c] pressing: Beutler AG	D-7257 Ditzingen/Stuttgart D-5910 Kreuztal-Littfeld Waldwiesenstrasse 8 CH-6130 Willisau
4.	Welding machines AC/DB-welding, spot welding, Acetylene-gas-welding	a] AEG Telefunkten b] Oerlikon-Bührle Schweissmaschinen a] Messer Griesheim GmbH b] Sauerstoff + Wasserstoffwerke AG	D-6000 Frankfurt/M Theodor-Stern-Kai CH-8050 Zürich, PO Box D-6000 Frankfurt/M, POB 119087 CH-6002 Luzern, PO Box
5.	Foundry machines, equipment		
5.1	Electric/induction furnace	a] Russ-Electroofen GmbH	D-5000 Köln, PO Box 510940
5.2	Cupola furnace and renewing of a cupola furnace		
5.3	Ladles	a] see 7.5 b] Ralupur (= General representative,	
5.4	Core-sand mix units	a] Vogel + Schemman AG	D-5800 Hagen, PO Box 2460
5.5	Preparation of moulding sand	a] Heinrich Herring, Machine factory	D-583 Schwelm
5.6	Drying unit for sand	a] C.G. Mozer KG, Machine factory	D-7320 Göppingen
5.7	Sand stream units ("sablux")	a] H.A. Dietiker AG	CH-8600 Dübendorf, Sonnentalstrasse 5
5.8	General facilities/ auxiliaries for foundry equipment and pattern making	a] Hohnen & Co	D-4800 Bielefeld, PO Box 4126
6.	C-I-sheets Plate rolling mill; profile guillotine shear, reeling machine, lifting yokes	a] Schloemann-Siemag AG b] see Danish study, C-I-sheets	D-4000 Düsseldorf, PO Box 7240

Annex 13: Possible suppliers for machinery, equipment and material

7.	Auxiliary equipment, service equipment		
7.1	Trucks	a] local - Mercedes Benz	
7.2	Forklifts, diesel, pallet-rollers	a] Jungheinrich + Co GmbH	D-2000 Hamburg 70, POB 700941
7.3	Aluminium general containers transpo/t and stor-	a] Kaiser + Kraft AG	CH-8038 Zürich, PO Box 115
7.4	age means Pallets		
8.	Materials, Tools; miscellaneous		
8.1	Steel sheets SWG 34, 28 in coils	a] see: Danish study, C-I-sheets wheelbarrows	
8.2	Steel plates 1,5 m		
8.3	Steel tubes, bars, 4-angle, diverse profiles L, I		
8.4	Pig iron, ferro alloys	Brazil, Nigeria	
8.5	Coke, limestore, scorifier, iron oxide, sodium silicate, bentonite, seacoal	a] Friedrich Wahrenburg (also for moulding/core sand)	D-8000 München 86, POB 860825
		b] Ralupur AG (also for various foundry equipment)	CH-8057 Zürich, PO Box 167
	Moulding sand, core sand	a] Zimmerli Mineralwerk AG	CH-8038 Zürich, Hohlstr. 500
8.6	Tools, dies, jigs for machine tools	a] Brütsch-Rüegger AG	CH-8023 Zürich, PO Box
8.7	Material testing laboratory	a] Georg Fischer AG	CH-8201 Schaffhausen, POB 671
	Scrap-iron breaker Hand operated breakers, shears	b] Serva Technik AG	CH-8152 Glattbrugg, PO Box
8.8	Compressors, compressed air-tools	a] Atlas Copco (Schweiz) AG	CH-2557 Studen
8.9	Air drying painting boxes, units for painting, drying	a] see 7.7 b] Serva Technik AG	
8.10	Airhammer, forging facilities	a] Reiter KG	D-8900 Augsburg 1, POB 102243
8.11	Cranes, equipment for cranes, etc.	a] Mannesman-Demag AG ◆Hans Fehr AG	CH-8305 Dietlikon

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Annex 14: Job cards

Job cards serve to identify:

- every order of a product (custom and serial production)
- how to produce exactly a certain lot of a product
- the quantity and quality of used basic materials
- every work station a product runs thru its production run

An example of a simple job card follows:

(size of job card; approx. this sheet)

Job card	Product description	pcs to be manufactured	week of delivery	current Number 83- 0001
	Shovels	100	33/27	Date

1. Material required for 1 piece:

Qty	Dimension [pcs/m/kg]	Name of material and main dimensions	location of material	latest provision in weeks before delivery
1	pcs.	Steel 100 x 200 mm / 2 mm	Metal working shop	8
...	...	.....	.....	...
...	...	.....	.....	...
...	...	.....	.....	...

2. Operations to be done:

location of operation	No. of operation	Description of the operation	average op. time given for 1 pce [minutes]	latest provision in weeks before delivery
MW - Shop	1	cut out the form of shovel as shown in drawing Nº	10'	7
...	...	.....	.....	...
...	...	.....	.....	...
...	...	.....	.....	...

Worked out by: (date)	No. of acceptable pieces Visa of supervisor	No. of unacceptable pieces Visa of supervisor	Remarks by Quality control:
Mr Hans Meier 18/05/83	92 / Johnson	8/ Johnson	10 of the 92 good pcs had to be refused first

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Annex 14: Job cards

Explanations to this sheet:

- individual figures and description of the job are worked out by the production support office (reporting to the Chief Engineer)

- notice particularly:

  1. 83 = year / 27 No. of week
  2. 83 = year / 0001 - every job (like these shovel for example) gets an own number, which is also fixed in a book in the production support office
  3. should not vary! The optimized lot is given by production support office.
  4. valid for the qty of item 3. Should be fixed. Worked out by production support office.
  5./6. given by production support office. 6 is valid for the qty of item 3.
  8. Here, the last supervisor of the job signs and indicates the number if acceptable/unacceptable pieces.
  9. Remarks by quality control (QL)-office.

Using the job card

1. The original of every job card is filed at the production support group office. For each lot of a product or semi-product to be produced, the p-s-group establishes the following copies:

   - two copies to every supervisor whose shop figures under the column "location of operation"

   - one copy for the product support group

   - one copy for the packing/delivery section

   - one copy as reserve (can be used later for calculations).

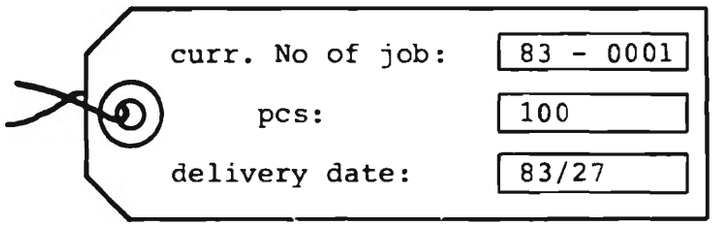
2. The job card remains at a particular work station until the operation has been finished. The supervisor then controls the work and takes the job card to the work station of the next operation.

Annex 14: Job cards

3. When the job has been finished and all the acceptable pieces are in stock, the last operational supervisor to control the work sends one of his two copies to the production support office.

4. After a certain job is done and item 2 also has be done, all remaining job cards have to be destroyed by every supervisor. Responsible for that: only the supervisor.

The supervisor is responsible for identifying each lot and for this purpose the following ticket is proposed:



Tickets should be attached to the aluminium work-transport containers or, when these are not provided, to the pieces being worked.

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Annex 15: Profiles for the internationally recruited experts for the management posts

a] Profile for General Manager

1. Age: minimum 37

2. Languages:

- fluent in spoken and written English
- local dialect favourable

3. Educational background

- industrial engineer with additional education in business administration or business administration with pronounced technical comprehension
- excellent general education
- good knowledge of modern methods of managing an industrial enterprise, familiarity with strategic management principles
- evidence of having completed training courses in general management, planning, leadership, marketing strategies and/or controlling.

4. Professional experience

- 12 years' proven technical experience including:
  - . finance and cost controlling
  - . marketing (for instance as product manager),

  in one or several industrial enterprises of minimum size 100 employees
- good understanding of technical processes and preferably of mass production
- minimum of 5 years' experience in a managerial line-position, including 2 years at top-management level

- proven experience of at least 1 year in a developing country, preferably in Africa
- desirable is experience as industrial project leader or coordinator on several different jobs.

5. Personal requirements, characteristics, abilities

- good leadership qualities
- excellent skill in understanding and implementing organizational and planning measures
- resolute decision-making ability with an outstanding intellectual flexibility
- comprehensive cost- and quality-awareness in all measures and decisions
- pronounced ability for delegating responsibility and job-authority
- tenacity and high ability to carry through his objectives and orders
- skill to withstand exceptional burdens
- entrepreunerial charisma, ability to discuss on all levels
- independent (referring to relationships with personnel)
- team-oriented in his way of getting things done.

Annex 15 (cont.)

b] Profile of Chief Engineer

1. Age: minimum 32

2. Languages:

fluent in spoken and written English

3. Educational background

- mechanical engineer from accredited technical university, or technical school; master's degree acceptable
- good general education
- good knowledge of fabrication methods of the metal working and assembly industry as well as foundry processes.

4. Professional experience

- 10 years' experience as mechanical engineer in metal working and foundry industries; work experience in a design/engineering office and sufficient understanding of mechanized production processes
- at minimum 2 years of experience in a technical managerial position of a metal working industry firm or a foundry preferably as Chief Engineer
- proven experience in the engineering and design of several successful industrial products, preferably in the metal working or apparatus industry
- proven experience in assignments as a project leader/coordinator for launching a new industrial product
- if possible, job experience in one or more developing countries, preferably in Africa.

Annex 15 (cont.)

5. Personal requirements, characteristics, abilities

- sense and skill for activating the innovation potential in others
- outstanding technical creativity
- developed awareness of the inter-relationships between production, function and reorganization
- comprehensive cost- and quality-awareness
- teamwork oriented
- tenacity and skill to withstand exceptional burdens
- objective oriented way of solving day-to-day problems
- skill in leading and motivating subordinates.

Annex 15 (cont.)

c] Profile of Marketing Manager

1. Age: minimum 32

2. Languages:

   - fluent in spoken and written English
   - spoken French desirable
   - local dialect favourable.

3. Educational background

   - business administration or thorough commercial education from a well-known school
   - good general edcuation
   - good theoretical background in modern marketing instruments/strategies.

4. Professional experience

   - 10 years' broad marketing experience in
     . technical sales representation of industrial goods
     . co-working in a marketing-services office of an industrial firm
   - minimum 2 years of experience in a managerial marketing position of a metal working company
   - proven experience in important assignments in the launching of a newly developed product
   - if possible, job experience in developing countries, preferably Africa.

Annex 15 (cont.)

5. Personal requirements, characteristics, abilities

- sales oriented manager-type with outstanding flair for the right market-product-mix
- highly developed sense of price
- feeling to neact immediately on changed market tendencies/opportunities
- accustomed to actively monitoring the market in the field
- used to being a hard-bargaining party to a deal
- pronounced market-oriented thinking
- responsive in his decision
- good intellectual flexibility
- excellent manners.

Annex 15 (cont.)

d] Profile of Production Manager

1. Age: minimum 35

2. Languages:

   - fluent in spoken and written English
   - local dialect favourable

3. Educational background

   - industrial engineer, mechanical engineer, or foundry engineer with additional education in industrial engineering from accredited technical university, or technical school
   - good general education
   - outstanding knowledge of fabrication methods and organization in the metal working and assembly industry as well as in foundry processes.

4. Professional experience

   - 10 years' experience as industrial engineer in metal working and foundry companies of an average size of 300 employees; directly involved in the process of mass-production; (for example, as assistant to the manufacturing or production manager)
   - exceptional understanding of mechanized production process, especially in mass-production
   - minimum 5 years' experience in a production management position of a metal working and/or foundry company; (for example, as production-, manufacturing-, or foundry manager)
   - proven experience as head of one or several production lines with an annual output of about 10'000 units each
   - desirable is the experience in industrial project teams (as leader or member) on several jobs
   - proven experience of a minimum of one year in a developing country, preferably in Africa.

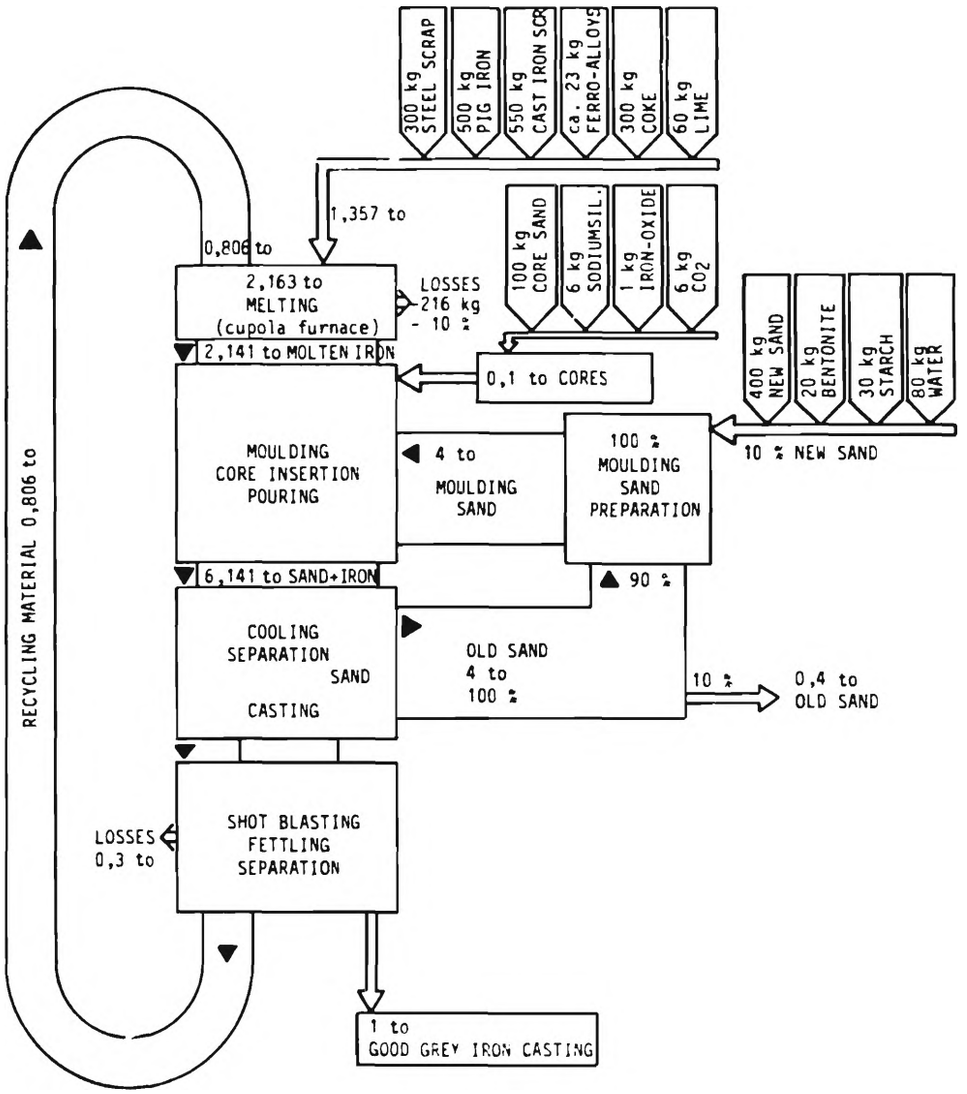
Annex 15 (cont.)

5. Personal requirements, characteristics, abilities

- outstanding ability to understand and implement organizational and planning measures
- pronounced skills for working out simple practical and feasible solutions for technical production runs
- comprehensive cost-, quality-, and quantity-awareness in manufacturing
- pronounced ability for delegating responsibility and job authority
- well acquainted with modern management methods and skilled at leading a large number of personnel; experience in leading and motivating people
- real decision making ability
- tenacity and ability to carry through his objectives and orders
- teamwork oriented.

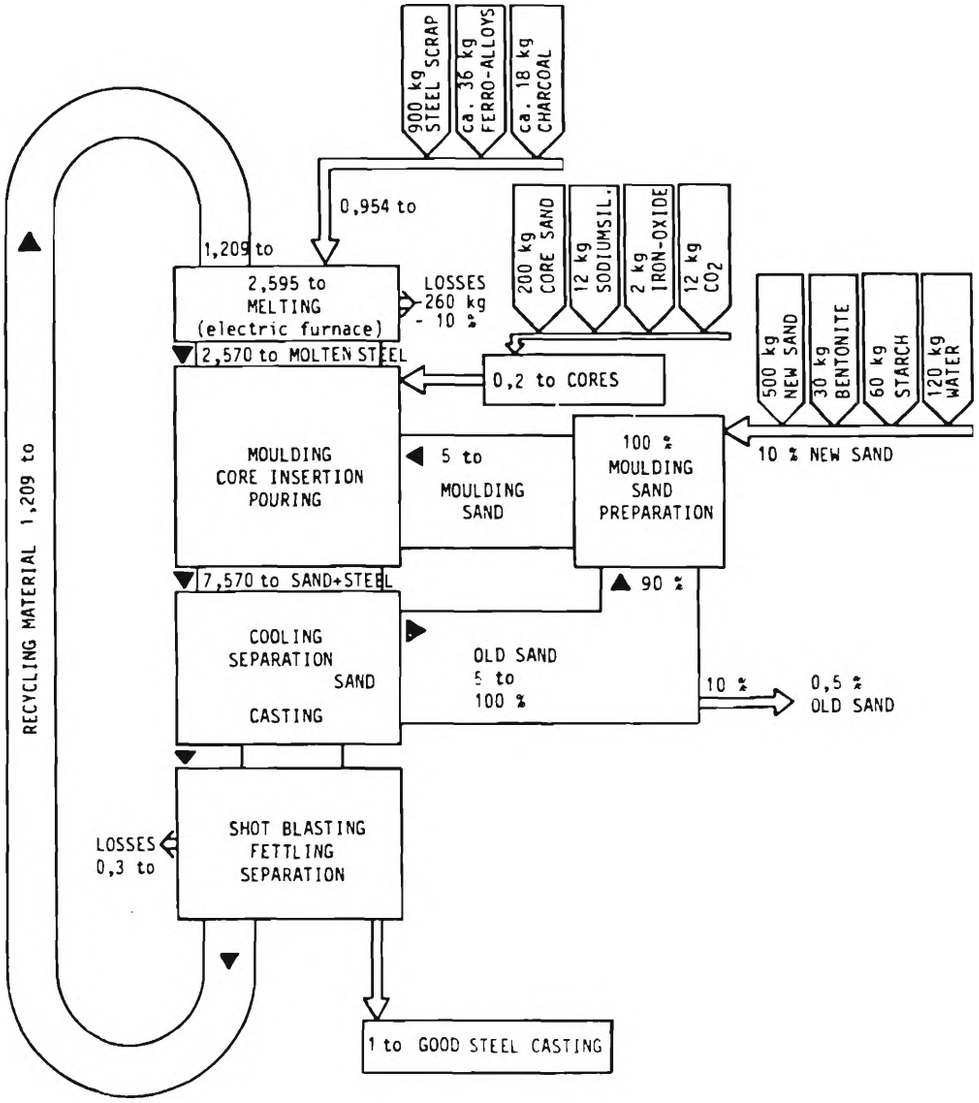
Attachment 1: Casting technology and procedure in the new foundry

1. Material flow for 1 t good grey-iron casting (cupola furnace)



Attachment 1: Casting technology and procedure in the new foundry

2. Material flow for 1 t good steel casting (electric furnace)



Attachment 1: Casting technology and procedure in the new foundry

3. Electric furnace: timing of operations

- content of melting pot: 0,5 t
- max. capacity: 170 kg molten steel/h
  = 66 kg good steel/h
- capacity at full prod: 30 kg good steel/h

Pos.	description	time (min.)
1	loading	20'
2	melting	170'
3	sampling, waiting for test-result	10'
4	correction of analysis	10'
5	measurement of temperature	10'
6	overheating	10'
7	scuming	10'
8	switch over to keeping warm	20'
	TOTAL	260'

Attachment 1: Casting technology and procedure in the new foundry

4. Evaluation of furnaces for the new foundry

The heart of every foundry is the furnace. The former TESCO Study recommended for melting down of steel and grey iron two furnaces of medium frequency. We have made a comparison between:

- 2 medium frequency induction furnaces

and

- 1 cupola furnace
  1 electric furnace for steel castings (grey iron possible as well).

We chose the second variant for the following reasons:

- the investment costs are substantially lower
- no additional electricity capacity is required
- the workers already have experience with the cupola-type furnace
- grey iron production is higher than steel production
- the two systems are independent; one can always be in operation
- very high working capacity of cupola furnace is possible.

Some disadvantages of first variant are:

- high investment costs (double) while melting capacity remains the same
- high consumption of energy causing high investment costs for primary energy
- dependance on electric energy as sole energy source
- higher melting costs
- higher, more complex demands on the factory

Attachment 1: Casting technology and procedure in the new foundry

The rising cost of energy is the most important reason for re-assessment of the cupola furnace in the field of melting technique even in Europe.

In consumption of primary energy, the cupola furnace is at present the cheapest melting unit for cast iron. Since 60 - 80 % of the whole energy consumption is taken by the melting process, it is important to keep this expenditure down. To allow the cupola furnace to work more economically, modifications can be made, such as: enrichment of the air with oxygen and pre-heating it or an improvement in the tapping technique in order to keep the running expenses down and to increase productivity.

5. Short description of the planned induction (electric) furnace

For melting steel, a main supply induction melting pot with a capacity of 0,5 tons is planned. The melting pot comprises a furnace body, the induction spool with the transformer plates and the melting crucible.

Electric energy is supplied to the induction spool from the mains. The electromagnetic field built up by the spool transfers the electric energy to the metal in the melting pot. The great advantage of induction heating is that the electric energy is converted into heat in the metal itself.

Owing to the high concentration of working capacity in the induction melting pot, it is imperative that the induction spool be water cooled. A control system ensures that the unit is switched off by low water pressure or lack of water.

Inside the induction spool is the melting crucible with a monolithic lining material.

A liquid pool is not necessary in order to put the furnace into operation. The furnace can be started up with solid material of a certain size.

By continual operation, the melting pot will be emptied leaving a third of its content with every load. This will remain in the pot as liquid pool and speed up the melting operation of the new load thus reducing the energy consumption considerably.

Attachment 1: Casting technology and procedure in the new foundry

6. Operating the induction furnace

Design and operating methods of the induction unit demand special standards for its use, as the quality of the molten mass, the durability of the fire-proof lining and the operating safety of the whole unit depend upon it.

Quality and safety standards must be high for operating the induction unit. For this reason, the sorting of the iron and steel must be checked by a well-trained supervisor in order to ensure the smooth and safe running of the plant.

6.1 Requirements for iron scrap

Each delivery load of scrap should be as uniform as possible. Cast iron scrap must not contain:

- steel scrap
- coloured metal and alloys
- light metal and alloys
- annealed cast iron
- foreign metal alloys.

Cast iron scrap must not be dirty or oily. The size of the scrap pieces depends on the diameter of the furnace but must not be bigger than a third of the diameter; thus, pieces are approximately 30 cm length.

6.2 Requirements for steel scrap

The scrap pieces are usually about 30 cm in lenght and should not exceed one third the diameter of the electric furnace. Small pieces of scrap are also suitable for the electric furnace as well.

Bulky scrap is seldom usable, and chippings are to be avoided.

Foundry steel scrap must not contain foreign metals, because even a small acmount can cause destruction of the lining of the electric furnace. Scrap contaminated by organic substances such as wood, cotton waste, oil, grease, etc. can jeopardize the safety of the working force. Wet scrap is also a safety hazard.

7. Breaking, sorting and load preparation

7.1 Cast iron scrap

In order to break up the cast iron scrap to the required size a breaker is used. The breaker is made up of a tower (steel construction), winch and weight. The weight is brought up to the highest position and then dropped onto the large scrap pieces. Smaller scrap pieces are broken down with a hammer. The scrap iron breaker causes great vibration and noise, and it is therefore proposed to place it in a remote part of the factory grounds.

7.2 Steel scrap

Steel scrap must also be broken down to the required size. Large flat pieces can be cut up and heavy thick profiles must be cut up with an oxyacetylene torch. The use of small cutter-grinder machines run on petrol is also very productive.

7.3 Method of sorting

Once broken down, the scrap should be sorted into five groups:

- cast iron scrap
- steel scrap
- aluminium and alloys
- copper and alloys
- other metals.

A container is provided for each group. Sorting is not very difficult and can be carried out by visual inspection. Other possible methods are:

- drop analysis (chemical)
- spectroscopic analysis
- magnetic separation testing.

The scrap must be freed of all dirt accumulation. It is possible to put the steel or cast iron pieces into a bath with diesel fuel and burn it off.

7.4 Load preparation

The broken down scrap is weighed in containers and the required amount transported to the furnace or stored. It is important that the material be kept very dry even in the rainy season, and thus must be stored in covered store rooms. When needed, the containers are transported to the melting shop with a fork lift.

8. Moulding sand preparation

8.1 Moulding sand mixture

For both mechanised and hand moulding for grey iron and steel, a green sand mixture should be used. This moulding sand has storability of the moulds. The basic materials do not contain any harmful components, are not so expensive and 90 % of the used sand can be recycled.

However, there are two different mixtures to be made up. For grey iron the moulding sand is prepared as follows:

100 kg sand (H31)
approx. 6 % bentonite
approx. 4 - 5 % coal dust (or 1 - 1,5 % pitch)
approx. 4 % water.

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For steel casting the mixture is as follows:

100 kg sand (H31)
approx. 6 % bentonite
approx. 2 % starch
approx. 4 % water.

For hand moulding, the water content must be increased from 4 % to 6 %.

The above recipes refer to new moulding sand preparation. During operation, however, old sand will be used. The old sand can be mixed with 10 % new sand and re-used. The mixture will be made up as follows:

approx. 90 kg old sand
approx. 10 kg new sand
approx. 0,6 % bentonite
approx. 2 - 3 % water.

The moulding sand mixed in such a way can be re-used to mould. The moulding sand is prepared in a mixer. Above the mixer is the sand silo from which the sand dose can be measured out. The silo is loaded from containers which have come from the drying plant. The dosage of the other components (bentonite, coal dust, etc.) is also done automatically by conveyor from other containers suspended over the mixer. The water can also be dosed at this point.

The prepared mixture is automatically tipped into a container with a base opening. The containers with the moulding sand are then tipped into a storage tank above the moulding machine or transported directly into the hand moulding shop where the sand is tipped directly into the moulds.

8.2 Mechanised moulding

8.2.1 Moulding machine

The moulds are manufactured on the lift-off moulding machine. The machine is equipped with an anvil shaker. The shaker is encapsulated to ensure a noiseless operation process while reaching a high intensity of compression. The swinging anvil offers the possibility, after a short pre-shake, to continue shaking under pressure. The machine works with a two-hand control system. The machine is also equipped with a change-over adjustment to allow top and bottom flasks to be moulded one after another on one machine.

8.2.2 Procedure

The empty mould boxes (top and bottom) are pushed into the change-over adjustment device. The press plate is swung out. The operator opens the fish-mouth lock on the overhead suspended storage tank and lets the required amount of moulding sand into the moulding box. Then the machine shakes and compresses the moulding sand onto the moulding plate with pattern. The press plate is then swung back and the moulding box pressed onto the plate. Thus formed, the bottom part of the moulding box is lifted off and pushed onto the roller conveyor and turned. The same procedure applies on the top.

8.2.3 Core insertion

The cores manufactured in the core moulding shop are placed into transportable shelves and made available to where the cores are inserted in the mechanised moulding shop or the hand moulding shop. The insertion of the cores is done manually and demands careful handling in order not to damage the moulds or the cores. At the same time, cleaning the moulds with a brush can be done.

8.2.4 Assembly of the moulds

After inserting the cores into the bottom moulds, the top moulds are carefully put on top. Both halves are clamped together. An excentric piece is hammered on to the bolts of the moulding box.

The ready moulds are transported with wagons onto the roller conveyor and are ready for casting.

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8.3 Hand moulding

Hand moulding is intended for larger pieces. After filling sand in the moulding boxes it is manually compressed with a stamp hammer driven by compressed air. This has to be repeated several times according to the height of the moulding box. In the case of thick-walled castings, the moulds can be coated and dried. After insertion of the cores, the top and bottom halves are clamped together and are ready for casting. The moulds are lifted by crane.

8.4 Casting

The molten metal is poured into the warmed ladle by tipping the electric oven used for making the alloy. For grey iron castings, a crane ladle is used, and for steel castings a stopper ladle is necessary. The ladle with the molten metal is brought to the casting section/pouring section by way of crane.

In hand moulding, the ladle is driven to the forms, and the prepared moulds are poured and cast.

8.5 Cooling

After being poured, the castings have to cool down for a certain length of time according to size. Grey iron needs approximately 30 minutes. Steel castings need a little longer to cool according to the alloy and to the size of the casting taking between 60 minutes to about 3 hours.

8.6 Shake out

When the moulds have cooled off, they are transported to the shake out. Through vibration of the grid, the sand falls through into the containers. The casting with sprues and runners remains on the grid and is put by the operator into a container which will then be transported to the fettling shop for further processing. The old sand is transported for re-preparation.

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8.7 Rotary dryer

Since the delivered or stored sand is damp, it has to be dried before it can be prepared for moulding or core sand so that an exact dosage can be maintained. This is done in the rotary dryer. The sand is first put into the inner drum and runs through it. At a certain turning angle the sand falls onto the outer drum. In order to ensure that the sand flows, the rotational axis of the drum is slightly inclined. The drying gas from the burner streams through the sand as it falls from the ridges in a uniform current. Entry and exit of the sand are on the same side of the dryer. The burner is placed on the front side.

For good drying results it is important that the sand be introduced evenly into the drum.

The rotary dryer is attached to the extraction system. Since the foundry requires two types of sand -- core sand H32 and green sand H31 of differing granulation -- they must not be mixed but dried separately. Only new sand 10 % of the whole amount is dried, as 90 % of the old sand is re-used and is already dry.

9. Sand preparation and core making

9.1 Core sand mixer unit

The most important part of the core sand preparation unit is the universal mixer.

Owing to faster mixing speeds, shorter mixing times are reached and less service is needed.

The mixer is equipped with dosing units for sand, sodium silicate and ferrous oxide. The unit is fitted with a complete control system which makes the whole operation automatic. This system guarantees a constant quality of core sand.

The unit is mounted on a stand. Above it is a small sand container. Dried sand is filled into this container by crane from another container with fish-mouth opening. Next to the mixer is the dosing unit for the sodium silicate which is filled into the mixer through

the dosing unit in the appropriate amounts and at the set times. For the addition of ferrous oxide, a powder dosing unit with loosening device is placed above the mixer. The loosening device gets rid of "bridging" and allows for a reliable dosage.

After mixing, the core sand is automatically emptied out into the container underneath.

The processing of the sodium silicate sand into the core boxes should be done relatively quickly, since the sand mixture can begin to harden otherwise.

9.2 Core making

Cores serve to form the inner part of the casting.

It is proposed to produce the cores using the CO_2 process. The cores are made in wooden core boxes manufactured in the Workshop's own pattern making shop. It is proposed that the cores be made exclusively by hand.

The preparation of the sand mixture is carried out according to the CO_2 principle, with the dosages:

- 100 kg sand H32
- approx. 6 % sodium silicate binder
- approx. 1 % ferrous oxide (optional).

The silica sand is put into the core boxes and directly gassed with CO_2 causing the cores to harden.

The hardening takes place within seconds at normal temperature according to the size of the core. Larger cores need to be gassed a little longer. The amount of CO_2 for gassing is approximately 6 % in relation to the amount of sand.

Simple apparatus is proposed for the gassing operation comprising CO_2 cylinder, CO_2 heater (to prevent freezing), a pressure reducing valve, CO_2 hose, spray gun. A small quantity of large size cores will be made by ramming table. For this purpose, a ramming table and core making table are situated in this area.

9.3 Coating of cores

Cores are made of porous material into which the molten metal tries to seep. If the metal penetrates into the pores, a hard crust of sand and metal sticks on to the casting and is difficult to remove. This can be prevented by coating the core in order to close the pores completely.

The coating must be chosen to suit the type of metal. For castings which remain molten for a longer period, a thicker or more enduring coating is required.

We recommend that cores for steel castings as well as those for thick-walled grey iron castings be coated.

The coating can be applied with a brush, or the cores may be dipped and dried.

10. The fettling shop

The operations to be carried out in the fettling shop are as follows:

- separation of the casting from the sand, de-coring and de-scaling
- cleaning
- separation of the recycling material
- rough cleaning
- hand cleaning
- fine cleaning
- checking.

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After being checked, the casting can receive secondary treatment, if necessary, which can consist of:

- processing
- heat treatment (annealing)
- painting/preservation
- checking
- trimming/assembly.

Then the casting is ready for transport to the warehouse or for despatch.

10.1 Cleaning off the form sand and de-coring

The cooled-off moulds are taken to the shake-out table where the castings fall out of the mouldy. By way of vibration of the grid, castings are freed of sand. The sand is caught in the container and taken for preparation.

The de-cored castings roughly freed from sand are transported to the fettling shop.

10.2 Separation from the recycling material

Separation takes place at the fettling table. The grey iron is separated from sprues and runners by hand with hammers. Oxyacetylene torches must be used for steel. Owing to contraction of the cross section of the sprues and runners, knocking off of the material is easy. The larger castings are separated with a cutter. The non-metal castings would be separated with a band saw.

The removed material will be transported in containers for remelting.

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10.3 Blasting

According to their size, the castings are put into cabins with outside control and shot blasted. The castings are put into the cabin, the door closed. The blasting pistols can be fixed into any position by the man operating the cabin. According to the type of casting, different blasting materials can be used.

10.4 Grinding

For small pieces, a grinder with two disks is provided. For larger castings (up to 25 kg) a grinder with bigger disks will be provided. There is no danger of over-grinding during the first coarse treatment even if these bigger disks are used.

10.5 Hand cleaning

Cleaning by hand is carried out with various small apparatus driven by compressed air. Two working places are provided comprising:

- fettling table with vise
- surface grinder (suitable for coarse grinding and cutting)
- radial grinder
- small grinder
- chisel hammer for large castings.

Various grinding materials for different metals and milling machines are provided. Usually, castings of about 25 kg coming straight from the trestle grinder are cleaned here. The advantage of hand cleaning is the high flexibility the various shapes of the castings.

Small defects on castings can be repaired by welding. For this purpose, oxyacetylene welding equipment and AC/DC welding equipment is provided in the shop.

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10.6 Requirements for the working places

The blasting cabins and the trestle grinder are connected to the exhauster. There are no safety precautions necessary for personnel on the blasting cabins with external control.

For the remaining grinding and cutting operations during hand cleaning, safety equipment such as aprons, gloves, goggles, etc. is necessary.

10.7 Quality control

Visual quality control must be maintained during the consecutive fettling processes. By way of visual control by each worker in the fettling shop a high standard of quality can be maintained while keeping the quality control costs low.

11. Pattern making

11.1 Storing of patterns

After forming the castings, the patterns should be cleaned and then stored. The costs of the patterns for products manufactured at the Workshop should be calculated in the price of the castings.

For customer orders, the costs of the patterns are charged to the customer. On delivery of the castings, the customer may take the patterns to have them stored at the Workshop for further orders, but not for longer than three years. If the customer has not ordered after this period, a storage fee would be charged.

The storage times are determined as the circumstances and conditions may require. However, the patterns wnich have not been used for many years or which have become unserviceable should be taken out of store. The following recommendations are given for storage times:

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Type of pattern	Storage times in years since last casting	
	workshop's own patterns	customer patterns
serial patterns	10	5
large patterns	3	2
small patterns	2	1

All patterns should be stored in numerical order so that they may quickly be found for later use. They should also be stored in good condition.

11.2 Short description of the pattern making

Since only wooden patterns are manufactured in the shop, the wood must be of very good quality.

Hard and soft wood is used. Spruce and alder are mostly used. The wood does not have to be imported, as there is enough of it locally. The wood has to be chosen carefully. It should have no cracks or snags and must be well dried. It is recommended that the wood be seasoned for a minimum of one to two years.

The first operation in the treatment of the wood is by rough planing. Then the snags and cracks must be cut out of the boards. Afterwards, the boards are sorted according to their size and quality and according to the requirements of the pattern, pressed together and pasted into blocks. A synthetic glue is used.

The blocks are then roughly processed according to the requirements of the pattern. This will be followed by hand-processing of the pattern to give it shape and size. After checking, finishing and polishing will be carried out. The next step is the assembly and then the varnishing of the patterns using different colours according to international standards (see note on standard specifications).

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11.3 Pattern design

The most important points where costs can be influenced before they occur are - design - casting - pattern making. Thus, the casting should not take on shape merely in the fettling shop but already on the drafting table. The designer determines the entire scope of further operations such as fettling, processing and quality, etc.

A good and close exchange of ideas between designer, caster and pattern maker during the development leads to the best solutions. How the tasks of these three are related in the making of a casting is shown as follows:

Designer	Caster, Pattern maker
TEAM	
1. draft	
- mental picture - first sketch	- first pattern - choice of material - determination of feeding head
2. correction	
- correction of sketch	- design suited to material - design suited to manufacture for casting and mechanical - processing
3. design	
- drawing, showing, processing and material specifications	- mould diagram or drawing of moulded blank: . composition of pattern . determination of casting method; sprues and runners, casting temperature - determination of points for processing test casting - checking of unfinished casting - determination of changes - release for production

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Manufacturing should be done with a minimum of costs. The many difficulties which can be the cause of high expenditure must therefore be overcome in the design phase.

One of the most important tasks of the design office in the production of a design for a casting is to minimize investment costs.

11.4 The pattern making shop

The pattern making shop plays an important part in the proposed foundry since the quality of the castings depends on the quality of the patterns. Mainly wooden patterns are produced in the shop for the production program, for customer orders as well as wooden core boxes for the manufacture of cores.

Since the Workshop has the only foundry in the country, the role of the pattern making shop is of importance since it makes it possible to make patterns and core boxes in its own workshop for customer orders for spares and parts.

The pattern making shop produces single and split patterns for the mechanised and hand moulding shop. The patterns for the mechanised moulding shop are mounted on moulding plates. The moulding plates on the moulder are for top and bottom flasks and can be divided into various fields. The mounted plates with the patterns for a low piece numbers can be changed quickly when the required number is reached. The cutout (feeding head for the molten metal) and the sprues and runners can be mounted on the moulding plate making it unnecessary to cut out by hand in the mould. Larger series of metal patterns can be produced in the toolmaking shop.

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The following is a note of the most important specifications for pattern making. While they are German specifications, they correspond to international standards.

DIN-Standards

DIN 1511 - Foundry - pattern facility, manufacture and quality
Note:
1. quality grade of pattern
2. allowed variation in dimension of pattern
3. recommended values for draught of mould
4. shrinkage

DIN 1522 - moudling plates for machine mould box
DIN 1523 - guide pins for machine mould box and moulding plates
DIN 1525 - foundry pattern facilities and permanent moulds, plugs
DIN 1526 - foundry pattern facilities, pattern signs
DIN 1527 - foundry pattern facilities, core box locks

VDG code of practice

M1 - recommendations for enquiries and ordering of pattern facilities
M2 - information for pattern making
M3 - storing of patterns, crganization and installation
M200 - pattern painting