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ASSISTANCE TO BUSH AND TOWN CO. LTD.

UC/SIL/86/317

SIERRA LEONE

Terminal report*

Prepared for the Government of Sierra Leone
by the United Nations Industrial Development Organization

Based on the work of: Sinan Cinar, consultant in managerial problems
in small manufacturing business (woodworking industry)

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Vienna

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EXPLANATORY NOTES

1. The following abbreviations are used in this document:
 - HSS : High Speed Steel.
 - TCT : Tungsten Carbide Tipped.
 - UF : Urea Formaldehyde.
 - UNDP : United Nations Development Programme.
 - UNIDO: United Nations Industrial Development Organization.
2. The rate of exchange of the Leone (Le) to the United States Dollar in March 1988 was: Le 29.00 = U. S. \$ 1.00

ABSTRACT

The Bush and Town Company Limited is the only furniture factory in the Country owned solely by indigeneous Sierra Leoneans. It started its operations in a purpose built building in January 1987.

Upon the Government's official request, the United Nations Industrial Development Organization (UNIDO), as part of its Technical Assistance Programme to Developing Countries, provided the Bush and Town Co. Ltd. with the services of two consultants, one in managerial problems of woodworking industry and the other in furniture design.

The UNIDO Consultant in Managerial Problems of Woodworking Industry, Mr. Cinar, analyzed various techno-managerial aspects of the business and provided ad-hoc advice and assistance, and on-the-job training to the management and the technical staff of the factory during his assignment from 31 March to 31 May 1988.

The Consultant's recommendations to the Company, based on his findings and observations, include improvements of its present managerial system and management structure, skills of middle management and supervisory staff, physical factory facilities and machine layout, and technical specifications of additional production and maintenance equipment to be purchased in stages.

The recommendations to the Government include improvements of technical and vocational education for contemporary machine woodworkers and cabinet makers, encouragement of the furniture manufacturers to form their association, and allocation of adequate foreign exchange to those manufacturers with future export potential for the purchase of basic supplies, machinery, and spare parts they need.

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INTRODUCTION

The Bush and Town Co. Ltd. is a private company owned and managed by indigeneous Sierra Leoneans. It was set up in 1982 as a trading company in general merchandise, especially in used tyres. Due to potential demand for good quality and better designed furniture on the local market, and encouragement and incentives by the Government to the indigeneous industries using locally available materials and resources, the management had taken the decision to venture in wood processing industries, especially furniture manufacturing. Consequently, the Company started to manufacture furniture in a multi-storey building at No. 4 Caulker Street in Wellington, Freetown, in early 1983. At the same time, the Company acquired a piece of land in the Wellington industrial area, about 7 km from the centre of Freetown, built a new and modern furniture factory building. The new building for housing the production machinery was completed by January 1987 and the Company moved its furniture production operations to the new building on 1 January 1987.

To ensure regular supply of timber in required quality and quantity, it has leased a 600 acre (some 250 ha) forest in Kakayama forest region, 60 km from the town of Pujehun in the South-eastern tip of Southern Province.

In anticipation of sound techno-managerial and product design and development skills required by the new furniture manufacturing business on an industrial base, the management of the Company had approached UNDP in Freetown, through the Ministry of Industry, to request technical assistance.

This was conveyed to UNIDO by UNDP in their letter UNIDO/GP/20 dated 9 January 1986.

This report covers the findings and recommendations of a consultancy mission to Bush and Town Co. Ltd. from 31 March to 31 May 1988, undertaken by Sinan Cinar, a UNIDO consultant in managerial problems in small manufacturing business (woodworking industry). The Consultant's job description is given in Annex I. The duration of his contract was extended for a further 6 days to enable him to accompany the President of the Company during a study tour to the specialized international fairs "INTERBIMALL, International Exhibition for Woodworking Machinery and Tools" and "SASMIL, International Exhibition of Accesories and Semifinished Products of Furniture, Upholstered Furniture and the Woodworking Industry" from 24 to 29 May 1988 in Milan, Italy.

The Consultant carried out his main duties at the furniture factory and trained the counterpart staff on-the-job in techno-managerial aspects of production management.

Upon completion of his mission, the Consultant presented his findings, proposals and recommendations to the Company Management and the UNDP and UNIDO officials at their respective headquarters in Freetown and Vienna. The list of persons met is given in Annex II.

UNIDO also appointed a furniture design consultant, Mr. Niko Kralj, for one month, to complement Mr. Cinar's work. He submitted an independent report.

I. FINDINGS

1. Factory Location and Site:

The new furniture factory is located on a 10,200 sq meter land in the Wellington Industrial Estate, about 7 km from the City centre. It is well accessed by road. It is only 3 km away from the Freetown harbour. A drawing showing the factory location and the existing buildings is given in Annex III.

2. Factory Premises:

The construction of the production hall and the office buildings has been completed. Reinforced concrete for load bearing columns and joists and concrete building blocks for walls are used. The roof of the production hall is of steel frame and the roof covering material used is galvanized corrugated metal sheets with transparent sheets at places. The production hall receives enough light through these transparent sheets. The internal height of the building is sufficient for the installation of a complete dust extraction system at a later stage.

3. Range of Products:

The factory has production machinery of universal type. This enables it to produce items ranging from doors and windows to domestic and office furniture. Currently the factory is engaged in the manufacture of the following ranges:

- Solid wood and flush doors,
- Window frames,
- Shelves and wall storage units,
- Dining chairs
- Office and conference chairs,
- Office tables,
- Dining tables,
- Conference tables,
- Settees and armchairs with upholstery,
- Beds,
- Wardrobes,
- Fitted furniture.

4. Plant Capacity:

At present the overall production capacity of the factory is limited to the capacity of the bottleneck machine which is the combined planing and thicknessing machine. The estimated average production capacity of this machine is about 1,200 cubic meters per year if operated as a single machine. This capacity is halved by the use of the machine for two purposes, namely for surface and thickness planing. Therefore the practical capacity is $(1,200 / 2 \times 0.8 *)$ 480 cubic meters per year.

(*): Machine utilization rate.

5. Work Programme:

The factory is operated 6 days a week on one shift. The total working time in a week is 45 hours.

6. Production Methods and Technology:

The jobbing production method is used throughout and high percentage of manual work is involved at all production stages. The existing production machinery of general purpose type are used for only rough dimensioning and shaping of parts. The final sizes and shapes are obtained by the use of carpenter's hand tools. Only one or two jigs are used for some work on the spindle moulding machine.

Mortise and tenon joints are used extensively. Dowel joints are not used at present.

7. Production Equipment:

The existing production machinery is of the semi-mechanized type. The range of machinery includes such standard machines as cross-cutting saw, band-saw, combined planer-thicknesser, combined rip saw and mortiser, circular saw, tenoner, and a combined planer, circular saw and mortiser. In addition to these standard machines, there is a single head wide-belt sanding machine and a narrow-belt edge sanding machine. A detailed list of existing production equipment is given in Annex IV.

However, additional production machinery is needed for making round-end tenons, dovetailed drawers, dowel and hinge holes, final sized parts, shape cutting, routing and machining of shaped parts, turned parts, and for sanding of various shaped, straight and flat parts. Annex V contains a list, in order of priority, of this additional equipment giving their technical characteristics and specifications.

8. Auxiliary Equipment:

The current situation of the auxiliary equipment at the factory is as follows:

(a) Wood drying equipment:

Currently there is no wood drying equipment. Only air dried timber is used in the production. Detailed discussions were held with the management on the type and technical specifications of a suitable wood drying kiln (see item 23 in Annex V). Aspects of solar drying of timber was also discussed. The unavailability of kiln dried timber puts the export of furniture and furniture components out of question in terms of markets of industrialized countries, because the use of wet wood leads to the following undesirable results:

- (i) Rough surfaces during cutting. The cuts will not be very smooth, because some of the wood fibres will not be cut but will be torn off by the cutters.
- (ii) Twisted or warped parts. The furniture parts will be twisted or warped as they dry more on one side than other.

(iii) Weak glue joints. Wood glues require a moisture content below 13% for adequate adhesion.

(iv) Loose joints. When a mortise and tenon joint is made with wet wood, the joint becomes loose when wood dries in use.

(v) Poor surface finish. To obtain good results in sanding, sealing and varnishing, the moisture content of wood should be below 12%.

All the above factors will result in poor quality which cannot be accepted on export markets.

(b) Tool maintenance equipment:

There is only a narrow bandsaw sharpening machine (Robinson, Model LFB/T) and a bench grinding and dressing machine for hand tools. The two machines are located in a room together with the compressor. In the Consultant's opinion, the existing room is too small to house the additional maintenance equipment which has to be purchased as soon as possible, and therefore proposes that a new room

be built and the maintenance equipment be located as per drawing in Annex VI. Currently, those band-saw blades that have to be butt-welded are taken to a nearby furniture factory. The planer knives and circular saw blades are also taken to outside shops for resharpener. However, those circular saw blades with tungsten carbide tips (TCT), can not be resharpened anywhere since there is no suitable sharpening equipment and wheel in and around Freetown. Therefore, it is imperative that the Company purchases the basic maintenance equipment and attachments as soon as possible. The technical specifications of the equipment recommended by the Consultant are given in Annex VII.

(c) Dust extraction equipment:

Currently there is no dust extraction equipment at the factory. The Consultant was informed about the intention of the management to buy a single unit for the wide-belt sanding machine. However, due to the difficulties in obtaining foreign exchange, it is understood that there will be sometime before an eventual purchase of such equipment.

The installation of a central dust-extraction system would benefit the factory in the following ways:

(i) Cutting tools stay sharp for longer periods before resharpening.

(ii) Especially saw blades would have longer usable life, because the saw dust is removed instantly from the tooth gullets. This prevents the sawblades from heating excessively.

(iii) Electric circuits and contactors last longer because there would be no or little dust getting inside and causing short circuits.

(iv) To a certain extent, it helps to obtain better surface quality.

(v) There would be a reduced fire hazard.

(d) Compressed air equipment:

There is a stationary compressor (Ingersol Rand, Model: Euro-10) with a compressed air tank of 300 litres capacity. The line pressure is 8 bar which is sufficient for both the wide-belt sanding machine and the spray gun. The compressed air used for spraying should be free from moisture, oil and impurities. On the other hand, machinery and equipment require compressed air free from moisture and impurities but should be mixed with a mist of oil. The existing compressed air system at the factory has one filtering and pressure regulating unit for the spray gun. The wide belt sanding machine which uses compressed air, has a trio unit consisting of filtering, pressure regulating and oiling sections installed on it. The existence of a 1% slope (approximately 3 degrees) on the compressed air pipe line was not evident. The Consultant recommends the installation of moisture separators on the pipe line with drainage pipes coming down close to floor. An empty paint tin can be placed under the drainage pipes for collection of water.

As indicated elsewhere in this report, the compressor room is shared with the sharpening machines. In the Consultant's opinion, the existing room should be allocated solely for the compressor. Two windows, one close to the floor but opposite to the compressor fan and air intake valves for the supply of dust-free fresh air, and other close to the roof for hot air to escape should be opened on the outer wall of this room. Opening of windows on the outer wall minimizes dust entering.

9. Range of Cutting Tools:

The range and quality of cutting tools used at the factory include the following:

- Narrow band-saw blades, (HSS),
- Circular-saw blades, (HSS and TCT),
- Grooving cutters, (HSS and TCT),
- Tenoning cutters, (HSS),
- Boring bits, (HSS),
- Mortising bits, (HSS).

Due to the lack of appropriate maintenance equipment, the cutting tools are not sharpened and repaired regularly. Cutters and saw blades are often kept on the machine after they have become blunt and used without resharpening. Cutting of hard and resinous timber species with blunt cutters at excessively high feed rates and in large sizes, causes most of the carbide tips on the circular saw blades to chip-off. It was noted that fourteen out of forty teeth of a circular saw blade were broken and the blade was still being used in ripping and cross cutting of timber.

The use of blunt knives and blades have the following negative points:

- (a) Surfaces of cuts are rough because some of wood fibres are not cut but torn-off.

(b) More force is needed in tearing off of fibres, hence more electricity is consumed.

(c) The machine motor and bearings are under excessive load, hence more wear in bearings and sometimes burning of motor wiring occur.

(d) High rate of accidental injury to operators from flying broken tooth tips.

(e) Excessive material and labour wastage because of more material removal in subsequent operations due to roughly cut surfaces.

(f) Difficulty in obtaining good surface quality because of deeply torn-off surface fibres.

There is no trained tool sharpener at present. The factory manager is undertaking this task until somebody is found and trained.

10. Factory Layout:

The existing factory layout was not up to standards. The machines were placed without giving much attention to the sequence of production, and to the space required for machine operators, work-in-progress and manipulation of workpiece stacks between the machines. The Consultant discussed the above shortcomings with the management and proposed a new layout as shown in Annex VIII. This was accepted by the management and was largely implemented with the assistance of the Consultant during his stay at the factory.

The existing floor space allocated for the existing machinery and for the additional machinery proposed is adequate. However, the rooms allocated for tool maintenance and lacquer spraying were considered inadequate. This aspect was discussed with the management and construction of a new room for tool sharpening and extension of the spray room towards an existing space available next to it was also proposed. Annex III shows the relative location of these. The extension of the lacquer spraying room has to be implemented by the factory management as soon as possible. The new tool sharpening room on the other hand, has to be constructed by the time the additional tool sharpening equipment arrives at the factory.

11. Material Inputs:

Timber: Timber is supplied by both outside sawmillers and forestry operations of the company from its forest concessions in the Fujehun District. The quality of timber is not very high especially because of poor logging and sawmilling practices. Some of the logs remain in the forest for too long time and the insect and borer damage occurs by the time the logs are converted. The thickness variation in a board is as high as 5 mm. especially when chain saws are used in conversion. Kiln dried timber is not available from the sawmills. The most widely used species are given hereunder:

<u>Trade Name</u>	<u>Botanical Name</u>	<u>Name in Mende</u>
Idigbo	Terminalia invorensis	Bajii
Iroko	Chlorophora regia	Semei
Opepe	Nauclea diderrichii	Bundui
Walnut	Lovoa trichilioides	Wosimei
Mahogany	Khaya anthotheca	Njilei
Nianga	Heritiera utilis	Yawii
--	Gmelina arborea	Yemani

The most common timber sizes used at the factory are as follows:

<u>Thickness</u>	<u>Width</u>	<u>Length</u>
50 mm.	20, 55, 105 mm.	From 4 to 5 m.
40 mm.	140, 305 mm.	_____ " _____
35 mm.	310 mm.	_____ " _____
30 mm.	310 mm.	_____ " _____
25 mm.	310 mm.	_____ " _____

Wood based panels: Wood based panels are not manufactured in the country. But panel materials such as plywood in thicknesses of 4, 6, 12 and 18 mm. , hardboard in thickness of 4 mm. and particleboard in thickness of 18 mm. are imported and sold by local merchants.

Veneer: Wood veneer is not readily available in the local market and therefore it is almost never used.

Lacquers and varnishes: Imported nitrocellulose type of lacquers, varnishes and thinners of reasonable good quality are used. However, the quality of workmanship has to be improved considerably. Currently the quality of surface finishing is very poor. The Consultant proposes, by taking into account the local conditions and available materials, the following method for a superior surface finish:

Following surface sanding with 220 grit aluminium oxide sand paper, the filler is applied by a spray gun. When the filler is completely dry, intermediate sanding with 280 or 320 grit silicon carbide sand paper is undertaken and the surface is properly cleaned. Then, the top coat is applied by spray gun. After the top coat is fully dry, wet sanding with 280 or 320 grit silicon carbide sand paper is done. Following this, hand polishing with a cloth ball using nitrocellulose top coat is carried out and then the pieces are left for drying. A demonstration was undertaken at the factory by the Consultant and good results were obtained.

Adhesives: A cold setting UF type of modified adhesive (Cascamite, made by Borden, U. K.) is used in the assembly work. According to the Consultant's observations, the performance of this type of glue under conditions of tropical climate and inadequately dried wood was very satisfactory.

Hardware and fittings: Selected items of hardware such as butt hinges, simple handles for drawers and wardrobe doors, locks for drawers and doors, and various sizes of wood screws are available from the ironmongers and importers in Freetown. The use of hardware with better quality and design is necessary.

Upholstery materials: Upholstery materials such as springs, webs, and fabrics are all imported. Currently only polyurethane foam is manufactured locally.

Packaging materials: Items of furniture for the local market are delivered unpacked. Only polyethylene bags are used to protect the upholstered parts of furniture against dust and dirt. It should be pointed out that the locally manufactured polyurethane foam can be used to protect the surfaces of furniture against rubbing, scaffing and minor physical impacts which take place during transport. In consideration of unavailability of corrugated paper board and boxes, the wood should be used to the extend possible as packaging material. This can be in the form of wooden crates, skids, trays and corner protectors. Thick cotton cloths, felts and blankets can be used in combination with wood for padding of surfaces and corners. Without the use of appropriate packaging materials and methods, export of furniture and furniture components even in semi-finished form is not possible.

Factory supplies: General purpose materials such as sand paper for hand sanding, oils and greases for lubrication of machine parts, grinding wheels for tool sharpening, and general purpose bearings are available locally. However, specific materials such as endless sanding belts for narrow and wide belt sanding machines, diamond grinding wheels for grinding of tungsten carbide cutters and tips are not available. Therefore it is advisable to purchase these materials in adequate quantity by taking into account the time required to obtain a new import licence.

12. Material Handling and Storage:

Currently there is no materials handling equipment such as carts, trolleys, pallets or fork lift truck at the factory. Therefore, all the materials arriving to or leaving from the factory are manually handled.

The stacking of timber for air drying in the open air has been improved considerably on recommendations of the Consultant. It is necessary to use concrete stack supports to give timber stacks adequate clearance from the ground and stickers between boards to provide ample space for circulation of air so that timber dries more rapidly. This is absolutely necessary since there is no wood drying equipment at present. The management intends to erect a shed for air drying of timber before the rainy season

starts and reproduce concrete stack supports according to the drawings provided by the Consultant (see Annex IX).

Inside the factory, the workpieces are put on the floor and carried from one machine to other manually. Dropping of workpieces on the floor can easily damage the surfaces and corners of the pieces which can not be repaired after thickness planing and turning. The manual transportation is also a time consuming method. Therefore, it is necessary to use wooden pallets for stacking workpieces and a hydraulic pallet transporter for moving the pallets from one machine to other (See Annex X).

13. Manpower:

Labour: Currently there are 54 direct production workers of which 21 are skilled and the rest unskilled. The number of indirect labour is 18. The skill groups of the labour force are shown in the following Tables 1 and 2:

Table 1: Direct Labour

Skilled carpenters	17
Carpenter apprentices	7
General helpers	24
Spraymen	2
Upholsterers	2
Upholstery apprentices	2

Total: 54

Table 2: Indirect Labour

Storemen	2
Mechanics	2
Electrician	1
Watchmen	12
Cook	1

Total: 18

When the carpenters started working at the factory, they had no previous experience in the operation and use of woodworking machinery. The factory manager trains them who himself had been trained in the U. K. on various aspects of machine woodworking. But it must be pointed out that the carpenters use the existing woodworking machinery only for rough cutting and sizing which is proceeded by hand tools. They have to be taught that the machines are capable to manufacture parts with precision.

Staff: The total number of administrative, clerical and sales staff is 15 as shown in the following Table 3:

Table 3: Staff

President	1
General manager	1
Director of industrial operations	1
Factory manager	1
Administrative secretary	1
Accountant	1
Trainee accountant	1
Trainee production supervisor	1
Clerk / Typist	1
Salesmen	6

Total: 15

14. Management Structure:

The existing management structure is in the form of traditional pyramid but the functioning of it at present is rather informal. By taking into account the existing activities of the company, The Consultant suggests a formalized company organization structure where identical activities can be allocated to functional divisions as shown below:

(a) Accounting and financial division:

- General accounting,
- Credit and collections,
- Budgetary control
- Cost accounting
- Tax unit,
- Office services.

(b) Marketing division:

- Sales management,
- Market research,
- Marketing and sales promotion,
- Customer service.

(c) Manufacturing division:

- Materials purchasing.
- Industrial engineering,
- Personnel,
- Production planning and control,
- Production,
- Quality control and inspection,
- Machine and tool maintenance.

(d) Construction and civil engineering division:

- Bidding,
- Project management.

(e) External trade division:

- Importing,
- Exporting,
- Distribution,
- Retailing.

Following the formal organization of the company as

proposed above, each divisional manager should be given the following general management objectives as a guide:

(a) Organization: To develop and maintain a sound and clear-cut plan of organization within the division through which Management can most easily and effectively direct and control the division.

(b) Personnel: To develop and administer a constructive personnel development and training program which will gradually ensure that all positions in the division are filled by individuals fully qualified to meet the requirements of their respective positions.

(c) Planning: To formulate well-considered plans and objectives, covering all operations, activities, and expenditures for each year or longer period ahead, as a basis for authorization, a guide to achievement and a measure of performance of the respective division.

(d) Administration: To accomplish all functions and responsibilities fully, effectively and harmoniously.

(e) Costs: To keep all costs and manpower at an economic minimum, consistent with essential purposes.

(f) Betterment: To plan, stimulate and develop improvements in methods, products, facilities and other fields as applicable, keeping abreast of the best thought and practice throughout the industry and to insure that out-moded procedures and uneconomical facilities are abandoned.

(g) Employee relations: To make sure that all employees are accorded fair and equitable treatment and that they are inspired to their best efforts.

In the face of non-existence of an organizational structure for the furniture factory, the Consultant also proposed to the management a formal organization chart for the furniture factory as shown in Annex XI. This was discussed with the factory manager and agreed upon and is suitable for the existing stage of development. It requires centralized authority and detailed supervision.

A written statement of duties, responsibilities authority and relationships should be provided for each managerial and supervisory staff of all divisions. As an example, the proposed job specification for the factory manager is given in Annex XII.

15. Production Planning and Control:

Such production planning functions as sales forecasting, long and short term production planning, determination of materials, machinery, manpower and tools requirements for the planned production, and scheduling of customer orders are not performed at present. Although the management is aware of the importance of production planning, currently they do not have any suitably qualified employee to perform these functions. However this can not justify the omission of production planning. Management should recruit a suitably qualified candidate and train him to undertake the above tasks.

A production plan for the year 1988 was prepared by the Consultant by taking into account the sales forecast of the management (see Annex XIII). This production plan can form the basis for determining materials, manpower, machinery and tools requirements for 1988. The available production machinery can also be scheduled against the quarterly sales plans contained in the same production plan. These were discussed in detail with the factory manager and the proposed system was demonstrated to him.

The implementation of yearly production plan should be checked regularly on a monthly and cumulative basis and necessary corrective action should be taken by the management. A simplified production control report for daily and monthly use is given in Annex XIV.

One of the existing shortcomings in the factory is the inability to meet delivery dates of customer orders. This is due to the characteristics of jobbing production method used at the factory, and non-existence of a detailed production planning and control system.

Currently, there is a simultaneous production of a series of different products in very small or unit batch sizes to customer orders. This is giving rise to differing sequences of operations for each product and a large range of operations and jobs, and inaccurate prediction of individual operation times. These inaccuracies can be lessened with intensive daily production planning and control work. If this is not done, predicting processing times will be more difficult, work-in-progress stocks will even be higher, the equipment utilization rate will fall, and the total production time will be far greater than the processing time, often as high as 10 : 1. Therefore the factory management should adapt batch production methods initially for a range of standard items and eventually to the entire production as far as the local market allows.

16. Order Processing:

The current practice of order taking and processing is verbal and informal in most cases. Orders come from individual customers or through contracts from the Government departments. Ordinary customers normally bring with them a sketch or a photograph of the furniture they want. Others and the Government departments invite the company to visit the site and take measurements, and then propose what is needed. These are then passed on to the factory manager as a customer order with verbal instructions. The factory manager sketches out the item, determines the measurements of parts and materials for production. However, this again is informal and the instructions and drawings sent to production lack the exact measurements, and detailed and scaled drawings.

The current method of order taking and processing is the prime cause of the following shortcomings:

- Too much material and manpower is wasted until the correct sizes and details are established by trial and

error.

- Completion and delivery of the orders are delayed.
 - Orders, instructions and details transmitted verbally may be forgotten by the carpenters.
 - Control of materials, manpower, processes, and quality becomes inaccurate and difficult.
- Therefore the Consultant had proposed a very simple order taking and processing procedure and demonstrated it to the factory manager (see Annex XV).

17. Quality Control:

Currently, the quality of products manufactured is very low by any standard. Apart from non-existence of a company quality plan and a quality control method, there are many other constraints which hinder achieving a better quality. In the Consultant's opinion these constraints are as follows:

- Timber used in production has a moisture content above 40% . Due to irregular and short supply of timber, it cannot be kept in stacks long enough for full air drying.
- Foremen and workers do not pay any attention to the colour uniformity and colour and grain matching of timber. A chair with three dark brown heartwood legs and one whitish sapwood leg can always be seen.
- Most of timber species used have interlocked or spiral grain. Machining against grain direction causes very rough surfaces especially when the cutting tools are blunt.
- Cutting tools are rarely sharpened if at all. Because of this the machining quality is very poor.
- Machining is inaccurate. No two parts are alike.
- Quality and amount of sanding prior to surface finishing operations are inadequate and poor. Hand sanding is not adequate in most cases to eliminate fully the deep cutter marks and torn-off or raised fibres.
- The freshly sprayed workpieces are put in the dusty factory hall or outside to dry. Dust particles can be seen on the dried surfaces, which become an integral part of the lacquer film.
- The workers are untrained and are unaware of the quality level the management expects.

In the light of the above points, the Consultant sees it difficult for the company to achieve any meaningful improvement of the quality in the near future without remedying the existing shortcomings. It has to be pointed out that quality control and factory performance are closely related. A proposal for the formalization and methodological implementation of a quality control system is given in Annex XVI.

Good quality control and supervision are most likely to exist where each supervisor has in writing a job description that clearly defines his duties, responsibilities, authority and accountability. Individuals must carry out their duties and are to be held accountable for them.

18. Machine Maintenance:

Machine maintenance is carried out when breakdown occurs. This causes down time which means loss in productivity and production capacity. The aim of the management should be to minimize down time. This can be achieved only through predictive and preventive maintenance practices. Many signs of trouble such as oil leaks, hot bearings and electric motors, out of balance wheels and spindles, and excessive vibration give the maintenance staff advance warning.

Predictive maintenance predicts the usable life of components such as bearings and electric motors, and uses these criteria to replace it before it breaks down. For example, if the predicted life of an electric motor is 2,300 hours, it is replaced after 2,000 hours.

On the other hand, the aim of preventive maintenance is to keep a machine running smoothly and to keep it from breaking down. The work involved here are cleaning, inspecting, making minor adjustments, aligning, lubricating, draining, testing, calibrating, measuring, replacing minor parts, and recording of information for future use.

The correction of problems found by preventive maintenance, major overhauls, alterations and replacements can be undertaken under corrective maintenance.

It has to be pointed out that documentation is the first step in scheduling and controlling maintenance. A general maintenance system with very simple instructions and minimum documentation was demonstrated to both the management and the maintenance staff (see Annex XVII).

Currently the maintenance team is composed of 3: One electrician and two mechanics. However, it was noted by the Consultant that the qualifications and experience of mechanical maintenance staff was very limited and special care and action is needed to upgrade their skills. The job specification of a fully qualified maintenance technician is contained in Annex XVII.

At present, maintenance materials and spare parts are virtually non-existent in the stores at the factory. Under the existing local conditions where it is extremely difficult to find any special maintenance material or spare part readily, it is advisable to keep certain top priority items in stock. These items should be kept in stock for two reasons: the item will be needed frequently for operation of the factory and equipment, or the item is critical to production and a spare one must be on hand to insure against a production loss if the one in use fails. If it can be documented that a spare part or material will be used in large quantities, a decision to stock these, immediately will pay off both from operational and economical points of view.

Currently, the range of mechanical maintenance shop equipment existing at the factory is limited to mainly standard accessories supplied with the machines. A list

containing minimum equipment for mechanical maintenance that the factory should have is given in Annex XVIII.

19. Product Costing and Pricing:

In the current costing system, only the material content of the product is recorded and costed at actual price. Other cost elements such as direct labour, factory overheads and operating overheads are only rough estimates. The existing cost structure has two elements. Average ratio of each cost element in the total cost is as follows:

<u>Cost Structure</u>	
Materials	66%
Overheads	34%

According to the calculations made by the Consultant, 23.5% of overheads shown above is direct labour. This corresponds to 8% of total costs. On the basis of this calculation, the above cost structure table can be reconstructed as follows:

<u>Cost Structure</u>	
Materials	66%
Direct labour	8%
Overheads	26%

In the face of above findings, it can only be said that a realistic cost calculation is necessary for realistic pricing of products. In view of this principle and the current practice of costing, the Consultant proposes that the company uses full costing system to record and precisely predict all the cost elements. For this purpose, a cost analysis sheet has to be made out for every single product (see Annex XIX). The material usage can be estimated with the data from parts/materials list, and the direct labour hours with the data from the routing sheet (see Annex XV). The rate for applied overheads per man hour of direct labour can be calculated by dividing the total overhead figure for the year with the total direct labour man hours for the same year. Then the cost figure for overheads can be obtained by multiplying the rate by the number of direct labour man hours required for producing a particular item.

The selling price of items can be determined according to:

- Market price of the item,
- Cost plus profit,
- Agents'/purchasers' price.

In any case, market conditions play an important role on the decision of the management regarding pricing policy to be chosen.

20. Product Design and Development:

The current methods of product design and development

are based on either customer specifications or adaptations from existing designs of European modern styles. A list of prototypes that the management wishes to produce in the first half of 1988 is given in Annex XX. In examining of the existing products it was found that the amount of wood used in any single product is much higher than required. The various parts and components are oversized up to 100% more than in Europe. This is partly due to non-standard timber sizes.

In general, the furniture items being manufactured lack a system in design details and colour co-ordination of different materials used, especially in upholstered furniture items. Measurements of furniture do not match with the human measures and standards used in Europe.

More detailed analysis of existing furniture items in terms of designs and forms can be found in the technical report based on the work of Mr. Niko Kralj, consultant in furniture design, issued under symbol IO/R/77.

21. Requirements for Export:

Requirements of export markets are quite different from domestic market. Techno-managerial capabilities play a critically important role besides marketing skills.

Therefore before embarking on an export mission the management should make sure that the various existing shortcomings in many areas identified throughout this report has been remedied. Additionally, the following factors have also to be taken into account:

(a) Availability of dry wood: It is essential to have regular supply of good quality timber species, kiln dried down to 8% moisture content. Straight grain and uniform colour is also important.

(b) Precision in machining: The processing machinery should be well maintained and adjusted for the production of precise interchangeable parts and components as a final product in order to achieve trouble-free assembly at the importers' warehouse or at the customers' house if it is a knocked-down (K. D.) self assembly item.

(c) Quality: The company should have a fully trained workforce and a formal quality control procedure to attain the level of quality required by the target markets.

(d) Production capacity: The production machinery, equipment, tools, and general factory supplies such as sanding paper necessary to achieve the required quantity of production should be on hand.

(e) Techno-managerial skills: A diverse range of skills and experience is necessary for the interpretation of export enquiries, trade terms, and technical drawings for the preparation of proposals, bids, and offers. Technical staff should be able to draw constructional drawings and details, prepare product specifications, enumerate the characteristics of materials used, and give advice on their maintenance etc. If the items are of knocked-down (K. D.) construction, a clear instruction sheet should be

prepared for the steps to be taken in assembly, methods to be followed in fixing of hardware and other fittings, and range of suitable tools to be used. The instruction sheet should also contain an exploded view of the item, showing fixing positions of each part.

(f) Availability of designs: Due to unavailability of local furniture designers, it is difficult for the company to develop its own designs for sale in export markets. Therefore it is advisable to contact dealers and manufacturers in the target export markets for their designs to be manufactured locally. Help can be sought from relevant agencies and organizations which promote exports from developing countries. A list containing the names and addresses of such organizations is given in Annex XXI.

(g) Knowledge of markets: It is of utmost importance that characteristics and requirements of the target export markets are studied in detail with regards to types of designs, wood species, trade laws, packaging requirements, and ways of entering. The characteristics of some of the most important potential export markets are as follows:

United Kingdom: For the U. K. market, best product potential exists for reproduced traditional designs in mahogany and some lighter woods.

Germany, Federal Republic: The German market requires high quality, solid wood lines especially dining room and lounge furniture. Traditional styles are considered to have the best market chance, featuring exotic woods.

Sweden: Scandinavian furniture in general and Swedish furniture in particular is dominated by functional design. Light coloured woods are most popular.

Belgium: Belgium has many well established chair manufacturers with whom competition is difficult. These local manufacturers' interest to purchase semi-finished furniture blanks offer good possibilities for Bush and Town Co. Ltd. in supplying semi-finished chair parts, or joint venture arrangements.

Japan: High quality living and dining room sets of hardwood sell well. There is also an excellent opportunity for selling semi-finished parts in inexpensive hardwoods.

More detailed information on these and other markets can be found in the following publication:

Major Import Markets for Household Furniture.

(Geneva, 1982. 252 pages, published by ITC)

obtainable from the address no. 14 shown in Annex XXI.

In any case, a copy of the company profile as shown in Annex XXII should accompany the correspondence to the potential business partners to give all the pertinent information about the company.

II. RECOMMENDATIONS:

A. Addressed to the Government:

1. The furniture industry as a whole lacks trained woodworking machinists at the shop-floor level and technicians at the middle-management level. The existing courses on cabinet making and carpentry are designed to develop handicraft skills of students which do not meet the requirements of industrial furniture production with modern woodworking machinery. The Ministry of Education should, in close cooperation with the appropriate ministries and the furniture industry itself, transform an existing craft course (e.g. carpentry course at Freetown Trade Centre) into a contemporary machine woodworking course based on "reverse day release" scheme whereby students go to a selected furniture factory for one day a week. This will satisfy the needs of the Sierra Leonean furniture industry for suitably trained manpower in the medium term, and help the industry to prosper and develop into export markets with high quality and value added products manufactured on an industrial basis in the long term.

2. The furniture industry of Sierra Leone lacks up-to-date technical information on production methods, technology, and equipment. The appropriate ministry or the government department should encourage the entrepreneurs of the sector to set up a national furniture manufacturers association which can play an active role in acquisition and dissemination of information to its members and the industry as a whole through seminars and workshops.

3. In all the factories visited, there is a chronic shortage of most essential production machinery, spare parts, supplies and consumables because of unavailability of foreign exchange. As a result, a great deal of machinery is idle, and the quality and productivity is very low. The Government should take the necessary steps urgently to allocate the required foreign exchange to the industrialists to activate their latent production capacity.

4. There is a shortage in the supply of good quality timber and prime species to the furniture industry. Appropriate action should be taken for the allocation of good quality timber in regular supply to those factories manufacturing more value added wood products for export than only sawn timber.

5. Various forms of incentives should be made available to the exporters of higher value added wood products such as furniture and joinery. One way of incentives is to allow them to keep 20 to 33% of their export revenue in their external account to be used for the financing of their imports of additional machinery, spare parts and supplies.

6. The Bush and Town Co. Ltd. has been identified to have the highest potential for export in the near future. However, as identified in this report it has to purchase

additional equipment and supplies as a pre-requisite for export. The Government should help it by allocating necessary foreign exchange as soon as possible.

B. Addressed to Bush and Town Co. Ltd. :

1. The existing factory layout should be improved by taking into account the work sequences in the processing of workpieces, space requirements for machines, operators, feeding and outfeeding, and servicing. The space between machines should be enough for the storage of work-in-progress up to 8 hours (see Annex VIII).

2. The existing production machinery should be complemented with additional machinery in stages (see Annex V).

3. Saw blades and cutting tools should be resharpened regularly and frequently. The necessary maintenance and sharpening equipment for this purpose should be purchased as soon as possible (see Annex VII).

4. The tool sharpening equipment should be positioned in a purpose built tool sharpening room (see Annex VI).

5. The compressor room should be improved by taking the existing workbench and the band-saw blade sharpening machine out and openings on the outside wall for fresh air intake and hot air outlet should be made.

6. Production machinery and equipment should be maintained regularly to prevent breakdown and to increase the usable life in view of short supply of spare parts, high cost of replacements, and scarcity of foreign exchange. A mechanical maintenance workshop with the equipment listed in Annex XVIII should be established.

7. The existing cutting tools which are damaged should be repaired as soon as possible. Those that cannot be repaired should be replaced with new ones. The use of cutters without resharpening should be stopped.

8. Existing practice of lacquer spraying and drying in the factory hall and in the open air should be stopped. Instead, the existing spray room should be enlarged to the next storage room to have a dust and wind free area for proper spraying and drying.

9. Timber with moisture content above 12% should not be used for furniture and interior joinery. A timber drying kiln should be purchased and put into use as soon as possible (see item 23 in Annex V).

10. Air drying of timber should be done under sheds to eliminate degradation by exposure to direct rain water and sun. Timber should be stacked properly to increase the rate of drying (see Annex IX).

11. Wooden pallets for stacking and carrying of workpieces in the production hall should be used. A manually operated hydraulic truck should be purchased to transport the pallets (see Annex X).

12. The labour force should be grouped according to group of operations (see Annex XI).

13. The labour force should be trained on machine

woodworking skills to increase labour and machine productivity, utilization of installed capacity, and interchangeability of parts. The existing working habits with hand tools should be abandoned as soon as possible.

14. There should be no hand fitting of parts and components at the assembly stage. Any part or component leaving the machining section should be identical with the same ones to attain interchangeability and should be seen as final products. (This is a sine quo non condition for exporting components).

15. A quality awareness should be created among the workforce and the middle-management. Greater attention should be paid to colour and grain matching in timber, squareness and straightness of parts and assemblies, and tightness of joints. Quality slogans should be used as an aid to create a quality awareness.

16. Quality and process control should be implemented in a formal way as soon as possible starting with the selection of timber and continued throughout all the stages of production to the shipment (see Annex XVI).

17. Such production management functions as production planning, order processing, and production control should be performed to rationalize, and to control the use of materials, production capacity, labour and energy, and to predict more realistically cost and delivery time of orders.

18. Customers' orders and any other information to factory management should be conveyed in the form of written instructions (see Annex XV).

19. Production drawings should be drawn to scale and the details should be shown in actual size.

20. Up to date information on woodworking machinery, materials, and new developments should be obtained on a continuous basis through subscriptions to specialized periodicals (see Annex XXIII), and visits to specialized fairs (see Annex XXIV).

21. Suitably qualified additional staff for techno-managerial positions should be recruited and trained on-the-job. Their managerial capabilities should be developed continuously in either of the following ways:

- Through the system of management by objectives,
- By giving responsibility requiring different levels of experience,

- By internal and external training programmes.

Attempts should not be made to make bad managers out of good technicians.

22. The existing high rate of timber waste should be reduced by choosing appropriate timber sizes in procurement, and by taking into account the available sizes at the product development stage, during cross cutting and ripping.

23. To the extent possible, furniture items manufactured in batches should be introduced to the market. The batch production method will enable the factory management to make more realistic production planning and

control, reduce material waste, rationalize manpower and equipment usage, and increase productivity.

24. To the extent possible, more use of common components should be made in products through designing of standardized, simplified, and specialized range and type of items

25. The existing costing system should be improved in order to predict costs of materials, direct labour, and overheads to price the items manufactured more realistically (see Annex XIX).

26. The existing production facilities, product quality and techno-managerial skills should be improved and the characteristics and requirements of the markets should be studied thoroughly before committing to export orders.

27. Initially, the company's export efforts should be concentrated on semi-finished furniture and joinery components such as drawer parts, kitchen doors, chair legs and rails, table legs and rails, carved door panels, staircase parts, and various turned, moulded and carved parts for toys etc. made of solid tropical hardwood species.



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
UNIDO

Project of the Government of Sierra Leone

JOB DESCRIPTION

UC/SIL/86/317/11-51

Post title Consultant in Managerial Problems in Small Manufacturing Business
(Wood Working Industry)

Duration Two months

Date required As soon as possible

Duty station Pujehun

Purpose of project To assist a newly established woodwork and furniture unit in respect of new designs, modern management practices and accounting procedure.

Duties The consultant is expected to make recommendations on the introduction of improvements in order to have a new wood working unit on a sound technical and commercial footing. More specifically the consultant will cover the following areas:

1) Management

- Management structure
- Production planning (including production targets on a weekly basis, purchase of materials, stock control, evaluation of work in progress, etc.)
- Costing system which clearly identifies the cost of labour, materials, direct production overheads and indirect costs, etc.
- Equipment maintenance and repair.

2) Pricing and Marketing

- Investigating pricing policies of competitors and their effectiveness.
- Evaluation of realistic profit margins to be used in setting selling prices.
- Identifying possible discounts that might be offered to other retailers and bulk purchases.
- Analysis of domestic market and export opportunities.
- Proposals on effective sales promotion techniques.

..../..

Applications and communications regarding this Job Description should be sent to:

Project Personnel Recruitment Section, Industrial Operations Division
UNIDO, VIENNA INTERNATIONAL CENTRE, P.O. Box 300, Vienna, Austria

The consultant will also be expected to prepare proposals on training of two specialists from the factory abroad.

The proposals should include recommendations on the candidates to be trained, fields of training and places of training.

The consultant should also prepare a final report listing his findings and recommendations including those for further improvements which may be required.

Qualifications

University degree in business administration or production. Experience in running up small manufacturing business. Experience in woodwork and furniture production is desirable.

Language

English

**Background
Information**

The Bush and Town Co. Ltd. is a private company which is owned and managed by indigenous Sierra Leoneans. The company had been previously engaged in trade but from February 1984 it diversified its activities by venturing into wood industry. Its current outputs consist of furniture for homes, offices and schools as well as doors and windows. It has leased a 600 acre forest area at Kakayama, 35 miles from Pujehun and therefore integrated its industrial activities to saw milling.

Construction at the new site is progressing. The company expects to start operation in the new building in early 1986. Its labour force has increased from 7 to 120 people since the company started production.

The company is likely to incorporate a foam making unit in the future. This would enable it to be self-reliant in its major input requirements. However, technical assistance to the company is required in making a start on a sound technical and commercial footing. As the construction of the factory is in an advanced stage, assistance in factory layout product flow designs etc., if rendered in time, will generate high benefits compared to costs involved.

This assistance can be generalized to cover other units in the industry making the designs and guidelines on management and accounting procedures available to them.

Annex II

LIST OF PERSONS MET

Ministry of Agriculture, Natural Resources and Forests:

Mr. A. P. Koroma, Chief Conservator for Forests.

Ministry of Works:

Ms. Melissa Muhlemann, Chief Architect.

Mr. Santigie M. Tholley, Architect.

Freetown Trade Centre:

Mr. J. G. T. Barlatt, Principal.

Freetown Technical Institute:

Mr. Henry Mjantu-sie, Principal.

Bush and Town Co. Ltd., Freetown:

Mr. Lawrence M. Kamara, President.

Mr. Prince A. Kawa, Director of Industrial Operations.

Mr. Albert O. Jones, Factory Manager.

Mr. Thomas O. Redwood-Sawyers, Company Secretary.

Mr. Jelani S. Kamara, Trainee Production Supervisor.

Mr. Charles Jarett, Workshop Supervisor.

Decore Furniture Company, Freetown:

Mr. Mahmoud A. Saghir, Production Manager.

Unique Furniture Company, Lower Allen Town, Freetown:

Mr. Daher Bedran, Production Manager.

West Furniture Company, Freetown:

Mr. Elias Zachariah, President.

Amtech Furniture Company, Freetown:

Mr. Ahmed Kadi, President.

Raad and Company Ltd., Freetown:

Mr. Ibrahim Sarkis, Workshop Manager.

Paul Kamara Ltd., Freetown:

(Personnel manager of the factory)

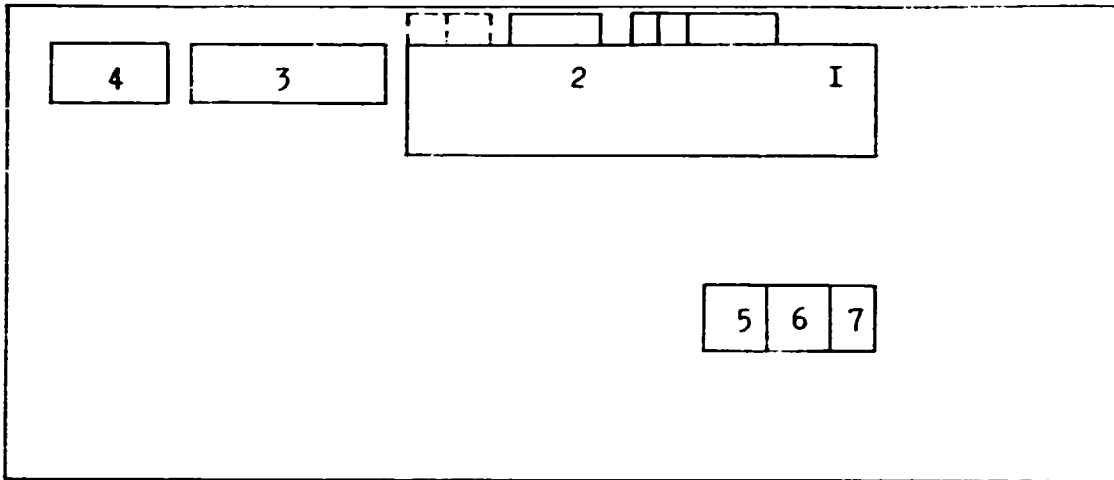
UNDP Office, Freetown:

Mr. M. H. Kamali, SIDFA (UNIDO).

MR. A. Loef, JPO (UNIDO).

FACTORY SITE

Scale: I/1000



L= 157 m.

LEGEND (Measurements are approximate):

- I. Finished goods store (12 m. X 14 m.).
2. Main production hall (53.5 m. X 14.5 m.).
3. Timber store (27 m. X 8 m.).
4. Semi-finished goods store (16.5 m. X 8 m.).
5. Administrative office (9 m. X 9 m.).
6. Upholstery section (9 m. X 9 m.).
7. Upholstered goods store (6 m. X 9 m.).
8. General store (12 m. X 4 m.).
9. Lacquer spray room (4 m. X 4 m.).
10. Compressor + sharpening room (4 m. X 4 m.).
11. Workers' toilets (12 m. X 5 m.).
12. Proposed sharpening room (6 m. X 4 m.).
13. Proposed mechanical maintenance room (6 m. X 4 m.).

Annex IV

LIST OF EXISTING PRODUCTION EQUIPMENT

<u>Item</u>	<u>Description and Specification</u>	<u>Quantity</u>	<u>Condition</u>
1.	Cross cutting saw, Wadkin, 5 HP.	1	Second hand, operational.
2.	Band saw, Vertongen, 70 cm., 2.2 HP.	1	New, operati- onal, but no blades.
3.	Universal woodworker, Dominion, 5 HP + 5 HP	1	Second hand, operational.
4.	Universal woodworker, Robland, K-26, 2.2 KW + 2.2 KW.	1	New, under repair.
5.	Universal woodworker, S. Tyzack, 5 HP.	1	Second hand, unoperational
6.	Combined surface planer and thicknesser Vertongen, C-630.	1	New, operational.
7.	Tenoner, Multico, TM-3	1	Second hand, operational.
8.	Spindle moulder, Robinson, EC-T, 1.1 KW.	1	Second hand, Operational.
9.	Turning lathe, (self made)	1	Operational.
10.	Narrow-belt edge sander, Baby-80, 1.5 HP.	1	Second hand, under repair.
11.	Circular rip-saw, with tilt arbor, Startrite, 220 volts, single phase.	1	Second hand, operational.
12.	Wide-belt sanding machine, DMC, SL/130/PR, 2.1 HP.	1	Second hand, Operational, but no sanding belts

Annex V

LIST OF RECOMMENDED ADDITIONAL PRODUCTION EQUIPMENT
(IN ORDER OF PRIORITY)

<u>Item</u>	<u>Description and Specifications</u>	<u>Quantity</u>
A. <u>To be purchased as soon as possible</u>		
1.	Circular sizing saw with tilting arbor and travelling table. Max. saw blade diameter: 350 mm., Motor power: 3 HP.	1
2.	Narrow band-saw for cutting shaped parts. Motor power: 3 HP. Pulley diameter: 400 mm.	1
3.	Manual turning lathe with copy attachment. Max. working length: 1,200 mm., Motor power: 2 HP, RPM: 1,640, 2,630, 3,280, 5,260.	1
4.	Pneumatic drum sanding machine for shaped solid wood parts. Motor power: 2 HP, RPM: 1,100, 1,500.	1
5.	Disk sanding machine for sanding straight solid wood parts. Motor power: 3 HP, RPM: 1,500.	1
6.	Narrow-belt stroke sanding machine with manually operated pressure pad, movable work table, and exhaust fan. Work table size: 2,500 mm. X 800 mm., Motor power: 3 kw.	1
7.	Bench type column drill (drill press) to bore holes for dowels, locks, hinges etc. on faces of panels and solid wood parts. Motor with variable speed and 0.5 HP power.	1
8.	Manually operated hydraulic frame press. Working size: 1,000 mm. X 2,300 mm.	2
9.	Wood drying kiln of conventional type. Complete with a simple control unit, wood waste burning boiler, and prefabricated aluminium chamber. Capacity per charge: 30 cubic meters.	1
10.	Manually operated hydraulic pallet transporter. Load capacity: 1,500 Kg.	1
11.	Dovetail making machine for drawers. Working length: 500 mm., RPM: 20,000, Motor power: 2,200 watt.	1
B. <u>To be purchased during the second stage of expansion</u>		
12.	Thickness planing machine. Max. workpiece width: 630 mm., Max. workpiece thickness: 240 mm., Max. material removal at a time: 3 mm., Motor power: 5 HP.	1
13.	Narrow band-saw for cutting shaped parts. Pulley diameter: 400 mm., Motor power: 3 HP.	1
14.	Cylinder sanding machine for shaped solid wood parts. Motor power: 2 HP, RPM: 1,500.	1
15.	Narrow-belt stroke sanding machine with manually operated pressure pad, movable work	1

table and exhaust fan. Work table size:
2,500 mm. X 800 mm., Motor power: 3 kw.

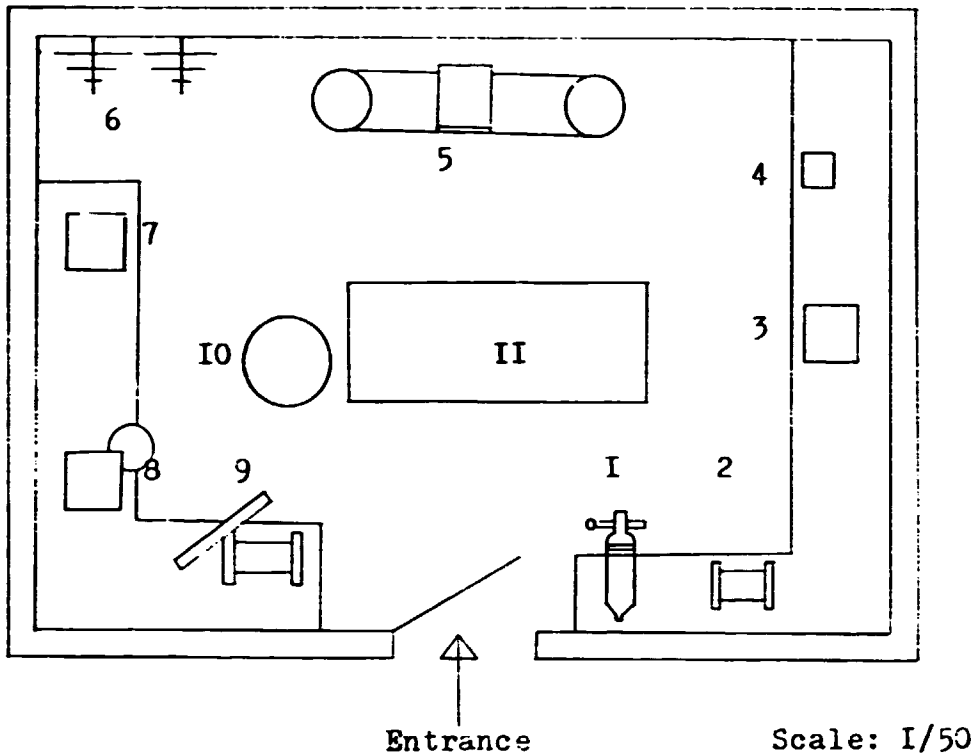
C. To be purchased during the third stage of expansion:

- | | | |
|-----|---|---|
| 16. | Overhead router with inclinable work table and floating head. Motor power: 4 HP, RPM: 7,500. | 1 |
| 17. | Spindle moulding machine with detachable travelling table. Motor power: 5 HP, Work table size: 650 mm. X 700 mm. | 1 |
| 18. | Manual turning lathe with copy attachment. Max. working length: 1,200 mm., Motor power: 2 HP, RPM: 1,640, 2,630, 3,280, 5,260. | 1 |
| 19. | Round end tenoning machine with inclinable and angle adjustable work table. Motor power: 4 HP. | 1 |
| 20. | Horizontal boring and mortising machine. Motor power: 1,5 HP. | 1 |
| 21. | Chain mortising machine for window and door joinery production. Max. mortise depth: 160 mm., Max. mortise length: 180 mm. Mortise width: 80 mm., Motor power: 2 HP. | 1 |
| 22. | Dowel hole boring machine with 6 spindles. Work table size: 500 mm. X 250 mm. Motor power: 1.5 kw., RPM: 3,000. Complete with mechanical clamping. | 1 |
| 23. | Dowel milling machine for spiral grooved dowel rods. Dowel diameter: 6 to 18 mm. | 1 |
| 24. | Dowel cutting and chamfering machine. Dowel diameter: 6 to 18 mm. | 1 |
| 25. | Dust extraction unit for wide-belt sanding machine. Suction power suitable for the existing wide-belt machine. | 1 |

SPECIAL NOTES:

1. All machine motors shall be suitable for running on 3 phase , 380 volts and 50 cycles electricity and have tropicalized wiring. Switches of explosion-proof type are recommended.
2. All machinery should be purchased with cutters, operating supplies and spare parts sufficient for two years.

PROPOSED LAYOUT
FOR TOOL SHARPENING ROOM



Scale: 1/50

LEGEND:

1. Vice.
2. Bench grinder.
3. Butt welder.
4. Horizontal grinder for butt welds.
5. Band-saw sharpener.
6. Storage for sharpened saw blades.
7. Bench type cutter sharpener.
8. Bench type TCT circular saw blade sharpener.
9. Bench grinder with planer knife grinding attachment.
10. Deresination tank for circular saw blades.
- II. Work bench.

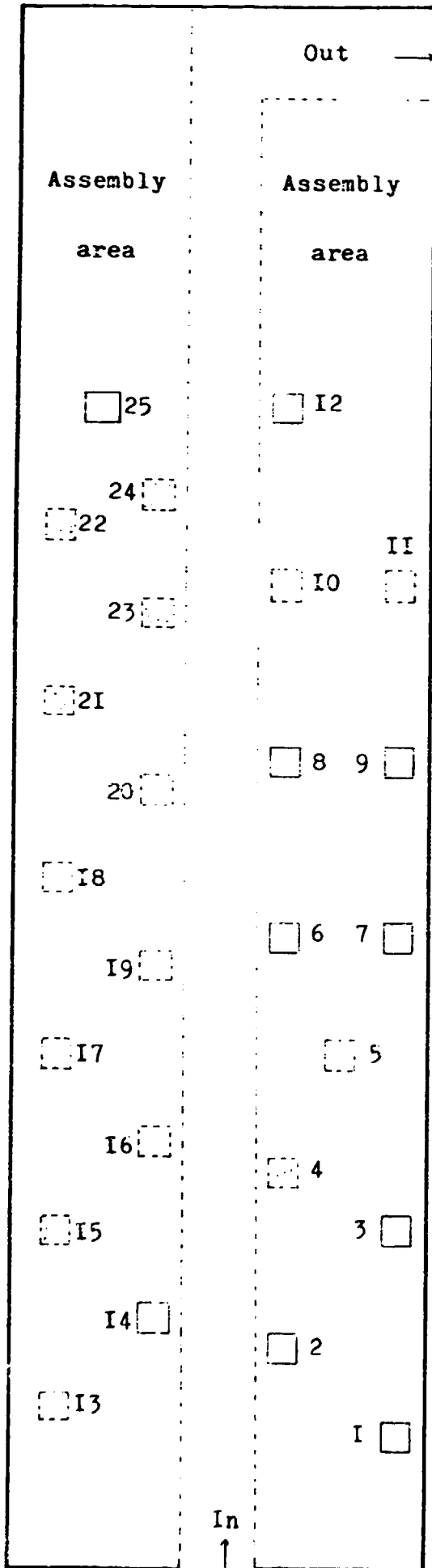
LIST OF RECOMMENDED TOOL SHARPENING EQUIPMENT

<u>Item</u>	<u>Description and Specifications</u>	<u>Quantity</u>
1.	Band-saw blade shearing apparatus. Max. blade width: 50 mm., (Similar to Ideal (*), Type no. 50)	1
2.	Band-saw blade butt welding machine. Welding range: 8 to 50 mm., Welding capacity: 8 KVA. (Similar to Ideal, Type no. BS/2).	1
3.	Band-saw blade butt weld grinding machine. Max. grinding width: 60 mm. (Similar to Ideal, Type no. SM/60).	1
4.	Spare grinding wheels for item 3 above.	3
5.	Universal sharpening machine for HSS and TCT cutters and circular saw blades. Motor power: 0.25 kw., RPM: 2,800. (Similar to Graule (**), Article no. 2451)	1
6.	Sharpening attachment for TCT and HSS circular saw blades for item 5 above. Max. saw blade diameter: 450 mm.	1
7.	Sharpening attachment for moulding knives and boring bits for item 5 above.	1
8.	Sharpening attachment for straight cutter head knives for item 5 above. Max. blade size: 150 mm. X 20 mm.	1
9.	Sharpening attachment for router bits for item 5 above.	1
10.	Diamond grinding wheels for item 5 above to grind TCT cutters, boring bits, and circular saw blades. (1 pc. for TCT straight cutters, 1 pc. for TCT boring bits, and 1 pc. for TCT circular saw blades).	3
11.	Aluminium oxide grinding wheels for item 5 above for HSS cutters, boring bits and circular saw blades. (Wheel shapes as in item 11 above, but 2 pcs. of each shape).	6
12.	General purpose grinding and dressing machine with two wheels. Heavy duty and bench type.	1
13.	Grinding attachment for HSS planer knives for item 12 above. Max knife length: 710 mm.	1
14.	General purpose, aluminium oxide grinding wheels for HSS planer knives and hand tools for item 12 above.	4
15.	Hand files with 3 sharp edges for sharpening saw blades manually.	2
16.	Hand files with 3 round edges for sharpening saw blades manually.	2
17.	Hand files with 2 round edges for sharpening hand tools manually.	2
18.	Manually operated natural water stone grinding wheel for hand sharpening and	1

- | | | |
|-----|--|---|
| | dressing of HSS hand tools and cutters. | |
| 19. | Oil stones in silicon carbide for dressing of HSS cutters and knives manually. | 5 |
| 20. | Diamond sharpening stones for sharpening knives, blades, hand and power tools, router bits, carbide blades manually. | 2 |
| 21. | Deresination sink for circular saw blades. (To be self made at the factory). | 1 |

(*) : Ideal Werk C. + E. Jungeblodt GmbH. and Co.
Bunsenstrasse 1,
D-4780 Lippstadt,
Federal Republic of Germany.

(**): I. Graule KG., Maschinenbau,
Robert Bosch Strasse 7,
D-7080 Aalen,
Federal Republic of Germany.



PROPOSED FACTORY LAYOUT

(Scale: 1/200)

LEGEND :

1. Cross cutting saw.
2. Band saw.
3. Planer - thicknesser.
4. Thicknesser.
5. Circular sizing saw.
6. Mortiser.
7. Spindle moulder.
8. Tenoner.
9. Circular saw bench.
10. Dowel hole borer.
11. Chain mortiser.
12. Narrow-belt edge sander.
13. Narrow band saw.
14. Narrow band saw.
15. Universal woodworker.
16. Spindle moulder.
17. Turning lathe.
18. Turning lathe.
19. Round-end tenoner.
20. Dovetailing machine.
21. Narrow-belt sander.
22. Narrow-belt sander.
23. Pneumatic drum sander.
24. Disc sander.
25. Wide-belt sander.

□ : Existing machines.

▤ : Non-existing machines proposed by the Consultant.

STACKING METHOD OF
TIMBER FOR AIR DRYING

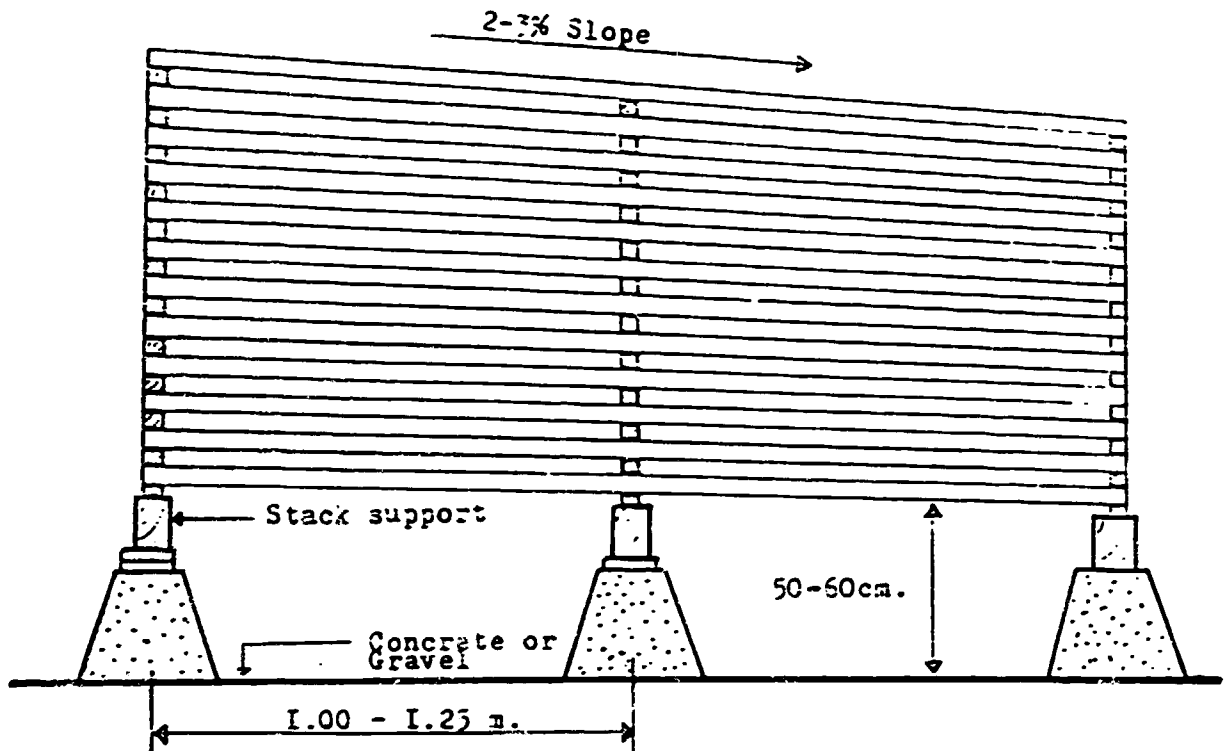


Figure 1: Side view of a timber stack for air drying.

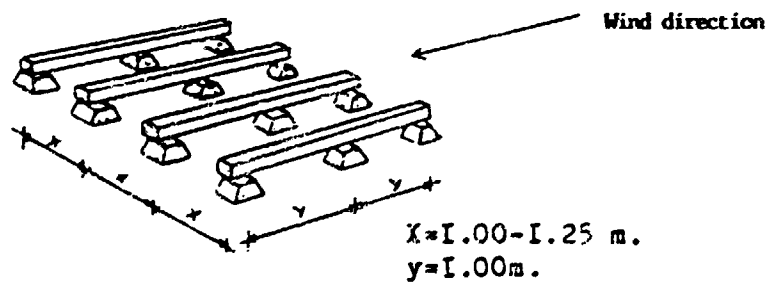


Figure 2: Plan of stack foundation blocks.

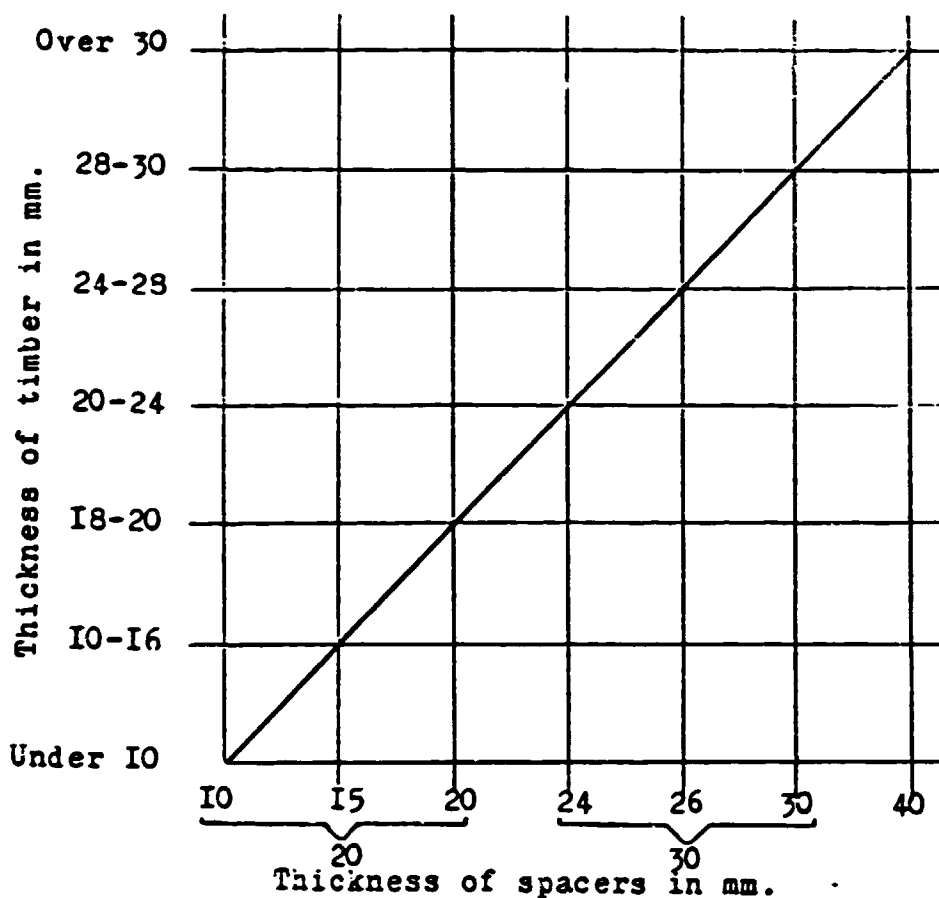


Figure 3: Diagram for selecting spacer thickness.

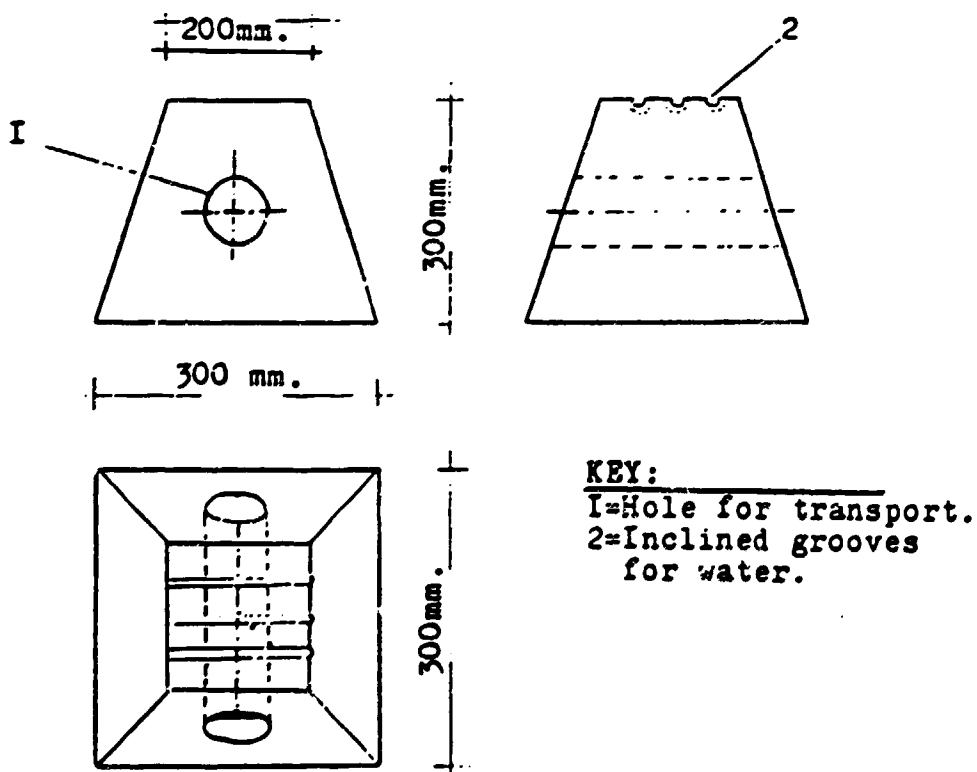


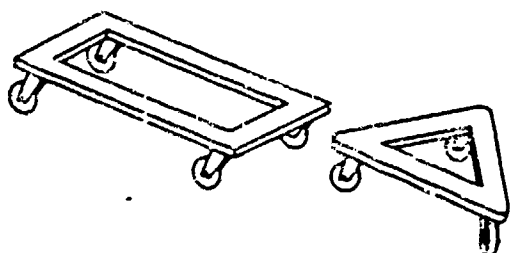
Figure 4: Construction details of concrete foundation blocks.

MATERIALS HANDLING DEVICES FOR FURNITURE AND WOODWORKING FACTORIES

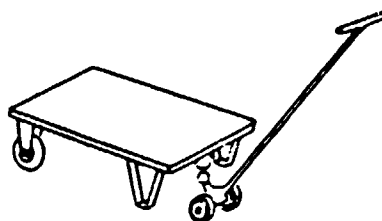
The most common devices for the handling of raw materials and work-in-progress are the various types of wooden and combination of wood and metal pallets. They can either move on the floor on wheels or be moved by various transport devices such as manually operated hydraulic pallet trucks, flat deck pallet cars or lever type pallet transporters.

Various types of pallets and pallet transporters are shown in Drawings 1 to 9. Especially the types 1, 2, 3, and 4 are easy to manufacture by the factories themselves.

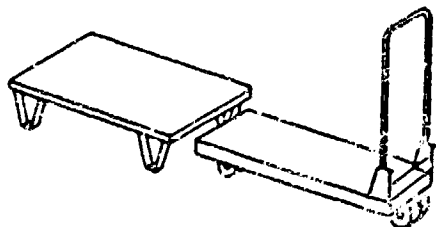
The overall sizes of various types of pallets are shown in Drawing 10.



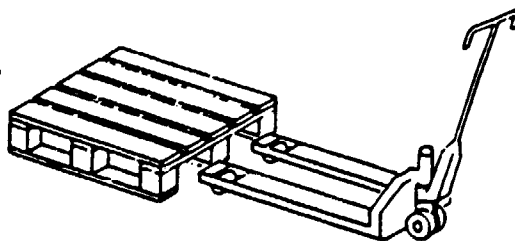
Drawing 1: Wheeled Frame Pallet



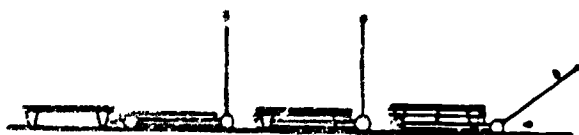
Drawing 2: Lever Type Pallet Transporter.



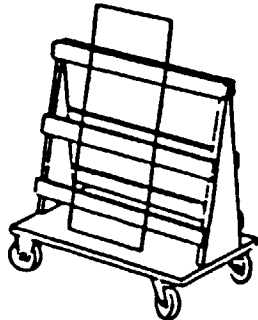
Drawing 3: Flat-deck Pallet Car.



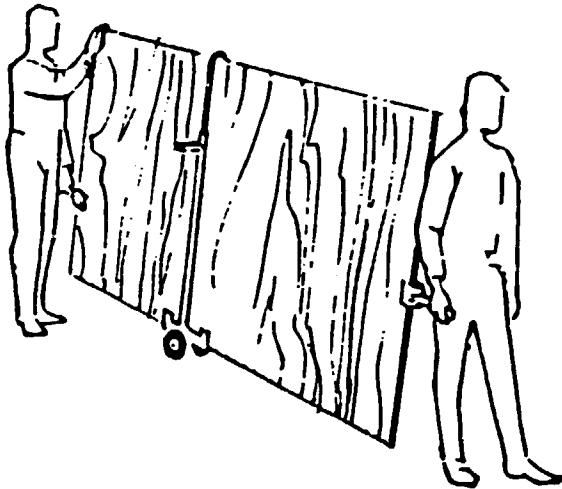
Drawing 4: Fork-type Pallet Car.



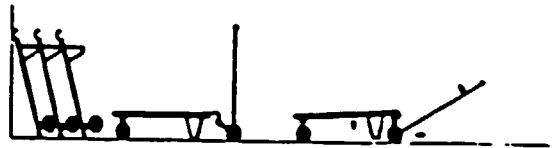
Drawing 5: Working Principle of Flat-deck Pallet Car.



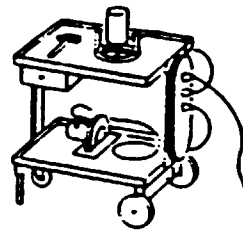
Drawing 7: wheeled Pallet for Glass Sheets.



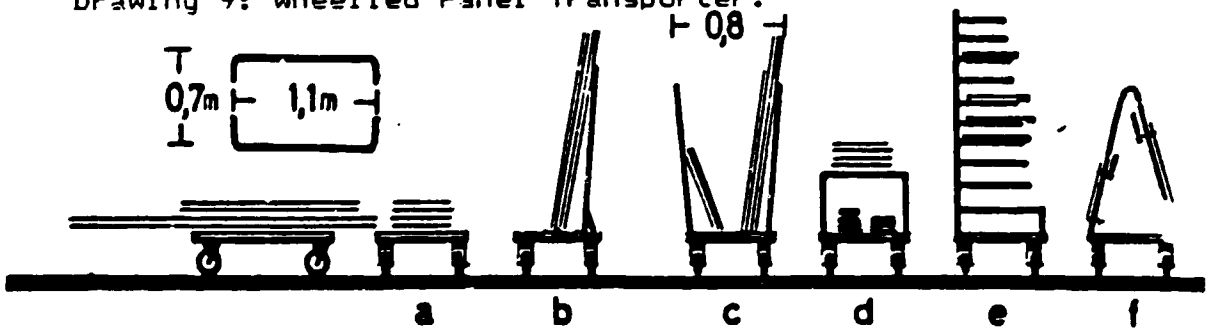
Drawing 9: Wheeled Panel Transporter.



Drawing 5: Working Principle Lever Type Pallet Car.

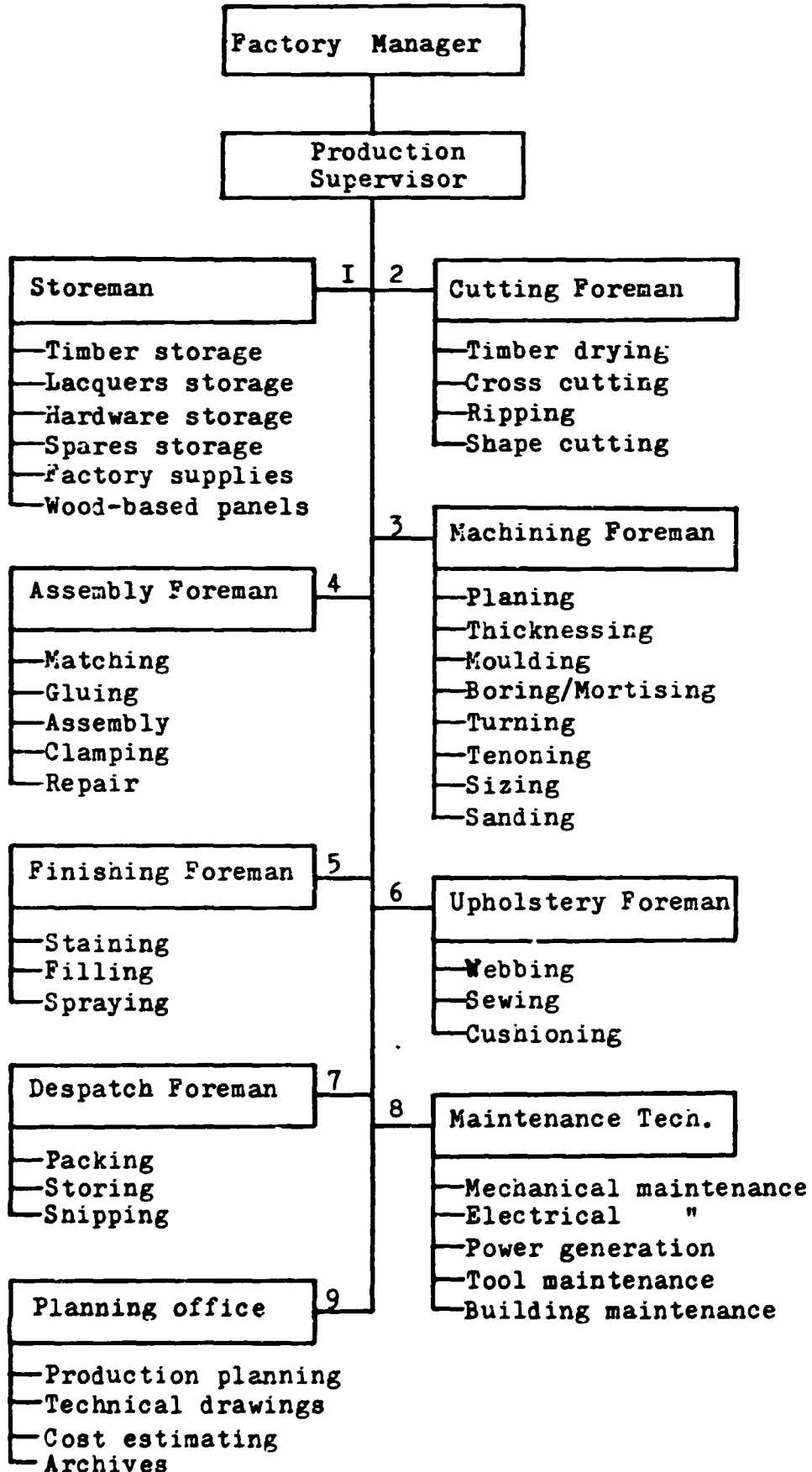


Drawing 8: Mobile Bench for Power Tools.



Drawing 10: Overall Sizes of Various Pallets and Transport Aids. (Legend: a= Standard wheeled pallet truck. b and c= Special pallet trucks for panels. d= Cupboard type pallet truck. e= Pallet truck with drying shelves for lacquer sprayed parts. f= Special pallet truck for cramps.)

FUNCTIONAL ORGANIZATION CHART FOR THE FURNITURE FACTORY



JOB SPECIFICATION FOR THE FACTORY MANAGER

- Title** : Factory Manager.
- Qualifications:** Technical education or vocational training in woodworking or furniture manufacturing.
- Experience** : At least five years experience in furniture manufacturing with proven record of good interpersonal and interdepartmental communication skills.
- Duties** : He will be responsible to the President in all aspects of production and will supervise work force assigned to him. In particular he is expected to:
1. Assist in setting up of the annual production budget and monthly programmes and check on their adherence.
 2. Issue operating instructions to be carried out by the operators in order to achieve the forecasted production target at an acceptable quality level.
 3. Evaluate the consumption of raw materials and utilities (e.g. compressed air, electricity etc.) to determine the efficient use thereof.
 4. Co-ordinate the maintenance work with the electrical and mechanical maintenance departments to obtain the highest operation at the lowest cost.
 5. Recommend improvements and co-ordinate solutions for technical problems to optimize operating conditions and to increase cost savings and factory safety
 6. Control the production operations, quality of incoming raw materials, and outgoing finished goods, their warehousing, packaging and despatch.
 7. Maintain good working relationships and co-operate actively with the President and other company and outside associates to ensure that the objectives of the factory and company are met.
 8. Plan, carry out, and supervise the training of manpower.
 9. If and when needed, prepare technical studies for expansion plans, selection of equipment, and new product ranges etc
 10. Plan and supervise the purchase of raw materials and factory supplies.
 11. Undertake any other tasks assigned by the President of the company.

PRODUCTION PLAN FOR 1988

<u>Code No. (*)</u>	<u>Product Name and Model</u>	<u>Quantity per quarter</u>			
		<u>II</u>	<u>III</u>	<u>IV</u>	<u>Total</u>
03.04.00.00	Dining chair (88/1)	100	130	130	360
03.04.00.00	Dining chair (88/3)	50	65	65	180
05.04.00.00	Executive tables (Jones)	15	20	20	55
01.02.00.00	Beds (Double)	3	5	5	13
01.03.00.00	Bedside tables	6	10	10	26
01.04.00.00	Dressing tables	3	5	5	13
01.08.00.00	Dressing stools	3	5	5	13
01.07.00.00	Wardrobes (2 Doors)	3	5	5	13
03.01.00.00	Dining tables (4 Seater)	10	15	15	40
03.02.00.00	Dining tables (6 Seater)	10	15	15	40
03.03.00.00	Dining tables (8 Seater)	10	15	15	40
03.05.00.00	Side boards (Dining room)	30	45	45	120
02.03.00.00	Settee (3 Seater)	10	15	15	40
02.01.00.00	Upholstered armchair	60	80	80	220
02.04.00.00	Lounge chairs (3 Seater)	4	6	6	16
02.05.00.00	Lounge chairs (1 seater)	12	16	16	44
02.06.00.00	Coffee tables (Refinery)	3	4	4	11
02.07.00.00	Lounge stools (Refinery)	12	16	16	44
02.08.00.00	Stock chairs	30	40	40	110
06.01.00.00	Conference chairs	40	55	55	150
06.02.00.00	Conference tables	5	7	8	20
04.01.00.00	Space saving beds	5	7	8	20
04.02.00.00	Space saving wardrobes	5	7	8	20
04.03.00.00	Space saving tables	5	7	8	20
04.04.00.00	Space saving chairs	5	7	8	20
13.00.00.00	Miscellaneous products	5	7	8	20

(*): For the explanation of these product code numbers please see Appendix I.

STEPS AND DOCUMENTATION INVOLVED
IN ORDER PROCESSING

A. Order Taking:

Orders are received by the sales office in the following forms:

1. Direct from customers,
2. From representative, or from subsidiary company, by telephone, telex, post or verbally.

After orders are received, sales office carries out administrative and technical checks. Administratively, customers are checked for credit worthiness and against their present outstanding account. Technically, orders are checked against availability of manufacturing capacity, cutters and jigs, materials, and factory supplies. If a requested delivery date cannot be met, this will need to be cleared with the customer.

B. Order Processing:

The steps in processing of orders and the documents used are as follows:

Step I. Customer Order Form:

Following the positive results of the above checks, and a mutually agreed upon delivery date, the sales office makes out the customer order form (see drawing 1), which means the order is accepted.

The customer order form is a four copy document. Each copy is used to perform the following functions:

- (a) Sales office copy: Retained by sales office for record of customer's order.
- (b) Production planning copy: Used by the production planning office as a basis for generating materials and job instructions.
- (c) Order acknowledgement copy: Sent to customer to acknowledge acceptance of order.
- (d) Delivery planning copy: Used by shipping department for advance planning of deliveries and as subsequent advice to production planning and control office that delivery has been made.

Step II. Parts/Material List:

On the basis of customer order copy from the sales office, and the technical drawings from the technical office, the production planning office makes out the parts and material list (see drawing 2). This document is prepared in two copies. Each copy serves the following purposes:

- (a) Planning office copy: Retained by planning office for record of orders planned and for making out route cards.
- (b) Material requisition copy: It is an instruction to storeman from production planning office for issuing materials. Passed back to production planning office to notify actual material issued for stock control. Passed to accounts office for costing and pricing of direct materials.

Step III. Tool and cutter list:

This is a document which gives instructions from production planning office to the tool shop for preparation of tools and cutters. Prepared in two copies:

- (a) Planning copy: Kept by the planning office for record and future reference.
- (b) Tool maintenance shop copy: Passed by tool maintenance shop to production supervisor to notify that tools and cutters have been prepared. If appropriate, it can also be used for recording of time and materials costs.

Step IV. Route Card:

On the basis of part list, a route card is prepared for each kind of part having the same technical drawing. It carries instructions from production planning, showing the sequence of operations to be followed in producing the part (see drawing 3). This document is prepared in three copies. Each copy serves the following purposes:

- (a) Planning office copy: Retained by the production planning office for record.
- (b) Production control copy: Used for controlling production sequences, processing times, and quantity.
- (c) Production copy: Used by production department as an identification document of a part and order, and sequence of operations. Right hand side of each operation is cut, actual information is entered by the operators, and passed on to production manager to notify job completion. Returned from production department to production control to notify work completed. (Can also be used for bonus calculation).

Step V. Delivery Note:

When the finished furniture item or part reaches shipping department, a delivery note is issued (see drawing 4). This document is prepared in three copies. Each copy serves the following purposes:

- (a) Loading copy: Instruction for lorry loading and delivery.
- (b) Delivery record copy (in duplicate): Used by the lorry driver to record delivery and receipt by customer. The duplicate copy is passed to sales office through production control for issuance of final invoice.

Drawing 3: Route Card

ROUTE CARD			Batch No: 1		Type: 03 Model: 01 Unit: 03			Date: 16.5.88 By: S.C.	
Part No:	PART NAME	Final Dimensions (mm)			Gross Dimensions (mm)			Material:	
		L	W	T	L	W	T	Species: 03	Finish: 01
43	Leg	720	70	50	770	75	55		
Operation No:	Operations and Technical Information	Quantity	Setting Time	Total Time	Machine No.	Batch No.	Type:	Unit:	Initials Operator
			Operation Time		Part No:	Finish Type	Model:	Finished on:	
10					10		03	01	
							03		
9	Spraying	100	7'	157'	9	88/1	03	01	
			1.5'				03		
						01			
8	Assembly (use 1 long rail, 1 short rail and 4 corner blocks)	100	15'	815'	8	88/1	03	01	
			8'			01		03	
7	24.0 Sanding (first sandings: 150 grit, final sanding 180 grit)	400	2'	202'	7 24.0	88/1	03	01	
			0.5'				03		
					43	01			
6	6.0 Mortising	400	12'	172'	6 6.0	88/1	03	01	
			0.4'				03		
					43	01			
5	5.0 Sizing	400	7'	167'	5 5.0	88/1	03	01	
			0.4'				03		
					43	01			
4	4.0 Thicknessing	400	12'	612'	4 4.0	88/1	03	01	
			1.5'				03		
					43	01			
3	3.0 Planing	400	8'	408'	3 3.0	88/1	03	01	
			1'				03		
					43	01			
2	2.0 Ripping (kerf: 3.4 mm)	400	10'	150'	2 2.0	88/1	03	01	
			0.35'				03		
					43	01			
1	1.0 Cross cutting (use TCT sawblade)	400	10'	110'	1 1.0	88/1	03	01	
			0.25'				03		
					43	01			

- Perforated lines for tearing off and returning to planning office for production control

A QUALITY CONTROL PROCEDURE

A. Principles:

From the manufacturing point of view, quality is to meet customer expectations in materials used, workmanship, design and function in a product intended for a specific end use.

The level of quality is determined by:

1. The value of quality to the customer. This varies from customer to customer, market to market, and item to item.
2. The cost of achieving quality and the price the customer is willing to pay for it. The customers often want high quality but are willing to pay only a limited price for it.

Therefore, before establishing a quality level for our furniture, we have to find out:

1. Who are our customers and what quality do they want?
2. What quality level we can achieve and at what price with the facilities, materials and expertise at our disposal?

Once the quality level for a furniture is established by finding answers to the above questions, then we have to establish a system to attain that. The steps in establishing the system include the following:

1. Setting of standards and control parameters for the desired quality level.
2. Measuring actual performance against standards set by using the control parameters.
3. Making corrections to the standards and control parameters when necessary.

An effective quality control system through inspections, should be able to reduce faults, rejects, and waste in production and hence the chances that a poor quality of product will be passed through the production process and to the customer. But all defective work cannot be eliminated. By recording the number of defective parts per 100 parts, we can observe the quality performance by processes, machines and persons and take corrective decisions.

B. Organization:

The management of the furniture company must develop a quality policy based on the target customers' expectations, cost of quality and the means available as explained before. This policy then is delegated to the factory management with the overall responsibility resting on the individual who is in charge of quality control. However, the required quality level cannot be attained by inspections and policing only carried out by a handful of

quality control staff. The quality level aimed at should be the ideal of every single person from top to the shop floor. It is the collective quality awareness and determination of all involved that will be directed and complemented by the quality control staff. Figure 1 below illustrates the involvement of staff of various levels in a quality control system in a furniture factory.

Figure 1: Organization of Quality Control.

<u>Organizational Level</u>	<u>Major Responsibilities</u>
1. General management.	- Adopting a quality policy. - Setting a quality level.
2. Quality control dept.	- Setting quality standards. - Designing quality control system. - Carrying out inspections. - Monitoring, evaluating and revising the system.
3. Production department.	- Training operators and foremen. - Training workers. - Carrying out inspections.
4. Foremen and operators.	- Training workers. - Setting machines correctly - Using appropriate and sharp cutters etc. - Carrying out inspections.
5. Workers.	- Carrying out inspections. - Informing foremen and operators.

C. Determination of Quality:

In order to achieve an effective quality control system, the personnel involved in it should have a thorough knowledge of the various materials, production machinery and processes used.

Quality controls and inspections are carried out according to pre-set quality standards for materials and workmanship. The dimensions and density of parts and viscosity and flowness of lacquers, paints and varnishes which can be expressed numerically may be measured by instruments such as vernier calipers, micrometers, gauges, and viscosity cups (Ford cups) in combination with a stopwatch. A list of basic quality control equipment for

furniture is given in Table 1.

Table 1: Basic Quality Control Equipment.

Quantity	Description	Potential Supplier
5	Vernier callipers. Measuring capacity: 150 mm.	FIRA (*)
1	Micrometer. Measuring capacity: 25 mm.	"
1	Flow viscosimeter. (Ford cup. No.: 4)	--
1	Hole position gauge.	FIRA
2	Stopwatch	--
1	Clock timer. (60 min.)	--
2	Immersion type industrial thermometer. Measuring range: up to +250 deg. C.	--
2	Length gauge. (1,000 mm.)	FIRA
1	Angle gauge. (180 degrees)	"
1	Precision digital balance. Capacity: 1 kg. Sensitivity: 0.1 gr.	--
1	Portable wood moisture meter. Measuring range: 4 to 60%. with selector switch calibrated for 4 tropical wood groups and temperature compensation from -20 degrees C to +80 degrees C. Long hammer electrode.	--

(*): Furniture Industry Research Association, Stevenage, U. K.

The quality of materials have to be checked at the time of delivery before they are admitted in the stores. Any materials which do not meet the quality standards are rejected. The main features of the materials controlled are listed in Table 2. The quality requirements vary for different parts of the furniture and also for different levels of quality. For example, at a very high quality level, no defects in material and workmanship is allowed in an exposed part whereas a very small defect forming a hardly noticeable contrast against the surrounding surface may be permitted in a half exposed part. In a concealed part on the other hand, a defect clearly visible as a single large defect or a number of smaller defects may be permitted. In a medium quality product, tolerances for defects are widened.

Quality requirements for different parts of furniture in terms of materials and workmanship can be set by using the specifications drawn up by the International Standards

Organization (I. S. O.) in their document ISO / TC 136-M13.

According to this document, three groups of parts may exist in a piece of furniture:

1. Fully exposed parts: Parts that are clearly visible by normal use of furniture. (e.g. tops, fronts, sides).

2. Less exposed parts: Parts that are visible but less conspicuous. (e.g. crossbars, rails, inside of cupboards, legs, surfaces hidden by cushion or mattress etc.).

3. Concealed parts: Parts which by normal use of furniture are not visible or are hidden. (e.g. reverse side of seat, table top or cupboard, parts covered by upholstery).

Table 2: Quality Control of Raw Materials

<u>I. Solid Wood:</u>	
1. Moisture content.	6. Straightness.
2. Thickness.	7. Stains.
3. Species.	8. Fungal attack.
4. Colour (overall).	9. Insect damage.
5. Defects (cracks, knots).	10. Grain direction.
<u>II. Panels (Plywood/Particleboard):</u>	
1. Surface smoothness.	
2. Colour and grain pattern (surfaced particleboard and plywood).	
3. Thickness.	
4. Moisture content.	
5. Specific gravity (Kgs./ Cubic meters).	
6. Delamination (knife test).	
7. Swelling.	
8. Manufacturing faults (gap, pleat etc.).	
<u>III. Lacquers:</u>	
1. Viscosity.	9. Shininess.
2. Solids content.	10. Hiding properties.
3. Film hardness.	11. Elasticity.
4. Drying time.	12. Temperature resistance.
5. Adhesion.	13. Solidification at the base.
6. P.H. value.	14. Shelf life.
7. Colour fading.	15. Pot life.
8. Colour uniformity.	
<u>IV. Glues:</u>	
1. Viscosity.	5. Open life.
2. P.H. value.	6. Storage temperature.
3. Shelf life.	7. Curing time.
4. Pot life.	8. Curing temperature.

D. Process Control:

The process control function is complementary to the quality control and inspection in achieving the desired quality level. Its other main function is to eliminate re-work, rejects and waste in materials and manpower. After every operation, the parts are controlled to determine whether they are ready for the next process.

The main features controlled at processing stages of production are grouped in Table 3.

Table 3: Process Control Features in Production.

I. At the Machining Section:

(a) Rabbit and Groove Control:

1. Rabbit depth.
2. Rabbit width.
3. Rabbit length.
4. Groove width.
5. Groove depth.
6. Groove length.

(b) Final Dimension Control:

1. Length.
2. Width.
3. Thickness.
4. Corner angles.
5. Squareness.

(c) Surface Control:

1. Roughness.
2. Cutter marks.
3. Surface imperfections.
4. Straightness.
5. Grain direction.

(d) Holes (in general):

1. Diameter.
2. Depth at the centre.
3. Depth at the edge.
4. Distance to part's edge.
5. Distance between holes (centre to centre).

(e) Plywood and Chipboard Parts:

1. Grain direction.
2. Waste.
3. Press platen marks.
4. Scratches.
5. Dirt and impurities on surfaces.
6. Colour uniformity and matching.
7. General panel production faults.

(f) Veneering Press:

1. Glue viscosity.
2. Amount of glue (Gr./sq. m.).
3. Press temperature.
4. Pressure.

5. Pressing time.
6. Veneer joints.
7. Cracks on the face.
8. Face veneer slippage.
9. Face veneer adhesion.

II. At the Surface Preparation and Finishing Section:

(a) Sanding:

1. Grit size.
2. Belt speed.
3. Feed speed.
4. Pad pressure.
5. Sand paper marks.
6. Sanding dust on the surfaces.

(b) Spraying / Lacquering:

1. Viscosity.
 2. Amount of lacquer applied on the surface (gr./sq.m.).
 3. Colour and tone of stain or lacquer.
 4. Air bubbles in the lacquer.
 5. Pressure and cleanness of compressed air.
 6. Colour uniformity of the filler or stain applied surface.
 7. Stains or marks occurring on the surface during production.
 8. Overall visual control during and immediately after spraying.
-

A SIMPLIFIED
MACHINE MAINTENANCE SYSTEM

1. Preventive Maintenance:

A preventive maintenance system in its simplest form covers the following:

(a) Preparation of preventive maintenance files for each machine and piece of equipment:

This file contains all the information which is necessary for undertaking preventive maintenance work. The information includes the specifications of the machine, instructions on the nature of work involved, the parts of the machine to be inspected and feed-back from the maintenance and inspection carried out.

Most of this information is derived from the technical documentation of the machine in question and from experience.

(b) Preparation of machine maintenance cards:

These cards contain a summary of the above information and serve as a programme and as a check list during the inspections and maintenance and a record for future reference. (See Drawing 1).

GENERAL DATA		TECHNICAL DATA	
1. Machine Name : 2. Brand and Make : 3. Model and Type : 4. Serial No : 5. Seller /Agent : 6. Capacity : 7. Inventory No : 8. Date of purchase: 9. LengthxWidthxHight : 10. Weight :	1. Main Motor : V: Phase: Hz: HP: RPM : Kw: 2. Control Gear : V: Amp : AC/DC 3. Grease type : 4. Bearings : 5. Oil Type : 6. Compressed air :		
Date	Details of intervention and materials used	Carried out By	

Drawing 1: Machine Maintenance and Repair Card.

A more detailed inspection or maintenance report is made separately after each visit. Machine maintenance cards can be used in two different methods:

One method is to make one card per machine, on which both the mechanical and electrical interventions are marked as in Drawing 1. The other method uses two different cards, one for mechanical work, one for electrical work.

In either case, a separate card is made for each machine or equipment for each frequency of work in such a way that each card will only mention those parts to be inspected on that particular occasion, (weekly, monthly, quarterly, yearly etc.).

(c) Preparation of a maintenance plan:

After preparation of all the machine cards for each frequency, a detailed plan is made for all the machines. (See Drawing 2). This plan takes into account the time which is necessary for doing all the work on each machine and location indicated in the maintenance cards. It also takes into consideration the frequency of monthly, quarterly and annual inspections. For practical reasons, the plan makes a distinction between the preventive mechanical maintenance and the preventive electrical maintenance and contains at the same time the plan for lubrication activities. This lubrication work is done at the same time.

2. Lubrication:

The lubrication system operates in the same way as the preventive maintenance system. It consists of:

(a) The lubrication files:

For each machine and piece of equipment, they contain all the information which is necessary for carrying out the lubrication activities. This information may concern the type and nature of work and lubrication points.

(b) The lubrication cards:

A separate card is prepared for each machine and piece of equipment and for each frequency. It contains information on the machine, the subassembly, the lubrication points, the type of intervention, the frequency and the type of lubricant which will be used. In this connection, a check-list for the comparison of specifications of lubricants of different manufacturers and for identification of alternatives is extremely useful. (See Table I).

(c) The lubrication plan:

The lubrication plan is made for those lubrication activities occurring more often than every two weeks. The lubrication plan is based on the one hand on the lubrication cards and on the other hand on the planning of preventive maintenance. The lubrication activities with a frequency exceeding one month, are planned so that they

coincide with those of preventive maintenance, hence included in the preventive maintenance plan.



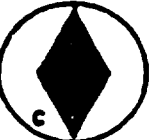
Lubrication activities which take place during daily production work, are carried out by the machine operators.

Those maintenance activities which require expertise and close monitoring are carried out and/or supervised by a fully qualified technician. A standard job specification for such a technician is as follows:

JOB SPECIFICATION

- TITLE:** Machine maintenance technician
- EDUCATION:** Technical School Certificate in Mechanics or Machine maintenance and repair.
- EXPERIENCE:** Experience in AC/DC drives, and machine maintenance and repair and working knowledge of pneumatic control systems is required. Familiarity with woodworking machinery is desirable.
- DUTIES:** Under the direct supervision of the Factory Manager; he will be responsible for the predictive, preventive and repair maintenance of all the machinery and equipment of the factory. Specific duties will include:
1. Preparation and updating of machine maintenance files and cards.
 2. Determination of spare parts needs and their specifications.
 3. Determination of the types of lubricants and greases.
 4. Preparation of a preventive maintenance programme and undertaking of preventive maintenance functions such as inspection, testing, lubricating and replacement of wear and tear parts.
 5. Preparation of machine lubrication charts.
 6. Undertaking of breakdown and repair maintenance when necessary.
 7. Rehabilitation of run-down machinery and equipment by replacement of parts, assemblies and sub-assemblies.
 8. Monitoring of equipment during operation.
 9. Drafting of technical drawings and determination of specifications for spare parts and work to be sub-contracted.
 10. Technical inspection of spare parts upon their receipt.

Table I: Lubricants and their specifications.

Lubricant Code & Symbol	Lubricant type	Equivalent Lubricant Grades	Lubricant Description & Properties	Lubricant to be for :
<p>A</p>  <p>(Spindle Oil)</p>	Oil	<ol style="list-style-type: none"> 1. Shell Tellus Oil 15 2. Mobil Velocite Oil 6 3. BP Energol HLP 40 4. Esso Spinesso 34 5. Castrol Hyspin 34 6. Caltex Spindura AA 	<ol style="list-style-type: none"> 1. A good quality mineral oil 2. Viscosity : 60 - 70 SSU @ 100° F 3. Contains oxidation inhibitors to prevent gum and varnish formation 	<ol style="list-style-type: none"> 1. Ball & roller bearings over 4000 RPM 2. Oil Mist Lubrication 3. Cut spray 4. Air Cylinder
<p>B</p>  <p>(Lubricating Oil)</p>	Oil	<ol style="list-style-type: none"> 1. Shell Tellus Oil 33 2. Mobil Vactra Oil Heavy Medium 3. BP Energol HLP 100 4. Esso Teresso 52 5. Castrol Hyspin 100 6. Caltex Regal Oil FC 	<ol style="list-style-type: none"> 1. A good quality turbine type mineral oil 2. Viscosity : 290-330 SSU @ 100° F 3. Contains oxidation inhibitors to prevent gum and varnish formation. 	<ol style="list-style-type: none"> 1. Ball & roller bearings under 4000 RPM 2. Plain bearings under 4000 3. Roller Chains 4. Friction points ways, slides,
<p>C</p>  <p>(General Purpose Oil)</p>	Oil	<ol style="list-style-type: none"> 1. Shell Carhea Oil 31 2. Mobil Vactra Oil (Heavy Medium) 3. BP Energol EM 125 4. Esso Coray 50 5. Castrol Magna ED 6. Caltex Aleph Oil 	<ol style="list-style-type: none"> 1. A straight mineral oil where long periods of continued use is not required and an inexpensive oil is desired. 2. Viscosity : 290 - 330 SSU @ 100° F 	<ol style="list-style-type: none"> 1. Roller chains 2. Friction points ways, slides,

LIST OF RECOMMENDED MECHANICAL MAINTENANCE
SHOP EQUIPMENT

<u>Item</u>	<u>Description and Specifications</u>	<u>Quantity</u>
1.	Column drill with accessories. Max. boring capacity: 16/20 mm. Boring bit housing: MK. 2 Boring height: 100 mm., Table size: 220 mm. X 310 mm., Power: 0.75 kw., RPM: 340, 530, 900, 1,530, 2,400.	1
2.	Oxy-acetylene welding outfit (complete).	1
3.	Arc welding unit complete with accessories. Welding capacity: 300 amp., 60% duty cycle.	1
4.	Horizontal cut-off saw.	1
5.	Heavy duty bench grinder.	1
6.	Pipe threader set complete with ratchet, handle, die head, and dies.	1
7.	Tap and die set (metric).	1
8.	Portable hydraulic boom crane. Lifting capacity: 500 Kg.	1
9.	Heavy duty bench vise.	1
10.	Single sided cantiliver rack (for tooling and supplies).	1
11.	Portable electric hand grinding machine.	1
12.	Flexible shaft grinding machine. Motor power: 1 HP.	1
13.	Portable electric hand boring machine.	1
14.	Set of electrician's measuring tools.	1
15.	Set of mechanic's measuring tools.	1

A SIMPLE METHOD FOR
COSTING AND PRICING

A. IDENTIFICATION OF COST ELEMENTS:

In furniture and joinery manufacturing various cost elements are involved. Depending on their nature, they fall in one of the following cost groups:

1. Direct materials
2. Direct Labour
3. Overheads
4. Transport

The most common cost elements in each cost group are given below:

1. Direct material costs:

These are the costs of materials that can be physically identified on the product and are directly used in the manufacture of the product. For example:

Timber	Stains
Plywood	Hinges
Particle board	Handles
Fibreboard	Locks
Veneer	Drawer slides
Laminates	Screws
Glue	Nails
Lacquer	Upholstery fabrics
Varnishes	Leather (including synthetic)
Thinners	Foams
Fillers	Purchased parts
Webs	Packaging materials
Springs	Threads and strings
Upholstery nails and staples	Other direct materials.

2. Direct labour costs:

These are the costs of labour directly used in the actual manufacture of the product. For example:

Machine operators
Machining and other production helpers.

Hand sanders
Spraymen
Hand polishers
Assemblers
Fabric cutters
Sewing machine operators
Upholsterers
Packers

3. Overhead costs:

There are cost elements which are not directly attributable to any particular product but are shared with all products manufactured. Examples are as follows:

Indirect materials such as:

Cutting tools, bits and knives
Sanding paper
Veneer tapes
Needles for sewing
Cutting blades
Maintenance supplies
Water
Steam
Electric power
Fuel oil.

Indirect labour such as:

Plant supervision
Engineering and technical personnel
Quality control
Prototype making
Research and development
Maintenance services
Tool sharpening services
Storage room services
Timber yard services
Work area cleaning
Warehouse and showroom services
Security services
Materials handling.

Other indirect costs such as:

- Administrative
- Sales and marketing
- Depreciation of plant and machinery
- Depreciation of buildings
- Interests on loans
- Rent
- Licence and royalty fees
- Property taxes
- Amortization of jigs
- Amortization of special tools and equipment.

4. Transport costs:

These are the costs incurring from the delivery of products to the customers and/or distributors. For example:

- Freight costs
- Container fees.
- Handling expenses

3. PRICING:

There are various methods used for pricing of products in the furniture industry. The widely used method among the small to medium size manufacturers is the "full-cost" pricing. The main reason for its popularity is its simplicity.

The "full-cost" pricing method is based on the following:

- 1 - The estimation of actual quantity of direct materials and subsequent calculation of their costs.
 - 2 - The estimation of the actual amount of direct labour hours and subsequent calculation of their costs.
 - 3 - The computation of overheads as a direct proportion of either 1 or 2 above (m^2, m^3 or man hours).
- In light of the above, the product pricing is done as follows:

Direct material costs
(+) Direct labour costs
(+) Overhead costs.

Total: Factory costs

Factory costs
(+) Transport costs
(+) Profit

Total: Selling Price

The use of a standard form for the recording of each cost component for each job is recommended. An example of such a form is shown in Drawing 1.

PROTOTYPE PROGRAMME FOR FIRST HALF OF 1988

<u>Item No.</u>	<u>Product Description, Model and Type</u>	<u>Complete By</u>
1.	Stock chair.	End April
2.	Dining chairs (four designs).	End May
3.	Executive tables (four designs).	End May
4.	Bedroom sets (four designs).	End May
5.	Conference chairs (three designs).	End May
6.	Lounge chairs with exposed frames. (four designs).	End May
7.	Executive chairs (three designs).	End June
8.	Judge's chairs (two designs).	End June
9.	Executive table for President.	End June
10.	Space saving set (consisting of bunk-bed, wardrobe, desk and chair).	End July

IMPORT PROMOTION OFFICES AND SIMILAR ORGANIZATIONS
IN SELECTED COUNTRIES

1. AUSTRIA:
Mr. J. Schwald, Director,
Foreign Trade Promotion,
Bundeskammer der gewerblichen Wirtschaft (Austrian
Federal Economic Chamber),
Wiedner Hauptstrasse 63,
A-1040 Vienna.
2. DENMARK:
Mr. Ivan Norgaard, Import Consultant,
Import Promotion Office,
Danish Chamber of Commerce,
Borsen,
DK-1217 Copenhagen K.
3. FINLAND:
PRODEC-IMPORT (The Finnish Import Promotion Office
for Products From Developing Countries),
Lapuankatu 4,
SF-00100 Helsinki 10.
4. FRANCE:
Head of Office,
Bureau de Promotion des Exportations Etrangères
(Office for Foreign Exports),
Centre Français du Commerce Extérieur,
10, Avenue d'Iena,
F-75783 Paris Cedex 16.
5. GERMANY, FEDERAL REPUBLIC OF:
Mr. G. Leonhardt, Head of Department,
Bundesstelle für Aussenhandelsinformation (German
Office of Foreign Trade Information),
Blaubach 13,
P. O. Box 108007,
D-5000 Cologne 1.
6. ISRAEL:
Mr. Adin Talbar, Chairman,
Israel Centre for Trade with Developing Countries
(ICTDC),
Chamber of Commerce,
84, Hachasmonaim Street,
P. O. Box 20027,
61200 Tel Aviv.
7. ITALY:
Cooperazione e Rapporti co gli Organismi
Internazionali (CROI),
Istituto Nazionale per il Commercio Estero (National
Institute for Foreign Trade),
Via Liszt 21,
P. O. Box 10057,
I-00100 Rome-Eur.
8. JAPAN:
Japan External Trade Organization (JETRO),

2-5 Toranomom 2-chome,
Minato-ku,
Tokyo.

9. NETHERLANDS:
Centre for the Promotion of Imports from Developing Countries (CBI),
Coolensingel 58, 5th. Floor,
P. O. Box 30009,
NL-3001 DA Rotterdam.
10. NORWAY:
Mr. Age Roed, Head of Division,
NORIMPOD (Norwegian Import Promotion Office for Products from Developing Countries),
Fridtjof Nansens Plass 2,
P. O. Box 8147-Dep.,
N-0033 Oslo 1.
11. SWEDEN:
Contact Service Section,
IMPOD (Import Promotion Office for Products from Developing Countries),
Norrholmstorg 1, 2nd. Floor,
P. O. Box 7508,
S-103 92 Stockholm.
12. SWITZERLAND:
Ms. Martine Darbre, Head,
Trade Promotion Service in Favour of Developing Countries,
Office Suisse d'Expansion Commerciale (Swiss Office for the Development of Trade),
Avenue de l'Avant-Poste 4,
P. O. Box 720,
CH-1001 Lausanne.
13. UNITED KINGDOM:
Mr. Arthur Day, Director,
United Kingdom Trade Agency for Developing Countries (UKTA),
London Chamber of Commerce Building,
69, Cannon Street,
London, EC4N 5AB.
14. UNITED NATIONS:
International Trade Centre UNCTAD/GATT,
Palais des Nations,
CH-1211 Geneva 10,
Switzerland.

COMPANY PROFILE

COMPANY NAME: Bush and Town Co. Ltd.

PERSON IN CHARGE: Mr. Lawrence M. KAMARA

ADDRESS: Private Mail Bag 722, Freetown

CITY : Freetown

CABLE ADDRESS: BATCO

PHONE NO.: Freetown, 22699

TELEX NO.: 3210 (Attn. BATCO)

COUNTRY: S I E R R A L E O N E (W E S T A F R I C A)

TYPE OF BUSINESS:

Furniture manufacturer

Building constructor

Importer

Retailer

Wholesaler

Dealer in general merchandise

Exporter

ESTABLISHED IN YEAR: 1982

NUMBER OF EMPLOYEES: 105

TECHNO-MANAGERIAL: 20 WORKERS: 85

BANKERS:

1) Barclays Bank Siaka Stevens Street branch, Freetown.

2) Barclays Bank Wellington Branch, Freetown.

3) Barclays Bank, Bo.

4) National Development Bank, Freetown

COMMERCIAL REFERENCES: Local references are available on request.

MEMBER OF: Sierra Leone Chamber of Commerce.

LINE AND RANGE OF PRODUCTS:

FOR LOCAL MARKET:

Dining room furniture

Living room furniture

Kitchen furniture

Bed room furniture

Occasional furniture

Special designs

Joinery

Tyres

Furniture materials and supplies

Building materials

PRODUCTS MANUFACTURED ARE: Medium and high priced.

FOR EXPORT MARKETS:

Furniture components

(Semi finished)

Joinery components

(Semi finished)

Finished furniture

Finished joinery

TRADING TERMS

DELIVERY: 8 Weeks

PACKING: In wooden crates

SHIPMENT: In container with West African shipping lines.

MIN. ORDER: One container

PAYMENT: Irrevocable and confirmed L/C

LIST OF SELECTED PUBLICATIONS
ON FURNITURE PRODUCTION AND TECHNOLOGY

A. PERIODICALS:

1. Furniture Manufacturer.
(Monthly technical and trade journal in English).
Magnum Publications Ltd).
110-112 Station Road East,
Oxted, Surrey RH8 0QA,
United Kingdom.
2. B. M. - Bau und Mobelschreiner.
(Monthly technical and trade journal in German).
Postfach 10 02 52,
D-7022 Leinfelden-Echterdingen,
Federal Republic of Germany.
3. H. K. International, Holz und Mbelindustrie.
(Monthly technical and trade journal in German).
DRW Verlag GmbH.,
Postfach 104,
D-7000 Stuttgart 1
Federal Republic of Germany.
4. Furniture Design and Manufacturing.
(Monthly technical and trade journal in English).
Delta Communications Inc.,
1020, South Wabash Avenue,
Chicago, Illinois 60605,
U. S. A.
5. Wood and Wood Products.
(Monthly technical and trade journal in English).
Vance Publishing Corporation,
300, West Adams Street,
Chicago, Illinois 60606,
U. S. A.

B. BOOKS AND MANUALS (*):

1. Manual on Jigs for the Furniture Industry.
UNIDO Document Symbol: ID/265.
United Nations, New York, 1981.
2. Manual on Upholstery Technology.
UNIDO Document Symbol: ID/275
United Nations, New York, 1982.
3. Manual on the Production of Rattan Furniture.
UNIDO Document Symbol: ID/299.
United Nations, New York, 1984

4. Production Management for Small and Medium Scale Furniture Manufacturing Firms in Developing Countries
UNIDO Document Symbol: ID/300.
United Nations, New York, 1983.
5. Manual on Documentation and Information Systems for Furniture and Joinery Plants in Developing Countries.
UNIDO Document Symbol: ID/315.
United Nations, New York, 1984.
6. Low-cost Automation for the Furniture and Joinery Industry.
UNIDO Document Symbol: ID/154/Rev. 1.
United Nations, New York, 1982.
7. Value Analysis in the Furniture Industry.
UNIDO Document Symbol: ID/298.
United Nations, New York, 1983.

(*): Two copies of each of these publications were obtained from UNIDO Headquarters and handed over to the President of Bush and Town Co. Ltd. by the Consultant during his stay at the factory.

SELECTED LIST OF SPECIALIZED INTERNATIONAL FAIRS
ON WOODWORKING MACHINERY, TOOLS, AND MATERIALS

1. INTERBIMALL, International Exhibition for Woodworking Machinery and Tools.
(Held biannually during May of even years).
Contact address:
INTERBIMALL,
c/o EFIMALL,
Centre Commerciale Milanofiori
1-a Strada, Palazzo F-3,
I-20090 Assago (Milano),
Italy.

2. SASMIL, International Exhibition of Accesories and Semifinished Products of Furniture, Upholstered Furniture and the Woodworking Industry.
(Held in conjunction with INTERBIMALL above at the same time and place).
Contact address:
COSMIT, Segreteria Generale,
Corso Magenta, 96,
I-20123 Milano,
Italy.

3. LIGNA, International Trade Fair for Machinery and Equipment for the Wood Industries.
(Held biannually during May of odd years).
Contact address:
Deutsche Messe und Ausstellungen A. G.,
Projektteam LIGNA HANNOVER,
Messegelände,
D-3000 Hannover 82
Federal Republic of Germany.

4. INTERZUM, International Trade Fair for Furniture Production, Interior Design and Soft Furnishings-Upholstery Machinery.
(Held biannually during May of odd years).
Contact address:
Messe und Ausstellungen GmbH.,
Postfach 21 07 60,
D-5000 Cologne 21,
Federal Republic of Germany.

SELECTED LIST OF SPECIALIZED INTERNATIONAL
FURNITURE FAIRS

1. International Furniture Fair, Cologne.
(Held annually in January in Cologne, FRG).
Contact address:
Messe und Ausstellungs GmbH.,
Postfach 21 07 60,
D-5000 Cologne 21,
Federal Republic of Germany.

2. International Furniture Fair, Milan.
(Held annually in September in Milan, Italy).
Contact address:
COSMIT,
Corso Magenta, 96,
I-20123 Milano,
Italy.

3. London Furniture Show.
(Held annually in May in London, U. K.).
Contact address:
Philbeach Events Ltd.,
Earl's Court Exhibition Centre,
Warwick Road,
London, SW5 9TA,
U. K.

4. Scandinavian Furniture Fair.
(Held annually in May in Copenhagen, Denmark).
Contact address:
Scandinavian Furniture Fair,
Center Boulevard, 5,
DK-2300 Copenhagen S.,
Denmark.

DIGITAL CODING OF PRODUCTS

Digital coding of products is most useful especially in factories manufacturing a diverse range of products in large numbers and using electronic order taking and accounting systems. Digital codes simplifies both the product identification and electronic data processing.

Bush and Town Co. Ltd. is currently manufacturing a diverse range of products. It is envisaged that the number will increase in the coming years and their identification will be a difficult task especially in the case of high labour and staff turnover. In light of these facts, digital coding of products even at this stage will prove very useful for the company.

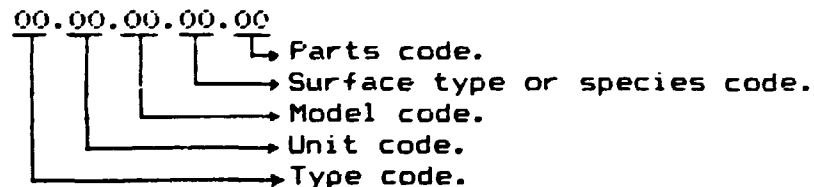
The following system is to be taken as a basic example and a more detailed study should be considered necessary for the preparation of a complete coding procedure.

In its simplest form, a product coding system for Bush and Town Co. Ltd will work as follows:

In the furniture factory, the products manufactured should be identifiable in terms of;

- Type of furniture,
- Unit of furniture,
- Model of furniture,
- Surface type or species of wood.
- Parts of units of furniture. (Digital coding of furniture parts should be introduced together with a production planning and control system).

As it can be seen from the above, a ten-digit code system is required to identify the above five different particulars of a piece of furniture as shown hereunder:



1. Type of furniture code: This code identifies if the furniture is one of the following types:

01. Bedroom furniture.
02. Living room furniture.
03. Dining room furniture.
04. Miscellaneous domestic furniture.
05. Office furniture.
06. Institutional furniture.
07. Fitted furniture.
08. Miscellaneous institutional furniture.
09. Door joinery.
10. Window joinery.
11. Ceiling and wall boards.
12. Miscellaneous joinery.

2. Unit of furniture code: This code identifies if the item of furniture is one of the following units:

02. Living room furniture units:

01. Single seater armchair.
02. Double seater armchair.
03. Three seater armchair.
04. Coffee table.
05. Side table.
06. Stool.
07. Lounge chair.

03. Dining room furniture units:

01. Dining table (4-seater).
02. Dining table (6-seater).
03. Dining table (8-seater).
04. Dining chair.
05. Side board.

04. Miscellaneous domestic furniture units:

01. Space saving bed.
02. Space saving wardrobe.
03. Space saving tables.
04. Space saving chairs.

05. Office furniture units:

01. Secretary's table.
02. Junior officer's table.
03. Manager's table.
04. Executive's table.

06. Institutional furniture units:

01. Conference chairs.
02. Conference tables.

(Units in any furniture type should be as many as number of units actually exists).

3. Model of furniture code: This code identifies the model of furniture, such as:

01. Jones design.
02. Refinery design.
03. Wokie design.
04. Forest Industries design.

4. Surface type or species of wood code: This code identifies the type of surface finish or the wood species, such as:

01. Clear lacquered surface.
02. Walnut stained lacquer.
03. Mahogany wood.
04. Walnut wood.

If we have a dining table of Jones design, for B

persons in walnut, the digital coding of the product according to the coding system outlined above will be as follows:

03.03.01.04