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ASSISTANCE TO REVOLUTION WORKSHOP

SI/PDY/75/807

DEMOCRATIC YEMEN

Terminal report

Prepared for the Government of Democratic Yemen
by the United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

Based on the work of Koka Kesava Rao, industrial engineer

United Nations Industrial Development Organization
Vienna

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Explanatory notes

References to dollars ($) are to United States dollars, unless otherwise stated.

The monetary unit in Democratic Yemen is the dinar (YD). During the period covered by the report, the value of the YD in relation to the United States dollar was $US 1 = YD 0.343.

A full stop (.) is used to indicate decimals.

A comma (,) is used to distinguish thousands and millions.

References to "tons" are to metric tons, unless otherwise specified.

ABSTRACT

The Revolution Workshop, Aden, Democratic Yemen, of the Ministry of Industry is housed in the sheds of an ex-army workshop dating from the Second World War. It undertakes repair and reclamation work for the public sector and government establishments, in addition to jobbing and manufacture of simple metal-fabricated products. It is equipped with a varied assortment of general purpose machine tools and metal preparation and fabrication equipment. Much of this equipment is in a bad state of repair and maintenance, making it unsuitable for fast precision production. Because of an inadequate work-load, low productivity and ineffective production planning and control, there is considerable underutilization of the Workshop's capacity. The economic functioning of the Workshop would be possible only through optimum capacity utilization and increased productivity; that is, by taking on regular production work up to a minimum of 60% of the Workshop's capacity, in addition to its present commitments.

In considering the products for manufacture, to minimize additional capital expenditure and to facilitate immediate implementation, the Workshop's infrastructural facilities, the stage of development of engineering and metal industry in the country and the domestic demand potential for such products have to be taken into consideration. From a study of these factors, it appears logical for the Workshop to expand and diversify into regular and planned production of relatively sophisticated metal-fabricated products up to its maximum underutilized capacity, in addition to batch production of existing products.

Demand projections and techno-economic analysis of a programme of production of steel furniture offers adequate scope for expansion and diversification, with appreciable economic and other benefits. A summary of techno-economic factors is given at the beginning of chapter II.

The effective and successful implementation of the steel furniture-manufacturing programme would depend to a large extent upon the progress achieved by the Workshop in upgrading its skills; in systematic formal and on-the-job training; in improving its general engineering practices and methods to achieve quality production; and, most importantly, in the development of efficient managerial and supervisory talent.

In view of the present limitations of the Workshop, it is not practical to refine its organization and to introduce specialized industrial engineering methods and procedures. A more general and continuous technical counselling is likely to achieve progressive improvement. Only practical grass-roots level organizational changes in the methods and procedures for production planning, purchase and inventory control, bookkeeping and cost accounting and repair and maintenance are suggested for immediate introduction.

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INTRODUCTION

In June 1974, the Government of the People's Democratic Republic of Yemen approached UNIDO/ECWA for the award of some fellowships to the personnel of the Revolution Workshop, to be trained in suitable fields. With a view to identifying specific areas where assistance was needed, the UNIDO Industrial Advisory Unit in the country made a preliminary general survey of the workshop in July/August 1974.

As a result of the above survey, the Industrial Advisory Unit recommended that a team of two SIS experts, one a mechanical/industrial engineer and the other a metallurgical engineer, make a specialized study of the Workshop to achieve the following objectives:

(a) To reorganize and reorient the production;

(b) To organize the manufacture of some of the maintenance spares;

(c) To organize the manufacture of relatively simple items, such as steel storage tanks, ladders, gangways, simple structural items etc.;

(d) To survey and recommend manufacture of some capital items such as pumps, with some addition to capital equipment by way of balancing;

(e) To give recommendations for decision making on:

(i) Items to be selected for drawing up regular manufacturing programme;

(ii) Selection of balancing equipment required and suitable revision of plant layout;

(iii) Organizing an industrial engineering section, a material procurement section, and proper storekeeping;

(iv) Means of interplant transportation, and transportation of finished goods;

(v) Proper system of bookkeeping and cost accounting;

(vi) Other important aspects that may come to light during the studies.

The project involved not only the reorganization of a jobbing and repair unit into a production unit but also reorienting its technology, know-how, methods and skills and additionally undertaking feasibility studies for setting up foundries. Further, the experts were requested to suggest suitable repair and maintenance organization and schedules for the Workshop's machinery and equipment.

The experts visited various government departments and agencies, industrial undertakings and workshops, and followed up with questionaries to assess the existing industrial potential and demand and consumption of gray iron castings and related industrial products. In the absence of precise information and data, certain rational assumptions had to be made to forecast the present and future demand, likely growth rate and availability of industrial inputs to arrive at planned figures for products and production volumes.

The rationale for the achievement of effective reorientation and reorganization of the Revolution Workshop is:

(a) Maximum capacity utilization;

(b) Product expansion and diversification with the minimum of capital outlay in the way of additional machinery, equipment and buildings;

(c) Product selection to suit the existing machinery and skills;

(d) Introduction of relatively simple industrial engineering methods, inventory control and cost accounting to achieve progressively higher productivity;

(e) Systematic organized formal and in-plant training to upgrade the know-how and skills.

I. PRESENT STATUS OF REVOLUTION WORKSHOP

The engineering and metal-working industry in Democratic Yemen is in the initial stage of repairs and simple manufacture. A limited domestic market and lack of industrial experience, aggravated by the absence of local engineering raw-material sources and the dearth of an industrial labour force, hold but small promise for the development of engineering and metals industry in the country. The progressive development of the industry would depend on careful selection of priorities, acquisition of necessary skills and know-how, and the establishment of technically and economically viable industrial units. From the pattern observed in other developing countries we may identify three broad stages of development for the engineering and metals industry:

(a) The initial stage of repairs and simple manufacture;

(b) Engineering production (true metals-transforming industries);

(c) Development and diversified metals industry.

The present structure of the industry as a whole in Democratic Yemen and the state of the engineering industry are given in tables 1 and 2. The industrial sector in the country is least developed and an organized engineering industry is almost nonexistent.

A great variety of machinery, equipment and industrial goods are presently in use in the country. At the present stage of development of the engineering industry, it would be highly unrealistic to undertake the manufacture of spare parts for such heterogeneous equipment. The manufacture of spare parts requires, firstly, material specifications, manufacturing drawings, limits and tolerances, quality standards and user trials. Secondly, it requires technological know-how, a high degree of skills, and precision machinery and test equipment. Therefore, the question of manufacture of even simple spare parts must be examined in detail and for each individual case, taking into account availability of the required resources and the urgency. At the most, the manufacture of spare parts can be undertaken by the Workshop on a jobbing basis and cannot be considered for sustained production.

The Revolution Workshop, with its present resources and skills, can only diversify and expand into a metal fabrication unit, undertaking in addition limited jobbing work. Since it is not possible to achieve the economies of large-scale production in small batch production and jobbing work, attempts should be made to achieve comparatively longer production runs and optimum capacity utilization by the rationalization and standardization of manufactured products.

Table 1. Present structure of industry in Democratic Yemen

Type of industry	Establishments Total	Establishments Small	Employees Total	Employees Small scale industry	Employees % of total
Electrical energy production and distribution	16	15	1,280	250	19
Extracting industry	2	-	240	-	-
Building material	5	5	180	180	100
Textile and clothing	13	9	1,490	248	17
Furniture and carpentry	13	12	840	590	71
Leather and plastic fancy goods	4	3	224	108	49
Paper products and printing	16	16	316	316	100
Food	27	25	737	357	48
Chemical products	6	5	1,879	129	7
Metal working	17	11	1,782	515	28
Others	4	3	868	145	17
	123	104	9,836	2,838	30

Source: Report by Mr. Stanislav Gajossky on Small Scale Industry Mission.

Table 2. Engineering industry in Democratic Yemen

Type of industry	Number of units	Number of employees	Main products and services
Central Workshop, Aden	1	360	Vehicle and construction machinery repairs
Vehicle Repair Workshop, Mukalla	1	75	Vehicle repairs
Vehicle Repair Workshop, Khormaksar	1	82	Vehicle repairs
Vehicle Repair Workshop, Maala	1	25	Vehicle repairs
Vehicle Repair Workshop, Khormaksar	1	46	Vehicle repairs
Vehicle Repair Workshop, Crater	2	22	Vehicle repairs
Revolution Workshops, Khormaksar	1	106	Manufacture of simple spare parts and fabrication
Tins Factory, Little Aden	1	67	Oil tins (one type)
Dockyard Workshops, Aden	1	316	Ship repairs
Nails Factory, Aden	1	7	Wire nails
Aluminium Products Factory, Maalla	1	101	Household utensils
General Engineering Workshop, Aden	1	11	Engineering services
Vehicle Repair Workshop, Abyan	1	25	Vehicle repair
Agricultural Machinery Station, Sayon	1	264	Vehicle and agricultural machinery repairs

Type of industry	Number of units	Number of employees	Main products and services
Tins Factory	1	21	Tins for oil
Other Repair Workshops, Aden	2	25	Engineering services
Agricultural Implement Factory, Khormaksar	1	120	Simple agricultural hand implements, knives and scissors
Total	19	1,673	
Small-scale units	11	515	

The reorientation of a repair unit into a production unit and its further expansion/diversification are restricted owing to the following shortcomings:

(a) Severe shortage of qualified and experienced personnel in production, management and technical administration;

(b) Unsuitability of machine tools and equipment for sustained precision production operations;

(c) Lack of know-how and required skills for quality production;

(d) Unsuitability of infrastructural facilities, such as workshop buildings and their organizational and administrative support.

The main function of the Workshop is to cater to the repair and reclamation needs of other public sector industries, and to undertake jobbing work for government departments and agencies. For the most part, the manufacturing activities are limited to metal fabrication of some simple substandard products in small uneconomic quantities. These include steel roof trusses, metal doors and windows, simple structurals etc. Limited quantities of hand-operated chaff cutters, wheelbarrows, simple gas cookers and baby tricycles are also manufactured. The jobbing work consists of repair and reclamation mainly of cast-iron components, and the manufacture of small shafts, bushes, gears etc. Practically all the work is undertaken on order, without regard to the economies of production.

Capacity utilization

Barely 20% of the Workshop's capacity is now used for repair and reclamation work, besides sporadic jobbing work and the manufacture of simple metal-fabricated products in uneconomical quantities. For economic functioning of the Workshop, optimization of capacity utilization by undertaking production work is essential.

Machinery and equipment

A large proportion of the general purpose machinery and equipment is old and is in a bad state of repair and maintenance, making it unsuitable for precision production. Considering the large additional capital outlay needed for their immediate replacement, it is more economical and advisable to continue to utilize such machinery until it is unserviceable for production and repair/reclamation work not involving precision operations. This could be achieved by stepping up the volume of production of the products now manufactured in the Workshop, and of similar products on a batch production basis.

Repair and maintenance

Out of a total of 21 machines in the machine shop, only 10 are in satisfactory operating condition; of the rest 40% are unserviceable. While recognizing that some of them were obtained second-hand, mishandling, prolonged neglect of maintenance and lack of inspection and repair know-how are some of the reasons for rendering them unserviceable. When the machinery is outmoded, it is not possible to obtain spares. Although in most cases adequate maintenance instructions and check-lists of the machinery manufacturers are available, this important information has been translated into the local language for the supervisory staff and operators to follow. There are no established maintenance schedules, inspection programmes and repair priorities.

Power and water

The main electric supply is 220/440 V, 50 Hz. The installed capacity is about 80 kW. The average monthly consumption is 2,000 kWh.

There is adequate water supply both for industrial and social purposes. Average consumption of water for all purposes is 5,000 gal per month.

Production know-how and skills

As a jobbing and repair unit the Workshop has had no opportunity to develop proper production technology and methods. Technical skills are limited to metal preparation and fabrication, and general purpose machining operations. Nevertheless it would be a step in the right direction to introduce simple planning and production control organization and systems, with the available resources, to help the Workshop to train the personnel and to identify future manpower requirements for such functions and the need for systematic pre-planning, scheduling, progressing, final evaluation and feedback. It will assist the management to avoid the present system of accepting work-orders and undertaking manufacture without any relation to scheduling, progressing, provisioning and costing, which has resulted in underutilization of capacity,

low productivity and avoidable delays in delivery schedules.
Considering the overall shortage of skilled manpower in the country, it would be logical to expand and diversify the manufacturing activities of the Workshop where its present skills and know-how could be used, such as primarily in metal-fabricated products.

Choice of products for manufacture

Apart from the limitations of the present industrial infrastructural facilities, both in the country and in the Workshop, the choice of products for production by the Workshop is limited owing to inadequate demand potential, making its production in small quantities highly uneconomical, particularly when all the raw materials have to be imported. In a detailed onsideration of demand projections for various metal conversion and metal-fabricated products, including spare parts for the heterogeneous transport and equipment now in use in the country, and taking into consideration the available machinery and skills in the Workshop, it is recommended that metal-fabricated products, agricultural implements and machinery and spares be manufactured by the Workshop, besides the present range of products under manufacture:

- Steel furniture
- Metal-fabricated material handling equipment
- Hand-operated agricultural implements and machinery on batch production basis
- Spares required for agricultural implements. It is recommended that the manufacture and production of agricultural implements and connected spares should be centralized at an agricultural implements factory where the essential technical and production inputs would be available, and adequate underutilized capacity exists.

Procurement, inventory control and storage

All the above functions are carried out by one store assistant who is responsible to the General Manager of the Workshop. Not only is the work involved beyond the capacity of one person but it is wrong in principle to make the same individual responsible for procurement and storekeeping, for obvious reasons. A delegation of the routine work, such as supervising the above functions, to the Technical Manager or Production Manager is recommended.

Material procurement

Purchases are not regulated by timely forecasting and provisioning. The system of price inquiry, and of obtaining quotations and their acceptance by proper analysis, are not satisfactory, resulting in much higher prices being paid. In placing purchase orders the principle of "economic order quantity" is not followed, resulting in huge stocks of items which could not be consumed and which are deteriorating in storage.

Inventory control

The total inventory was estimated, in 1975, at YD 64,000, consisting of raw materials, YD 31,000; spares, YD 25,000; general stores, YD 2,000; and tools, gauges etc.,YD 6,000. Considering that the Workshop has utilized only YD 6,000 worth of raw materials and consumables for a production of YD 14,793, the Workshop was holding almost five years' stock of raw materials and the value of production was not even a quarter of the total value of inventory, or half of the value of the raw materials. Because of the total absence of inventory control and of realistic consumption figures, a large inventory of valuable components, spares, material, tools and gauges are held as dead stock. As there is no organized and regulated stock-taking, it is difficult to arrive at realistic inventory figures for any remedial management action. Although there is some system of stores requisition and issue to production shops, there is no system of correct material booking and control to ensure its optimum use and the reduction of wastage/scrap.

Storage

The stores are located in two buildings with an approximate area of 325 m^2. Most of the raw material is stacked outside. At present there is an attempt to put them on racks. To say the least the storekeeping suffers from lack of scientific planning and layout. Different types of items are not stored separately according to their nature or requirement, and in most cases they are not even binned or arranged in racks. It is doubtful whether some of the equipment, tools, spare parts and stores kept in different places of the store are placed in the inventory and properly accounted for. Store ledgers and bin cards are maintained, but there is no system of audit or periodical check to ensure their correctness. The purpose of maintaining bin cards in addition to ledgers is defeated if the same person has to maintain both.

An appreciable quantity of worn-out, damaged and unwanted stores have accumulated in the store without any disposal action, taking up storage space and avoidable accounting of such stores. A detailed survey of all the stores, tools and equipment in the Workshop, as recommended to the management, and their separation as required and not required, would greatly assist in reducing the unwanted/unserviceable inventory and its disposal. The Workshop is advised to explore the possibility of disposal, by sale or transfer, of a considerable amount of automotive spare parts and other stores, which are not required but which could be usefully utilized elswhere.

Salvage and scrap

The Workshop is surrounded by heaps of scrap. A considerable amount of salvageable material is strewn around the shop, contributing in no small measure to the poor attitude of the workers towards housekeeping. There is an immediate need to clear the Workshop of all the scrap, and to institute an efficient system of collection, sorting and disposal of scrap and salvageable material. There is some progress in this direction.

Costing and sales

Costing

There is no prescribed system of costing jobbing work or pricing manufactured products. Whatever bargaining and rough-and-ready methods are employed at present have proved to be uneconomical, putting the Workshop to appreciable losses. Because of the underutilization of capacity, low productivity and idle labour, although the overhead is extremely high, only a nominal amount of 10% overhead is added to the cost of production. Further, the cost of depreciation on buildings and machinery, and their repair and maintenance are not taken into consideration. Only the direct labour costs are considered, and no provision is made for supervision and administrative expenses. This is due to the fact that the vital economic function of costing/pricing has been left to technical staff and shopfloor personnel. If the Workshop is to improve its economic performance, financial accounting has to be perfected first, to introduce and maintain scientific cost-accounting and pricing policies and methods.

Sales

Since almost all the jobbing and production work is undertaken on order there are no organized sales and marketing functions. Apart from this the management has not been able to devote adequate time to the specialized function of marketing. However, as a public sector unit undertaking work for sister concerns and agencies, marketing and sales have little significance. But the necessity for such functions would arise if the Workshop goes into regular production of consumer items.

Location and buildings

The Workshop is located at Khormaksar adjacent to Aden airport. The sheds and the auxiliary buildings are of World War Two origin and are of temporary construction, with corrugated galvanized iron roofing and walls, supported by light steel trusses. The sheds are in a bad state of repair and maintenance, particularly the flooring. The Workshop occupies an area of 17,500 m^2 affording adequate area for expansion.

II. REORGANIZATION AND REORIENTATION OF THE WORKSHOP

The techno-economic aspects of steel furniture manufacture, and the proposals for the reorganization and reorientation of the Workshop are discussed in the following section. These aspects and proposals take into consideration that at least 60% of the Workshop's capacity will be utilized for steel furniture manufacture and the remaining for other manufacturing work on a jobbing basis and repair and reclamation work as at present. However, if the Workshop's efficiency is 80%, only 20% of capacity can be used for such manufacturing/repair work. This is considered to be adequate from past experience of the Workshop.

Techno-economic aspects of manufacture of steel furniture

Table 3. Summary of techno-economic factors, 1978-1981

	1978	1979	1980	1981
Planned utilization of production capacity	60%	60%	60%	60%
Planned production (pieces of furniture)	5,000	7,300	9,200	11,500
Planned production (tons)	100	150	200	250
Net profit (YD)	6,270	25,205	33,097	44,844
Cash accruals (YD)	12,770	31,705	39,577	51,344
Cost of production (YD)	55,630	74,295	93,703	116,655
Total investment (YD)	99,500	112,500	127,500	143,500
Total sales (YD)	76,400	115,400	144,200	180,500
Break-even point (planned production)	82%	54%	48%	42%
Additional capital costs		YD 61,600 ($US 180,000)		
Payback period		2 years 7 months		
Target employment		100 (all categories)		

For the purposes of this report the steel furniture is classified as follows:

(a) Furniture fabricated out of mild steel sheets including:

Steel cabinets
Filing cabinets
Workshop lockers
Store shelves
Cupboards
Hospital bedside tables

(b) Tube furniture, including:

Beds, hospital and domestic
Chairs, office and domestic
Tables, office and domestic
School desks
Bedside tables

Demand projections

With the overall development of the country, the need/demand for steel furniture is likely to occur and grow not only in urban and industrial areas, but also in rural areas, where there is no choice of wooden furniture. Rationalization of products to meet the larger and popular demand would ensure longer production runs and more economic production, particularly in the initial stage of production. Therefore only such products are selected for production by the Workshop, initially. It is expected that as the know-how improves and demand arises, the Workshop could diversify. Sustained demand for steel furniture manufactured by the Workshop is likely to depend on:

(a) Acceptable quality of furniture being manufactured and made available in the local market at reasonable prices;

(b) The effectiveness of the marketing organization;

(c) Not duplicating the products manufactured by the Workshop in any other local undertaking;

(d) The restrictions on import of such products manufactured locally

It is estimated that the Workshop can go into production of steel furniture in 1978. The production programme envisages stepping up production, gradually, every year, commencing with 5,000 (105 tons) pieces of all types of furniture in the first year; 7,300 (150 tons) pieces in the second year; 9,000 (200 tons) pieces in the third year and 11,500 (250 tons) pieces in the fourth year of production. This works out to approximately 17 pieces per day in the first year, 24 in the second, 30 in the third and about 40 in the fourth year, working on the basis of 300 working days in a year and one 8-hour shift per working day.

The product mix should take into consideration the minimum economical production volume and optimum utilization of additional facilities proposed, and about 60% utilization of the existing facilities for metal fabrication work, leaving the remaining capacity for the present commitments of the workshop. Optimum capacity utilization and economies in production can be achieved only if the metal preparation operations are planned in economical lots, i.e. about 500 to 1,000 pieces at a time. Processed material should be readily available before the fabrication and assembly operations are started.

Production process

The main processes involved in the manufacture of steel furniture are relatively simple and do not require sophisticated know-how. However, quality production can only be achieved by the application of the proper processes, methods and quality standards.

Material preparation. This involves shearing, cutting and bending the sheets, pipes, flats and other sections of raw material to the required sizes and shapes. The other operations can be done only after the material is cut to the required sizes. Adequate material must be stored after it is prepared for subsequent operations. All material prepared must be checked for dimensional accuracy.

Slotting, punching and drilling. The required machining operations for fastening, assembly and fabrication are carried out. This would require the facilities of properly designed dies, punches, jigs and fixtures.

Grinding and cleaning. The processed material would require grinding or deburring to remove rough edges and surplus material, either with hand grinders or by pedestal grinders. In some cases simple filing may be adequate. The material should be free of high spots, rust or dirt before it is sent for fabrication. Cleaning by wire brush and kerosine oil should eliminate all dirt.

Fabrication and assembly. This mainly involves electric/gas/spot welding and fastening various parts of the furniture. It may also involve minor bending, cutting and drilling operations to facilitate assembly. For quick and standardized quality production, proper welding and assembly fixtures would be necessary. All fabricated furniture needs to be inspected before it is sent for painting/metal finishing.

Painting. Besides preventing the metal components of the furniture from rusting, the final finish of the product will depend to a great extent on the quality of painting and on its finish. All components to be painted need to be cleaned, finally, with turpentine or other cleaning agent. To prevent rusting, first a coat of red-oxide paint should be sprayed. After drying the surface should be sand-papered before the application of the final paint by spraying. All painted goods should be protected from dust till they are sufficiently dry. Provision for a drying oven is made for this purpose. The furniture is finally inspected before dispatch for packing.

Packing and dispatch. Corrugated cardboard and brown paper should be sufficient to protect the paint during transportation. Care should be taken to protect the edges and delicate parts from getting damaged. Standard packing instructions would help to eliminate defective packing.

Production plant and machinery. In considering the requirements of plant and machinery, the suitability and serviceability of the existing facilities have been taken into account. Plant and machinery found to be suitable have been included in the list of plant and machinery required for manufacture of steel furniture. Although some of them are old and may require repairs, duplicating such plant/machinery at this stage is considered not economical. Only the minimum essential additional facilities have been suggested. In keeping with the existing machinery and production volume of steel furniture envisaged, the additional machinery selected for material preparation and fabrication is suited for batch production. The existing and the additional machinery required and the investment involved are given in tables 4 and 5.

Table 4. Machinery and equipment for manufacture of steel furniture

Type of machinery	Size	Number required	Existing		Additional			Remarks
			Number	Value (YD)	Number	Value YD	Value $US	
Sheet metal preparation								
Plat shearing and cutting machine	Capacity 50 ton, 12 x 2,000 mm	1	1	1,000	-	-	-	To shear/cut 21 to 16 gauge mild steel sheets
Brake press	Capacity 50 ton, bed length 2,500 mm	1	-	-	1	3,500	10,200	
Power press	Capacity 10 ton	1	-	-	1	800	2,400	
Crank press	Capacity 20 ton	1	1	1,250	-	-	-	Not capable of operating at full capacity
Bending machine, double screw type, hand operated	Bed length 200 mm	1	-	-	1	500	1,500	To bend 20 to 18 gauge mild steel sheets
Combined punching and shearing machine	Bed length 200 mm	1	-	-	1	400	1,200	
Tubular material preparation								
Pipe bending machine, power operated	Outside dia 50 mm	1	-	-	1	500	1,500	To bend pipes from 6 to 50 mm
Power hack saw	High speed, to cut rounds up to 200 mm, and square 200 mm	1	-	-	1	300	2,400	Existing one too slow

Table 4 (continued)

Type of machinery	Size	Number required	Existing		Additional			Remarks
			Number	Value (YD)	Number	Value YD	Value $US	
Fabrication and assembly								
Vertical/pillar drilling machine	Dia 36 mm	2	2	1,500 a/	-	-	-	
Bench drilling machine	Dia 13 mm	2	2	200 a/	-	-	-	
Double wheel pedastal grinder		1	1	375	-	-	-	
Hand grinder (electric)	Grinding disc dia 200 mm	2	-	-	2	200 a/	600 a/	
Welding transformer	33 kVA	1	1	700	-	-	-	
Welding generator	60 to 300 A	1	1	200	-	-	-	
Spot welding equipment	24 kVA	1	1	200	-	-	-	Existing one to be repaired
Gas welding set	-	1	-	-	1	170	496	
Painting and finishing								
Air compressor	10 ft^3/m	1	1	400	-	-	-	
Spray painting unit	-	2	-	-	2	400 a/	1,200 a/	
Drying oven	600°C	1	-	-	1	500	1,500	

a/ Value for two.

Table 4 (continued)

Type of machinery	Size	Number required	Existing		Additional			Remarks
			Number	Value (YD)	Number	Value YD	Value $US	
Auxiliaries								
	500 x 2000 mm	1	1	1,200	-	-	-	
Tool and cutter grinder	200 x 400 mm, capacity 8 in. x 6 in.	1	-	-	1	1,550	4,500	Only a small percentage of its capacity is required for production of furniture
Tool room surface grinder	450 x 150 mm capacity 18 in. x 6 in.	1	-	-	1	1,700	5,000	Only a small percentage of its capacity is required for production of furniture
Pedastal grinder	-	1	1	375	-	-	-	
Platform weighing machine	500 kg	1	-	-	1	170	500	
Mobile crane hand operated	500 kg	1	-	-	1	100	300	
Total all types		29	13	7,400	16	11,290	33,000	
		Say		7,500		12,000	35,000	

Table 5. Cost of new machinery for steel furniture

Item		YD
Total f.o.b. price of new machinery		12,000
Freight and insurance charges at 10%		1,200
Spares at 10% (provision for two years maintenance spares)		1,320
c.i.f. cost of machinery and spares		14,520
Allowance for escalation at 10%		1 452
Total cost including escalation		15,972
	Say	16,000
Clearing, handling, transportation and erection at 10%		1,600
Total cost of new machinery		17,600
Foreign exchange requirement	approx.	47,000

Auxiliaries and process inputs

Tool-room machinery. As mentioned earlier, the Workshop is not equipped with tool-room facilities. Although a minor percentage of the capacity of the tool-room machinery may be utilized for the production of steel furniture, it would be essential to include one tool-room cutter grinder and surface grinder in the additional machinery to be procured.

Jigs, fixtures and dies. It is envisaged that the Workshop is not in a position to design and manufacture the jigs, fixtures and dies for the initial start-up of production. Therefore it would be necessary to obtain such assistance from the collaborators or other outside agencies. An ad-hoc provision of 20% of the cost of plant and machinery to be procured is considered adequate for this purpose.

Compressed air. Compressed air would be required primarily for spray painting of the furniture, apart from some cleaning operations in the machine shop. The air consumption for painting operations is estimated at 1,000 m^3/h at the maximum production level in 1981.

Material handling equipment. The Workshop is already equipped with two electric hoists of 0.5 ton capacity. These need to be repaired and uses in the fabrication and assembly shops. In addition one 0.5 ton mobile hand-operated crane is recommended for material handling outside the shop. The Workshop can fabricate few hand trollies for transportation of processed material within the shops. For transportation of finished furniture, the Workshop would require one 1-ton van, provision for which is made under transport.

Electric power. The total working load of plant and machinery is estimated at 120 kW. This includes the existing installed load of 80 kW.

Water. Bulk of water requirements are for drinking purposes, and the cost involved is negligible. There is an adequate water supply for the Workshop.

Services

Transport. When the Workshop starts production of steel furniture, the existing transport facilities would not be adequate. A lump sum provision of YD 5,000 is made for additional/replacement of transport.

Office equipment and furniture. A properly equipped design and drawing office would be essential for designing/modifying furniture, jigs, fixtures and dies. Even for the present commitments, the Workshop is badly in need of such facilities. A lump sum provision of YD 1,000 is made for drawing office equipment and furniture.

Land and buildings

Land. There is adequate land for expansion of the Workshop if necessary. It is recommended that any such expansion should be on the north side of the existing workshop sheds.

Production shops. The existing covered area of production shops, excluding foundry and forge, is about 1,200 m^2 including the previous vehicle repair shop of about 530 m^2. This shop is used only for crankshaft grinding. It is recommended that the crankshaft grinding operations be shifted to the machine shop to make room for the crankshaft grinder. Thus the whole of the vehicle repair shop will be available for welding, tube preparation, fabrication, assembly, and painting operations of steel furniture. By shifting the welding operations, the present metal-cutting and fabrication shop will provide adequate room for the proposed new machinery, and free movement of material and will be used for sheet metal preparation only.

Packing and finished goods store. It is likely that at least one month's production of furniture may have to be held in stock. Considering the climatic conditions, all finished furniture must be stored in a covered shed. It is recommended that a packing and finished goods store of about 100 m^2 be built on the north side of the proposed fabrication and assembly shop adjoining the proposed paint shop as shown in figure I.

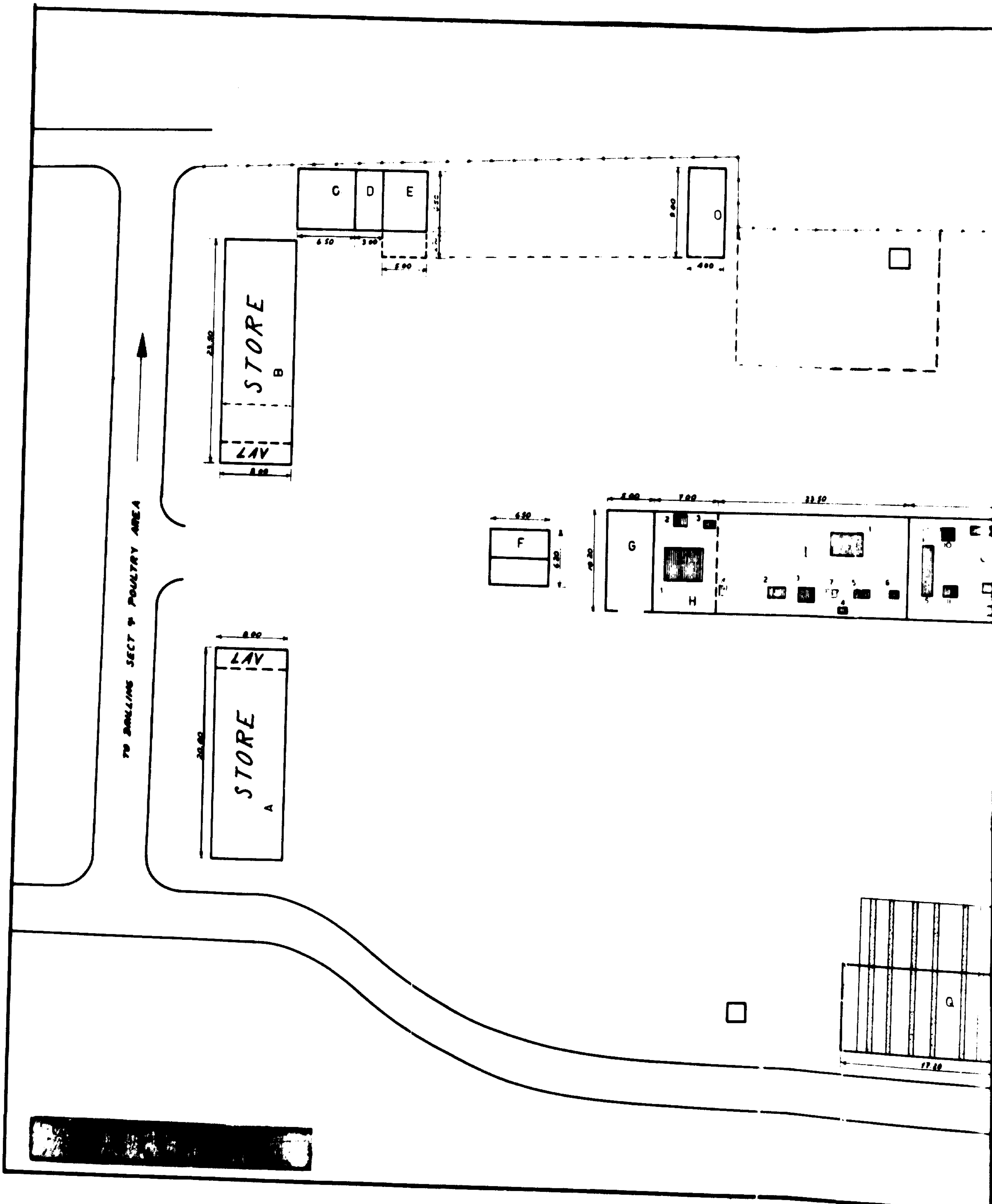
Design, drawing and production office. The existing office buildings are poorly ventilated and cramped. It is recommended that a combined design, drawing and production office of 150 m^2 be constructed (see figure I).

Foremen's office and expense store. The mezannine on top of the present offices may be used for this purpose (see figure II).

Repair of buildings. The workshop sheds and other buildings need extensive repairs. The flooring in the workshop sheds should be relaid, and the ceiling, doors and windows should be repaired. There is no proper drainage for water, and the welfare buildings need maintenance. A lump sum provision of YD 20,000 is required for this purpose.

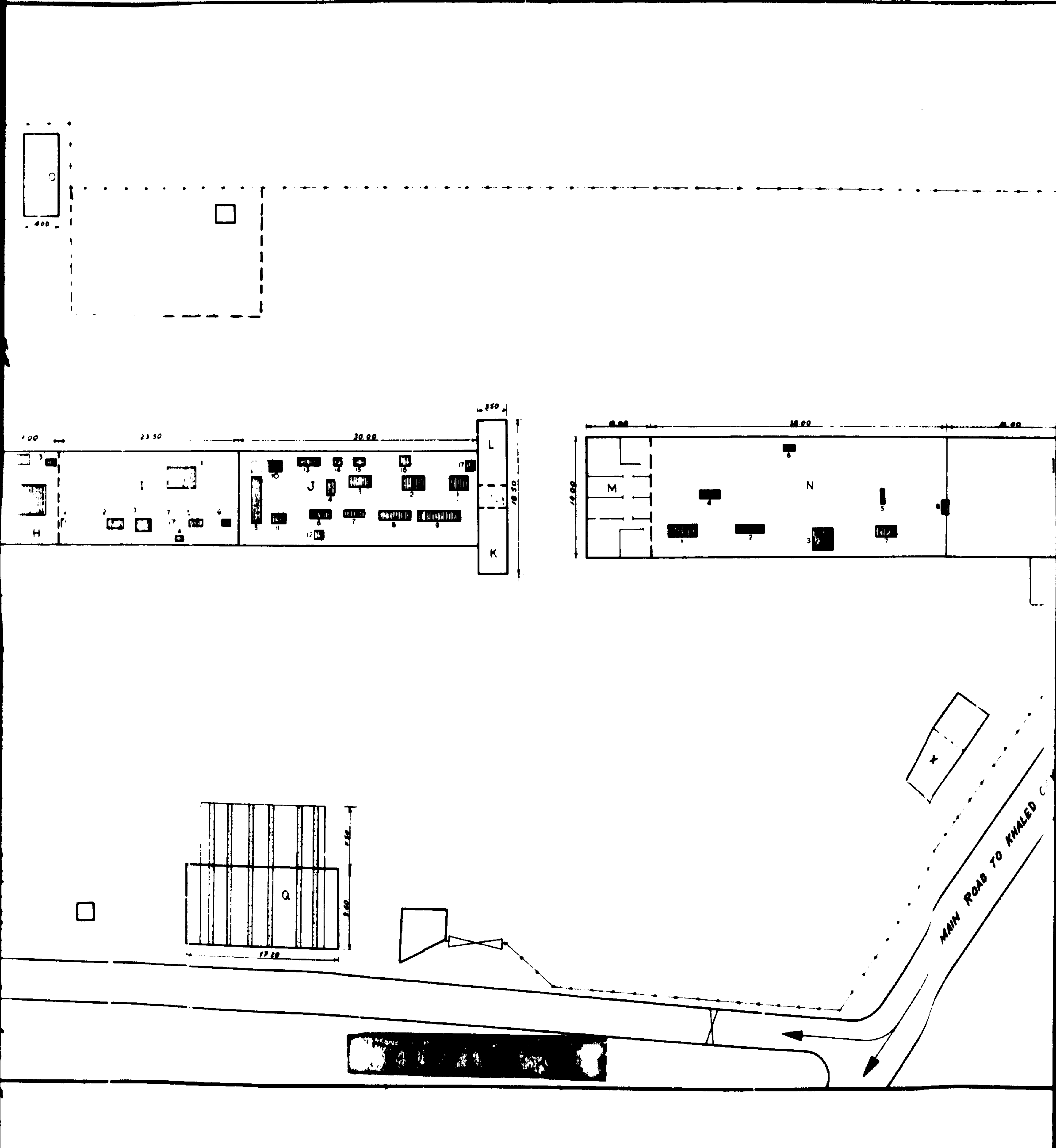
Open yard for raw materials. An open steel yard, equipped with suitable racks and fenced, is necessary for the storage of mild steel material. The present open storage yard should be relocated as shown in figure I.

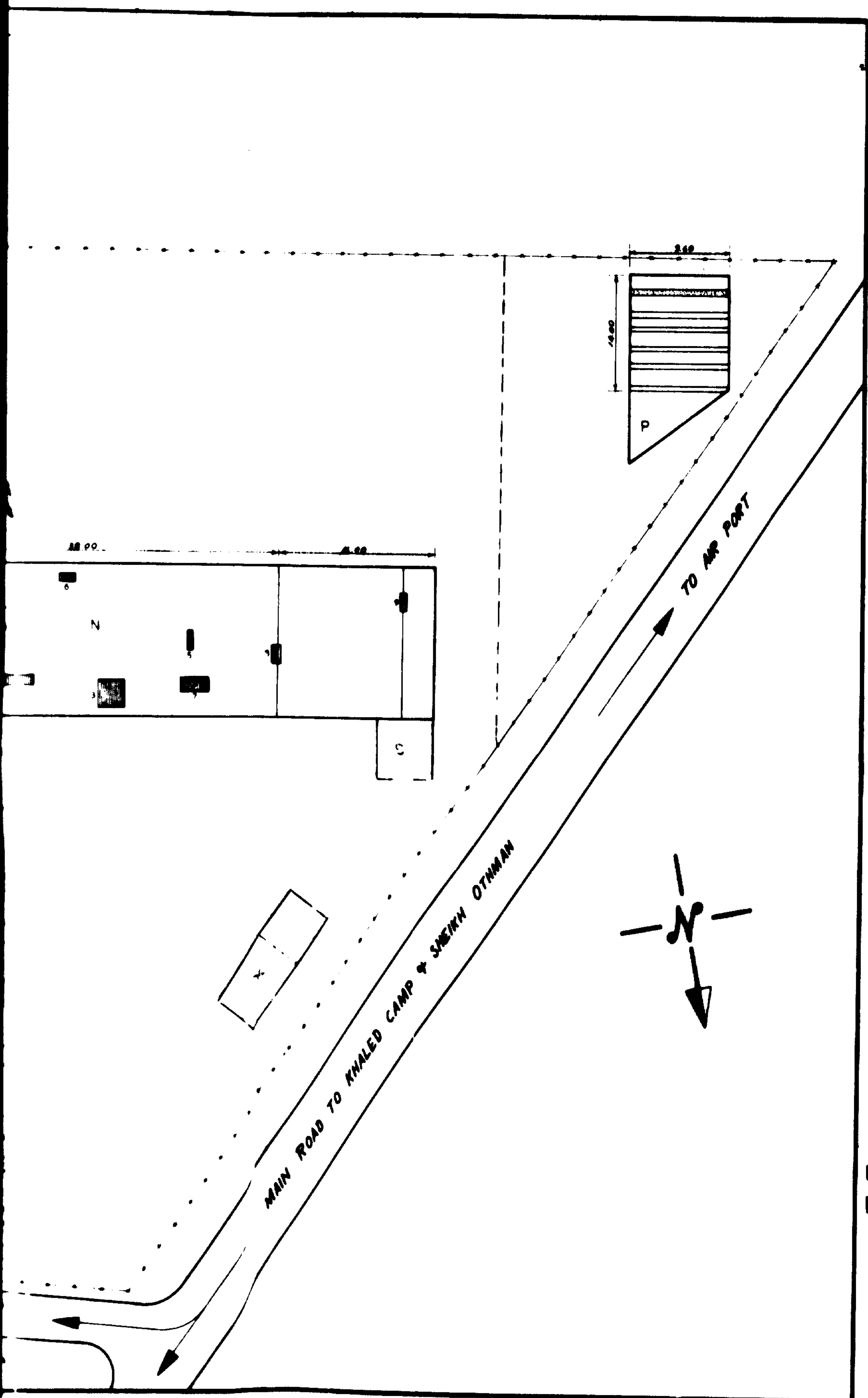
Scrap yard. Necessarily in metal fabrication work, a considerable amount of metal scrap accumulates. Unless this is controlled and segregated at a special area, it would cause obstruction to the movement of men and material and slow down production. It is recommended that a scrap yard as shown in figure I should be properly fenced for the collection and segregation of useful scrap.



STORE
B
LAV
STORE
A
LAV
C
D
E
O
F
G
H
I
Q
TO BAILING SECT & POULTRY AREA

Figure I Fxisting layout of Revolution Workshop





Key:

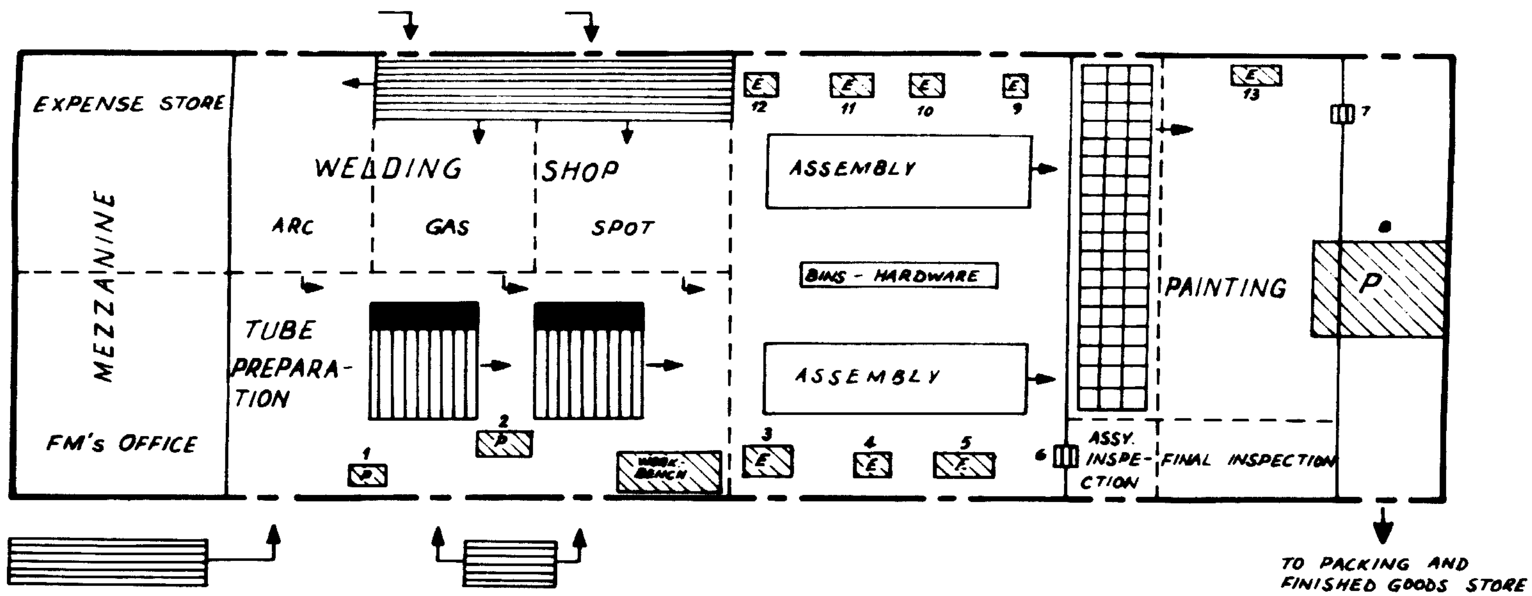
- C - Foundry
- D - Roller shutter shop
- E - Welding and fabrication shop
- F - Oil Store
- G - Canteen
- H - Forge shop
  - 1 - Air hammer
  - 2 - Oil furnace
  - 3 - Blower
- I - Metal fabrication shop
  - 1 - Plate cutting and shearing machine
  - 2 - Vertical drilling machine
  - 3 - Screw press
  - 4 - Bench drilling machine
  - 5 - Hack saw
  - 6 - Double wheel grinder
- J - Machine shop
  - 1 - Slotting machine
  - 2 - Vertical milling machine
  - 3 - Shaping machine
  - 4 - Vertical drilling machine
  - 5 to 9 - Centre lathe
  - 10 - Surface grinder
  - 11 - Centre lathe
  - 12 - Pedestal grinder
  - 13 - Centre lathe
  - 14 - Facing machine
  - 15 - Shaping machine
  - 16 - Horizontal milling machine
  - 17 - Vertical milling machine
  - 18 - Crankshaft grinding machine (proposed relocation)
  - 19 - Tool room cutter grinder (new proposed)
  - 20 - Tool room surface grinder (new proposed)
- K - Tool crib (proposed)
- L - Lavatory
- M - Office
- N - Vehicle repair shop
  - 1 - Crank shaft grinding machine
  - 2 - Link bearing boring machine
  - 3 - Radial drilling machine
  - 4 - Fine boring machine
  - 5 - Double wheel grinder
  - 6 - Oil pump pressure test rig
  - 7 - Centre lathe (unserviceable)
  - 8, 9 - Electric hoist (0.5 ton)
- O, P, Q - Vehicle servicing ramps
- S - Packing and finished goods store (new proposed)
- T - Tool room (proposed)
- X - Technical and drawing office (new proposed)

Existing machinery

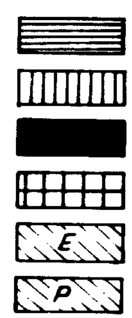
Proposed new/shifted machinery

SECTION 3

Figure II. Layout of fabrication and assembly shop



MACHINERY			
1	Power Hacksaw	11	Vertical Drilling M/C
2	Pipe Bending M/C	12	Spot Welding M/C
3	Radial Drilling M/C	13	Compressor
4	Bench Drilling M/C	14	
5	Centre lathe	15	
6	Electric Hoist 0.5 ton	16	
7	Electric Hoist 0.5 ton	17	
8	Drying oven	18	
9	Pedestal Grinder	19	
10	Bench Drilling M/C	20	

LEGEND	
	Raw Material
	Processed Material
	Deburring and Inspection
	Assembled Furniture
E	Existing M/C
P	Proposed M/C
→	Material Flow

Layout of the plant

Sheet metal preparation shop. All sheet metal preparation, such as shearing, cutting, punching and bending operations should be centralized in the present welding and fabrication shop. This will not involve any shifting of machinery installed at present in this shop. Four additional machines are proposed to be installed as shown in figure III. The welding operations should be shifted to the proposed fabrication and assembly shop. The proper storage of raw materials, processed materials, and their flow within the shop is important to avoid production bottle-necks. Suggested material flow is also indicated in the figure.

Fabrication, assembly and paint shop. This shop is proposed to be established in the previous vehicle repair shop. The crankshaft grinding machine and other machinery connected with repair of vehicles should be moved to the machine shop. It is recommended that all the machinery for vehicle repairs should be placed in maintenance workshops. The fabrication and assembly shop would consist of a tube preparation section, welding (arc, gas and spot), fabrication and assembly and painting operations. Detailed layout of the shop is given in figure II. The two existing electric hoists (0.5 ton) will be used for handling finished furniture after assembly and for painting.

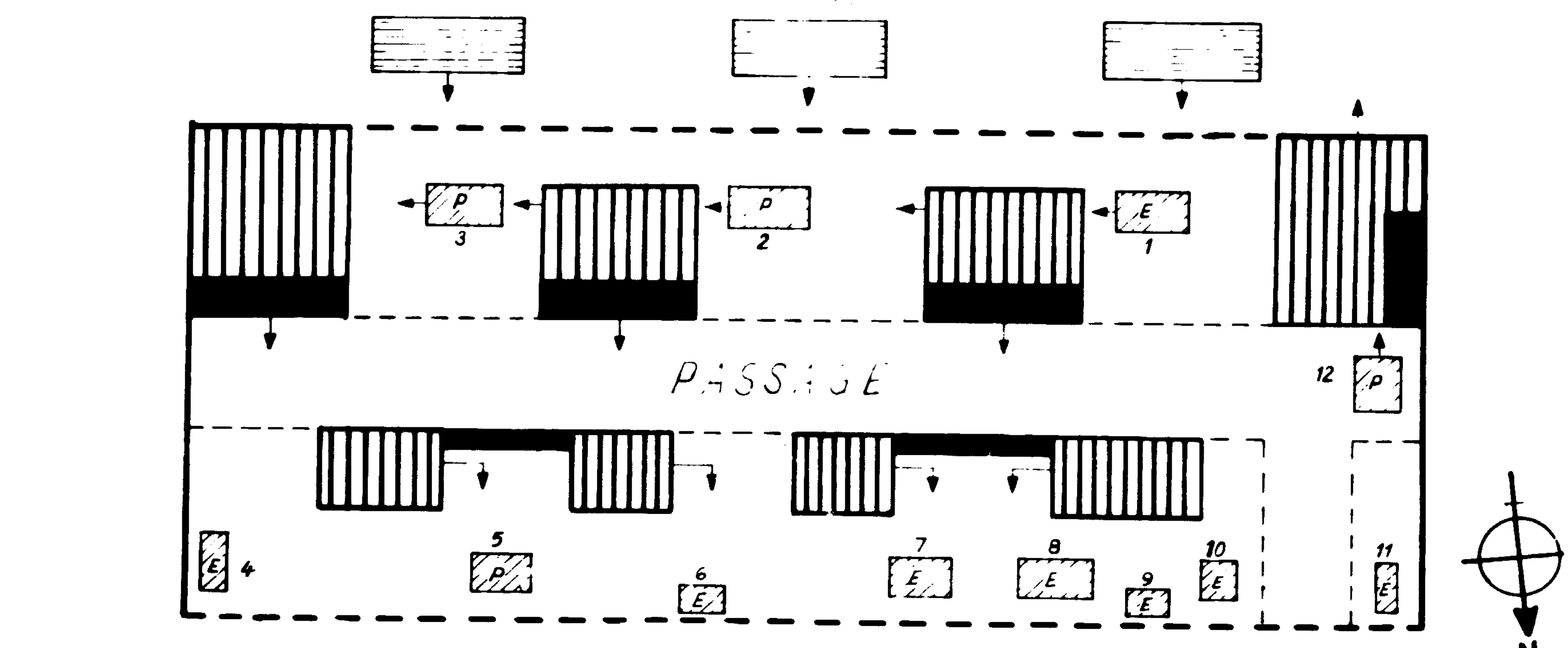
Tool room. The proposed tool room including a tool and cutter grinder and a surface grinder is suggested to be located in a separate room adjoining the machine shop.

Electrical repair shop and tool crib. At present, all the special tools and the replacement tools are obtained by the tradesmen from the store, which is situated apart from the production shops. It is proposed that the present electrical repairs shop be used next to the machine shops and close to other production shops as a tool crib. The electrical repair shop may be moved to a part of the store building.

Raw materials and consumables

The material inputs are considered under three groups, i.e. raw materials, consumables and process commodities. The estimated cost of raw materials and consumables is given in table 6.

The raw materials include mild steel sheet and structurals, such as angles, channels, flats, rods etc. and steel tubing. Steel sheeting (18 to 21 gauge)



MACHINERY			
1	Cuttung and Schearing M/C	9	Hack saw
2	Comb. Punching + Schearing M/C.	10	Pillar drilling M/C
3	Bending M/C (double Screw type)	11	Double wheel Grinder
4	Pedestal Grinder	12	Break Press 50 ton
5	Power Press 10 ton	13	
6	Vertical drilling M/C	14	
7	Friction Press 1.5 ton	15	
8	Break Press 20 ton	16	

LEGEND	
E	Existing Machine
P	Proposed Machine
	Raw Materials
	Processed Material
	Deburring + Inspection Area
→	Material Flow

Table 6. Estimated cost of raw materials and consumables

	Year 1978	1979	1980	1981
Total number of furniture - all types	5 000	7 300	9 200	11 500
Total estimated tonnage of raw materials	100	150	200	250
	Dinars			
Average cost per ton of raw materials[a]	150	158	166	174
Cost of raw materials	15 000	23 700	33 200	43 500
Adding wastage at 5%	15 750	24 885	34 860	45 675
Adding duty at 10%	17 325	27 373	38 346	50 242
Adding allowance for 10% price escalation	19 057.50	30 110.85	42 180	55 266.75
Adding consumables at 20%	22 869	36 133	50 616.72	66 320
The final cost of raw materials and consumables	23 000	36 000	51 500	66 500

Note: Provision for handling charges and transportation at YD 1 per ton is included in the administrative expenses, as the amount involved is too small. Almost all raw materials and consumables, except paints and industrial gases, have to be imported. The cost of any locally bought out or imported items like ply-wood seats and back rests, for chairs, and springs and wire mesh for beds have not been considered, since this will depend on the design of individual furniture, and the type and quality of products. However a fair proportion of such costs are covered in the estimation of the quantity of raw material required.

a/ Present cost per ton of mild steel sheet YD 128, steel structural YD 132, steel tube YD 240.

and steel tubing (10 to 30 mm dia) would have to be imported. Since the exact quantity of such material requirements would depend on the final selection of design, the tonnage of furniture proposed to be manufactured is taken as an indication of the weight of materials required.

Consumables include welding electrodes, fasteners, paints, thinner etc. and cleaning and packing materials. As a rough indication, 20% of the cost of raw materials may be incurred for consumables, and on an average about YD 0.25 for packing material for each piece of furniture.

Process commodities include industrial gases like oxygen and acetylene, electric power, compressed air and water. The requirements of compressed air, electric power and water have been indicated previously. It is estimated that on an average 1,000 m^3 of oxygen and acetylene (proportion 2:1) would be required for the manufacture of 1,000 pieces of furniture.

Manpower and organization

The following fundamental organizational principles should be taken into consideration:

Activity-based organizational components

Clear division of responsibility

Accountability of each component, in terms of productivity, quality and cost

Functions and operations of similar or complimenting nature should be grouped together in a single organizational element. This should facilitate easy co-ordination and faster communication

The overall manpower requirements of the Workshop have been considered in the light of their present commitments and additional requirements for the future manufacturing programme of steel furniture. The total projected manpower requirement is 100. The increase in manpower from the present strength is primarily due to creation of a production department and other auxiliaries, like tool room, tool crib etc.

Manpower requirements for manufacture of steel furniture excluding administrative, supervisory and indirect labour, are given below:

Year	Skilled workers	Unskilled or semi-skilled workers	Total
1978	7	21	28
1979	9	31	40
1980	10	39	49
1981	17	49	66

It is expected that 60% of the capacity of other workshop's manpower resources will be diverted for the production of steel furniture.

The summary of the manpower distribution and the projected requirements are given below:

Category	Projected	Existing	Increase/ decrease	Remarks
Managerial	5	4	+1	Production manager
Supervisory	8	6	+2	Technical assistants
Direct industrial workers:				
Skilled	45	48	-3	22 are trainees
Unskilled	13	11	+2	
Indirect industrial workers	11	3	+8	
Administrative	18	16	+2	
Total	100	88	+15/-3	

It is recommended that the services of suitable expatriates be obtained for the posts of production manager and technical assistants until they can be replaced by trained and experienced local personnel. Selected skilled personnel should be given training abroad for design draftsman, tool-room mechanic and senior repair and maintenance mechanic.

Financial analysis

Capital outlay. A summary of steel furniture project costs is given in table 7. The total cost of the project, taking into consideration the existing land, buildings, the depreciated cost of existing machinery that will be used for the manufacture of steel furniture and other capital costs, is YD 125,000.

Table 7. Summary of steel furniture project costs

Item	Existing (YD)	Additional (YD)	Total (YD)
Land	35 000	-	35 000
Buildings	20 000	9 500	29 500
Repairs to existing buildings	-	20 000	20 000
Machinery	7 500	17 600	25 100
Jigs and fixtures	-	3 500	3 500
Office equipment and furniture	500	1 000	1 500
Transport	400	5 000	5 400
Ad-hoc provision for training, pre-operative expenses, and omissions	-	5 000	5 000
Total	63 400	61 600	125 000

The additional capital outlay involved is YD 61,600, out of which the foreign exchange requirement would be YD 35,560 ($US 103,670).

Land and buildings. New construction is suggested for packing and finished goods store of 100 m^2 and for design, drawing and production office of 150 m^2. Provision of YD 20,000 is made for the extensive repairs of the existing buildings. Total cost of additional construction and repairs amounts to YD 29,500, out of which the foreign exchange requirement would be YD 14,750 ($US 43,000).

Cost of new machinery and equipment. The cost of new machinery is given in table 5. The total cost of machinery, including 2 years maintenance spares, and 10% price escalation is YD 17,600, out of which the foreign exchange requirement is YD 16,000 ($US 47,000).

Jigs and fixtures. For the initial supply of jigs and fixtures 20% of the cost of machinery, amounting to YD 3,500 ($US 10,200) will be needed.

Other capital costs. Details of existing and additional costs of vehicles, office equipment and furniture are given below:

(a) Vehicles:

	YD
Depreciated value of existing transport	400
Cost of additional transport	5,000
Total	5,400

(b) Office equipment and furniture:

Depreciated value of the existing office equipment and furniture	500
New provision for drawing office equipment and furniture, and other additions	1,000
Total	1,500

It is envisaged that 60% of the existing vehicles, office equipment and furniture will be used for the project of steel furniture manufacture.

Training and pre-operative and start-up expenses. Provision of YD 5,000 is made for the training of operators on new machinery and of one engineer in the manufacture of steel furniture. This would also cover any pre-operative and start-up expenses.

Electric power, fuel and water costs. The breakdown of these costs is given in table 8.

Table 8. Electric power, fuel and water costs
(Dinars)

	1978	1979	1980	1981
Electric power at YD 0.027 per kWh	2 600	3 100	3 600	4 050
Water and fuel	200	300	400	500
Total	2 800	3 400	4 000	4 550

Wages and salaries. These costs are given in table 9; 60% of the wages and salaries of Workshop personnel other than those directly connected with the production of steel furniture is also taken into account. Provision for 2.5% wage increases every alternate year has been made in the estimates.

Table 9. Wages and salaries
(Dinars)

Type of labour	1978	1979	1980	1981
Direct labour				
Skilled	2 940	3 780	4 200	7 140
Semi-skilled or unskilled	7 560	11 160	14 040	17 640
Total	10 500	14 940	18 240	24 780
Supervision				
Foremen/technical assistants	3 300	3 300	3 300	3 300
Managerial	1 680	1 680	1 680	1 680
General manager	900	900	900	900
Total	5 880	5 880	5 880	5 880
Total labour and supervision	16 380	20 820	24 120	30 660
Cost of 60% of the remaining workshop labour, excluding foundry and forge	4 200	4 200	4 200	4 200
Increase in emoluments at 2.5% every alternate year	—	625	625	1 496
Total labour cost	20 580	25 645	28 945	36 356

Repair and maintenance. The repair and maintenance cost is estimated at YD 2,750 per annum.

Administrative expenses. It is estimated that the administrative expenses will be as follows: YD 6,600 in 1978; YD 6,800 in 1979; YD 7,000 in 1980; and YD 7,200 in 1981.

Selling prices and sales

The approximate selling prices of individual pieces of steel furniture have been assessed and are given in table 10. The prices indicated compare very favourably with imported prices and are reasonable. More detailed costing will have to be undertaken after the production commences. The estimated sales based on the planned production are also given in the table.

Packing, selling and distribution expenses. The average packing cost of furniture is assessed at YD 0.250 per piece. Of the total selling and distribution expenses of the workshop, 60% is assigned to the steel furniture project. It is estimated that packing, selling and distribution expenses will amount to YD 2,900 in 1978; YD 3,500 in 1979; YD 4,000 in 1980; and YD 4,600 in 1981.

Depreciation charges. The depreciation charges are estimated at YD 6,500 per annum.

Working capital requirements. See table 11.

Interest charges. The interest charges at 5% on total investment will amount to YD 5,000 in 1978; YD 5,600 in 1979; YD 6,400 in 1980; and YD 7,200 in 1981.

Profitability. Considering the optimum utilization of the capacity of the Workshop and the small aditional investment involved, the project looks very attractive and profitable. Further, taking into consideration the demand potential, scope for diversification and expansion, and the savings in foreign exchange by import substitution, the project offers other social and economic benefits. Profitability statement is given in table 12.

Break even analysis. See table 13.

Table 10. Selling prices and sales

Item	Price per unit (YD)	1978		1979		1980		1981	
		Number of units	Price (YD)	Number of units	Price (YD)	Number of units	Price (YD)	Number of units	Price (YD)
Storage shelves	32	400	12 800	600	19 200	800	25 600	1 200	38 400
Bedside tables	6	1 000	6 000	1 200	7 200	1 300	7 800	1 500	9 000
Beds	25	800	20 000	1 000	25 000	1 200	30 000	1 500	37 500
Tables office	32	500	16 000	1 000	32 000	1 200	38 400	1 300	41 600
Chairs	8	1 500	12 000	2 500	20 000	3 500	28 000	4 500	36 000
Tables square	12	800	9 600	1 000	12 000	1 200	14 400	1 500	18 000
Total			76 400		115 400		144 200		180 500

Table 11. Working capital requirements
(Dinars)

Item	1978	1979	1980	1981
Raw materials and consumables (6-months stock)	11 500	18 000	25 750	33 250
Goods in process[a] (1 month)	4 748	6 354	7 988	9 996
Goods in warehouse[a] (1 month)	4 748	6 354	7 988	9 996
Bills receivable[b] (2 months)	10 445	13 979	17 574	21 991
Interest at 5% on total investment (1 month)	416	447	533	600
Total	31 857	45 134	59 833	75 833
Say	32 000	45 000	60 000	76 000

a/ Value based on packed cost.

b/ Value based on cost prices plus 10%.

Table 12. Profitability statement
(Dinars)

Item	1978	1979	1980	1981
1. Total sales	76 400	115 400	144 200	180 500
2. Raw materials and consumables	23 000	36 000	51 500	66 500
3. Power, water and fuel	2 800	3 400	4 000	4 550
4. Wages and salaries	20 580	25 645	28 945	36 356
5. Repair and maintenance	2 750	2 750	2 750	2 750
6. Administrative expenses	6 600	6 800	7 000	7 200
7. Selling and distribution expenses, including packing	2 900	3 500	4 000	4 600
8. Total packed cost	58 630	78 095	98 195	121 956
9. Profit prior to depreciation (1–8)	17 770	37 305	45 997	58 544
10. Depreciation	6 500	6 500	6 500	6 500
11. Profit after depreciation	11 270	30 805	39 497	52 044
12. Interest	5 000	5 600	6 400	7 200
13. Profit after interest	6 270	25 205	33 097	44 844
14. Add depreciation	6 500	6 500	6 500	6 500
15. Cash accruals	12 770	31 705	39 597	51 344
16. Cost of production (8 + 10 – 6 – 7)	55 630	74 295	93 703	116 656

Table 13. Breakeven point analysis
(Dinars)

	Item	1978	1979	1980	1981
A.	Total sales realization	76 400	115 400	144 200	180 500
B.	Variable costs				
	Raw materials	23 000	36 000	51 500	66 500
	Power, water and fuel	2 800	3 400	4 000	4 550
	Repair and maintenance	2 750	2 750	2 750	2 750
	Selling and distribution	2 900	3 500	4 000	4 600
	Wages and salaries	10 500	14 940	18 248	24 780
	Total variable costs	41 950	60 590	80 498	103 180
C.	Total sales - total variables (A-B)	34 450	54 810	63 702	77 320
D	Fixed costs				
	Supervision etc.	10 080	10 705	10 705	11 576
	Administrative expenses	6 600	6 800	7 000	7 200
	Depreciation	6 500	6 500	6 500	6 500
	Interest	5 000	5 600	6 400	7 200
	Total fixed costs	28 180	29 605	30 605	32 476
E.	Breakeven point (planned production) $\frac{D \times 100}{C}$	82%	54%	48%	42%

Payback period. Taking only the capital costs as applicable to steel furniture manufacture, the payback period is 2 years and 7 months.

Improvements in general engineering practices and introduction of production and industrial engineering methods

Considering the size and present status of the Workshop, only relatively simple and practical improvements, methods and procedures have been suggested. More extensive alterations will be necessary when the Workshop takes up a regular and increased manufacturing programme.

Engineering and technological improvements

Housekeeping. The standard of housekeeping needs considerable improvement:

(a) All the scrap accumulated around the Workshop and inside the shops should be disposed of. A suitable area should be earmarked for scrap collection and sorting for ultimate disposal;

(b) The shop floors should be kept free of unwanted raw material, finished goods, tools etc. to provide adequate free place to work in safety;

(c) The repairs and maintenance of buildings, particularly the flooring, doors and windows, need immediate attention;

(d) The general cleanliness and drainage system need attention.

Better housekeeping and working conditions should help to motivate the workers to increase productivity and improve the quality of production.

Workshop layout. A more rational layout of the Workshop is possible by optimum utilization of the existing workshop sheds, stores and other covered accommodation. At present, one workshop shed and a major portion of the stores are occupied by unwanted and unserviceable equipment and material. For instance, the space provided for electrical repairs is cramped; there is no proper tool crib and technical office. Metal fabrication is done at different places, despite the improvements in layout suggested for the foundry by the metallurgical expert. Although extensive changes in the layout of machinery is not suggested, centralization of metal fabrication and assembly operations needs to be considered for the future development of increased metal fabrication and assembly operations. This applies particularly to bending, drilling, welding, assembly and painting operations, which can be located in the vacant shed, providing adequate working space for the foundry, metal preparation and machine shops, and their expansion. The layout of the work benches, tool racks, raw material storage in the shops should be rationalized to provide ready access for the operators and to reduce material handling.

Material handling. Most of the material handling equipment of the Workshop is either repairable or unserviceable. Although the Workshop is not manufacturing very heavy products, except for steel doors in small numbers, the material handling of heavy raw materials such as steel bars and plates can be improved by improvising simple roller conveyors, as explained to the management.

Machining operations. Cutting speeds and feeds is generally low owing to the design and condition of the machines, the operator's proficiency and the non-repetitive nature of work undertaken. This can be improved only with more experience on the part of operators and an increased quantum of repetitive machining operations.

There are no facilities for sharpening cutting tools such as milling cutters, reamers and taps. Because of incorrectly shaped, sharpened and adjusted cutting tools the quality and rate of production is low. It would be necessary to provide the Workshop with a tool and cutter grinder, tool-room surface grinder, and other tool-room equipment for improved quality and increased production. But since such machinery and equipment is costly and requires trained personnel to operate, the Workshop should earmark suitable personnel for training and subsequent employment in the tool room.

Sophisticated jigs and fixtures are not needed for present production. However, for increased productivity and production of standard quality products the Workshops would require not only tool-room facilities, but also drawing and design facilities manned by qualified personnel. The production volume and the value added should justify the design and manufacture of costly jigs and fixtures, which is not the case at present with the products manufactured in the workshop.

Material selection

Considerable savings can be affected by careful selection of the raw materials. The choice of raw material is now dictated by what is available in stock/metal scrap, rather than by the material specifications, economical quantity and sizes required, and the ultimate use of avoidable excess material.

For instance, galvanized iron pipe is utilized, when only angle or flat iron, costing less, would suffice. This is due to the absence of proper designing, process study and inventory control.

Production process

Although the products manufactured are simple and non-repetitive, involving short production runs, it would be more economical, productive and conducive to quality production if at least a preconceived production process is worked out at the appropriate technical level, instead of leaving this important aspect to the operator/worker level. For instance, the present production process and operations for manufacture of spades can be improved by changing the process and operations, as suggested to the management.

Quality control

There is no separate quality control organization, or self-imposed quality standards. The quality of work and the products manufactured are only acceptable in an entirely uncritical market where there is no other choice. As a first step the management should lay down certain self-imposed standards, make the foremen and supervisory personnel responsible for inspection at intermediate stages of manufacture, and create a sense of pride in the craftsmen, by the display of simple charts indicating the number of goods that have come up to the required quality standards, and those rejected. Proper selection of raw materials, correct manufacturing process, and use of tools, care in fabrication and assembly will further assist in improving the quality. As regards tools and gauges for inspection of machined parts, the Workshop is adequately equipped for the kind of work it undertakes.

Quality improvement

The quality of products manufactured can be improved by more attention to the following common faults/omissions:

Deburring and filing. All machined components, particularly crankshafts, gears, and fasteners, should be examined for uneven finish and projecting metal particles. All the components should be deburred or filed to remove abrasive metal particles.

Job fixing and setting. Greater attention could be given to this important aspect. While using clamping devices, proper jack supports should be provided to hold the work firmly.

Punches and dies. These must be maintained to ensure their efficient functioning. Worn-out punches and dies should be repaired or replaced.

Metal cutting and shearing. Use of templates and proper measuring instruments will eliminate inaccuracies in cutting and shearing, besides speeding up such operations.

Metal fabrication. Use of simple welding fixtures will eliminate the present dimensional errors in the final fabrication operations.

Welding. Considerable savings can be affected by eliminating welding wherever possible by resorting to simple fasteners and other methods, as explained to the management. In most cases the quality of welding is poor because of lack of quality standards and poor workmanship.

Painting. The products should be properly cleaned, and red oxide primer coating should be given before the final painting operation. The quality of painting can be improved by resorting to spray painting whenever possible.

Correct use of tools and their maintenance. Frequent inspection of tools and their maintenance, and the replacement of condemned tools will help to reduce the defects in repair and manufacturing work. The condition of the tools with the workmen at present is far from satisfactory. Owing to lack of proper tools the workers tend to use wrong tools, resulting in poor workmanship.

Productivity of labour

It is the observation of the expert that the present abnormally low productivity of the Workshop's labour is the main cause for overall low productivity and underutilization of capacity. Admittedly, most of the machinery is old, but considering the products manufactured, the work force is quite suitable and can be fully and effectively employed.

Repair and maintenance of machinery and equipment

The present concept of maintenance appears to consist in the repair of broken-down machinery or equipment owing to the lack of a system of preventive maintenance, which requires besides laying down maintenance schedules an effective maintenance organization and a certain amount of documentation. Since the Workshop can ill afford to create a full-fledged maintenance organization, and the necessary documentation, only a skeleton organization, simple maintenance schedules and essential documentation are suggested for the present. A regular maintenance period every working day, or a specified time and day in a week, should be set aside for preventive maintenance, and the foremen and management should frequently check that the maintenance tasks have been carried out. For undertaking proper maintenance, breakdown repairs and periodic inspection of machinery, the guidance of maintenance and repair manuals and check lists would be necessary. Such technical literature supplied by the manufacturers/suppliers of the machinery should be translated into Arabic to enable the operators and maintenance personnel to follow them.

<u>Industrial engineering</u>

Considering the present organization and availability of suitably qualified manpower, the organization and introduction of advanced industrial engineering methods would not be a practical proposition. The introduction of time and motion study would require the establishment of certain norms and time standards. However, a very modest beginning in this direction, with the available resources, would help the Workshop to identify the requirements of future manpower and training needs for the organization and introduction of such methods, and would assist the management in orienting and training the existing personnel delegated such functions. Further it would help in pre-planning, scheduling, progressing, final evaluation and feedback.

<u>Purchase and storekeeping</u>

The present sales, purchase and stores organization is rudimentary. The inclination to over order imported goods and material is due to lack of planning and proper inventory control. Allowing for various bottle-necks in importing, and the size of minimum orders acceptable to the supplier, effective inventory control and scientific purchase procedures would help in reducing the cost of carrying huge inventories and dead stock.

<u>Sales and costing</u>

In view of the elementary accounting now practised in the factory, it is not advisable to put on additional load, by way of an historical cost accounting system. The financial accounting must be perfected as a minimum base before any cost-accounting methods can be brought into use. The former is being contemplated now to embrace the entire industrial complex in the country, which on implementation will pave the way for further necessary cost control systems. In the meantime, the forecast cost figures should be constantly checked against the actual production costs and taken as a basis for future costing and updating of any basic cost figures.

Industrial training needs of Revolution Workshop

Need for industrial training

For the successful functioning and development of an enterprise, of all the tools of management, human resources are of the highest importance. The most serious bottle-neck in the efficient and economic functioning of the Revolution Workshop at present, and for successfully implementing expansion/ diversification programmes, is the lack of suitably qualified personnel at all levels. The training needs as projected in this section cover the immediate and future requirements of the Workshop in order to rationalize and improve its present functioning and effectively to implement the programme of manufacture of steel furniture.

The basic objectives in the assessment and formulation of training proposals are:

(a) Upgrading of existing skills quickly and economically;

(b) Refreshing and updating supervisory and specialized skills and know-how;

(c) Inducting and generating new specialized skills and engineering talent.

The following factors are taken into consideration:

(a) Persons to be trained;
(b) Nature of training;
(c) Agencies through which training can be imparted;
(d) Length of training period;
(e) Costs involved, compared to the efficiency developed;
(f) Immediate and long-term needs.

Nature of training

(a) Inexperienced young employee: apprentice and on-the-job training;

(b) Employees with some experience: refresher and up-grading training;

(c) Supervisors/foremen: training within industry to upgrade and update technical skills. Supervisory and foremen training to develop the required skills;

(d) Young engineers: post-graduate/fellowship or specialization;

(e) Executive: management, industrial administration and organization, production planning and control etc.

Agencies considered for imparting training

Local technical institutions and industry. It is always more economical and quicker to make use of the local resources to impart the basic apprentice and upgrading training, apart from the fact that an inexperienced young employee is unable to adjust and assimilate such training at institutions and industry in more advanced countries. However, such training can be more harmful than useful if it is not organized, conducted and supervised properly. Examples of such cases are evident from the progress and performance of some of the trade trainees at the Revolution Workshop. Therefore, centralized and organized basic, apprentice and upgrading training is suggested at appropriate technical institutions and industry which are better equipped for imparting such training. For instance, training of forge operators can be centralized at the agricultural implements factory; general purpose machine operators at technical institutes, polytechnic and vocational training centres; and welders at the dock yard workshops.

Assistance from developing countries. The acquisition of new skills and know-how not available in the country would require the assistance of developing countries in possession of the required skills and know-how to suit the local conditions. This could be obtained in the way of technology transfer and training of selected personnel in the required skills. This training particularly applies to young engineers, supervisory personnel and experienced tradesmen, with the basic qualifications and aptitude. The manufacture of steel furniture, although it involves relatively simple technology and know-how, the production of modern and quality furniture, as a measure of efficient import substitution, would require improved know-how, designing and large-scale production methods. Therefore it is suggested that the required technology transfer may be obtained from a developing country such as India on direct or bilateral arrangement, and arrangements made for the training of the concerned personnel at the firm providing the know-how.

Bilateral and multilateral assistance. Such assistance is primarily helpful in obtaining fellowships for post-graduate or advanced scholastic specialized education for qualified and suitably experienced engineers and professional executives. Attendance of group training programmes can be fruitful only if properly selected personnel are detailed to participate in such programmes, which should be tailor-made to the needs of the country. Unless suitably qualified engineers and executives are inducted into the Revolution Workshop, or made available from other sources, such training at present is not envisaged. However, there is a need to organize in the country industrial management, production planning and control, preventive maintenance, quality control, purchase and inventory control, and cost-accounting clinics, modelled and conducted to suit the conditions and levels of knowledge in the country. The shortcomings and lack of knowledge in these aspects is not peculiar to the Revolution Workshop alone.

Expatriate assistance

Short-term technical counselling and assistance can at best be useful where there are well-defined and specific problem or knowledge areas to be covered, and the necessary potential exists to absorb and utilize such advice and assistance. Considering the present status of the Revolution Workshop, in particular, and the conditions obtained in Democratic Yemen where there is a dearth of qualified personnel and industrial labour and the engineering industry is still in its formative stage with numerous problems at the grass roots level and wide gaps in basic technical know-how, the planned intake of suitable expatriates from appropriate developing countries for extended periods till the local manpower resources develop appears to be the most adequate answer. Particularly at the middle management, foremen and supervisory levels such expatriates, by their involvement with the day-to-day working of the unit and its technical problems, can provide the necessary practical know-how and advice, besides imparting suitable on-the-job training to the local counterparts. Therefore employment of a few suitable expatriates to fill the vacancies of qualified engineers and experienced foremen/supervisors at the

Revolution Workshop is advocated. However, it must be cautioned in this context that expatriate assistance can only serve its purpose if adequate authority is given to carry out the functions effectively.

Immediate and long-term training needs

In considering the training needs, the immediate and future availability of suitably qualified and experienced personnel, the minimal requirements for the efficient functioning of the Workshop at present and the long-term requirements in the next three to five years have been taken into account. The suggested training programme is given in table 14.

Bilateral and multilateral assistance required

The pros and cons and suggestions for various types of assistance for industrial training was discussed in the previous section. Apart from such assistance, the Revolution Workshop would need further assistance to successfully implement a programme of expansion and diversification. Such assistance concerns the following aspects:

(a) Technology transfer for manufacture of steel furniture;

(b) Implementation of the expansion/diversification programme;

(c) Technical counselling and extension services;

(d) Financial assistance for initial capital expenditure for expansion/diversification programme.

Technology transfer

Although the manufacture of simple steel furniture appears to require little know-how and technology, the manufacture of such furniture to meet the current trends in design and demand would require a fairly advanced know-how and designing capacity. The development of know-how and designing capabilities in Democratic Yemen, considering the engineering skills obtainable, will take appreciable time. If the manufacture of steel furniture in the country is to be a reality, as an efficient import substitution measure, serious consideration must be given to acquiring the necessary know-how. Such know-how is not only available in advanced countries but also in the developing countries. Therefore a careful choice has to be made in the type of know-how and technology required, to suit the local conditions and demand. Considering the present *per capita*

Table 14. Suggested industrial training programme

Category	Numbers	Existing/ new	Immediate/ long term	Nature of training required	Period	Training agency	Place
Managerial							
Mechanical engineer	1	New	Immediate	Machine shop operations; metal cutting and fabrication; heat treatment, welding and painting; jigs and fixture design and tool room operation	2 years	Bilateral arrangement	In industry of a developing country
Production engineer a/	1	New	Immediate	Production planning and scheduling; production control; inventory control; job costing and estimating; work study and material handling	2 years	Bilateral arrangement or United Nations fellowship	In industry of a developing country
Quality control engineer a/	1	New	Long term	Stage and final inspection, material inspection quality control, test equipment and gauges; raw material selection; standards and specifications, gauge room, sub standards, and fundamentals of SQC	3 years	Bilateral arrangement or United Nations fellowship	2 years formal and 1 year practical with technical institutions and industry abroad

able 14 (continued)

Category	Numbers	Existing/ new	Immediate/ long term	Nature of [illegible] required	Period	[illegible]	Place
Chief executive/ general manager	1	Existing	Immediate and long term	Factory organization and administration; industrial relations, legislature, [illegible] wage administration; manpower selection, placement and training; management information	For [illegible] periods of [illegible] weeks	[illegible] assistance programme [illegible] local training	Local and [illegible] countries
Supervisory							
Production foreman machine shop	1	Existing	Long term	Refresher and upgrading, modern machine tool operations; cutting tools; jigs and fixtures; limits and tolerances, stage inspection and batch production methods	[illegible] year	Bilateral arrangement	In industr[illegible] developing countr[illegible]
[illegible] foreman metal fabrication a/	1	Existing	Immediate	Refresher and upgrading, [illegible] metal [illegible], cutting, [illegible], punching, bending and other operations;	[illegible]	Bilateral arrangement	In industr[illegible] developing [illegible]

Table 14 (continued)

Category	Numbers	Existing/ new	Immediate/ long term	Nature of training required	Period	Training agency	Place
				welding, rivetting, and fastening; painting and finishing; dies and punches			
Super-visor mainte-nance a/	1	Existing	Immediate	Preventive main-tenance, inspec-tion and repair of machine tools, and equipment; tool room opera-tions, reclamation and sharpening of cutting tools, maintenance and repair of jigs and fixtures	1 year	Bilateral arrangement	In industry of developing countries
Skilled workers							
Tool-room mechanic	1	Existing	Long term	Operation of tool and cutter grinder; surface grinder; types of cutting tools, shaping and sharpening of cutting tools, milling cutters, reamers and taps; jigs and fixtures repair and mainte-nance	1 year	Bilateral arrangement	In industry of developing countries

Table 14 (continued)

Category	Numbers	Existing/ new	Immediate/ long term	Nature of training required	Period	Training agency	Place
Maintenance mechanic machine tools	1	Existing	Immediate	Preventive maintenance, inspection and repair of general purpose machine tools	3 months	United Nations local training clinic	Democratic Yemen
Design draftsman, mechanical	1	New	Long term	Machine drawing, design of jigs and fixtures, preparation of manufacturing drawings from samples/prototypes	6 months	Bilateral arrangement	In developing country in a polytechnic institute
Welders	3	Existing	Immediate	Welding techniques, reclamation and repair of cast iron parts, low temperature welding, and upgrading of skill	3 months	Revolution Workshop management	Dockyard workshops, Aden, local technical institute
Machine tool operators	5	Existing	Immediate	Refresher and upgrading of skills	3 months	Revolution Workshop management	Local technical institute
Administrative staff							
Purchase and stores assistants	2	1 new, 1 existing	Long term and immediate	Purchase procedure invoicing, inventory control, store keeping, material inspection, stock taking etc.	6 months	United Nations local training clinic	Democratic Yemen

a/ Expatriate assistance is suggested.

income in Democratic Yemen and the availability of raw material and the required inputs for manufacture of steel furniture, more popular and less expensive types of furniture in the initial stages of manufacture are desirable. It therefore appears that Democratic Yemen should try to obtain such know-how and technology from the developing countries, where such furniture is manufactured. The Government of Democratic Yemen may directly negotiate such technology transfer or obtain the assistance of UNIDO in locating and advising on suitable technology transfer agreements.

Implementation

Stages of implementation. The implementation of the steel furniture manufacturing programme, as suggested, would primarily involve:

(a) Location and identification of suitable sources for technology transfer;

(b) Drawing up of a suitable technology transfer agreement, and its execution;

(c) Calling for quotations for additional machinery and equipment, and raw materials etc., their final selection, placement of orders and their procurement;

(d) Training of required personnel abroad and locally;

(e) Construction of additional buildings, and repairs to existing buildings;

(f) Revised layout of the Workshop's machinery and equipment to streamline and suit the production process of steel furniture;

(g) The erection and commissioning of machinery and equipment;

(h) Manufacture/modification of jigs and fixtures, and tooling;

(i) Prototype manufacture and modification, if required;

(j) Establishment of regular production.

Type of assistance required. Know-how and technology transfer should include complete manufacturing drawings, production process, raw material specifications and quality standards, besides supply of the initial set of jigs and fixtures. Necessary technological assistance and advice should be made available at the commencement of production, and as and when required during the period of agreement.

The technology transfer agreement should include provision of assistance in training of local personnel, in the factory of the collaborator, and, if found necessary, on-the-job training locally during the period of agreement. Initially the following personnel would need to be trained in the factory of the collaborator:

(a) One mechanical engineer in production technology, production process, production methods, quality standards and inspection etc.;

(b) One production engineer in design of furniture, jigs and fixtures, production planning and control, raw material specifications, inventory planning and control etc.;

(c) One foreman in metal preparation and fabrication, metal finishing operations, stage inspection etc.;

(d) Four or five experienced and selected skilled workers of the required trades, in upgrading their skills and on-the-job training.

It is envisaged that such training would be required for a period of 3 to 4 months.

Project management

For the speedy and successful implementation of the project, the management of the Workshop would require the assistance and on-the-spot advice of an experienced mechanical/industrial engineer. Such assistance is best obtained from a multinational organization, to ensure a proper technology transfer agreement and its subsequent execution, to obtain advice on final selection of machinery, its erection and commissioning, and establishing full production.

Technical counselling and extension services

The scale of the engineering/manufacturing industries, the very limited specialized engineering talent in the country, and the expensive nature of material analysis, testing equipment and instruments require the early establishment of centralized technical counselling and extension services, to ensure sound growth of engineering and other industries. Such technical counselling and extension services should necessarily be confined to provision of basic technological, engineering, production and management advice and services at the grass roots level, and progressively advanced as the local conditions and requirements warrant. With particular reference to the expansion/diversification programme of the Revolution Workshop, the type of technical counselling and extension services required are given below.

1. Technical counselling:

(a) Sources of procurement of raw material, machinery, equipment, gauges and tools;

(b) Proper selection and utilization of raw material, and engineering goods;

(c) Inventory control and storekeeping;

(d) Production planning and control;

(e) Capacity utilization;

(f) Training and manpower utilization;

(g) Quality control;

(h) Costing;

(i) Repair and maintenance.

A more general technical counselling would be required rather than highly specialized advice and know-how.

2. Extension services

These include technical and managerial assistance and certain common service facilities. Since setting up such facilities can be expensive, only the minimum requirements are considered and recommended, as given below.

(a) Co-ordination of training;

(b) Budgeting and financial management;

(c) Industrial relations and personnel policies;

(d) Factory organization and technical administration;

(e) Ferrous and non-ferrous material testing and quality control laboratory.

Financial assistance

Since the total investment involved is limited, no financial assistance should be necessary from multinational organizations. Considering the present economic functioning of the Workshop, government assistance for financing the expansion/diversification programme would be essential. United Nations assistance in this respect is recommended only for training of sel[illegible] and qualified engineers abroad.

II. CONCLUSIONS AND RECOMMENDATIONS

1. Type of steel furniture. The more popular and common types of steel furniture fabricated from mild steel sheets and tubing, to meet the domestic demand, is recommended for manufacture in the initial stage. As the know-how and quality of production improves, the products could be diversified in keeping with the demand.

2. Demand projections. Most of the steel furniture in use in the country was imported prior to 1970; no import data could be obtained. Besides the existing gap between the supply and demand position of steel furniture, the demand for such furniture is likely to expand with the development of the country, with scope for diversification. The projected demand for the items of furniture proposed for manufacture, in the next four years (1978-1981), fully justifies setting up local manufacturing facilities. The foam and steel furniture factory, a private sector unit that undertook the manufacture of steel beds, is no more in production owing to the lack of adequate production facilities and necessary industrial inputs. Even if they go into production again, their volume will not meet the demand in the country for various types of steel furniture.

3. Production programme. The proposed production programme envisages the production of 5,000 pieces (100 tons) of steel furniture in the first, 7,300 pieces (150 tons) in the second, 9,000 pieces (200 tons) in the third, and 11,300 pieces (250 tons) in the fourth year of manufacture.

4. Production process. Although the production process involved is relatively simple, quality production can only be achieved by the application of proper processes, methods and skills, and adherence to strict quality standards. The Workshop would require outside assistance in the way of know-how, jigs and fixtures, training of engineers and craftsmen, and in establishing sound production methods and quality control.

5. Plant and machinery. In keeping with the types and condition of the existing machinery, and proposed production volume, the additional machinery proposed is selected to suit batch production. Only existing machinery found suitable and serviceable is recommended for manufacture of steel furniture.

6. Land and buildings. No additional land or workshop buildings are required. Additional construction is recommended for a design, drawing and production office, and a finished goods store. The Workshop's buildings need extensive repairs; the flooring in particular requires to be relaid.

7. Organization and manpower. The total manpower requirements at the maximum production level, not considering absenteeism and other commitments, is approximately 100. It would be necessary for the Workshop to employ a few expatriates and train technicians in the works of a steel furniture manufacturing firm of a developing country till adequate know-how and skills are acquired.

8. Capital outlay. The additional capital outlay works out to YD 61,600, out of which the foreign exchange requirement is likely to be YD 35,560 ($US 103,670). The breakdown is as follows:

	YD
Land	-
Buildings (including repairs)	29,500
New machinery and equipment	17,600
Jigs and fixtures	3,500
Vehicles	5,000
Office equipment and furniture	1,000
Training, pre-operative and start-up expenses	5,000

9. Financial analysis. The financial analysis of the project indicates adequate returns on investment, with a payback period of 2 years and 7 months. Considering the small additional investment involved, and the scope for fuller utilization of the present unutilized capacity, the project is sound and is recommended for implementation.

10. Better housekeeping. There is considerable scope for improvements in housekeeping, such as proper disposal of salvageable material and scrap, and upkeep and maintenance of the Workshop's buildings, machinery and stores. Good housekeeping is an index of the morale and productivity of the workers.

11. Material handling. Simple labour-saving devices, as suggested, manufactured by the Workshop and taken into use, can reduce the present time and labour for handling heavy materials in the Workshop.

12. Machining. There are no tool-room facilities for proper maintenance and sharpening of cutting tools. For improved quality and increased rate of production, and for manufacture and maintenance of jigs and fixtures, the Workshop should be equipped with a tool and cutter grinder, and a tool-room surface grinder, operated by trained personnel.

13. Design and drawing. The Workshop is greatly handicapped because of lack of design and drawing facilities. For the design and manufacture of proper jigs and fixtures, and the establishment of quality standards and production, provision of one design draftsman and the required drawing office equipment would be essential.

14. Material selection. Owing to the absence of proper designing, process study and inventory control, there is considerable wastage of materials. Proper selection and use of material, based on material specifications, economic size and quantity to suit the design of the product, will result in considerable economies in production.

15. Production process. The determination of the production process is often left to the ingenuity of the technician, who by a process of hit-and-miss methods establishes poor quality of production. Sound production processes and methods can only be established when the Workshop is equipped with a drawing and design office, and production processes and methods are established at the appropriate technical level.

16. Quality control. The quality of production can be improved by establishing quality standards and proper inspection methods. Proper attention to job fixing/setting, deburring and filing, use of simple welding fixtures and care in welding, adequate cleaning and application of red oxide coat before final painting, proper maintenance of dies and punches, and use of correct working tools etc., should certainly improve the quality of products now manufactured.

17. Repair and maintenance. Besides laying down repair and maintenance schedules for preventive maintenance of machinery and equipment, an effective maintenance organization to undertake and supervise their implementation is essential.

18. Industrial engineering methods. More advanced industrial engineering methods and procedures are possible only when suitably qualified engineers are induced into the Workshop.

19. Purchase and storekeeping. The functions of purchase and storekeeping should be separated, and adequate staff should be provided to carry out such functions.

20. Sales and costing. It is not practical to introduce a conventional cost-accounting system, in view of the present elementary accounting practice in the Workshop. Financial accounting has to be perfected before cost accounting could be introduced successfully. The former is being attempted now by the Government to embrace the whole industrial complex of the country, which should pave the way for introduction of cost control systems.

21. Industrial training needs of the Revolution Workshop. The most serious handicap for the efficient and economic functioning of the Workshop, and for successful implementation of expansion/diversification programme, is the paucity of suitably qualified and experienced personnel at all levels. Objectives are:

(a) Upgrading of existing skills;

(b) Refreshing and updating of supervisory and specialized skills;

(c) Inducing and generating new specialized skills and know-how.

Bilateral and multilateral assistance required

Apart from the assistance required by the Workshop from bilateral and multilateral organizations for training and provision of workshop personnel, it would require further assistance for the successful implementation of the expansion programme to manufacture steel furniture. Such assistance concerns suitable technology transfer, actual implementation of the project, continued technical counselling, and the use of centralized extension services. It is recommended that the Workshop should obtain the know-how and technology for the manufacture of steel furniture from a developing country in keeping with its requirements, and the assistance of an industrial/mechanical engineer from UNIDO for the implementation of the project. The type of technical counselling and extension services required for the development of the engineering industry in the country is given earlier in the report.

Financial assistance

Although no financial assistance should be necessary from multinational organizations for the limited investment involved, considering the present financial status of the Workshop, either governmental assistance for the financing of the entire expansion programme, or multilateral assistance to the extent of providing the foreign exchange requirements for capital goods and training of workshop personnel abroad, oould be considered.

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