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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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GHANA

Technical report: Improving productivity in Ghana's furniture industry*

Prepared for the Government of the Republic of Ghana
by the United Nations Industrial Development Organization,
acting as executing agency for the International Trade Centre UNCTAD/GATT (ITC)

Based on the work of Sinan Cinar, adviser on production management in furniture and wood-based panels

Backstopping officer: A.V. Bassili,
Industrial Rehabilitation and Management Branch

United Nations Industrial Development Organization
Vienna

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EXPLANATORY NOTES

1. The rate of exchange of the Ghanaian Cedi to the United States Dollar in May 1987 was : U. S. $ 1.00 = Cedi 159.00.
2. The following abreviations are used in this document:

ECOWAS	Economic Community of West African States.
GATT	General Agreement on Tariffs and Trade.
GEPC	Ghana Export Promotion Council.
GFPA	Ghana Furniture Producers Association.
HSS	High Speed Steel.
ITC	International Trade Centre.
MDPI	Management Development and Productivity Institute.
NIB	National Investment Bank.
PVAc	Polyvinyle Acetate (Glue).
TCT	Tungsten Carbide Tipped (Cutters).
UF	Urea Formaldehyde (Glue).
UNCTAD	United Nations Conference on Trade and Development.
UNDP	United Nations Development Programme.
UNIDO	United Nations Industrial Development Organization.

ABSTRACT

Following a period of slow-down in its development in the 1970's, the Ghanaian furniture industry is undergoing a period of rehabilitation and expansion since 1984.

During an advisory mission from 11 May to 3 August 1987, a UNIDO advisor on Production Management in Furniture and Wood-based Products visited nine furniture factories and assisted / advised them on how to overcome their existing shortcomings and improve their factory premises, production equipment, dust extraction equipment, compressed air equipment, tool maintenance equipment, lacquer spray equipment, timber drying kilns, factory layout, production methods and technology, personnel, production planning and control, quality control, materials handling, costing and pricing, and, machine and tool maintenance. At various occasions, practical and on-the-job demonstrations were also given by the advisor.

It is recommended that the selected furniture factories with highest export potential identified by the advisor complement their existing production and auxiliary machinery with additional machinery and equipment as listed in the relevant annexes in the report. Additionally, these selected factories should receive further technical assistance in such specialized technical fields as machine woodworking, jig making and tool maintenance. On the other hand, the industry's needs for technology transfer, technical and trade information and trained technical and managerial local staff should be catered for.

TABLE OF CONTENTS

INTRODUCTION

Traditionally, wood and wood products are major foreign currency earners in Ghana. However, the share of the furniture manufacturing sector in the timber related export revenues is at present very small. The statistical data compiled by the GEPC indicates that the total exports in 1986 of finished and semi-finished furniture was only U. S. $ 967,677.

The Government's economic recovery plan, which was initiated in 1984 is directed towards an increase of value added exports using locally available raw materials. In this context, one of the priorities is concerned with the rehabilitation of existing and the creation of new wood processing facilities. Since then, new equipment and machinery are being imported with a view to the manufacture of higher value added products such as furniture and joinery components for export. This had helped greatly the development of a relatively well established furniture industry with basic manufacturing facilities.

Currently, the items manufactured are mainly for the local market. Designs are copied mainly from European catalogues or from competitors' products. Each item is more or less custom built to the customer's specifications and taste at a quality level acceptable locally.

Many techno-managerial aspects are needed to produce in series (a prerequisite for entering world markets) are not treated professionally. These include order processing and production planning,production and quality control, production technology, materials handling, costing and pricing, machine and tool maintenance, dust extraction and compressed air facilities, workshop layout, wood drying, product development, purchasing and inventory control, packaging etc.

In a comprehensive technical co-operation programme for trade promotion started in 1983, the International Trade Centre UNCTAD/GATT (ITC) is assisting the Ghanaian furniture industry to improve its shortcomings.

This report covers the findings and recommendations of an advisory mission to selected furniture manufacturers with export potential, from 11 May to 3 August 1987, undertaken by Sinan Cinar, the UNIDO Adviser on Production Management in Furniture and Wood Based Products. The adviser's job description is given in Annex I.

The adviser visited GEPC, GFPA and 9 selected furniture producers and met with the appropriate officials, managers and supervisors. The adviser's work programme is given in Annex II. The list of persons met is given in Annex III. The meeting with NIB, although contained in the advisor's terms of reference, did not take place due to reasons beyond his control.

In co-operation with the GFPA and the MDPI, the advisor organised two two-day seminars on production management, one in Accra and the other in Kumasi. The programme of the seminars is given in Annex IV.

Upon completion of his mission, the advisor presented his findings and recommendations to the Government, UNDP, GFPA and GEPC officials at their respective headquarters in Accra.

I. FINDINGS

A. General

Factory Premises:

The majority of factories visited were originally small carpentry and joinery workshops. Those companies which are still using their original site after expansion and growth have inferior premises than those that have moved to new sites with new premises. Some companies are still carrying out further improvements. However, lighting and working conditions in the production areas are universally neglected.

Production Equipment:

The production equipment is a mixture of old and new, with both standard and specialized machinery. Most of the existing equipment is of Italian, German or British origin. Some latest models of equipment such as automatic rotary shapers, automatic four-side planer -moulders also exist. In many instances, duplication and even triplication of some of the production machinery can be seen whereas only one machine would suffice if properly and fully utilized. On the other hand, dowel making, dowel hole boring and veneering equipment is missing. This can be attributed to the following shortcomings:

1. No proper study of what is to be produced, in what form and in what quantity.
2. No prestudy of processes and equipment involved exists.
3. Inadequate knowledge of existing modern production technologies and methods.
4. Partial advice from the machine manufacturers and sellers.

Auxiliary Equipment:

None of the factories visited had fully operational dust extraction equipment. Some factories however, had purchased the necessary fans and filter units or silos and are in the process of installing them. It is clear that the importance of having such equipment was recognized only recently.

All the factories visited, except one, lack a properly installed compressed air system. For instance the pipes are laid without any inclination and outlets are on the underside of the pipes. Such air purification and regulation units as filters, oilers, pressure regulators and moisture traps are not used.

Generally the tool maintenance equipment is considered as an integral part of the plant. Most of the necessary machines exist in the factories. However, grinding and maintenance of cutters and blades is somehow very much neglected.

Awareness of the necessity of kiln drying of timber is high among the management. The firms visited either had a kiln or were in the process of purchasing one. Two of the companies had vacuum dryers and both were very pleased with them because of the relatively short drying times obtained.

Range of Cutting Tools:

There is a general lack of appreciation of the importance of good quality and appropriate type of cutting tools on the quality of the final product. There is also a lack of technical know how necessary for the chosing of the right type of tool. The use of HSS circular saw blades in cross cutting and ripping of abrasive tropical Ghanaian timber species and in sizing of plywood and particleboard is wide-spread. Generally, a mixture of HSS and TCT cutting tools are used.

Factory Layout:

The factories visited had either one or both of the following two layout problems:

1. Inadequate space allocation for the operation, infeeding, outfeeding and servicing of machines, for the work-in-progress between the machines, and for the intermediate storage areas between the stages of production such as machining, finishing, assembly and shipping.

2. Location of the production machinery in the wrong sequence, i.e. not following the logical sequence of production.

These problems are more marked in those companies expanding around their original workshop.

Raw Materials:

Timber: Based on the county's vast tropical forest resources and valuable timber species, there are about 100 sawmills concentrated mainly in Takoradi, Kumasi and Ejisu. Almost all of them are currently export oriented because of attractive export prices and government incentives.

This leads to the export of high quality and long length timber and leaves the lower quality and shorter length timber to the local wood-using industries such as furniture and joinery industries. Those furniture manufacturers who want to enter in export are setting up their own log breakdown and resawing facilities to manufacture the sawn timber they need in the quality and dimensions which will satisfy them. However, from the dimension point of view, it should be pointed out that the nominal lengths of timber used in the furniture industry can be grouped as follows:

1. 30cm to 60cm : Can be used for certain parts of chairs and coffee, side, and nesting tables and stools.

2. 60cm to 100cm : Can be used for certain parts of chairs and dining,coffee, side and nesting tables, stools, settees, arm chairs and kitchen cupboards.

3. 100cm to 150cm : Can be used for certain parts of chairs and dining, coffee tables, beds and settees.

4. 150cm to 220cm : Can be used for certain parts of dining tables, settees, beds, cupboards and wardrobes.

The current high amount of waste can be reduced drastically by careful cutting to length and thickness during the machining operation.

Wood-based Panels: The principal wood-based panel material used in Ghana is plywood. There are about six manufacturers in the country. The common size is 1200mm X 2440mm, produced in thicknesses of 3, 4, 5, 6, 9, 12, 15, 18, 22 and 25mm. Its quality is relatively very low. The manufacturing faults such as pleats, gaps, knife marks, stains and delamination are very common. Wood particleboard is also produced with or without face veneers. However, as for plywood, the quality is low. The cross-sectional density is uneven, the fine surface layers are not equal on both sides. Currently its use in furniture is very limited. The quality has to be improved and the confidence of the manufacturers should be won to increase its share in furniture. At present, it has a very bad reputation among the furniture manufacturers.

Veneer: Although sliced and peeled veneers are produced extensively in Ghana and exported by about 35 factories, their use by the local furniture manufacturers is negligeable. This is mainly due to the unavailability of veneering equipment in the furniture factories and the extensive use of plywood.

Lacquers and Varnishes: All of the furniture manufacturers visited were using imported Nitrocellulose lacquers. However, the same type of lacquers and thinners are manufactured locally. The main reason given for not using the locally made ones was their inconsistent quality.

Adhesives: The most common adhesives used are PVAc emultions and neoprene contact adhesives. The PVAc adhesive is used for assembly gluing, veneering and laminating whereas the contact adhesive is used for veneering of both surfaces and edges and high pressure laminate gluing. Only one factory among the ones visited was using powder UF adhesive in the hot press for veneering and laminating. The PVAc adhesive is also manufactured locally though the furniture manufacturers claim that the quality is very low.

Hardware and Fittings: All the hardware and fittings are imported as there is no local production. The availability of different types and varieties is limited to a few, such as locks, butt hinges, iron connectors for bed sides and screws. Since the ease of import restrictions recently, some of the furniture manufacturers have been importing hardware and fittings for their own use. However it is a lengthy procedure. In view of this, almost all furniture manufacturers do not consider importing hardware for their furniture exports.

Upholstery Materials: All upholstery materials such as fabrics, webbings, springs and brad nails are imported. Polyurethane foam is the only upholstery material produced in Ghana.

Packaging Materials: Packaging materials such as corrugated paper board, single wall cardboard, polythene film and expanded polystyrene are manufactured locally. No packaging is used for the locally-sold furniture. For the exported items cardboard boxes, imported shrink foil, polythene film and wooden crates are used in combination with containers.

Management:

Almost all of the factories visited are managed by the owners who have started their businesses as small workshops. Having no experience in performing such vital functions as business planning (financial and operational) business control and personnel management of any significant magnitude, the problems associated with a weak management are clearly visible. The machines and workers standing idle, the low productivity, high rate of timber waste, poor quality, accumulated parts and components from past production runs, general attitude to take things easy, delays in meeting deadlines, aimless drift of company towards various unrelated product lines, little or no delegation of work to subordinates are some of these symptoms.

In order to cure many of the above problems, the owner managers should change their attitude, accept their shortcomings and take corrective action. One approach would be the appointment of generalist type of professional managers.

Most of the middle managers and supervisors are incompetent and untrained for the job they are doing. In most cases, qualified and trained personnel are not employed for such positions as production management, production planning and control, technical draughtmanship, machine and tool maintenance. Instead, these positions are occupied by craftsmen who have no skills in supervision and leadership, and lack initiative. Consequently these also compound the overall unsatisfactory performance of the company.

In the light of the above, it is difficult to see just how these young and growing businesses will achieve their objectives.

Workforce:

A mixture of artisans with some carpentry and joinery skills and plain workers / helpers with no skills are used in all the factories visited. There are no machine woodworkers to operate the recently purchased modern woodworking machinery correctly to the fullest capacity. It is not unusual to see carpenters cutting mortises with a hand chisel and hammer while the mortising machine stands idle, or hand planing while the planing and thicknessing machines stay idle. These workers also have no experience in correct machine setting-up procedures as well as in safety and tool and machine maintenance. Consequently

it can be predicted that the useful life of these new machines will be short.

Production Planning and Control:

There is a general misunderstanding of the whole procedure of production planning and control and what is involved in it. In most cases, such expressions as production planning, production control, process control and order processing are used interchangeably. The majority of factories visited see these as a procedure for processing orders. Hence, there is no yearly or monthly production planning originating from a sales plan. When an order is received, it is either entered on an order form or scribbled on a piece of paper and passed on to production. With only one exception, none of the factories visited use any kind of technical or working drawings in production. Instead, an artist's impression is poorly drawn on a piece of paper without any substantial detail and dimensional measurements. Many of the final dimensions of the final product depend on the ability of the carpenter to elaborate and to use his imagination. Therefore, production time, material usage and the amount of rework is very high. Other problems which are associated with poor or no production planning and control include incomplete production, non-interchangeable parts, excessive hand fitting work, left over parts and components from past production runs, idle production machinery and workers and high ratio of timber waste.

Quality Control:

None of the factories visited had adequate procedures for quality control. The existing quality level is attained by some visual inspection especially at the final stages of production. No quality control checks are made throughout any of the stages of production. Generally little attention is given to quality control since the attitude of "Good enough" prevails throughout the industry especially for furniture manufactured for local sale. This is probably because of the local customers' acceptance of low quality furniture matched with a low price. Under such a condition, improvement of general quality throughout the industry will be very slow unless a quality awareness is created among the end users. Local quality standards will affect adversely the quality of export products and hence the ability to export.

Costing and Pricing:

The extent of the Ghanaian furniture industry's success in securing a large share of export markets for furniture depends essentially on its ability to produce well designed, well constructed and competitively priced furniture.

Currently, an unskilled production worker earns about 5,000 Cedis/month and a skilled carpenter with some supervisory duties earns between 7,000 and 10,000 Cedis per month. These low wages do not play a bigger role in

achieving a competitive price if productivity is even lower. On the other hand, timber prices vary between Cedis 36,000 and 71,000 per cubic meters as shown in the following table:

Cost of Some Species in Accra, in May 1987

Species	Price per cubic m
Afromosia and Shedua	Cedi 71,500
Redwood species such as Danta, Makore, Sapele, Utile, and	" 62,500
Odum	" 50,000
Mansonia and African Walnut	" 46,500
Emery, Ofram, Wawa	" 36,000

Because of the low wage rates and availability of valuable timber species at reasonable prices, the furniture producers should be able to produce at competitive prices.

The information obtained on the costing and pricing practices of the factories visited indicates that the "full-cost" pricing method is used throughout. However there are wide variations in the cost structure from one company to another as can be seen from the data compiled and below:

Cost Groups	% of Total Cost
Direct materials	40-65
Direct labour	25-30
Overheads	7-30
Transport	1-5

Production Methods and Technology:

Almost universally, the local customers bring their own designs. Therefore, the production of local orders is done on a one-off basis. One or two companies had easy chairs and setees manufactured for stock in small batches. However, in both cases, extensive hand planing, mortising, sawing and fitting is involved. Those factories who were manufacturing for export used batch production methods according to buyer's samples and technical drawings.

The degree of automation is confined to automatic operation of some of the machinery such as through feed 4-side moulders, automatic hydraulic copy turning lathes and automatic rotary shapers.

Jointing of solid wood parts is by mortise and tenon, dovetail or corner locking. All the joints are nailed after gluing alledgedly "for holding the parts together during setting of the glue and for additional strength in use". However, instead of this practice, quick setting PVAc adhesives modified for tropical climates could be used.

Materials Handling:

The handling of timber in the timber yard is mainly by hand. Only one factory among the ones visited had a side-loading fork-lift, and another one had sheds for air drying. The use of stickers in the timber stacks was usually omitted. This slows down the natural air drying of timber and causes discoloration.

There are more than good examples in the production halls. Planed and moulded workpieces are put (sometimes thrown) on the concrete floor in a disorganized and careless way.

Such damages as surface sinking and corner breakages are difficult to remove after this stage; they have a direct influence on the quality of the final product.

Machine and Tool Maintenance:

The machine and tool maintenance is a total catastrophe. Daily or periodic preventive maintenance and lubrication of equipment and changing and sharpening of cutting tools are more the exception than the rule. It is not unusual to see rusty and worn-out machine slides, vibrating spindles and arbors due to lack of timely lubrication and change of bearings, smoke coming out of a piece of wood being cut with a blunt circular saw with resin accumulated in the gullets, burnt cutting edges and tips on boring and mortising bits. As a direct result of the above, dimensions of the work-pieces are inaccurate, fibres are either broken or torn off on the surfaces of the turned, planed and moulded pieces.

The following reasons are all contributing to this unsatisfactory situation:

1. The lack of appreciation by management of the importance of machine and tool maintenance and its effect on the life of machines and tools and the quality of the final products. Therefore, neither the necessary action is taken nor is guidance given by management.

2. The lack of technical schooling, in-service training and experience among the existing maintenance personnel.

3. The non-availabilty of necessary maintenance equipment. (This does not apply to all factories).

4. The shortage of spare parts and supplies and difficulty in obtaining them in a reasonably short time.

5. The lack of motivation and positive attitude among maintenance staff. Discipline can not be expected from a lubricator if he does not understand the usefulness of what he is doing.

B. At the Factories Visited:

1. Furnart (Ghana) Limited:

General:

This firm manufactures all kinds of furniture and doors copied from European designs and suited to the taste of local customers. So far it has not exported to overseas countries. The company profile is given in Annex V.

Factory Premises:

The original buildings are too disconnected, this does not allow a sequential production flow. A new shed is under construction which will connect the two existing buildings to form an L shaped production hall. It will be sufficient for a medium size factory if well organized.

Production Equipment:

A mixture of old and new equipment of good quality is used. Some of the newly arrived machines have not yet been commissioned because the production halls can only be re-organized after the completion of the new shed. If the existing machines are complemented with some additional ones, the factory could be one of the best equipped and most versatile to produce furniture, joinery and their components. The list of recommended additional equipment is given in Annex VI.

Dust Extraction Equipment:

Currently there is no dust extraction equipment.

Compressed Air Equipment:

There are three portable compressors in the factory for the operation of spray guns and pneumatic staplers. However, the piping needs to be correctly laid and the air purified as per Annex VII.

Tool Maintenance Equipment:

At present, the existing tool maintenance equipment is far from even minimum requirements. The existing equipment should be complemented with additional equipment as listed in Annex VI.

Lacquer Spray Equipment:

At present lacquer spraying is done with spray guns and in the open. A purpose-built room with adequate ventilation, water wash type spray booth and lighting is required.

Timber Drying Kilns:

During the advisor's presence, a vacuum drying chamber of 1.5 cubic meters capacity was put into operation. At least 10 cubic meter of kiln dried timber is needed per week for the current volume of production. The existing kiln can only dry about 4 cubic meters in a week, based on 2.5 charges per week.

Factory Layout:

At present the machines are badly laid out partly due to limited space and disjointed buildings. However, the management has plans to improve it as soon as the new construction is completed.

Production Methods and Technology:

Products are manufactured to individual customer's designs and specifications on a piecemeal basis.

The production machinery is used more or less for rough machining. All the remaining detail work and fitting is done by hand planing, sawing, chiselling etc. The main reason for this is the negative attitude of carpenters towards the use of machines. The joints are either mortise and tenon or corner lock and dovetail. The joints are always glued and then nailed. Wooden dowels are never used.

Personnel:

The factory is managed by an Italian expatriate who has long experience in building construction, carpentry and furniture making. The overall management of the factory needs to be improved considerably by organizing functional departments and delegating authority as suggested in Annex VIII.

The skills and competency of the supervisors have to be improved drastically.

The workforce is made up of carpenters and unskilled workers, whose working habits and methods have to be changed towards using machinery as much as possible.

Production Planning and Control:

At present no productin planning and control is carried out. The progression of orders is chased by the management verbally and/or visually.

Various aspects of production planning and control were explained to the management (See Annex IX).

Quality Control:

The management's understanding of quality is very high. The factory maintains a higher product quality than any other firm visited by the advisor. Designation of a quality control officer and implementation of a systematic quality control system as suggested in Annex X would increase the existing quality level.

Materials Handling:

Almost all the timber stacks in the timber yard are made without any spacer sticks and stack supports for air drying. Timber stacking as shown in Annex XI is essential for good air drying of timber without degradation. Pallets and pallet trucks are not used in the factory. Materials and work-in-progress are always put on the floor. The use of various types of wooden pallets shown in Annex XII would help to use the floor space more efficiently, reduce the downtime in moving the material and increase the production flow and quality.

Costing and Pricing:

The limited information obtained on this matter is inadequate to make a meaningful evaluation. However, the cost structure of products indicates that a rather accurate costing is undertaken.

Machine and Tool Maintenance:

No preventive maintenance and lubrication is undertaken on a regular basis. The existing maintenance personnel is capable of doing it if motivated. The implementation of a machine maintenance system as shown in Annex XIII is suggested.

Tool maintenance is very primitively done mainly due to unavailability of maintenance equipment, lack of supervision and motivation.

Prospects for Export:

The factory is one of the most promising for export of:

-Cut to size blanks,
-Machined furniture parts,
-Joinery,
-Turned furniture parts,

provided the adequate kiln drying capacity is urgently installed and the above shortcomings are remedied.

2. Pee Wood Processing Limited:

General:

This company moved recently to its new premises from the original workshops. At present only custom-made furniture on a one-off basis is manufactured. The company profile is given in Annex XIV.

Factory Premises:

A modern purpose-designed factory building is under construction. Halls for housing the production machinery are already in use. Sanding, finishing and upholstery departments are still kept at the previous workshop site, where the working conditions are primitive by any standards.

Production Equipment:

Basic woodworking machinery from the previous workshop have been complemented by some very modern and special purpose new machinery. However, some additional machinery is still needed to carry out all the necessary operations. These are listed in Annex XV.

Dust Extraction Equipment:

Currently there is no dust extraction equipment. Therefore, proper operation of some of the special purpose machinery is hampered and distrupted by the shavings and chips they generate. The management is already in contact with some manufacturers for the supply and installation of a complete dust extraction system.

Compressed Air Equipment:

A small size compressor is used in the new factory building and a portable one in the old workshop. A larger capacity compressor with a proper air conditioning and purification system will be required when all the machines are operating at full capacity.

The compressed air pipes are not correctly laid out and should be improved as suggested. (See Annex VII.).

Tool Maintenance Equipment:

The existing tool maintenance equipment is adequate and in good condition. The only missing piece of equipment is a lap grinding machine for butt-welded band saw blades.

Lacquer Spraying Equipment:

Lacquer spraying is done by spray guns at the old workshop premises under unsuitable working conditions; the necessary infra-structure is ready and remains unused at the new factory site. Fine sanding is carried out in the spray room using orbital hand sanders after the furniture has been assembled. Suggestions for doing the surface sanding in the production hall before assembly and reorganization of the spraying and drying rooms at the new factory site were made to the management. A water-wash type spray booth should be used.

Timber Drying Kilns:

Currently a vacuum kiln with a 4 cubic meters drying capacity per charge is in operation. A second 7 cubic meters kiln with conventional drying system is under construction. Further drying capacity will be required when the factory will be operating at full capacity.

Factory Layout:

In the existing layout, most of the machines are placed in a sequential order of production. However, a few machines need to be relocated. In addition to the above, the allocation of storage areas for work-in-progress may not be sufficient when operating at full capacity. An improved layout was suggested.

Production Methods and Technology:

At present, various furniture items are manufactured to customers' specifications on a one-off basis. Due to lack of precision in the machining of various parts, individual hand fitting using hand tools is carried out. The jointing techniques used are mortise and tenon and dovetail joints. Wooden dowels are not used. The use of nails after gluing the joints together is a common practice.

Personnel:

Despite the presence of a positive management, skilled and competent middle managers and technicians are urgently needed. This matter was taken up with the higher management and the job specifications were prepared. A model organization as shown in Annex VIII was also proposed.

The workforce is made up of skilled carpenters and unskilled workers. On the job training is urgently needed.

Production Planning and Control:

At present no production planning and control is carried out. The main reasons are non-existance of qualified staff, production on a one-off basis, as well as lack of appreciation of the importance of this aspect. The period until when a major export order is received could be used as a training period for supervisors and workers in using a system. Aspects of production planning and control were explained to the management (see Annex IX).

Quality Control:

It is very informal, unsystematic and relatively low. A quality level statement from higher management, designation and training of a quality control officer and the training of the workforce is urgently required. In this respect a systematic approach as outlined in Annex X is suggested.

Materials Handling:

The handling of timber in the timber yard and preparation of timber stacks for air drying was not proper. However, suggestions made by the advisor to rectify this were immediately followed up by the management.

Transportation of workpieces from one machine to the other is by wooden pallets and a hydraulic pallet truck.

Costing and Pricing:

This is not very precise at present. A thorough analysis of all cost elements especially the overheads is necessary. The entire costing procedure should be systemized as soon as possible. A simplified system as outlined in Annex XVI is suggested.

Machine and Tool Maintenance:

No preventive maintenance and lubrication was being carried out. Upon the advisor's suggestions, the positive attitude of management brought immediate action.

Despite the existance of a fairly well equipped tool maintenance room, blunt cutters and saw blades are used without regrinding at the right time. The machine operators need to be trained and instructed, and corrective action should be taken when needed.

Prospects for Export:

This factory has the highest potential for export among the ones visited. The production line is suitable to produce following high quality products:

-Chair componets,
-Profile boards and mouldings,
-Turned parts,

provided the existing limitations as identified under various headings above are remedied.

3. Motkits (Ghana) Limited:

General:

This company is producing wooden educational toys for both the local market and export, and radio boxes for a local radio manufacturer. The company profile is given in Annex XVII.

Factory Premises:

The existing premises are used for the manufacture of wooden toys and radio boxes, are adequate for the present machinery and production volume. A new building site is ready for the construction of a new factory building for flush door manufacturing.

Production Equipment:

A mixture of general purpose woodworking machinery and power tools with appropriate attachments are used. Additional equipment for mechanized high volume production was discussed and a suggested list of machines was drawn up (See Annex XVIII). A sperate list of machines and equipment for mechanized flush door manufacturing was also drawn up for the management.

Dust Extraction Equipment:

A fan and a filter have already been purchased. The management has plans to connect the system after the purchase of additional production machinery. Although the wood chips and the saw dust are not disturbing the production, their removal will increase the machines' performance and accuracy and cutter life.

Compressed Air Equipment:

The present system consists of a portable compressor and piping with no moisture traps and air purifiers. Trio units should be fitted on all machines. Suggestions to improve the compressor room and the piping as in Annex VII were made.

Tool Maintenance Equipment:

The basic equipment for the sharpening of standard cutters, boring bits and saw blades exists. However, a seperate room for tool maintenance with appropriate work benches and tool storage cupboards is required as shown in Annex XIX.

Lacquer Spraying Equipment:

Compressed air spray guns are used mainly for the lacquering of radio boxes. In order to improve the quality, working conditions and increase the volume of production, the use of a spray booth with an overhead transporter and a hot air drying tunnel are necessary.

Timber Drying Kilns:

At present this company has no timber drying kilns. Only air dried timber is used for the solid wood parts of the toys manufactured. Due to the the small size of these parts, no problem is encountered.

Factory Layout:

The existing workshop used for the manufacture of wooden toys and radio boxes is well organized.

Production Methods and Technology:

The production of wooden toys and radio boxes is carried out in batches resulting in good machine and manpower utilization.

Jigs are used extensively throughout the production. However, the precision of the existing jigs should be improved. The assembly of radio boxes can be speeded up drastically if quick-setting modified PVAc or Hot Melt adhesives are used. Practical suggestions in this direction were made at the workshop level.

Personnel:

The company is managed by its owner-manager. The management functions such as instructing, delegating, coordinating and controlling are used remarkably well.

The work force is a mixture of carpenters and unskilled workers but all are well trained for what they are doing.

Production Planning and Control:

A system adequate for the present volume of production is used. Scheduling of machines is done daily and the production control is delegated to the foremen but monitored by the owner-manager. The overall coordination is maintained through daily meetings with the senior production staff.

Quality Control:

This factory is the only one among the ones visited, which has a systemized and formalized quality control procedure. Each product is checked and a quality control report is issued. The quality of final products is relatively high.

Materials Handling:

Wooden pallets are used in most cases but there is still room for improvement. The use of some additional internal transport trucks and pallets as shown in Annex XII will be helpful.

Costing and Pricing:

A systemized full-cost pricing is used.

Machine and Tool Maintenance:

The regular preventive maintenance and lubrication of machines is lacking. However, this is not a major problem due to the present relatively small equipment inventory.

Prospects for Export:

This company is already exporting educational toys for children. The amount of exports is limited by its relatively small production capacity.

4. A.Lang Limited:

This company is a major contractor in Ghana with several production facilities all over the country. At their facility in Tema, furniture and joinery is also produced. The company now intends to transform the existing workshop into a high volume furniture and joinery production factory. The adviser prepared a suggested layout and drew up a list of required equipment.

5. Akuaba Limited:

General:

At present this company is producing a wide variety of items including several kinds of children's wooden toys, children's furniture, garden furniture, occasional furniture, beds, tables and chairs and chopping boards for kitchens. The company profile is given in Annex XX.

Factory Premises:

The expansion of the original factory buildings has just been completed. The available floor space for production activities is sufficient for the present production volume. However, intermediate storage areas for work-in-progress may not be sufficient at higher production volumes if machine loading and production flow is not well organized.

Production Equipment:

The production equipment consists of used toy manufacturing equipment from the original factory and new general purpose woodworking equipment acquired during the expansion programme. The company's aim is to have a universal factory which can switch from one product line to another as may be demanded by the market. In order to increase the versatility of the production line, additional equipment were suggested. (See Annex XXI.).

Dust Extraction Equipment:

All the necessary components of a complete system have been purchased and delivered. Construction of the silos and assembly of the system is under way.

Compressed Air Equipment:

This company has an adequate system well selected, designed and installed.

Tool Maintenance Equipment:

The tool maintenance room is well equipped. The only extra equipment necessary is a lap grinding machine for butt welded band saw blades.

Lacquer Spraying Equipment:

Spray guns and a dry-back spray booth is used. The spray booth is of a small size, suitable only for small items such as toys and toy components. A large size spray booth (w=2500 mm, h=2000 mm) with a water wash system mounted flush on the floor is suggested.

Timber Drying Kilns:

Currently only air dried timber is used. A dehumidification type of kiln is under construction which will be used exlusively to dry timber for export orders.

Factory Layout:

The factory layout is based on flow processing in a sinuous form. Some machines are badly placed and spaces between the machines for work-in-progress are not adequate.

Production Methods and Technology:

The production of various items is carried out in batches. Machine utilization rate is higher than in other factories that were visited by the advisor. Despite the existance of dowel making machinery, only mortise and tenon and dovetail joints are used.As common throughout the industry, the joints are always nailed after gluing.

Personnel:

The top management positions are occupied by the owner

managers. The over-occupied top management hardly finds time to supervise, guide and control the workforce. Therefore the middle management and supervisory positions have to be filled by qualified personnel immediately.

The work force is composed of carpenters and unskilled workers. The amount of manual work is comparatively little.

Production Planning and Control:

At present, production planning and control is limited to a computer print-out giving details of the product and instructions on various operations involved. In most cases, a technical drawing is also issued together with the instructions. This is only a fraction of a whole production planning and control procedure designed by the management. Currently it is not fully implemented because of the lack of middle managers. However, when implemented, the number of forms for conveying the information and for feedback will be too many. The use of only two forms which combine all the essential information from various forms is suggested. Various aspects of production planning and control were explained to the management (See Annex IX).

Quality Control:

There is a complete lack of quality control during processing. Machining faults such as sanded-through plywood cutter marks, torn off fibres, rough surfaces can be seen widely. These machining faults should be tracked at their source and preventive measures be taken before the next operation. One faulty part in an assembled item is enough for the rejection of the entire item.

Materials Handling:

The layout of the timber yard is well organized and the timber stacks are well prepared.

The handling and transport of work-in-progress within the factory need to be improved. Wooden pallets are not allways used. Sometimes, parts or components are thrown on the floor or on the pallets even after surface sanding. Such surface damages as marks and sinkings are difficult to remove after this stage.

Costing and Pricing:

A full-cost pricing system is used. Because of additional expenses such as container fees, transport charges to the harbour and courrier fees, a reduced profit margin is used in pricing the export orders.

Machine and Tool Maintenance:

No preventive maintenance and lubrication is undertaken in a programmed manner. The machine maintenance technician inspects the machine when there is a break-down. This can only be due to the lack of supervision by a technician and the appreciation of the usefulness of preventive maintenance. Implementation of a formal system is suggested (See Annex XIII).

Cutters and saw blades are often kept on the machine after they have become blunt and used without resharpening. Because of this, and because of the excessive feed rates used, most of the carbide tips are chipped off and used without repairing.

Prospects for Export:

The company is already exporting wooden toys and toy components. Specialization in the production of toys, toy components, cut to size blanks and profiled mouldings would enable it to emerge as a factory with a high export potential.

6. Modern Furniture Limited:

General:

The company is currently exporting chair components to the U.K.. In addition to the chair components for export, coffee tables, dining tables, office desks and upholstered chairs are manufactured for the local market. The company profile is given in Annex XXII.

Factory Premises:

The factory buildings are of steel framing and are built on a swampy land. The buildings lack any maintenance. The entry of raw material into the production halls is problematic because of the swamp just outside of the building, and high steps in front of the gates. Timber can be brought in only by hand piece by piece. The lighting is insufficient especially in the assembly and finishing areas. The installation of sufficient flourescent lighting and use of transparent roofing panels in parts of the roof are urgently needed.

Production Equipment:

Most of the production machines with the exception of three - (one surface planer, one thickness planer and one four-side planer moulder) - are from 1960's and 1970's. The existing machines do not add up to a full production line other than a line for the manufacturing of chair components. The addition of a set of dowel making machinery and a round tenon making machine to the existing machinery would enable the factory to produce also dowelled and round tenoned joints. The list of these and other additional equipment recommended for this company is given in Annex XXIII.

Dust Extraction Equipment:

There is no dust extraction equipment for most of the machines in operation. One small filter unit extracts the sanding dust from the belt sander into the atmosphere because only the fan is operational at present. For the improvement of the product quality, working conditions of the employees and proper functioning of the machines, a complete system is urgently required.

Compressed Air Equipment:

There are two stationary compressors for the supply of compressed air required by the main production machines. The piping system is incorrectly done. There are no moisture traps, drain outlets, air filters, pressure

regulators and oiling units connected to the system. A duo unit (filter and oiler) on one of the machines is in such a condition that it was not possible to ascertain whether it was still functional. A properly laid out piping system is necessary (See Annex VII).

Tool Maintenance Equipment:

At present there is no tool maintenance equipment in the factory. Tools are being sharpened by an outside service shop. The information obtained indicated that equipment for a complete tool maintenance room has been ordered.

Lacquer Spraying Equipment:

A spray gun is used in a specially built room. However there is no spray booth. The lighting is insufficient.

Timber Drying Kilns:

There are five kiln chambers, consisting of one Wells (U.K.) direct electric heated kiln with an estimated capacity of 10 cubic meters/charge, and four Bollman (F.R.Germany) hot water heated kilns each with an estimated capacity of 5 cubic meters / charge. However, at present the 10 cubic meters electric heated kiln is not operating due to high electric energy consumption.hence high operating costs. Two of the four Bollman kilns also are not operating because of lack of spare parts.

For the current rate of production, the kiln capacity which is (5 cubic meters X 2) 10 cubic meters, may be enough, but if the factory is operating at 50% of its capacity, about 3 cubic meters of dry timber is needed per day. If a drying cycle is considered to be 3 weeks then the installed capacity has to be (3x5=15 days x 3 cubic meters) 45 cubic meters.

In anticipation of future export orders of a large volume, all the kilns have to be put into operation as soon as possible. The management has indicated that they have taken action in this respect.

Factory Layout:

The order of the machines, as they are placed in the factory, does not reflect a sequential production flow. At high production capacities, congestions in material flow will occur. Modifications to the existing layout were suggested to the management.

Production Methods and Technology:

Production of local orders is piece-meal according to customers' own catalogues, pictures or desires. Chair components for export are manufactured in batches.

Hand planing, sawing and chiselling is done extensively, which is an indication of not using the production machinery fully, lack of precision in machining and lack of production control.

Personnel:

The factory is owner-managed since its foundation as a carpentry shop. The management skills are weak and

management functions are not performed fully. The work force is made up of carpenters with no or little motivation. The productivity is estimated at 10% of what can be achieved.

Production Planning and Control:

Currently no production planning and control is done. The production manager convevs instructions to the workers verbally. Various aspects of production planning and control were explained to the management (See Annex IX).

Quality Control:

No quality control is currentiv practiced to any acceptable degree, especially at the processing stage. The quality of finished items is relatively low. The use of a simplified quality control system is suggested and was explained to the quality control officer (See Annex X).

Materials Handling:

Wooden pallets and a pallet-truck are used for the internal transport of work-in-progress. However, this is not always the case.

Handling of timber before and after kiln drying is very rough. Boards are irregularly piled or thrown on the sandy floor. The sand particles which get into the wood cause severe blunting of the blades.

Costing and Pricing:

The costing of products is undertaken by the production manager according to full-cost pricing method. A round figure for overheads is used which seems rather high. Re-calculation of overheads and use of systemized costing procedure is suggested (See Annex XVI).

Machine and Tool Maintenance:

Machine and tool maintenance is not undertaken. Cutting tools - especially circular saw blades, band saw blades and boring and mortising bits - are in a very bad condition and should be replaced immediately. Saw blades are full of broken teeth and chipped off tips. Grinding is done so badly that no attention is paid to the original shapes and angles of the teeth.

Because of the lack of preventive maintenance and lubrication of any kind, the machines are run down with the exception of three newly purchased ones. A simplified maintenance system was discussed and the maintenance personnel was urged to implement it as soon as possible (See Annex XIII).

Prospects for Export:

Availability of timber drying kilns is an advantage. Chances in exports of cut to size blanks and semi-finished chair components are very high.

7. Ashanti Furniture Company Limited:

General:

This company is currently manufacturing sitting room and dining room furniture for the local market. However, the management's intention is to enter export markets within the next two years. The company's profile is given in Annex XXIV.

Factory Premises:

The existing factory premises are located on a relatively small plot with no possibility of expansion. The production halls are of timber frame construction with low ceiling. Minimum ceiling height for furniture factories is 4 meters. All the dust extraction ducts, compressed air pipes, and cables should be above the ceilng in the roof space.

The present lighting conditions are not adequate.

Production Equipment:

The production equipment consists of solid wood processing and veneering machinery. A relatively unutilized high excess production capacity exists due to duplication and triplication of several machines and underutilization. On the other hand, some basic machinery and equipment are missing. These are listed in Annex XXV.

Dust Extraction Equipment:

At present the factory has a half installed system consisting of a silo and main ducting. Nooe of the production machinery is connected to the system. Contrary to the normal practice of round cross sections, the existing ducts have square cross sections as in air conditioning systems. The wood chips and the saw dust move in the duct in a helice. Square ducts do not permit this to take place thus the proper extraction will not take place.

Compressed Air Equipment:

The factory has two compressor units. The main unit is for the production machinery and the secondary unit for the lacquer spray room. At the time of the visit, the main unit was out of order. The compressed air pipes are not properly laid and should be corrected. Details of a proper system are given in Annex VII.

Tool Maintenance Equipment:

The tool maintenance room is fairly well equipped and manned. The only major shortcoming is the nonexistance of a narrow band saw blade sharpening machine. The existing band saw blade sharpening machine is for wide band saw blades. Narrow band saw blades are currently sharpened by hand on a bench. Butt welded sections of the band saw blades areunevenly ground on a bench grinder.

Lacquer Spray Equipment:

Lacquer spraying is done with a spray gun in front of a wall. The lighting and ventilation have to be improved considerably.

Timber Drying Kilns:

Currently there is no timber drying kiln. Only air dried timber is used. The information obtained from the management indicates that two kilns each with 15 cubic meters capacity per charge are on order. They will have an oiled-fired boiler.

Factory Layout:

The present factory layout is very poor and has to be improved drastically. Cross-cutting, ripping and sizing machines are placed at the far end of the production hall opposite to the main materials entrance door. On the other hand, there are two foremen offices and one general production office situated in the production hall. This greatly interferes with the execution of a sequential production flow and rational materials handling. An improved layout was sketched for the management.

Production Methods and Technology:

The production of standard items such as sitting room furniture is done in batches. Special custom orders are manufactured individually.

Mortise and tenon joints are used in combination with nails. Despite the existance of dowell making machinery, wooden dowels are not used.

Personnel:

The company is managed by a professional manager. The staff occupying the middle management positions seem to be sufficiently experienced but unmotivated. Therefore, drastic improvements in overall management and motivation of personnel are urgently needed.

Production Planning and Control:

Currently no production planning and control is undertaken. As a result of this, a lot of parts had accumulated in between the various production stages on the production floor. This problem is so serious that there is hardly any space for new work-in-progress to flow freely between various production machinery.

Quality Control:

During production, the level of quality depends on the experience and the mood of the machine operators and the foremen. A formal control of quality is undertaken only after the assembly stage (during staining).

Materials Handling:

The existing inefficient plant layout causes excessive and unnecessary handling and transport of lumber over a long distance from the timber yard to the cross cutting saw. Rationalization of the material handling by improved factory layout is suggested. Faulty and inadequate materials handling are partly responsible for relatively high work-in-progress, deterioration and damage of parts, increase of labour costs and underutilization of space and machinery. Several different types of materials handling and transport aids can be used to improve the existing

inefficient materials handling. These are shown in Annex XII.

Costing and Pricing:

A pricing method based on full-costing of items is used. The percentage of overheads used seems relatively high. In the advisor's opinion, the overheads should represent between 25% and 35% of total costs.

Machine and Tool Maintenance:

This factory has one of the best equipped and manned machine and tool maintenance facilities. The grinding of cutting tools is done professionaly. On the other hand, The preventive maintenance and lubrication of the production machinery and auxiliary equipment is completely neglected. A simple but adequate preventive maintenance and lubrication system was explained to the maintenance staff at the factory (See Annex XIII). In the advisor's opinion, the motivation and effective management of the existing staff will improve the situation drastically.

Prospects for Export:

The existing production capability cannot be turned to any long-lasting export success until the procurement and commissioning of the timber drying kilns.

The existing production machinery if complemented with the items suggested in Annex XXV will be sufficient to produce turned and moulded furniture parts for export.

8. Kofaste Furniture and Trade Company Limited:

This company's existing production facilities consist of a very small general purpose carpentry workshop equipped with general purpose and light duty basic woodworking machines. The machines are well kept and the house keeping is good. However, the saw blades are extremely badly sharpened. There is no tool sharpening equipment available at the workshop.

At the time of the visit, various custom built furniture items and solid wood doors were being manufactured for the local market. Only air dried timber is used in the production as there is no timber drying facility.

The company's future intention is to expand with additional equipment, to produce solid wood doors for export. However, the existing site is extremely small. A list of basic additional equipment to produce solid wood doors was prepared (See Annex XXVI). In addition to this, a factory layout was also prepared by the advisor.

9. Ghana Allwood Export Company Limited:

Although not operating currently, this company's production facilities occupy a relatively large and well organized site. The premises of the factory, its stores and

and sheds for air drying of timber are above average and spacious. However, the production machinery and the layout draws much criticism. Most of the woodworking machinery are of Polish and Russian origin and are built either as prototypes or adapted mainly from metalworking machinery. They require a very high degree of mechanical expertise to set and operate.

On the other hand, the production machinery is so badly placed that a sequential production flow is not possible. In addition to this, various machines such as circular saws, band saws, chain mortisers, and turning lathes are duplicated or triplicated. Some of these machines will remain idle in a well balanced production mix.

An improved layout was prepared taking into consideration the intention of the company to start producing furniture for the local market with the existing machinery.

At present there is no timber drying kiln, but one unit is on order. The existing tool grinding and maintenance equipment is adequate.

II. RECOMMENDATIONS:

A. Addressed to the Government:

1. The following factories visited during the mission have been identified to have the highest potential for export in the immediate future:
(a) Fee Wood Processing Ltd., Accra.
(b) Akuaba Ltd., Accra.
(c) Motkits (Ghana) Ltd., Tema.
(d) Furnart (Ghana) Ltd., Accra.
(e) Modern Furniture Ltd., Accra.

2. The companies identified to have an export potential in the immediate future should receive further direct technical assistance to improve their manpower skills in the following specialized technical fields:
(a) Machine woodworking,
(b) Jig making,
(c) Tool maintenance.
The assistance in each field should last at least three weeks to each factory and at least three suitably qualified counterparts should be assigned by each factory to each expert for training on the job. The general outline of such an assistance (in the form of a project concept) is given Annex XXVII.

3. The middle management and the supervisory staff of the five factories selected should receive a comprehensive but practical in-service training for a period of two weeks to upgrade their skills in the following fields:
(a) Factory and production management,
(b) Production planning and control.
The training should be given by experts visiting the premises of the factories receiving the assistance. The possible topics that may be covered in this training programme are given in Annex XXVIII.

4. In close cooperation with the furniture industry, the appropriate ministry(ies) should transform an existing craft course in woodworking in one of the polytechnics into a contemporary machine woodworking and furniture manufacturing course based on "reverse day release" scheme whereby students go to a selected factory one day a week. This will satisfy the suitably trained manpower needs of the Ghanaian furniture industry in the long run. The course syllabuses of existing institutions can be used as models in drafting the new course syllabus. Their names and addresses are given in Annex XXIX. Academic training other than short seminars and on-the-job training programmes should be left to the national training institutions.

5. The woodworking industry at large lacks up to date technical information on production methods, technologies and machinery. The GFPA should be strengthened to provide such information to its members on a regular basis. A project concept outlining the required assistance to GFPA is given in Annex XXX.

6. Machinery and the technology being acquired by the industry should be monitored closely by an appropriate government body to ascertain that they match the existing indigeneous skills and resources such as solar energy. A project concept for the use of solar energy in timber drying is given in Annex XXXI.

7. If high technology and complicated machinery and equipment is purchased, the services of the manufacturers' technicians should be secured for the installation and commissioning of the machine and for the proper training of its operators.

8. In view of high capital cost and relative high technology of imported machinery, wherever feasible, foreign investors should be attracted to form joint ventures with local entrepreneurs. This can best be done through investment promotion activities at times of specialized trade fairs and through UNIDO's investment promotion offices in various countries.

9. The use of expatriate technicians and experts should be further encouraged until such time as the local staff is fully trained and an industrial labour force is created. An effective control procedure should be employed to make sure that the transfer of know-how and skills are taking place between the expatriates and local counterparts.

10. The industry lacks contacts and skills in export marketing. Joint exhibition stands should be organized in conjunction with such specialized fairs for furniture components as INTERZUM in Cologne (Federal Republic of Germany) and SASMIL in Milan (Italy) and followed up by a study tour with a flexible programme. Assistance by UNIDO and/or ITC experts who already know the Ghanaian furniture industry and the export markets in Europe should be obtained from these international organizations. These experts should accompany the study tours. Details of such a study tour programme is given in Annex XXXII.

11. Quality awareness should be created among the local wood products consumers to demand a higher quality than at present. This in turn will create a pulling force for the manufacturers to pay more attention to quality. To improve quality up to a certain level will cost very little.

12. A quality label is required to facilitate exports. Although premature, it is in the interest of the Government to give consideration to the introduction of a quality control scheme and labelling so as to facilitate, in the long run, exports of furniture and furniture components. This can be tackled at two stages:

(a) In factories,
(b) Institutionally,

by organizing for a national from an appropriate institution and a representative from the manufacturers' association a study tour for about one month to visit

relevant institutions such as FIRA (U.K.), Teknologisk Institut (Denmark), Centre Technique du Bois et de l'Ameublement (Paris, France). Upon their return, assistance should be given at least 3 months by a quality control expert through visits to selected factories and relevant institutions.

13. In the short term, it is in the interest of the local industry not to waste time and resources on developing their own designs. As in the far East, buyers' designs and specifications should be followed and an in-factory capability to interpret technical drawings and specifications should be developed.

14. In the long term, however, there is a need for trained local furniture designers to develop native designs. It is a fact that native designs lower the cost of manufacture and may fetch higher sales prices because the customer also pays for the design. Therefore, it is in the interest of the Government to motivate students in local schools of applied arts etc. to specialize in furniture design. To start with, a national seminar on furniture design for teachers and final year students could be held. Such a seminar would cover also such topics as ergonomics, construction details and the selection of materials based on their properties. A more detailed list of possible topics that could be covered during such a seminar is given in Annex XXXIII.

15. A 3 to 5 years development plan for the furniture and related industry should be drawn up and all the national and international efforts should be coordinated from one office or agency.

B. Addressed to the Factories Visited:

1. Furnart (Ghana) Limited:

(a) The wide range of items and designs currently produced should be reduced to a few basic designs with interchangeable parts. Several variations within each design can be achieved by using different wood species and trimmings especially in the showing parts such as fronts.

(b) Specialization should be attained by concentrating on selected lines such as bedroom furniture, sitting room furniture, and dining room furniture. This will bring specialization in the labour force, greater accuracy and higher quality, higher productivity while at the same time lower wastes and production costs.

(c) Facilities (labour force and production halls) for both local and export production should be separated. Currently, depending on the product, between 50% and 90% of the work in the production is carried out not on the machinery but on the carpenters' benches. For such a production, physical facilities and machinery are already existing in this particular factory. Furthermore, there is little possibility for this factory to change its working methods in the near future for the local production. To change is also uneconomical from the machine utilization point of view, because, no two local orders are alike. From the investment point of view, there will be very little additional investment. The buildings are there, the carpenters' benches are there, and most of the woodworking machinery is there as duplicates. This seperate unit can also be used to train apprentices.

(d) The existing factory layout should be improved to achieve a sequential production flow.

(e) Appropriately dimensioned working or technical drawings should be used throughout the production for greater accuracy and exactness.

(f) The existing production machinery should be used fully to manufacture parts as final products to eliminate the existing high degree of handwork and fitting.

(g) A proper production planning and control procedure should be used in transferring the information to the foremen and production workers so that guess-work is eliminated.

(h) Machine and tool maintenance should be carried out on a routine basis to achieve accuracy and high quality during machining operations.

(i) A formal quality control procedure should be introduced at the processing, final assembly and finishing stages to reduce rework and to achieve a higher quality.

(j) Construction details and jointing methods should be simplified considerably to save material and manpower. Wooden dowels should eventually replace dovetail, corner locking and most of the tenon and mortise joints.

(k) Tungsten carbide tipped (TCT) cutters and saw blades should be used wherever possible since most wood species used are abrasive in nature.

(l) A lacquer spraying room with spray booth, ventilation and drying shelves should be installed and should be well protected against dust.

(m) A timber drying kiln with a capacity of at least 25 cubic meters should be installed to supply the dry timber needed especially for future export orders. This will eliminate warping of various furniture parts in use, and improve the quality of processing and finishing.

(n) A full dust extraction system should be installed to improve the performance of the machinery and the work force, and to increase the quality of the machining.

(o) A better house keeping should be attained throughout the whole factory; proper cleaning of the floor after each working day, use of pallets for work-in-progress and waste boxes behind the band saws and circular saws for off-cuts should be enforced.

(p) The existing production machinery should be complemented with such additional machines as dowel making machine, jig saw, dowel hole borer, double cross-cut circular saw, manual edge bander, veneer shearing guillotine, veneer splicer, glue spreader, panel saw, wide belt sander and assembly clamps etc. (See Annex VI).

(r) In-service training for middle managers and supervisors, on-the-job training for machine operators and technicians should be carried out to upgrade their existing limited skills.

2. Pee Wood Processing Limited:

(a) The finishing, spraying and upholstery departments should also be moved to the new factory premises in order to achieve better control of production and quality.

(b) The existing production machinery should be complemented with some additional equipment as suggested in Annex XV.

(c) The dust extraction equipment should be installed as soon as possible in order to operate all the machines, improve working conditions, increase machine and cutter life, quality and accuracy in machining.

(d) The compressor room and the compressed air piping should be improved. The compressor should be placed in a dust-free and well ventilated room and moisture traps, filters and oilers should be incorporated in the system.

(e) The existing lacquer spraying equipment should be complemented with a spray booth and a drying tunnel.

(f) The timber drying kiln capacity should be increased to the level of the production capacity of the factory.

(g) An improved factory layout should be prepared to remove such deficincies as non-sequential work flow, inadequate storage areas between the machines and backward-forward movement of workpieces present in the existing layout.

(h) The use of hand tools should be minimized (if not eliminated completely) and the use of machinery should be maximized.

(i) The managerial skills of both the top and middle management should be improved and the basic management functions should be performed more effectively.

(j) The work force should be thoroughly trained in the full and correct use of the modern woodworking machinery already installed.

(k) A simple but effective production planning and control procedure should be introduced by first starting with an order processing system even for individual orders.

(l) A formal quality policy should be set by the management and quality controls should be carried out during all processing stages.

(m) The costing and pricing of products should be done more precisely and the distribution of overheads should be based on a thorough analysis of the cost elements.

(n) The machine and tool maintenance should be given more attention and carried out regularly.

3. Motkits (Ghana) Limited:

(a) The already purchased dust extraction fan and filter unit should be connected to the existing machines.

(b) The compressor and the compressed air pipes should be properly laid out with the necessary moisture traps, filters and oilers in the system.

(c) The tool maintenance equipment should be placed in a separate room and maintained.

(d) The lacquer spraying should be improved by the installation of a spray booth and a hot air drying tunnel in a well ventilated and dust-free area.

(e) Only kiln dried timber should be used in production so as to attain improved machining, finishing and stability of the parts manufactured.

(f) Machine maintenance and lubrication should be carried out regularly according to a pre-planned programme.

(g) A full feasibility study should be undertaken prior to taking a decission on the new flush door factory.

(h) A complete list of machinery and equipment required, their typical technical characteristics, dust extraction, compressed air, heat and electric energy requirements and an overall layout should be prepared before approaching any supplier. Acting contrary to this will result in either incomplete or excessive (unnecessary) production machinery being purchased.

(i) Sufficient time should be spent in studying all the alternative offers and options before making a final selection. Very often it is true that " One never finds time to do something right, but always finds time to do it twice ".

4. A. Lang Limited:

(a) A full feasibility study should be undertaken prior to any major investment decision.

(b) A complete list of machinery and equipment required, their typical technical characteristics, dust extraction, compressed air, heat and electric energy requirements and an overall layout should be prepared before approaching any supplier. Acting contrary to this will result in either incomplete or excessive (unnecessary) production machinery being purchased.

(c) Sufficient time should be spent in studying all the alternative offers and options before making a final selection. Very often it is true that " One never finds time to do something right, but always finds time to do it twice "

5. Akuaba Limited:

(a) Installation and commissioning of both the dust extraction system and the wood drying kiln should be completed as soon as possible.

(b) Only kiln dried timber should be used for both the local and export markets. An 8% final moisture content should be reached in kiln drying and the timber has to be conditioned in the factory for about 3 days before it is put into production.

(c) To the extent possible, a line of suitably qualified middle managers and supervisors in all sections of the factory should be appointed and trained on-the-job to perform required functions effectively.

(d) An inventory of all the machines, equipment and tools should be carried out to ascertain reasons of breakdown, malfunction and damages and a plan of action should be prepared for acquiring spare parts and carrying out repairs.

(e) A formal machine and tool maintenance procedure should be adopted, implemented and monitored closely.

(f) An uncomplicated and easy to understand production planning and control procedure should be adopted, implemented and monitored.

(g) The range of products manufactured should be reduced and specialized in about three product lines. Standardized and interchangable parts should be used as much as possible.

6. Modern Furniture Limited:

(a) The existing factory layout should be improved by re- arranging the production machinery in a sequential order.

(b) A dust extraction system should be installed which should be adequate both for the existing and the future production machinery.

(c) The lighting of the workplaces, especially at the finishing and assembly areas, should be improved.

(d) Handling of timber should be improved by using footings, pallets and spacers as appropriate.

(e) A proper machine and tool maintenance practice should start as soon as possible on a regular basis. Blunt and damaged tools should not be used without repair.

(f) A formal production planning and control procedure should be used to reduce waste, meet deadlines, improve productivity and reduce stocks.

(g) A formal quality control system should be used effectively by involving all the employees from top management to the individual workers.

(h) The current extremely low productivity of the work force should be improved by motivation.

(i) Management skills of the existing staff should be improved through training or short courses run by appropriate institutions in order to perform such management functions as planning, organizing, directing, co-ordinating and controlling.

7. Ashanti Furniture Company Limited:

(a) The existing factory layout should be completely revised in order to achieve a sequenti. production flow.

(b) The machinery and equipment currently unoperational due to breakdown should be examined by a competent mechanic to identify those which can be rehabilitated and re-conditioned. Based on this, all the spare parts and repair materials should be purchased and the machines repaired. Those machines that are not repairable at a reasonable cost should then be removed from the production hall to increase the floor space available for use.

(c) An effective production planning and control should start immediately to prevent future accumulation of huge stocks of semi-finished parts on the factory floor. Immediate action should be taken to utilize those that have already accumulated. The required know-how is available among the existing staff.

(d) The large number of currently unused templates hanging all over the production area are undermining the lighting and visibility as well as being a fire danger. All the unused templates should be labelled and stored in a suitable place for future use.

(e) The existing ducting of the dust extraction system is not suitable. Square shaped ducting is only used for air

conditioning systems. All the square ducting should be replaced with cyclindrical ducting.

(f) The existing huts in the production hall used for offices should be removed to regain the floor space they occupy. These include offices for foremen, electrician and production management.

(g) The production hall should be re-organized and the working conditions (especially lighting) should be considerably improved.

(h) A formal quality control procedure should be installed and the quality checks should be made during the all production stages. Quality control after assembly is too late.

(i) The existing low productivity could be considerably increased by motivation and re-training of the work force.

(j) The current cost structure contains a higher percentage of overheads than normally accepted. The company's cost structure should be re-examined.

(k) The existing high percentage of manual work should be eliminated by better product design, suitable for production with the existing machinery, and by a full use of the existing machinery.

8. Kofaste Furniture and Trade Company Limited:

(a) The production site currently used is too small for the intended expansion. A site with an area of at least 1000 square meters with additional expansion possibilities in the future is needed.

(b) A professionaly made feasibility study should be the base of the new investment decision.

(c) In case of expansion, the need for several well trained and skilled personnel should also be anticipated.

(d) A complete list of machinery and equipment required, their typical technical characteristics, dust extraction, compressed air, heat and electric energy requirements should be prepared before approaching any supplier. Acting contrary to this will result in either incomplete or unnecessary machinery being purchased.

(e) Sufficient time should be spent in studying all the alternative offers and options before making a final selection. It is also wise to see all the respective machinery in operation before purchase.

9. Ghana Allwood Export Company Limited:

(a) The existing machinery and equipment should undergo a full mechanical inspection and full reconditioning before its re-use.

(b) The existing factory layout should be improved as suggested during the advisor's visit to achieve a sequential production flow and a rational materials handling.

(c) After the layout has been improved, the surplus machinery should be removed from the production hall.

(d) A complete dust extraction system should be installed if the factory is to be operated at full capacity.

(e) A lacquer spray booth should be added to the existing spray room. The spray room should be well ventilated and lighted.

Annex I

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

PROJECT OF THE GOVERNMENT OF GHANA

PROMOTION OF EXTERNAL TRADE

JOB DESCRIPTION

DU/GHA/86/008/11-51/J-13101
(GHA/50/08)

Post title Adviser on Production Management in Furniture and Woodbased Products (phase 1).

Duration Three months

Date required October 1986

Duty station Accra, Ghana and internal travel within the country.

Purpose of project To increase exports of manufactured products from Ghana.

Duties Under the overall supervision of the Chief, Office for Africa, Division of Technical Co-operation, and with the substantive support and guidance of the Market Development Section, Division of Product Development of the International Trade Centre UNCTAD/GATT (ITC), the adviser will work in close co-operation with the Ghana Export Promotion Council (GEPC), the Ghana Association of Furniture Producers and Exporters, the NIB and the Investment Promotion Centre.

In particular, the adviser will:

- select 5-6 producing/exporting enterprises with export potential, for current and future direct assistance, identified initially on the basis of previous ITC activities and suggested by the counterparts;
- assist GEPC in preparation of company profiles and supply surveys in the field of furniture;
- advise selected enterprises on production and production management, production techniques, production planning, scheduling, workshop layout, use and proper mounting of machinery, efficient utilization of production material, quality control.

- take into account other development programmes in this sector; assess technical needs of enterprises for 1987-1988 with a view to:
  (a) bringing about improvements in production with respect to such aspects as production technology, design, quality control, production planning, new machinery and equipment needs, packaging, access to financing, and costing and pricing in light of target market requirements;
  (b) later penetration into target markets of selected West European countries;
- recommend appropriate training activities at various levels of production management and draw up a tentative programme;
- prepare a summary report on his findings and a detailed proposal of technical assistance for individual enterprises and associations.

Qualifications: University degree in industrial engineering or equivalent, with specialization in wood technology. In-depth experience in furniture manufacturing (including knock-down and semi-finished and components) at managing and production engineering level with knowledge of international marketing of furniture. Familiarity with problems of furniture marketing and components in developing countries would be an asset.

Language: Proficiency in English essential

Background Information: The Ghanaian furniture industry is well established and has a reasonably sized home market which is growing.

However, there is a lack of well designed furniture. Most items tend to be custom-built on a one or two off basis and are usually copied from manufacturers' catalogues or similar literature.

Manufacturing facilities, i.e. buildings, machinery and equipment are reasonably good throughout the industry but the potential contribution of appropriate design (as well as proper plant layout and factory organization) to the successful production and marketing process is not fully utilized.

Production fluctuates throughout the year in step with demand. A principal cause of this is the practice of custom-building and direct selling of furniture to the public.

Very few firms are financially strong: there is a shortage of working capital and capital for expansion.

The industry is experiencing a shortage of timber largely because there is not transport to deliver it from the sawmiller to the manufacturer. When available it is often second grade because the sawmiller prefers to export his prime material and thus earn much needed foreign exchange.

Worthwhile exports are mainly presently confined to one or two manufacturers who ship out their products in knock-down form. Export prospects for the remainder of the industry will depend on its ability to adapt for this purpose. At least four other manufactures appear to be close to the standards required.

A small number of Ghanaian manufacturers have the manufacturing facilities and the access to sufficient quantities of suitable wood to warrant the development of such exports.

However, the importers have very stringent requirements concerning delivery dates, continuity of supply, design and consistency of quality and competitive prices.

The International Trade Centre UNCTAD/GATT (ITC) is assisting the Republic of Ghana in a comprehensive programme of trade promotion. The project included the following programme of assistance in the furniture sector:

- a study on the export potential of the furniture industry in Ghana, followed by a market orientation tour in Europe (1983-84);
- assistance to the GIFEX Furniture Fair in Accra (1985);
- advisory services to selected enterprises on design.

The studies positively assessed the export potential fo Ghanaian furniture, particularly components, as long as the weaknesses in the design, management, production technology and marketing can be overcome. ITC assistance in the above-mentioned areas has been recommended. They concluded that the future of the industry lies in the full exploitation of Ghanaian hardwoods which already enjoy a high level of acceptance in foreign markets.

Despite the current world-wide recession, the demand for furniture manufactured from tropical or temperate hardwoods remain buoyant.

The potential for exports from Ghana for the immediate future lies in the production of high quality semi-or fully finished furniture components produced on a sub-contracting basis.

There are importers/manufacturers, especially in the United Kingdom, who are willing to buy such components made in Ghana.

The GIFEX furniture fair resulted in new contacts and orders for Ghanaian producers.

Annex II

PROGRAMME OF WORK

6 May 1987:	Travel to Vienna.
7 May 1987:	Briefing at UNIDO Headquarters.
10-11 May 1987:	Travel to Accra.
12 May 1987:	Briefing by UNDP, GEPC and GFPA officials, Accra.
13-27 May 1987:	Assistance to Furnart (Ghana) Limited, Accra.
28 May-10 June 1987:	Assistance to Pee Wood Processing Limited, Accra.
11-18 June 1987:	Assistance to Motkits (Ghana) Limited, Tema.
18 June 1987:	Visit to A. Lang Limited, Tema.
19-26 June 1987:	Assistance to Akuaba Limited, Accra.
29 June-3 July 1987:	Assistance to Modern Modern Furniture Limited, Accra.
6-10 July 1987:	Assistance to Ashanti Furniture Company Limited, Accra.
13-14 July 1987:	Assistance to Kofaste Furniture and Trade Limited, Accra.
15 July 1987:	Visit to Ghana Allwood Export Company Limited,Accra.
16-17 July 1987:	Report writing.
20-21 July 1987:	Conducting first seminar,Kumasi.
22-23 July 1987:	Report writing.
24 July 1987:	Visit to Trasacco Limited,Accra.
27-28 July 1987:	Conducting second seminar,Accra.
29-30 July 1987:	Report writing.
31 July 1987:	Debriefing by UNDP, GFPA and GEPC officials,Accra
3-4 August 1987:	Travel to Vienna.
5-6 August 1987:	Debriefing at UNIDO Headquarters, Vienna.
7 August 1987:	Travel home.

Annex III

LIST OF PERSONS MET

Ministry of Lands and Natural Resources:
Mr. Ohene Kenah, Under-Secretary for Lands and Natural Resources.
Ghana Export Promotion Council, Accra:
Mr. Kwesi AHWOI, Executive Secretary.
Mr. Henry OKO OKAI, Principal Export Promotion Officer.
Ghana Investment Centre, Accra:
Mr. Gustav Alexander ADU, Senior Project Officer.
Ghana Furniture Producers Association, Accra:
Mr. Kwame BOAKYE, Executive Secretary.
Ghana Timber Association, Kumasi:
Mr. Nana YAW OWUSU, President.
Furnart (Ghana) Limited, Accra:
Mr. B. STEFANI, Managing Director.
Mr. Albert ASIEDU, Assistant Production Manager.
Mr. Emmanuel MENSAH, General Foreman.
Mr. Mensah AGBEMEHIA, Supervisor.
Pee Wood Processing Limited, Accra:
Mr. E. Adu ARTHUR, President / Chairman.
Mr. John Martin ABANKWA, General Manager.
Mr. Dickson ANKU, Production Supervisor.
Motkits (Ghana) Limited, Tema:
Mr. E. N. O. LAWSON, Managing Director.
A. Lang Limited, Tema:
Mr. Angelo BENEDET, Area Manager.
Akuaba Limited, Accra:
Mrs. H. M. ADUSEI-HERBSTEIN, Managing Director.
Mr. M. I. HERBSTEIN, Technical Director.
Modern Furniture Limited, Accra:
Mr. Timothy A. ADJETEY, Chairman, Managing Director.
Mr. Jonathan ADJETEY, Deputy Managing Director.
Mr. J. F. SIMON, Production Manager.
Ashanti Furniture Company Limited, Accra:
Mr. A. K. TANDOH, Acting Managing Director.
Mr. Alphonse A. A. AGBO, Production Manager.
Mr. Robert K. ARMAH-SEKUM, Assistant Production Manager.
Kofaste Furniture and Trade Company Limited, Accra:
Mr. Kwabena OFOSU-ASANTE, Managing Director.
Ghana Allwood Export Company Limited, Accra:
Mr. Kamel KALMONI, President.
Acheampong Furniture Works, Kumasi:
Mr. Kwabena ACHEAMPONG, Managing Director.
P. Atkins Construction and Woodworks, Kumasi:
Mr. P. ATKINS, Managing Director.
Kumasi Furniture and Joinery Company Limited, Kumasi:
Mr. F. N. MINTA, Managing Director.
Trasacco Furniture Limited, Accra:
Mr. Ernesto TARICONE, Executive Chairman.
Unique Furniture Limited, Accra:
Mr. Michael J. J. MOUGANIE, Managing Director.

Premsons Wood Processing Limited, Accra:
Mr. K. A. DANSOH, Managing Director.
UNDP Office, Accra:
Mr. B. NIARKO-MENSAH, Programme Officer, (UNDP).
Mr. A. CAPALBO, Junior Professional Officer, (UNIDO).

Annex IV

SEMINAR PROGRAMME

Subject: Production Management.
Dates : Kumasi: 20 and 21 July 1987.
Accra : 27 and 28 July 1987.
Venues : M. D. P. I. Offices in Kumasi and Accra.

Day: 1

Time	Subject and Outline	Speaker
9.45-10.45	Plant Layout: -Raw material considerations. -Production methods. -Production flow of panels. -Production flow of solid wood. -Production machinery. -Processing stages. -Specification and capacity of machinery. -Floor space for machinery, operators and work-in-progress. -Preparation of block layout. -Preparation of detail layout.	Sinan CINAR
10.50-11.50	Production Planning & control: -Gross planning. -Sales forecast. -Sales plan. -Yearly production plan. -Monthly production plan. -Detail planning. -Order processing. -Scheduling. -Production control.	Sinan CINAR
11.50-12.15	B r e a k	
12.20-13.20	Quality and Process Control: -Determination of policy. -Determination of quality level. -Organization and involvement personnel. -Quality controls & inspections. raw materials, finished parts and goods. -Process control during machining. -Process control during finishing. -Basic quality and process control equipment.	Sinan CINAR
13.20	Closing of First Day	

Day: 2

Time	Subject and Outline	Speaker
09.00-10.00	Jigs for Furniture Production: -Technical considerations. -Economic considerations. -Materials for making jigs. -Identifications and storage of jigs. -Examples of jigs used in machining and assembly of furniture parts (with slide presentation of selected figures from UNIDO document ID/265).	Sinan CINAR
10.00-11.00	Packaging of Furniture: -Damages to furniture during transport. -Materials for packaging. -Packaging techniques. -Examples of export packaging. (with presentation of selected slides prepared by ITC).	Sinan CINAR
11.00-11.25	B r e a k	
11.25-12.25	Human Relations (in Accra only): Effective Communication.(Accra): Customs and Excise Regulations Relating to the Furniture Industry (in Kumasi only):	M. D. P. I. Consultant. " Officials from CEPS (Kumasi)
12.30-13.30	Costing and Pricing of Products: Production Management Games (in Accra only): Taxation (in Kumasi only):	M. D. P. I. Consultant. " Official from IRS. (Kumasi).
13.35	Closing Remarks	Executive Secretary of G. F. P. A.

Annex V

COMPANY PROFILE

Company Name: STUART GHANA LIMITED

Person in Charge: MR. B. STEMAH

P.O. Box or Street Address: P.O. BOX 6137, ACCRA.

City: ACCRA

Country: GHANA

Cable Address:

Phone No.: 777622, 776535

Telex No.: 2145 GOMSIL GH

TYPE OF BUSINESS:

[X] Manufacturer

[ ] Retailer

[X] Wholesaler

[X] Exporter

[ ] Others (Please specify)

Established in Year: 1975

Number of Full Time Employees: 252

Techno-Managerial: 22 Workers: 230

Bankers: STANDARD CHARTERED BANK
MERCHANT BANK
NATIONAL INVESTMENT BANK

Commercial references: Available in Ghana

Member of:

[ ] Local Chamber of Commerce

[X] Trade Association

State Which: FURNITURE ASSOCIATION

(Special information regarding services, licences, co-operation, line and range of Products, etc.)

DINING SETS
KITCHEN SETS
LIVING ROOM SETS
BED-ROOM SETS
VERANDAH AND GARDEN CHAIR SETS
SPECIAL REQUIRED DESIGN
FURNITURE COMPONENT

Products Manufactured are:

[X] Low-priced [X] Medium-priced [X] High-priced

TERMS:

Delivery:	3 MONTHS	Minimum Order:	1 Container
Packing:	CARTONS AT COST	Fair:	GIFEX LONDON FAIR
Shipment:	CONTAINER		
Payment:	LETTER OF CREDIT		

Annex VI

LIST OF ADDITIONAL EQUIPMENT RECOMMENDED FOR FURNART (GHANA) LIMITED

ITEM	DESCRIPTION AND SPECIFICATIONS	QUANTITY
1	Multi-spindle dowel hole boring machine with swivelling universal head. No. of spindles: 25, Distance between spindles 32 mm.	1
2	Horizontal boring machine. No. of spindles: 5, Boring depth: 70 mm. Boring head adjustable up to 360 degrees.	1
3	Wide belt sanding machine for surface and thickness sanding. Working width: 1000 mm. Max. working height: 170 mm. Minimum working height: Veneer thickness.	1
4	Round end tenoning machine. Tenon length: 4-100 mm. Thickness: 4-30 mm.	1
5	Twin table oscillating mortising machine. Maximum length of mortise: 100 mm. Maximum depth of mortise: 55 mm. RPM.: 10,000.	1
6	Double circular cross cutting saw with scribing saw units for sizing and squaring up. Max. working width: 2,500 mm. Diameter of main saw blades: 300 mm.	1
7	Bench type manual edge banding machine for curved, round and straight edges with hot melt glue pot and top and bottom trimming units.	1
8	Pneumatic drum sander for shaped solid wood parts. RPM.:1,100 and 1,500, Motor: 2 HP.	2
9	Dowel and round rod milling machine for spiral grooved dowel rods and non-grooved smooth rods. Dowel diameter: 6-18 mm. Feed rate: 4-7 m/min.	1
10	Dowel cutting and chamfering machine for dowels 6-18 mm. diameter.	1
11	Universal tool grinder for moulding heads, profile cutters, drill bits and circular saw blades.	1
12	Horizontal grinding machine for butt welded band-saw blades.	1
13	Manual sharpening machine for mortising chains.	1
14	Glue spreading roller for frames and panels. Coating width: 1000 mm. (For two side glue application).	1
15	Veneer pack edge shearing guillotine. Cutting length: 2,500 mm.	1
16	Zig-zag veneer splicer. Working width: 900 mm.	1

17	Jig saw or very narraw bad saw for cutting shaped parts. Throat depth: 500 mm.	1
18	Manually operated hydraulic pallet truck. Capacity: 2,500 kg.	4
19	Conventional type timber drying kiln. Capacity: 25-30 cubic meters / charge.	1
20	Multi-blade circular rip saw. Cutting height: 340 mm. Maximum blade diameter: 350 mm.	1
21	Four-side automatic planer-moulder, complete with 6 standard and 1 universal head. Working width X thickness: 230 mm X 140 mm. RPM. of spindles: 6,000.	1
22	Portable hand router for individual routing work. Stroke depth: 52 mm. Power: 750 Watt, RPM.: 25,000.	1
23	PVAc glue application pump. Capacity: 5 kg., Complete with glue pistol, hose, and nozzles.	2
24	Pneumatic assembly press for chairs.	1
25	Pneumatic assembly press for drawers.	1
26	Manually operated hydraulic frame press. Size: 1,000 mm X 2,300 mm.	1
27	Pneumatic carcass assembly press for panel furniture. Size: Width X Height X Length, 500 mm X 2,300 mm X 2,500 mm.	1
28	Set of quality control equipment. (See Annex X).	1

TECHNICAL ASPECTS OF COMPRESSED AIR SYSTEMS [1]

Components of the compressed-air supply system

Compressors

Compressed air is produced by compressors, which are nothing more than pumps that take in air at atmospheric pressure and deliver it at a higher pressure.

There are several ways of classifying compressors. For the purposes of this manual, compressors will be classified according to:

(a) The frequency of the compression cycle (mainly applicable to reciprocating types):
- (i) Single-acting, compression taking place every other stroke;
- (ii) Double-acting, compression taking place every stroke;

(b) The nature of the cycle:
- (i) Single-stage, compression taking place in a single cylinder;
- (ii) Double-stage, compression beginning in one cylinder and completed in a second cylinder, thus dividing the temperature rise between the two cylinders and permitting cooling of the compressed air between the stages;

(c) The moving parts:
- (i) Reciprocating, compression being achieved by the back-and-forth movement of a piston;
- (ii) Centrifugal, being designed to deliver large quantities of air at low pressure, moved by centrifugal force generated by a fast-revolving rotor;
- (iii) Rotary, having a vane motor or equivalent mounted eccentrically in a stationary casing, thus forcing incoming air into a smaller volume.

The type of compressor most commonly used in furniture plants is the reciprocating type, which can produce pressures up to 10 bar. Pressures lower than 5 bar may not be sufficient for some requirements, while pressures higher than 15 bar may result in ice formation on the LCA units due to too much expansion cooling.

Compressor capacity is normally given as the number of cubic feet per minute (cfm) or cubic metres per minute (m^3/min) of free air delivery (FAD). Occasionally, compressor capacity may be rated in terms of the volume of free air displaced, in which case this displacement figure must be multiplied by the efficiency of the compressor to obtain the FAD volume.

Sample problem. A compressor is rated at 500 cfm (14 m^3/min) free air displaced. The efficiency of the compressor is 88 per cent. Find its FAD rating.

FAD = (free air displaced) × (efficiency of compressor)
= 500 × 88/100
= 440 cfm (12.46 m^3/min)

Figure I gives the theoretical value of the energy required by single-stage and double-stage compressors to deliver a unit volume of air at a given compression ratio. This figure does not take the efficiency of the compressor system into account, which is normally only 35-50 per cent because of various mechanical and electrical inefficiencies.

1/ Source: Chapter V of the UNIDO document "Low-cost Automation for the Furniture and Joinery Industry. ID/154 Rev.1, United Nations, New York, 1982.

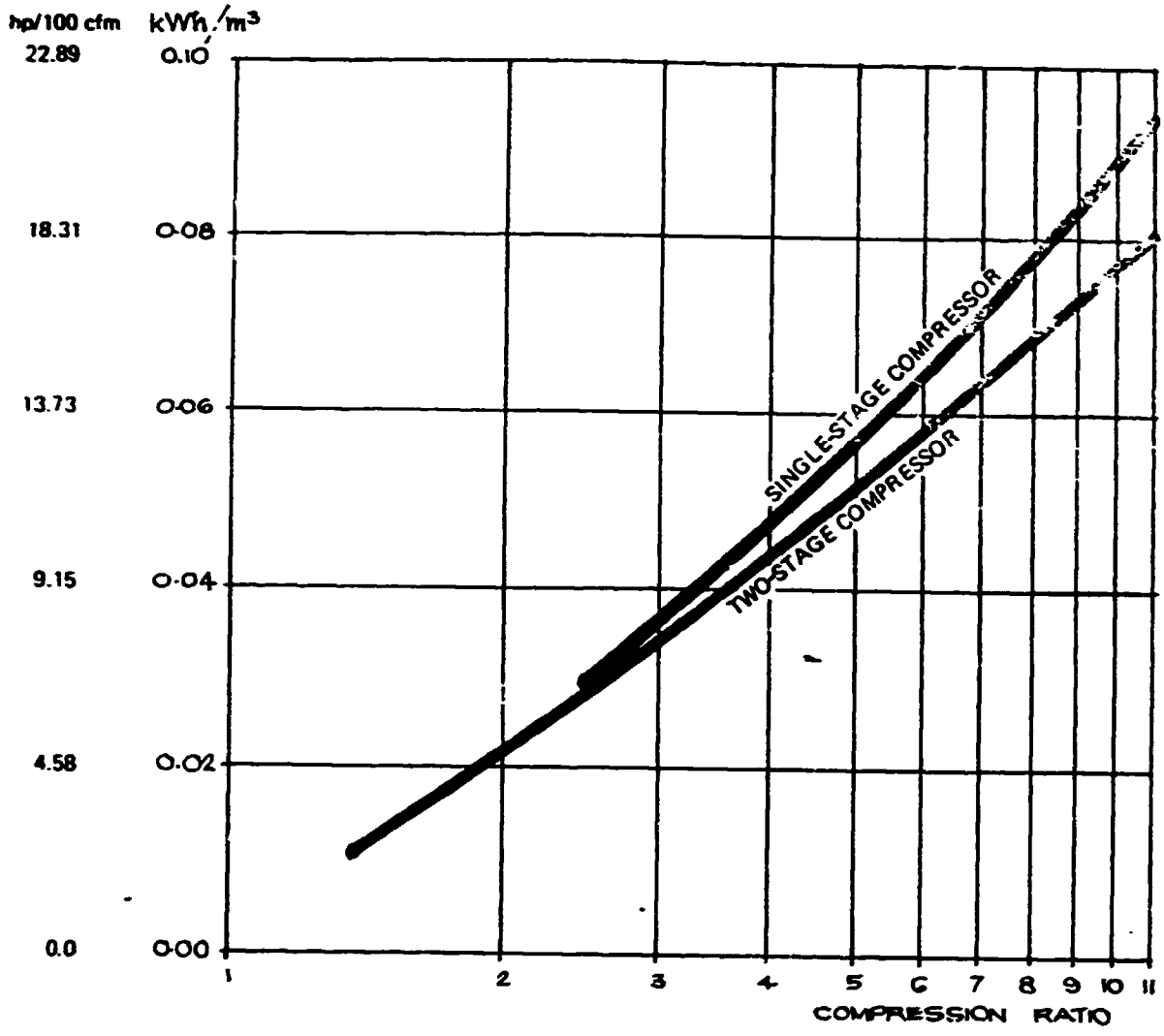


Figure 1 Theoretical specific energy requirements for air compression

Air receiver

The volume of the air receiver (storage reservoir) must be at least equal to the actual compressed air volume delivered by the compressor in one unit of time:

$$V_m = Q/r$$

where V_m is the minimum volume, Q is the compressor output in one unit of time (FAD), and r is the compression ratio. This minimum size is suitable, theoretically, for a constant demand system. In practice, it is better to employ a larger receiver to meet variable demand.

$$V_p = AQ/r$$

where V_p is the practical volume, and A is a factor ranging from 1.5 for constant demand to 3.0 for a variable demand system.

Piping

In an air compressor system (equipped with air receiver for storage), the main pipes (headers) to the various distribution points should be inclined at an angle of about 3° from the horizontal. Also, drain pipes with valves that can be easily opened for draining entrapped water should be connected to the low point of the header ahead of the actual distribution point. That will ensure that only clean, dry air gets into the LCA units.

Another rule to follow is that the lines to the LCA units should be connected to the top of the header pipe to prevent dirt from being fed to the machines.

Figure 2 shows an air-line system that illustrates the rules just given.

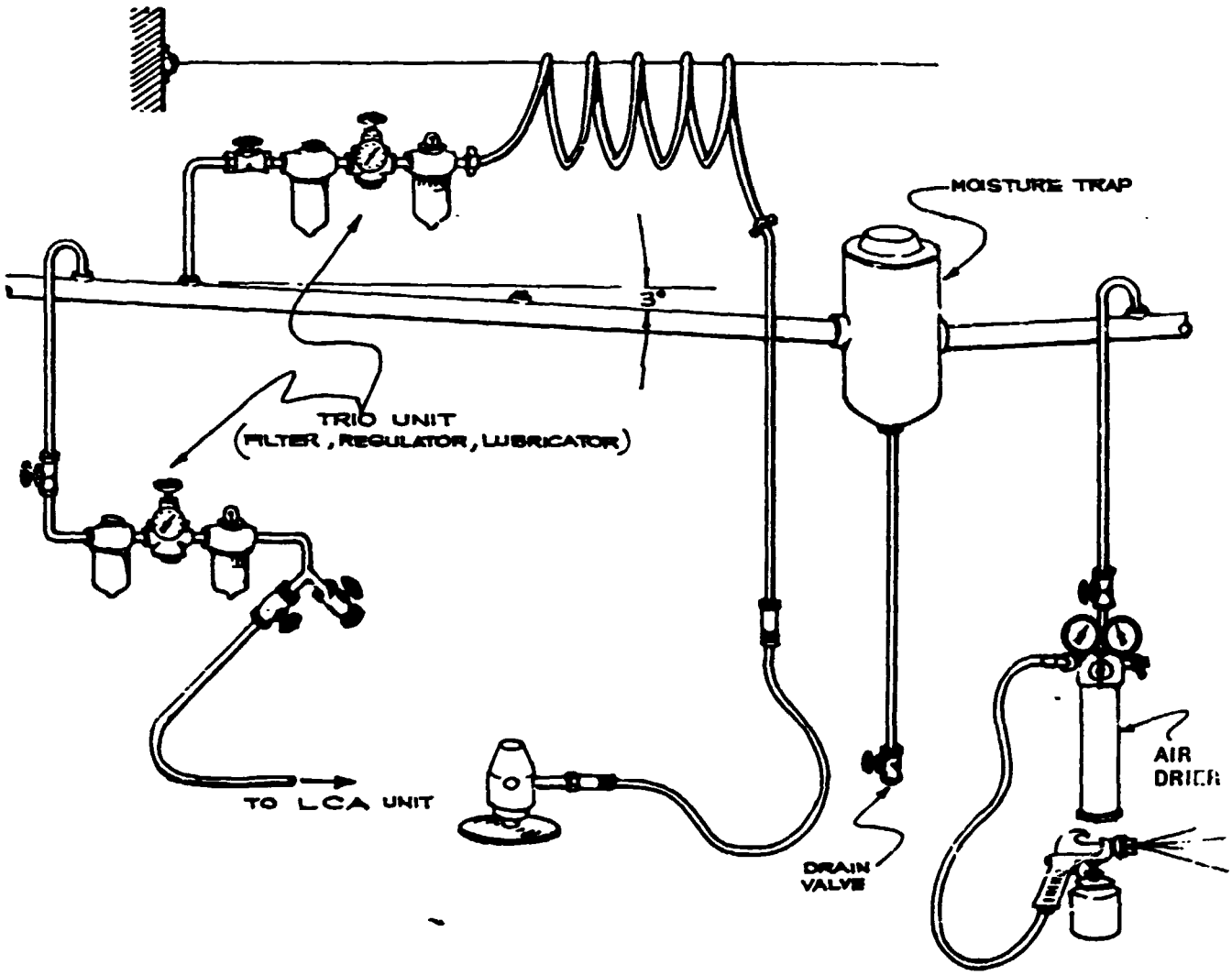


Figure 2 . Air-line system

For compressed air up to a pressure of 12 bar, medium-thickness pipes can be used. If possible, the pipes should be cleaned before being installed.

Since pipes run from a compressor air-receiver to a system that may be remote, the pipe should be large enough to minimize friction losses. Table 1 is a guide to finding the correct size. To use this table, first determine the air flow to be carried. Find its value in the first column and read across to the column showing the approximate length of run to find the suggested pipe size for minimum loss. For example an air-delivery rate of 25 cfm (0.7 m^3/min) can be maintained over a distance of 150 ft (45.7 m) using a pipe with an inside diameter of 0.824 in. (20.9 mm). If the total run is over 150 ft (45.7 m), a 1.049-in. (26.6-mm) pipe should be used all the way.

If the air flow is not known, use the compressor power (second column) to enter the table. For flows not included in the table, assume that the flow/power ratio is 3.5 cfm/hp (0.1 m^3/min per kilowatt). The calculation is only approximate, since the flow/power ratio depends on the efficiency of the compressor. When in doubt, it is best to oversize the air headers, as they become part of the air reservoir.

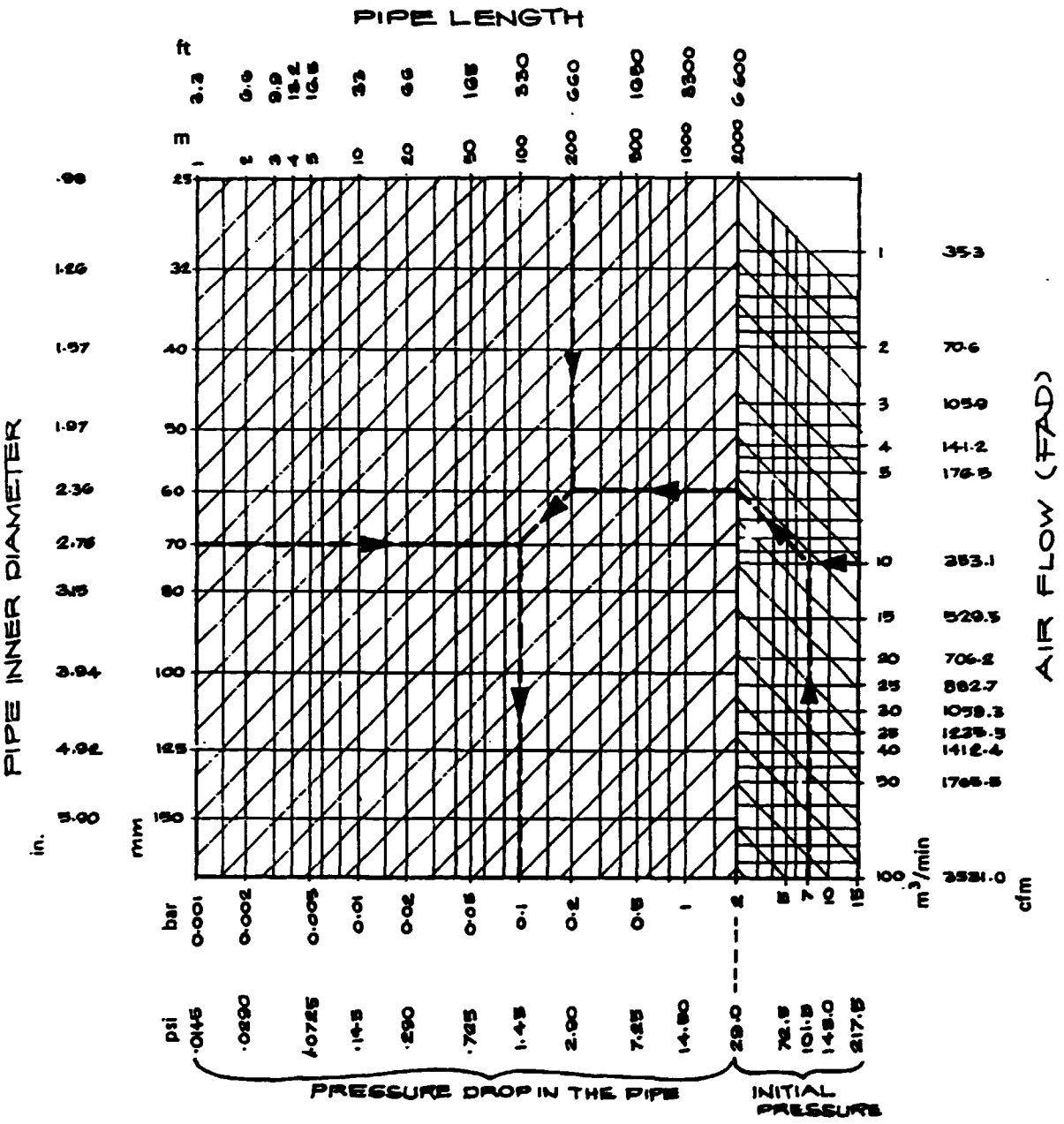


Figure 3 Pressure drop nomogram

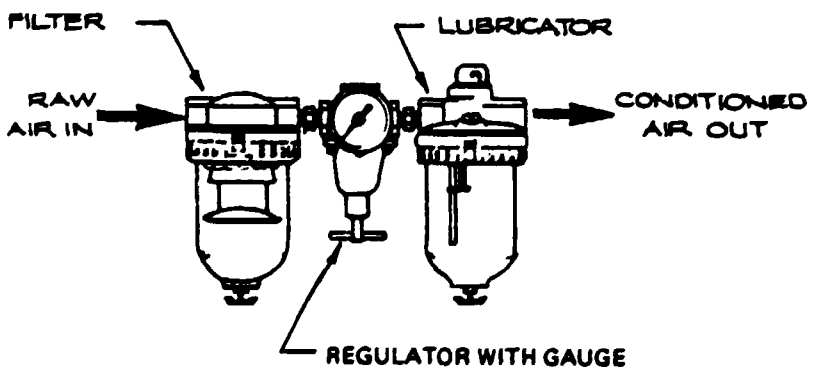


Figure 4 Trio unit: filter, regulator and lubricator

TABLE I. SUGGESTED PIPE SIZES FOR A COMPRESSED-AIR DISTRIBUTION SYSTEM

Air flow		Compressor power		Run							
				(feet)							
				25	50	75	100	150	200	250	300
				(metres)							
(cfm)	(m^3/mn)	(hp)	(kW)	7.6	15.2	22.8	30.5	45.7	61	76.2	91.5
5 or less	0.14 or less	1.4	1.0	0.622 (15.8)	→	→	→	→	→	→	→
10	0.28	2.8	2.1	0.622 (15.8)	→	→	0.824 (20.9)	→	→	→	→
15	0.43	4.3	3.2	0.622 (15.8)	0.824 (20.9)	→	→	→	→	→	→
20	0.56	5.6	4.2	0.824 (20.9)	→	→	→	→	→	→	→
25	0.70	7.0	5.2	0.824 (20.9)	→	→	→	→	1.049 (26.6)	→	→
30	0.85	8.5	6.3	0.824 (20.9)	→	→	→	1.049 (26.6)	→	→	→
35	1.0	10.0	7.5	0.824 (20.9)	→	1.049 (26.6)	→	→	→	→	→
40	1.12	11.2	8.4	0.824 (20.9)	1.049 (26.6)	→	→	→	→	→	→
50	1.40	14.0	10.4	1.049 (26.6)	→	→	→	→	→	→	→
70	2.0	20.0	14.9	1.049 (26.6)	→	→	→	1.380 (35.0)	→	→	→

Source: Air Compression Research Council.

Note: The figures in the main body of the table are the inner diameters in inches (millimetres in parentheses) of standard black pipe that will keep the pressure loss to a reasonable minimum over the runs indicated.

The pressure drop nomogram in figure 3 is also useful in piping design. The arrows illustrate how the nomogram is used to solve the following problem:

Suppose that an air flow of 10 m^3/min is desired in a 70-mm pipe, 200 m long. If the initial pressure at the head of the pipe is 7 bar, what will the final pressure at the delivery end be? The intersection of the lines representing 10 m^3/min and 7 bar is found in the right-hand part of the nomogram and projected diagonally upwards towards the left to the vertical border line between the two parts of the nomogram. Then the horizontal line is followed to its intersection with the vertical line representing the pipe length of 200 m. From this intersection the path is diagonally downwards to the horizontal line representing the pipe diameter, 70 mm, then vertically downwards to the scale, where the pressure drop, 0.1 bar, is read. The delivery pressure is therefore 7.0—0.1 = 6.9 bar. Any other problem involving the five quantities represented in the nomogram can be solved in analogous fashion.

As a rule of thumb, when interconnecting valves and cylinders for a pneumatic circuit, use the port-size of the cylinder as a guide. In any case, assuming that the factory already has a source of compressed air, the magnitudes of the pressure fluctuations and of the lowest pressure need to be known when calculating the cylinder size to decide whether there is enough air to drive the equipment. If not, the capacity of the compressed-air plant must be increased.

Air "conditioners"

Compressed air can be regarded as fully saturated with water vapour. Since the amount of water that can be retained in vapour form in a given volume of air is an increasing function of temperature, any fall in the temperature of saturated compressed air will result in excess moisture condensing out in the system. The quantity of water so deposited can be great enough to cause improper operation of a pneumatic system. Besides moisture, raw compressed air may contain abrasive compounds and sludges that can cause great damage to pneumatic components.

To prevent these bad effects an "air-conditioning" system is needed: suitable air-processing equipment placed in the circuit ahead of cylinders, valves and other tools to dry, filter and add lubricant to the compressed air and to regulate the pressure. The air-conditioning assembly pictured in figure 4 is referred to as a "trio" unit because it comprises three components:

1. *Air filter and drier.* This component traps residual moisture and dirt in the compressed air by swirling the "raw air" around the bowl. Because of centrifugal action, the heavier elements stick to the side

of the bowl and are no longer in the air stream. The accumulated water and dirt are periodically taken out of the filter by opening the valve below the bowl. This "flushing-out" should be performed before the bowl is completely filled with water; otherwise the dirt particles might get back into the system.

2. *Pressure regulator.* By setting the knob on the pressure regulator, a definite, constant air pressure can be maintained in the line. It is not advisable to have too high an air pressure; the extra pressure only means wasted energy. Note that a pressure regulator can only maintain pressures that are less than the header pressure. It cannot provide a pressure higher than the pressure at its inlet.

3. *Air lubricator.* Air lubricators are important since air by itself is not a lubricant. Without lubrication, the various components in the system will deteriorate and their life will be considerably shortened.

Air lubricators are normally filled with a light oil, which, converted to a fine mist, travels with the compressed air into the equipment. The amount of oil going into the system should be adjusted with care: too little, and wear will occur; too much, and clogging will result. A good rule-of-thumb in adjusting the lubricator is "one drop of oil (as seen in the sight glass of the lubricator) should fall for every 20 ft^3 (500 dm^3) of free air consumed by the equipment".

To determine the size of the trio unit needed, a good rule-of-thumb is that it should be one size larger than the largest component in the system.

Annex VIII

ORGANIZATION AND DELEGATION OF AUTHORITY

The most effective way to run a business is by setting up an administrative structure. This involves deciding what activities are necessary to attain the firm's objectives, divide them into groups and assigning each group to a manager possessing the necessary authority and expertise to carry out these activities properly. The most important principle in organizing the above, is the unity of command. This means that each employee should have only one supervisor to whom he is directly responsible.

The other principle to note is the fact that decisions are best made by the persons closest to the situation. Specialization should be used wherever possible, as it leads to increased expertise.

Delegating means giving responsibility and letting others take care of the details. It is perhaps the hardest thing that the owner-managers have to learn.

The following excerpt illustrates very well what was said above:

> The owner-manager of a small factory established three departments - a production department, a sales department, and an adminitrative department - and appointed a manager for each. He specified the following responsibilities:
> 1. The production manager was responsible for manufacturing, packaging, and shipping.
> 2. The sales manager was responsible for advertising, customer soliciting, and customer service.
> 3. The administrative manager was responsible for personnel, purchasing, and accounting.
> 4. The production manager also was designated assistant general manager and delegated authority to make all operational decisions in the owner's absence.
>
> The owner gave each manager a detailed statement of the function of his department and the extent of his authority. Actions that the managers could take on their own initiative and actions that required approval by the owner-manager were enumerated.
>
> Each department manager was instructed to designate and train an assistant who could manage the department when the need arose.
>
> The owner coordinated the departments. The sales manager and production manager set customer delivery dates together.
>
> Control was exercised by holding sub-

subordinates responsible for their actions and checking the results of those actions. The owner neither "breathed down his managers' necks" nor lost control of things. He relied upon reports and periodic staff meetings.

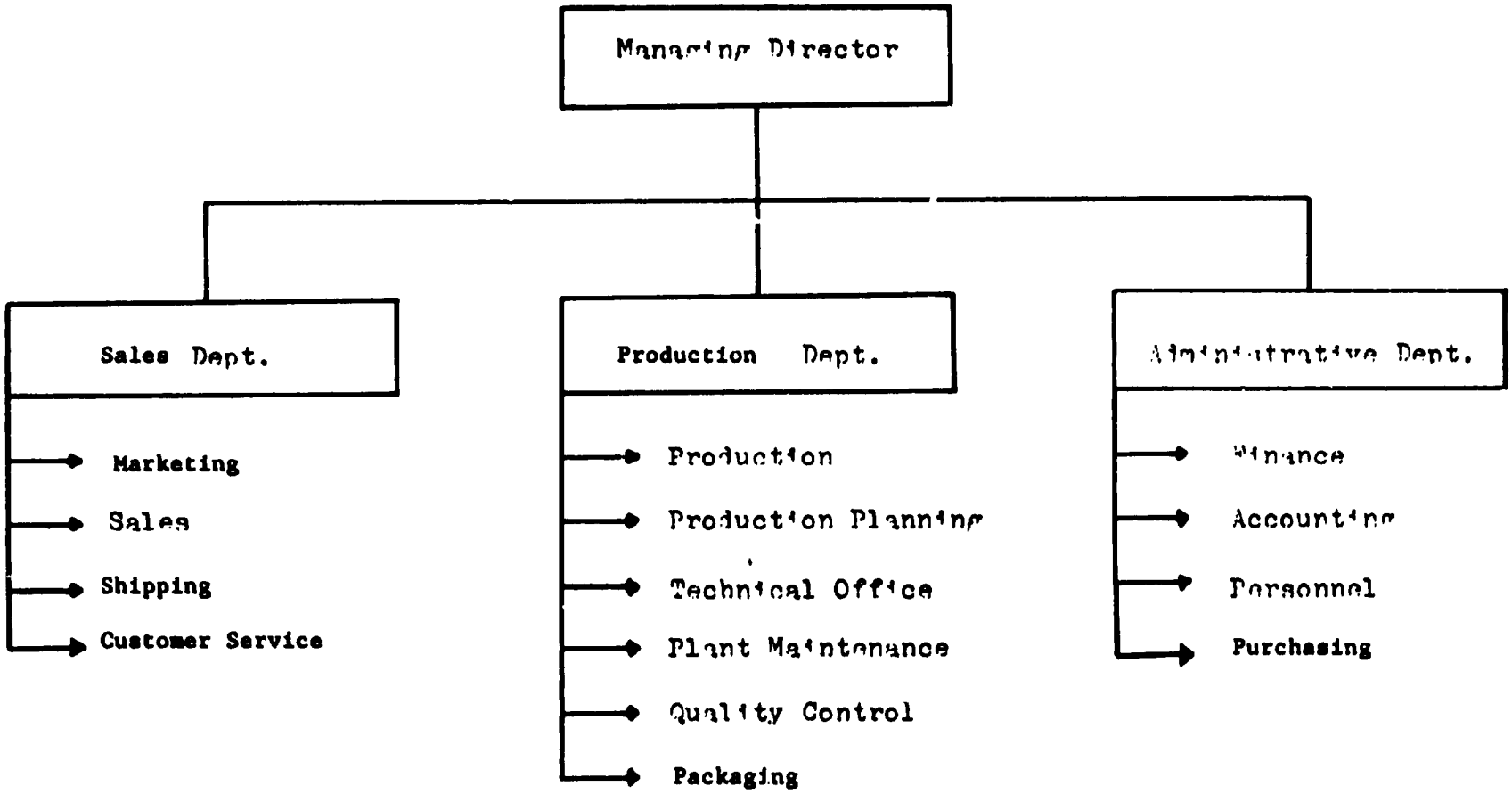
The owner kept his subordinates informed so that they would have the facts they needed for making their decisions. He tried to communicate effectively with them. He explained the "why" of his instructions.

His managers were given freedom to do things their way and he did not evaluate them upon whether they did a particular task exactly as he would have done it. He judged them by their results - not their methods.

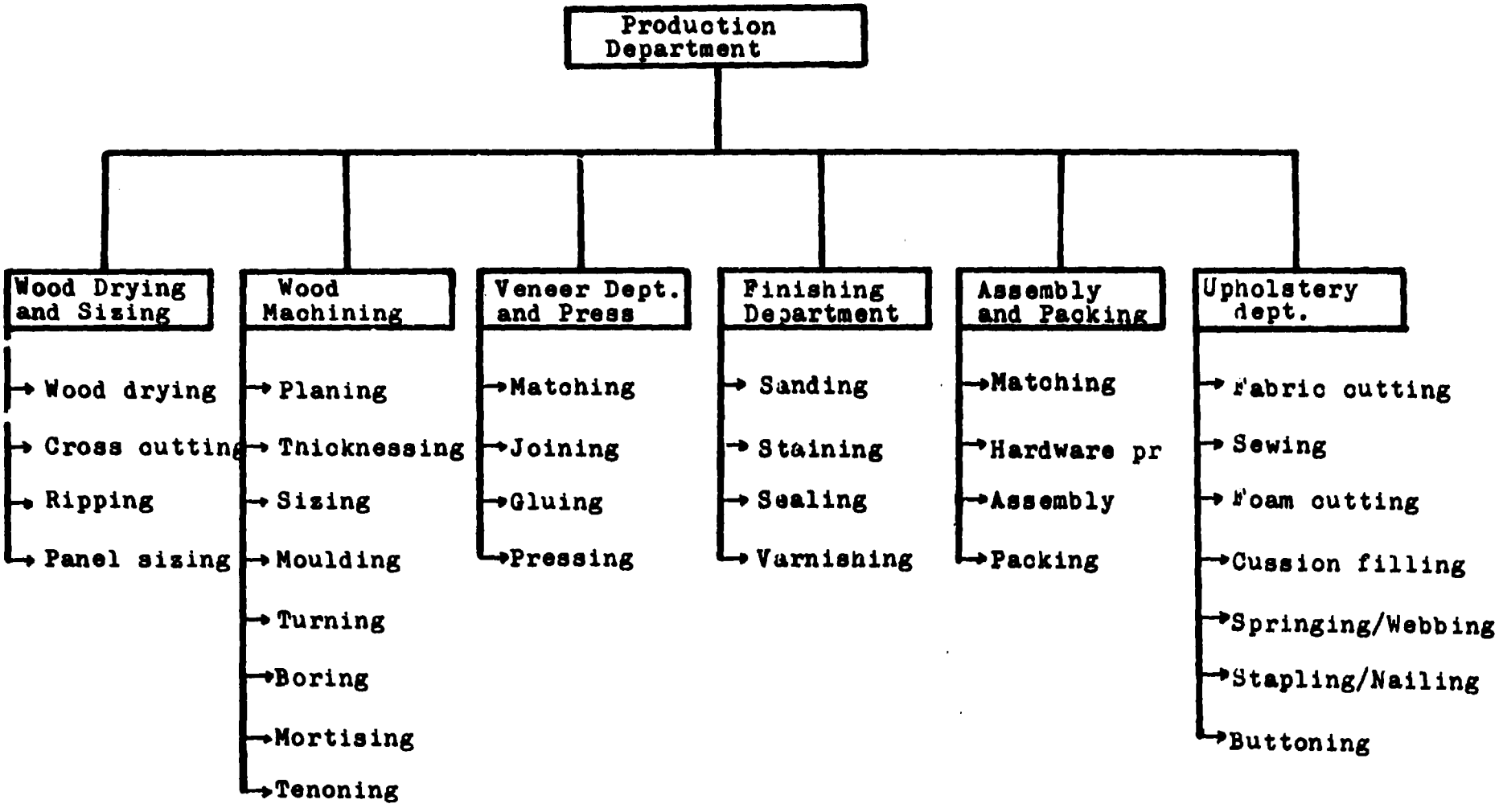
If managers deviated too much from policy, the owner brought them back into line. He avoided second-guessing his managers. If subordinates did not run their department to the owner's satisfaction and if shortcomings could not be overcome, the owner replaced the managers."(*)

An organization chart based on the above excerpt is given in Drawing 1. Drawing 2 gives a close look at the production department in a typical medium size furniture factory.

(*) Source: "Delegating work and responsibility" by Stanley Wantola, Small Business Administration, Washington D. C., U.S.A.



Drawing I : A Functional Organization Structure



Drawing 2: Allocation of production functions to various departments.

ASPECTS OF
PRODUCTION PLANNING AND CONTROL

Scope of production planning and control

Production planning and control is the most important production management function in any small-scale furniture manufacturing firm.

Essentially, it means the co-ordination, supervision and regulation of the rate at which the various production inputs - materials, manpower, machine-time etc. - are provided to the production system in order to meet delivery schedules at minimum cost. In a small firm, it encompasses the following tasks:

(a) Planning - forecasting sales, determining which products to produce, the amount of materials required, the processes to be performed etc.

(b) Routing - selecting the path through the manufacturing system which the product (or job-order) must follow in order to achieve scheduled deliveries at minimum cost. Here, it must be decided which machine to use and who will use it.

(c) Scheduling - preparing and monitoring production timetables and, in cases of job-order production, scheduling the incoming job orders bearing in mind the delivery requirements of other job orders on hand.

(d) Dispatching - authorizing the loading of a job order and sending it to manufacturing. This simultaneously releases the raw materials, tools, jigs, fixtures etc. required for the manufacturing operation.

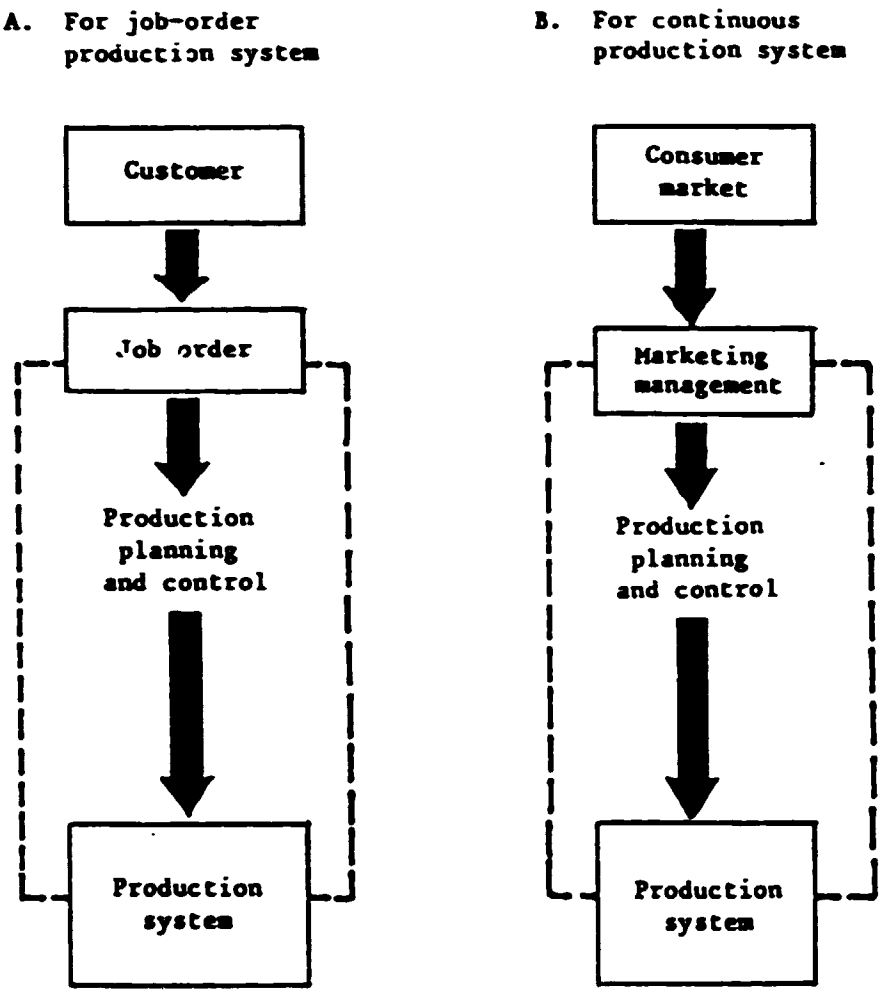
(e) Expediting - assisting or fostering the performance of the various manufacturing operations, minimizing or eliminating "surprises" that may develop along the way.

Production planning and control, therefore, acts as an interphase between the market and the firm's production system, as depicted in figure 1 In developing countries, the typical owner-manager of a small-scale furniture manufacturing firm tends to perform all the production planning and control tasks besides the more functional ones involved in day-to-day management of the firm. In performing these tasks, however, he is seldom in possession of all the information necessary to make correct decisions. The result is that the goodwill of the firm suffers, as failing to live up to delivery commitments is a sure way to lose customers.

A corollary to this unhappy practice is the persistent reluctance of some owner-managers to inform plant supervisors and workers of the production schedule (which is stored in his head). This situation can bring a firm's production activity to a halt as the workers await instructions on what to load next. This problem, which can severely drain productivity and resources, can be rectified simply by setting up a production schedule.

1/Source: Production Management for Small and Medium-scale Furniture Manufacturing Firms in Developing Countries. Chapter VIII.(UNIDO) United Nations, New York, 1983. (ID/300)

Figure 1. Production planning and control as an interphase between market and production system



In order to simplify the explanation of what constitutes production planning and control in furniture manufacturing, the two functions are treated separately below. In practice, however, they go hand in hand. Generally speaking, production planning consists of: co-ordinating the production function with other areas of the business; determining what products to produce, based on market study; calculating the quantities involved, based on sales forecasts; scheduling delivery; programming requirements of materials, parts, labour and facilities; and synchronizing the contributions of the finance, personnel, purchasing, marketing and administrative sections to the

overall production activity. Production control, on the other hand, involves: monitoring all activities within the production department, thereby promoting effective shop operation; co-ordinating manufacturing activities in line with production plans; routing, loading, scheduling, expediting and following-up; identifying deviations from the production plan during the manufacturing processes; finding the causes of such deviations and suggesting ways of eliminating them.

Production planning

Figure 2 shows a simplified production planning scheme for a small-scale furniture manufacturing firm. Even simplified, the task of production planning involves a number of steps and requires inputs of various types of information. The process is seldom as systematic-looking as the one depicted, as in most cases planning activities are performed and stored in the head of the manufacturer. One consequence of this is that the manufacturer may give in to changes of mind, with resulting confusion and frequent changeovers in production loads. Moreover, a manufacturer with a lot on his mind is liable to forget plans that he has only mentally recorded.

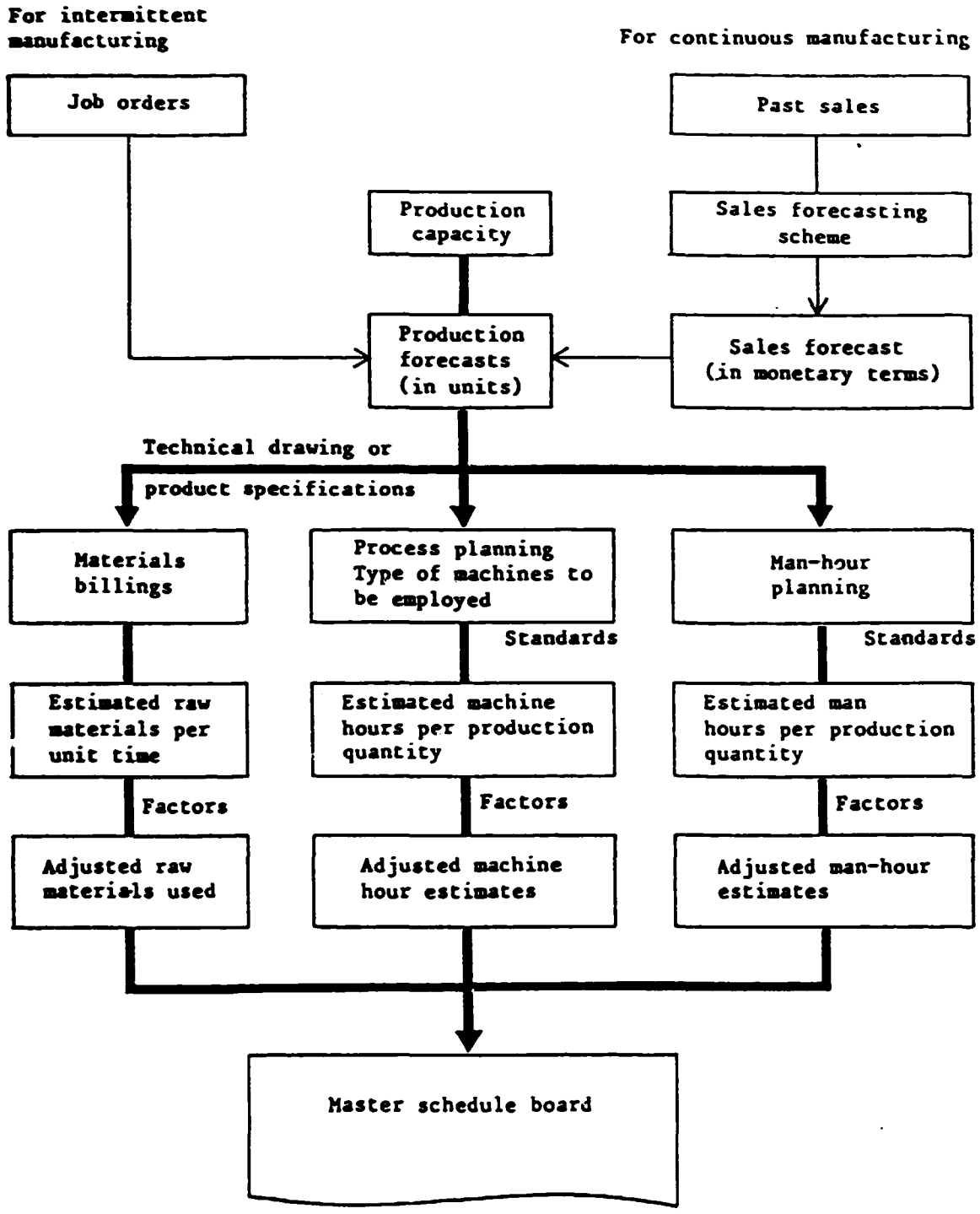
Production planning commences with awareness of the production capacity of the firm. Production capacity, in theory, is the maximum output that could be produced if there were no such thing as internal and external constraints. In reality, however, machinery, equipment and staff seldom operate without such influence: hence the term "effective capacity". This is always less than production capacity, because of the physical, product, process and human constraints that hamper the production of furniture products. Physical constraints may be the consequence of faulty plant location, layout, or materials handling procedures, among other things. Product constraints may have their roots in, for example, standardization and simplification efforts; the number of product lines or designs carried; or the quality and material requirements attaching to the products. Human constraints may be related to work methods; labour intensity; morale; working conditions; compensation and remuneration patterns; and the level of experience of the workers.

The effective production capacity of the firm acts as a "filter", separating jobs that can be accommodated on a one- or multiple-shift basis from those that might be sub-contracted to other firms. In intermittent furniture manufacturing operations, effective production capacity is generally expressed in terms of production hours. In continuous operations, it is expressed in terms of quantities per unit of time, e.g. 300 school desks per month. Thus, effective production capacity should be generally in accordance with production forecasts. The primary source of information for intermittent operations is the job-order, while that for continuous operations is the sales forecast.

Preparing production plans

On the basis of technical drawings, product specifications and/or a sample product, the total materials requirements are estimated. Initial estimates of raw materials (direct and indirect) should allow for spoilage, wastage, economic quantity ordering, re-order points, offcuts, existing inventory, and the like. At the process planning stage, the types of machinery needed to manufacture the product, as well as the estimated machine-hours required per process, are listed. Similar jobs carried out in the past will serve as a basis for the initial estimate of total machine-hour requirements. This estimate may be adjusted later to compensate for such factors as potential machine breakdown, repairs, power supply irregularities, and availability of operators.

Figure 2 A simplified production planning scheme for a small furniture manufacturing firm



Process planning is followed by man-hour planning. This process begins with the identification of all the areas of production where manpower inputs will be required. Man-hour estimates may be made using rough standards based on workers' experience levels and records of absenteeism, moodiness, tardiness etc. In some cases, man-hour planning is much simpler than process planning, because more than one worker may be assigned to a machine. The data provided by the materials billing, process planning and man-hour planning procedures will serve as inputs to the preparation of a "master schedule board" which should contain all the relevant information that is available regarding job orders on hand or in process, jobs to be completed, and so on.

From sales forecasts to production plans

In continuous manufacturing operations, the sales forecast is the basic information input to the formulation of a production plan. Sales forecasting refers to the ability of the owner-manager to plan in advance - by estimation and calculation - the future sales volume of the firm and the resources and activities needed to attain it. The increasingly scientific methods of estimating future sales have provided small-scale furniture manufacturers with a more sure approach to setting sales goals. Although the results of these initiatives may still, in many cases, be mere "guesstimates", such forecasting is vital to the preparation of the firm's budget and production plans. But how does one prepare a sales forecast?

A variety of techniques are available, ranging from the highly intuitive to the highly scientific. Simple approaches consider only a firm's production in relation to its share of the market, while more detailed approaches would take into account the state of the economy and possible substitution by or of the product manufactured. In the present publication, an attempt will be made to introduce scientific, but simplified, forecasting procedures. No matter which procedure is ultimately chosen, however, the following should be kept in mind:

(a) Whenever possible, scientific methods should be used to process sales forecasting data. When using the scientific approach, "cause-and-effect" relationships should be searched for which would justify - or not - the results obtained;

(b) Sales forecasting techniques should be used only as tools. They are "true" only to the extent that they are based on assumptions;

(c) Sales forecasting expenses should be kept to a minimum;

(d) The technique should be thoroughly understood by the user, who should never, in any case, rely on the results of only one method;

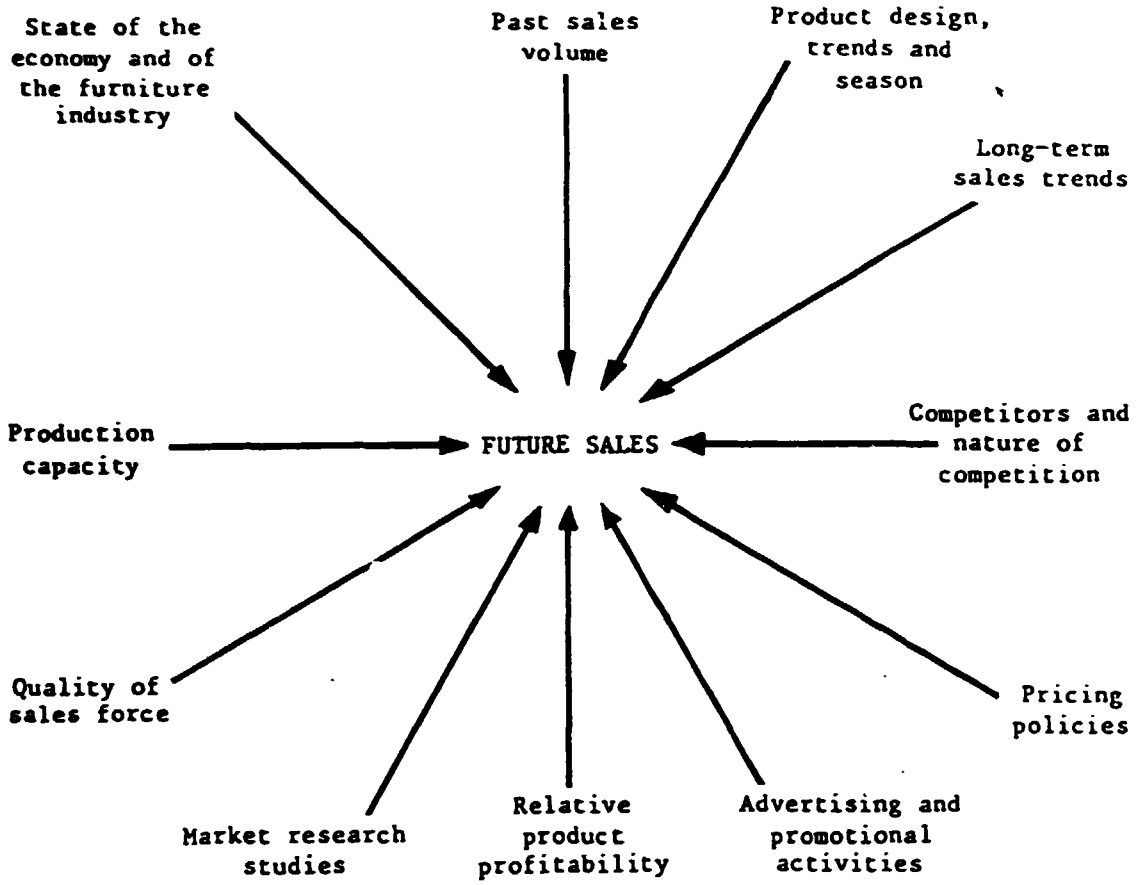
(e) Results expressed in ranges are preferable to absolute values;

(f) Attempts should be concentrated on generating accurate forecasts for the short term (some weeks or months). Long-term projections (e.g. 3 years or more) should at best be considered mere prospects;

(g) The procedure should be subject to continuous revision and updating.

Figure 3 shows the various factors that can have a positive or negative effect on future sales volumes.

Figure 3. Factors affecting future sales in small-scale furniture manufacturing firms



Sales forecasting techniques

The following forecasting techniques are particularly appropriate for small-scale furniture manufacturing firms.

Executive judgement method

Essentially non-mathematical, this method begins with the firm's salesmen being asked to submit their estimates of future sales. These are reviewed by the salesmen's immediate managers, who may adjust them if it is considered that the salesmen have tended to be too conservative in their estimates. The final (managers') estimates are then transmitted to a special committee charged with drafting the final forecasts. (In very small firms, this function is assumed by the owner-manager.) The committee would likely be composed of: the head of the marketing department; the head of the production department; the company treasurer; the company president; and the company secretary. The committee reviews, revises and adjusts the sales estimates in the light of other factors that the salesmen and their managers have not been in a position to consider, such as: expected changes in product design; possible increased use of advertising; probable adjustments in selling price; planned improve-

ments in project quality; expected revision of marketing strategies; and probable economic changes as a spin-off of changes taking place on the national scene. This final revision represents the official sales forecast for a particular product.

Derived demand method

Also non-mathematical, this approach is particularly appropriate for sub-contractors who depend on orders from another company. The sub-contractor's forecast could be based totally on the sales projection figures of the other company. For example, a small firm producing wooden cases for a bottling company can base its sales forecasts on the sales projections of the bottling company.

Market indicators method

Market indicators are economic factors that influence the demand for a product. In using these for forecasting purposes, the main idea is to obtain the increase/decrease rate of sales volume. This is especially applicable to products that behave according to a specific market indicator. A difficulty in applying the method, however, lies in the fact that some products are directly affected by a number of market indicators. Among the more common market indicators are: (a) population trends (population magnitude; birth rates; death rates; marital trends; migration; age patterns); (b) construction trends (private and public building); (c) foreign trade developments (import and export activities); and (d) general economic conditions (increases in gross national product, unemployment rates, inflation rates). In the case of furniture manufacturing, the volume of construction activity in an area can be an indicator. Marriage and birth rates can also be used, but these tend to be weak indicators.

Arithmetic method

If a firm has been in existence for some time, sales projections can be based on past sales data. The objective in using historical figures analysis is to compute average increases or decreases for a given forecast period, using the Simple Average Annual Increase (SAAI) system, as shown in the following example;

The annual sales record of a small-scale furniture manufacturing firm is:

Year	Sales (thousands of IC)
1	45
2	52
3	39
4	42
5	65

Using the arithmetic method, the following computations are obtained:

	(thousands of IC)
Sales in year 5 =	65
Sales in year 1 =	45
Increase in 4 years' operation =	20

Thus, SAII = 0.5 (obtained by dividing the increase by the years of operation).

Sales projections

Year	Sales (thousands of IC)
6	70
7	75
8	80

Year-to-year change method

It will be observed that using the arithmetic method only the last year (5) and the first year (1) were used in projecting the sales volume. The years in-between were virtually disregarded. In the year-to-year change method, however, the changes (positive or negative) are considered for each period, as shown in the following example:

Year	Sales volume (thousands of IC)	Year-to-year change (thousands of IC)	Percentage change
1	45	(base year)	
2	52	+7	+15.6
3	39	-6	-13.3
4	42	-3	-6.7
5	65	+20	+44.4
Algebraic sum		+18	+40.0

Thus, the year-to-year change of + IC 18,000 for a period of 5 years - or IC 3,600 per annum - can be used in projecting the sales volume. The average annual growth at 8 per cent (40.0 - 5) can likewise be used in forecasting sales.

The above are examples of possible techniques for sales forecasting. As soon as the forecasts are finalized, the production plan can be prepared. At this stage, instead of monetary units, the sales forecasts will have to be expressed in production volume equivalents. This is accomplished by considering the unit price of the product (for single-product firms) or the average price of the product (for multiple-product firms) together with the sales forecast results. Care should be exercised when using the average price for firms whose prices vary significantly. Still another way of converting the sales forecasts of multiple-product firms is to apply the percentage distribution of each product line to the total sales volume generated in the previous year. These percentages can be used as the basis for determining the contribution of each product line in succeeding years.

From job orders to production plans

Production planning for a continuous-type manufacturing operation is relatively simple compared with that for a job-order production system. This is primarily because planning per se tends to be more difficult in the latter case. The basic information for the preparation of a production plan for a job-order operation is entered in a production planning sheet, a model of which is shown in figure 4

Figure 4 Production planning sheet for a small-scale furniture manufacturing firm

1. Job order No. _____	5. Date received _____
2. Customer _____	6. Volume needed _____
3. Address _____	7. Other information _____
4. Contact _____	_____
_____	_____

8. Product specifications	
8.1 Standard product lines	8.2 Made-to-order products
Additional specifications (moisture content, finishing modification etc.)	Product design/technical drawing
Conditions of delivery	Breakdown of parts/components and fittings
	Additional specifications (type of materials, finishing etc.)
	Conditions of delivery

9. Materials list	Unit	Quantity/piece	Total quantity required
1. Wood and lumber materials			
2. Upholstery materials			
3. Hardware			
4. Other			

10. Manufacturing processes for standard product lines

Manufacturing processes	Machines, jigs, fixtures to be used	Estimated machine-hours required	Estimated man-hours required	Total	
				Machine hours	Man-hours

11. For made-to-order products

Parts	Machines, jigs, fixtures to be used	Estimated machine set-up	Estimated machine hours	Estimated man-hours	Total

Note: The estimated machine set-up time includes the time needed for the trial run.

12. Adjustments estimates

Materials (allowances for non-availability, rejection rates, scraps etc.)

Machine-hours (i.e. allowances for power failure, machine breakdown etc.)

Man-hours (absenteeism, tardiness etc.)

13. Prepared by: _____ 14. Verified by: _____

15. Approved by: _____

The production planning sheet inquires (item 8) whether the product needed is standard or made-to-order. If standard, then besides the materials (item 9), the manufacturing processes - including the machines and equipment needed - will have to be listed in detail. In firms using relatively sophisticated techniques, index cards may have to be consulted when filling in the manufacturing processes columns (item 10). The index cards should contain details of all standard product lines carried by the firm. For non-standard products, item 11 should be filled in. Various adjustments can later be made (if necessary) to allow for unexpected delays. Records of these adjustments will help the owner-manager in future estimating of realistic delivery dates.

Again, in the more sophisticated, medium-sized firms, a card detailing the process flow of the product is prepared. This accompanies the components throughout the factory, serving to inform workers about the next operation, how the machine is to be set up, which jigs to use etc. This card also states the exact operation to be carried out on each machine, describing the special tools or jigs that may be needed. A space is usually provided for the workers to initial when an operation has been completed, or to list the starting and finishing times of pieces machined if they are working on a piece-rate basis. As a rule, this card is encased in a plastic folder bearing a dimensioned sketch of the finished component, enabling the operator to set the machine for each operation.

After capacity, availability and other adjustment factors have been taken into account, the scheduling process may be started. The objective of scheduling in manufacturing, whatever the scale, is to prepare, allocate and make available all the physical inputs needed in the manufacture of goods or the provision of services, in order to ensure that:

(a) All job orders are executed in the shortest possible time;

(b) Estimated delivery dates are based on reliable information;

(c) A continuous supply of work flows to each process; and

(d) Plant supervision can be kept to a minimum.

Figure 5 gives an example of a general production plan for a job-order system. Such plans must not be too rigid; there should be leeway for any revisions that may have be made if:

(a) A new product (or job order) is added;

(b) Changes are called for in the design of a product (the result, for example, of rationalization, standardization or product adaptation efforts, cost effectiveness schemes or productivity studies);

(c) A need is seen to reduce production costs (through greater utilization of existing facilities) or to minimize labour or materials costs;

(d) Processes, equipment or methods become obsolete;

(e) It is decided to introduce more effective supervision and production control.

Plans may be revised through (a) periodic adjustments (in small plants that change products and accept job orders at regular intervals); (b) continuous adjustments (in small firms employing job-order systems with very short production cycles); or (c) accidental adjustments (upon discovery, in the course of production, of new or improved methods or processes).

Figure 5 Production plan for a job-order manufacturing system

Job order No.	Date received	Date of delivery	Quantity required	Materials required	Man-hours estimate	Machine-hours estimate	Volume per week	First machine loading date	Production to date

Basic production control procedures

Basically, production control means regulating, synchronizing and co-ordinating all the activities involved in manufacturing in order that delivery dates can be met, plans implemented with optimum efficiency and economy, and the right quality achieved using minimum capital investment. All furniture manufacturing companies, big and small, are beset by the following problems:

(a) How to satisfy customers' delivery and quality requirements;

(b) How to reduce production costs, thereby lowering the price of the product;

(c) How to maintain a minimum level of capital investment;

(d) How to streamline the production cycle.

These problems sometimes seem insoluble, as they appear to be inconsistent with one another. Salesmen and other marketing staff clamour for quick delivery, production personnel for more time, and financial staff for reduced capital expenditures.

The basic elements of a control system must be present in production control. Figure 6 illustrates the basic production control concept. Here, subject to control is the rate of production that will permit the realization of all delivery commitments at a relatively low cost. A daily production (or accomplishments) report should be prepared in order to keep track of the day-to-day rate of production. This report should tally with the production plan (which outlines the desired rate of production). Deviations from the production plan are recorded in a daily production variance report. Each deviation must be explained by the persons responsible, who should, besides,take the necessary corrective action. The production plan may sometimes need to be adjusted in the light of information acquired subsequent to the production planning stage. Production control is a continuous process of adjusting the actual production rate to measure up to the desired one.

Very small firms may consider that the basic production control concept is too sophisticated for their needs. In this event, a simpler approach could be employed, based on the use of a "production monitor chart", as explained later in the present chapter. In general, an efficient production control system helps to: systematize job-order scheduling; optimize the utilization of men and machines; provide better control of work methods; maximize workers' satisfaction, besides increasing their effectiveness; minimize waste; and bring to light more profitable options for manufacturing specific products.

Order and flow production control systems

There are two basic production control systems: order control and flow control. The two systems exist because there are two general types of manufacturing process: continuous and intermittent. It is difficult, however, to classify companies by type of manufacturing process, since some use both.

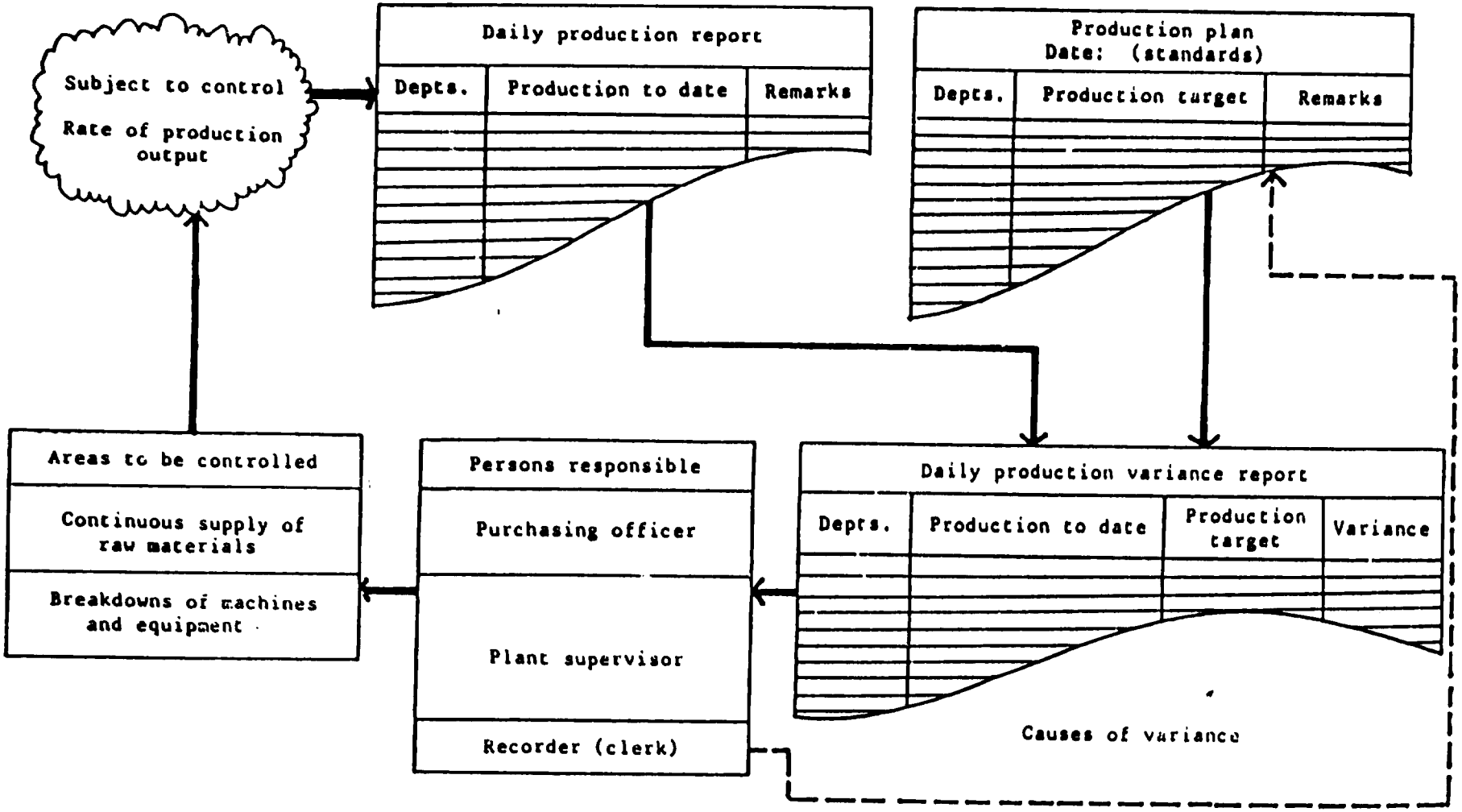
Order control system

A firm uses the intermittent process when it:

(a) Manufactures wide varieties of products per order;

(b) Manufactures small quantities of units that are seldom re-orders;

Figure 6 Basic structure of a production control system



(c) Uses multi-purpose machinery and equipment in the processing of its products;

(d) Is laid out along the lines of the production process;

(e) Bases its manufacturing activities on past sales records.

These cases call for the application of order control.

A feature of the order control system is that the process of production control actually starts with the signing of the contract or agreement between the firm and the customer, regarding the type, quantity and quality of products to be produced, and the delivery date. The elements of this agreement are embodied in the Production Planning Sheet (see again figure 4 - and sometimes in the Job Order Sheet. A routing scheme may subsequently be devised showing the most appropriate flow of materials within the plant in light of the various manufacturing processes required. The estimated time, raw materials and the machine-hour requirements for each manufacturing step involved in a specific job-order should be included in the routing scheme. This will lead to the establishment of an effective production schedule, and ensure that products will arrive at the finished goods storeroom on the date stipulated. To guarantee the success of this operation, the following steps should be taken:

(a) The product should be divided into its major and minor components and the decision made as to whether to make or buy them. This means determining in advance which parts or components it would be economical for the firm to make and which could be more economically bought outside.

(b) The owner-manager should make himself thoroughly familiar with the alternative ways of delivering the services stipulated in the job-order, in order that the most economical process will be selected prior to inserting the job-order in the production system;

(c) It should be ascertained that the various procurement lead times for the required raw materials are realistic;

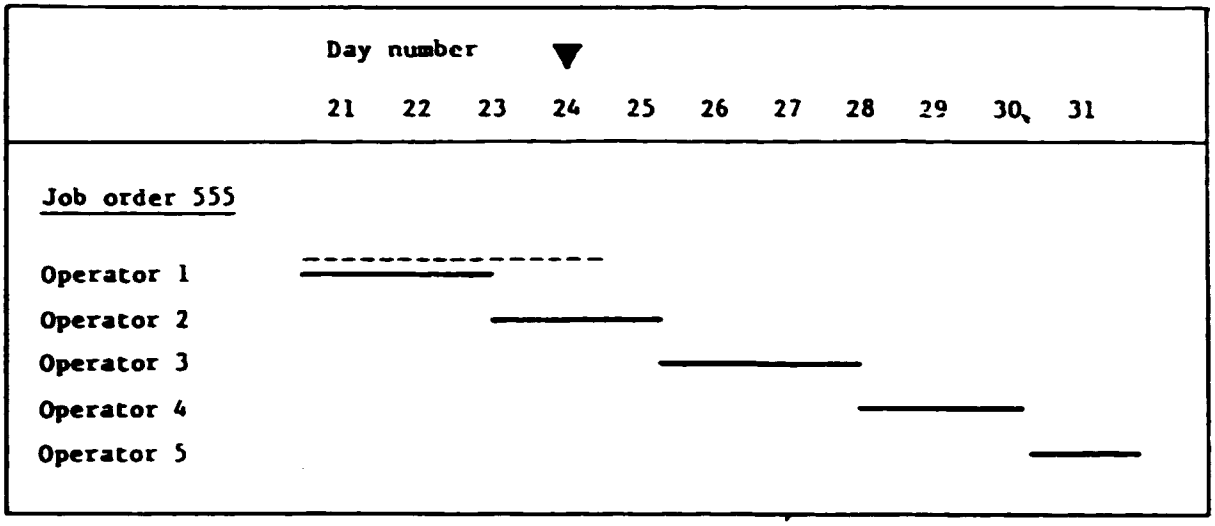
(d) The situation regarding job orders in process, as well as those scheduled to be processed, should be carefully considered before fixing a schedule for the new job order.

At this point, a formal schedule is prepared, preferably using a Gantt chart or the PERT (Programme Evaluation and Review Techniques) Network Analysis.

The Gantt chart shows, in descending steps, all the time and activities involved in a process, from the procurement of the raw materials to the completion of the product. In furniture manufacturing, two types of Gantt charts may be employed: a machine record chart and an operator record chart. Both use similar procedures and differ only in the type of "causes" of failure to meet production plans. An example of a Gantt chart for a particular job order is shown in figure 7

The PERT Network is a logical representation of the sequences and procedures involved in all the manufacturing activities associated with a given job order, using PERT principles of programming. At the moment, the PERT Network is applied only in sophisticated medium- to large-scale furniture manufacturing plants.

Figure 7 Gantt chart (operator record type)



Key:
- Date
- Planned time for job order
- Actual time for job order

Causes of delay
- Operator absent
- Power failure
- Tools jigs not available
- Machine breakdown
- Accident

The scheduling process will never be completed satisfactorily unless a production monitoring chart is employed which illustrates the stage-by-stage completion of the various job orders. Figure 8 shows an example of such a chart. Out of this production schedule will evolve a summarized report on the process of every job being processed. A format of a typical such report is shown in figure 9

In dispatching, which follows scheduling, the primary aim is to maintain lines of communication with all those concerned in the manufacturing processes to ensure that materials and products move from process to process as planned and on schedule. Dispatching involves:

(a) Co-ordinating all production schedules prior to their release to the various departments concerned;

(b) Machine and manpower loading, which means assigning specific jobs to specific machines and workers;

(c) Reporting and arranging feedback on the status of each job order being processed in the plant;

(d) Controlling work-in-process. This task involves assuming responsibility for uncompleted work after a certain date, reporting the level of work-in-process, the amount requiring re-work and the amount of scrap materials generated.

Figure 8. Production monitoring chart

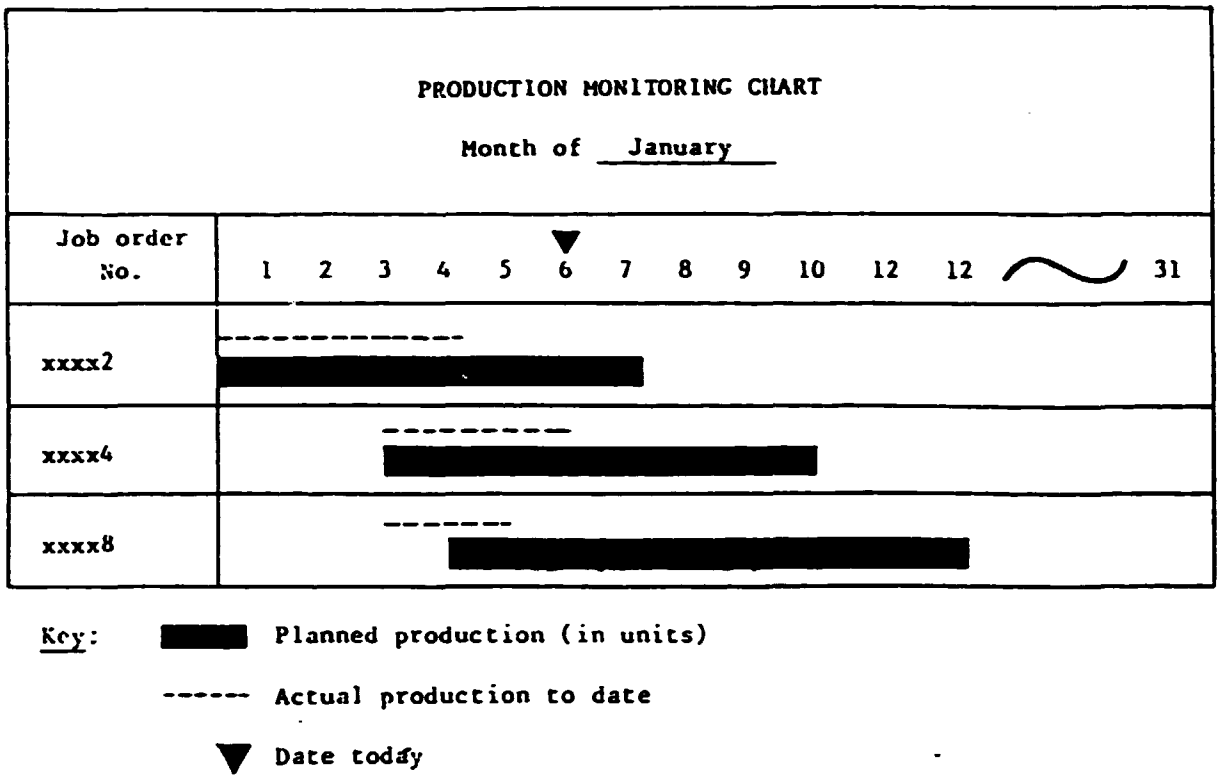


Figure 9 Format of a job-order processing report

Job-order processing report for the month of ...

Cusromer	Job order No.	Past due	This week	Next week	Remarks

If the production planning and control functions of an intermittent manufacturing operation have been well laid out, "expediting" should not be necessary. This, however, is seldom the case: schedules are not adhered to, machines break down, and other production mishaps occur - hence the need for a production expediter. Production expediters have an intimate knowledge of the firm's products, processes, machines, routing schemes etc. in order to be able to predict and forestall the occurrence of production set-backs.

Flow control system

The flow control system is applicable to small firms that employ the continuous manufacturing process. Such firms are generally characterized by: the large-volume production of standardized products; the departmentalization of the plant by product; the use of special-purpose machines; the tendency towards long-term sales contracts; and production for stock.

The primary function of flow control is to provide adequate control of the rate at which a product or material "flows" through the firm. A firm employing the continuous manufacturing process can reap the economic advantages of the mass production system - i.e. speed, low inventory in process, low unit costs, simpler supervision, and simple production control methods. Even if flow control is relatively limited in application vis-à-vis order control (e.g. in intermittent manufacturing) the basic elements remain the same: routing, scheduling, dispatching and expediting.

In continuous manufacturing, the production department must be told what to produce, in what quantities and by what date. Continuously manufactured products are usually standard products, i.e. they are produced for stock and not against customers' orders. The rate of manufacturing will be based on the company's sales forecasts.

The basic elements of flow control are routing, scheduling and dispatching.

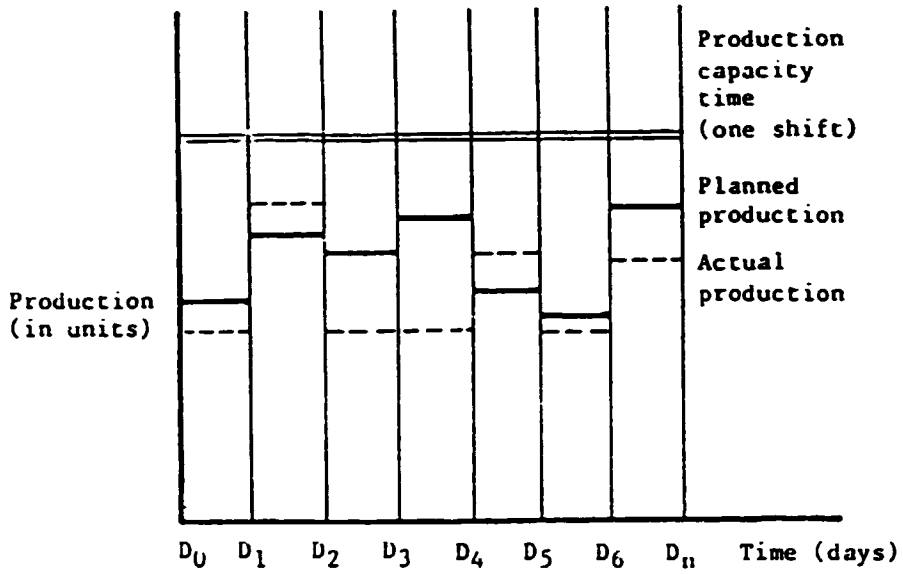
Routing. The production staff must be familiar with the different processes involved in the manufacture of the product. This is important because the processes may require special parts and tools.

Scheduling. As mentioned earlier, the scheduling of continuous manufacturing is much easier than that of intermittent manufacturing. The Gantt chart lends itself well to flow control methods. In addition, however, charts to monitor production progress should be used. Figure shows two examples of production monitoring charts for continuous-type furniture manufacturing. Critical to effective scheduling is the procurement, in good time, of all the necessary materials, so that the production processes will not be hampered or delayed.

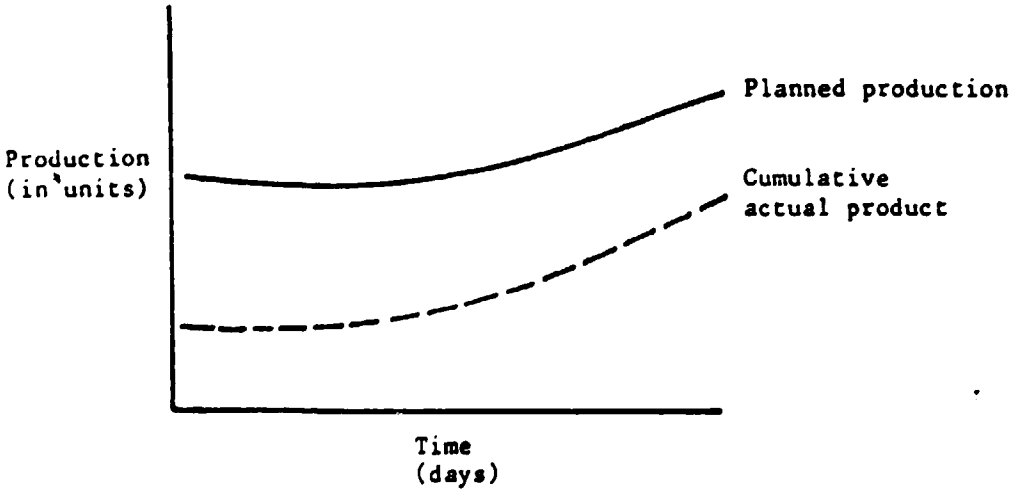
Dispatching. After the operating schedules and plans have been considered, the production control department contacts the purchasing department regarding the procurement of the raw materials. It then gives the production personnel instructions on the manufacturing processes to be employed. For continuous manufacturing, these instructions will be relatively complicated. For this reason, most small companies engaged in continuous manufacturing do not employ dispatch forms.

Figure 10 Production monitoring charts for continuous furniture manufacturing

Example A



Example B



Annex X

ASPECTS OF QUALITY AND PROCESS CONTROL IN THE FURNITURE INDUSTRY

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 decissions.

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 involvment of staff of various levels in a quality control system in a furniture factory.

Figure 1: Organization of Quality Control.

Organizational Level	Major Responsibilities
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 calipers. 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 dig tal 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 material which do not meet the quality standards is rejected. The main features of the materials cotrolled 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 detects 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-N13.

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 conspicious. (e.g. crossbars, rails, inside of cupboards, legs, surfaces hidden by cushion or matress 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

I. Solid Wood:
1. Moisture content.
2. Thickness.
3. Species.
4. Colour (overall).
5. Defects (cracks, knots).
6. Straightness.
7. Stains.
8. Fungal attack.
9. Insect damage.
10. Grain direction.

II. Panels (Plywood/Particleboard):
1. Surface smoothness.
2. Colour and grain pattern (surfaced particleboard and plywood).
3. Thickness.
4. Moisture content.
5. Specific gravity (Kg / Cubic meters).
6. Delamination (knife test).
7. Swelling.
8. Manufacturing faults (gap, pleat etc.).

III. Lacquers:
1. Viscosity.
2. Solids content.
3. Film hardness.
4. Drying time.
5. Adhesion.
6. P.H. value.
7. Colour fading.
8. Colour uniformity.
9. Shineness.
10. Hiding properties.
11. Elasticity.
12. Temperature resistance.
13. Solidification at the base.
14. Shelf life.
15. Pot life.

IV. Glues:
1. Viscosity.
2. P.H. value.
3. Shelf life.
4. Pot life.
5. Open life.
6. Storage temperature.
7. Curing time.
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) Rabbet and Groove Control:
1. Rabbet depth.
2. Rabbet width.
3. Rabbet 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 bubles in the lacquer.
5. Pressure and cleanness of compressed air.
6. Colour uniformity of the filler or stain applied surface.
7. Stains or marks occuring on the surface during production.
8. Overall visual control during and immediately after spraying.

Annex:XI

STACKING OF TIMBER FOR AIR DRYING

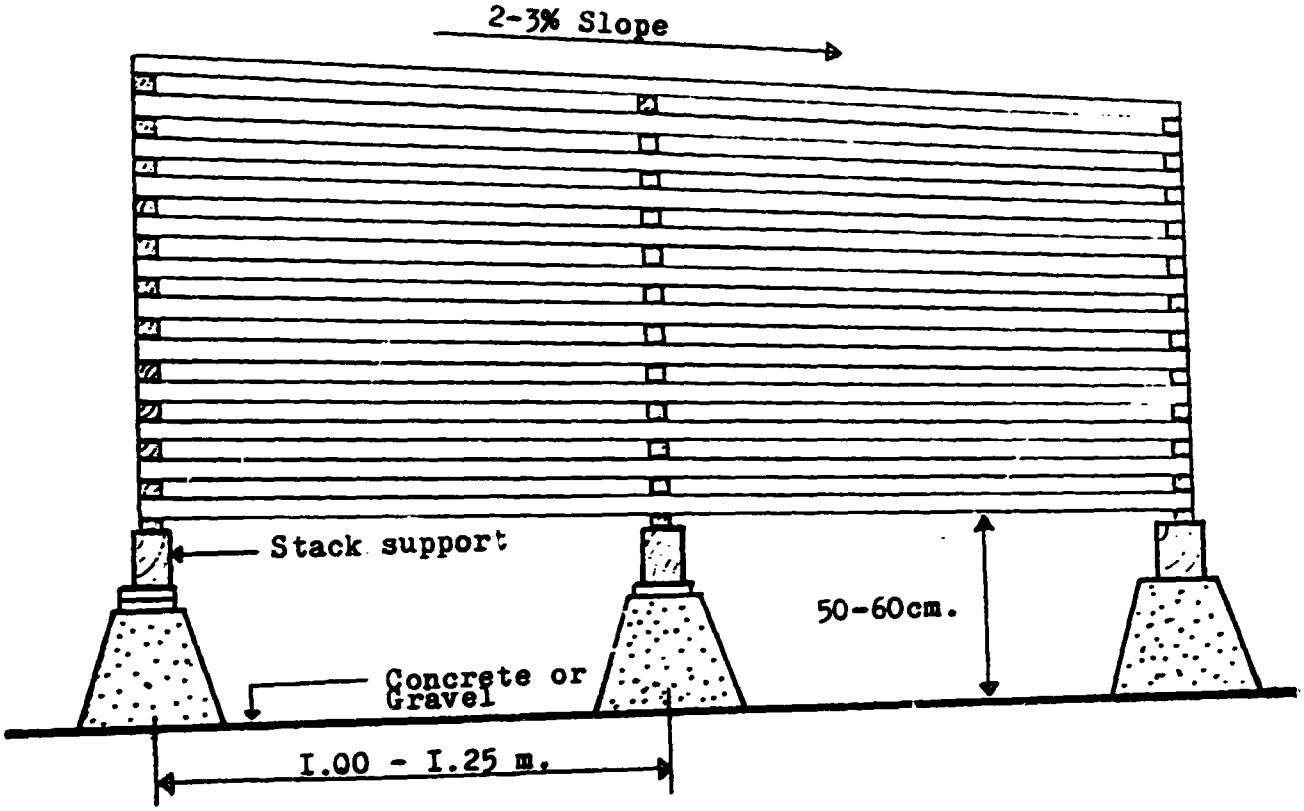


Figure I:Side view of a timber stack for air drying.

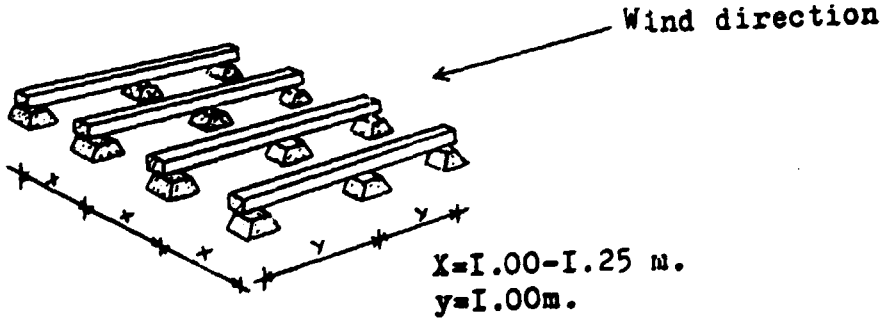


Figure 2:Plan of stack foundation blocks.

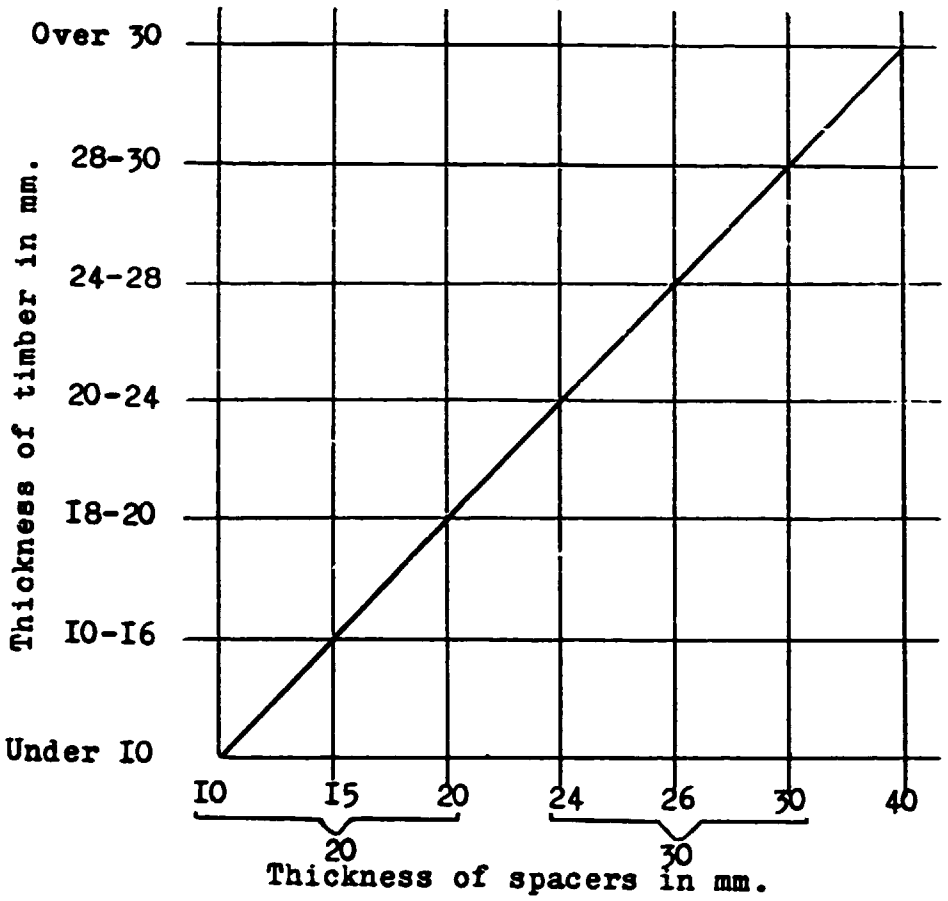


Figure 3:Diagram for selecting spacer thickness.

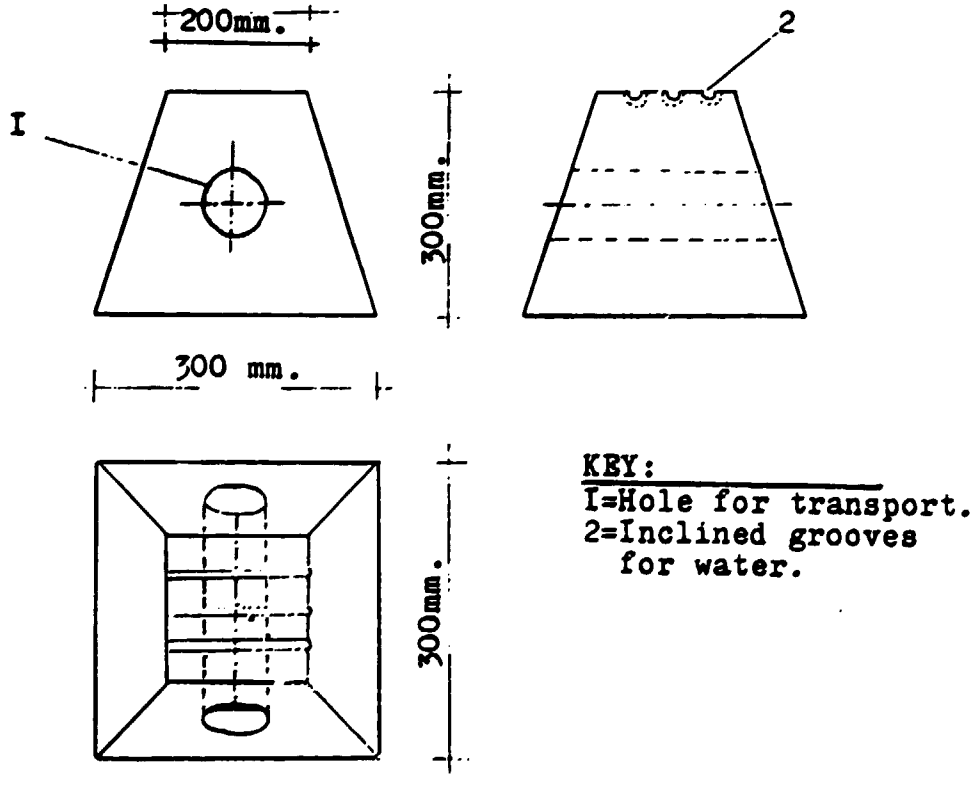


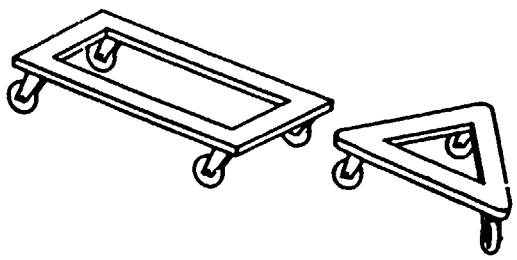
Figure 4:Construction details of concrete foundation blocks.

MATERIALS HANDLING DEVICES FOR FURNITURE AND WOODWORKING FACTORIES

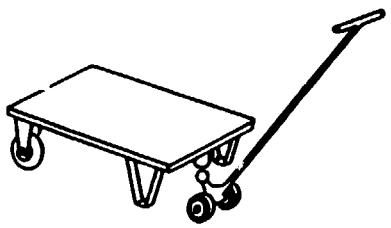
The most common devices for the handling of raw materials and work-in-progress are the various types of wooden and combination of wood and metal pallets. They can either move on the floor on wheels or be moved by various transport devices such as manually operated hydraulic pallet trucks, flat deck pallet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

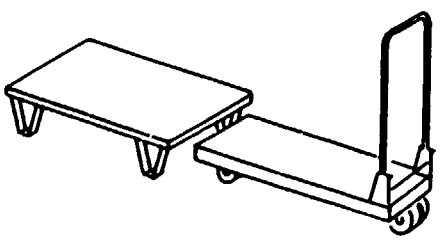
The overall sizes of various types of pallets are shown in Drawing 10.



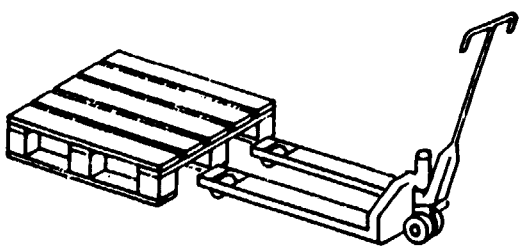
Drawing 1: Wheeled Frame Pallet



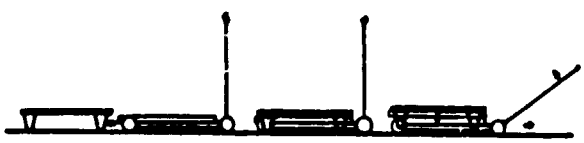
Drawing 2: Lever Type Pallet Transporter.



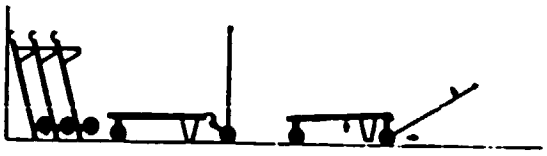
Drawing 3: Flat-deck Pallet Car.



Drawing 4: Fork-type Pallet Car.

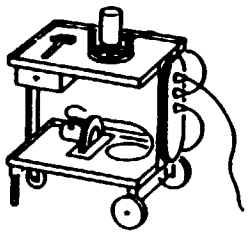


Drawing 5: Working Principle of Flat-deck Pallet Car.

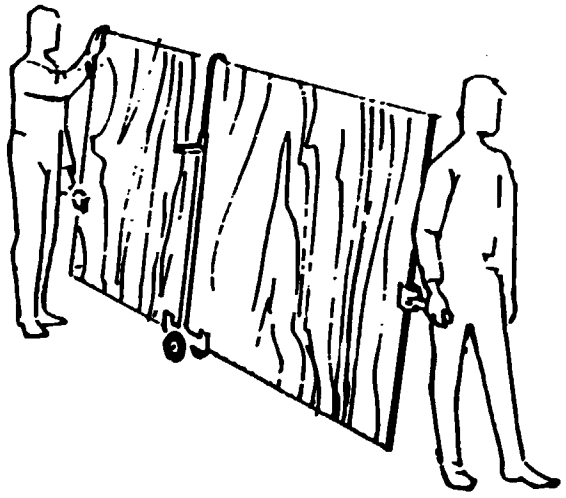


Drawing 6: Working Principle Lever Type Pallet Car.

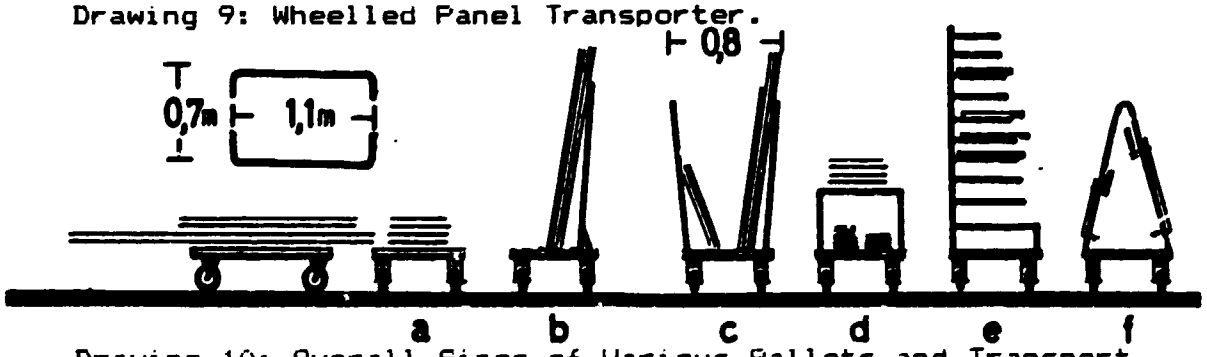
Drawing 7: Wheeled Pallet for Glass Sheets.



Drawing 8: Mobile Bench for Power Tools.



Drawing 9: Wheelled Panel Transporter.



Drawing 10: Overall Sizes of Various Pallets and Transport Aids. (Legend: a= Standard wheelled 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.)

Annex XIII

OPERATION OF PREVENTIVE MAINTENANCE (A SIMPLIFIED 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. Grease Type : 7. 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 seperately 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 seperate 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 usefull. (See Table I).

(c) The lubrication plan:

The lubrication plan is made for those lubrication activities occuring more often then 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

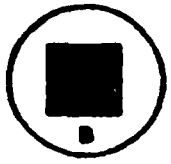
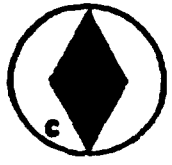
TITLE : Machine maintenance technician.
EDUCATION : Technical school certificate in mechanics.
EXPERIENCE : Some experience in machine maintenance and repair is desirable.
DUTIES : Under the direct supervision of the factory manager; he will be responsible for the preventive and repair maintenance of the whole machinery and equipment. Duties include:

1. Preparation and updating of machine maintenance cards.
2. Setting up of machine files.
3. Determination of spare parts needs and their specifications.
4. Determination of lubricants and grease types required.
5. Preparation of machine lubrication charts.
6. Preparation of a preventive maintenance programme and undertaking of preventive maintenance operations including lubrication, testing and inspection.
7. Undertaking of breakdown and repair maintenance when necessary.
8. Rehabilitation of the run-down machinery and equipment by replacement of parts, assemblies and subassemblies.
9. Monitoring of equipment during operation.
10. Drafting of technical specifications for work to be sub-contracted.
11. Technical inspection of spare parts upon their receipt.

Drawing 2 : Machine Maintenance and Lubrication Plan

MACHINE MAINTENANCE AND LUBRICATION PLAN				From : ..... to																										
Item No.	Machine Name	Machine Location and Position No.	Type of service to be carried out	WEEKS																										
				1							2							3							4						
				M	T	W	T	F	S	Su	M	T	W	T	F	S	Su	M	T	W	T	F	S	Su	M	T	W	T	F	S	Su

Table I: Lubricants and their specifications.

Lubricant Code & Symbol	Lubricant type	Equivalent Lubricant Grades	Lubricant Description & Properties	Lubricant to be for :
A  (Spindle Oil)	Oil	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	1. A good quality mineral oil 2. Viscosity : 60 - 70 SSU @ 100° F 3. Contains oxidation inhibitors to prevent gum and varnish formation	1. Ball & roller bearings over 4000 RPM 2. Oil Mist Lubrication 3. Cut spray 4 Air Cylinder
B  (Lubricating Oil)	Oil	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 PC	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.	1. Ball & roller bearings under 4000 RPM 2. Plain bearings under 4000 3. Roller Chains 4. Friction points ways, slides,
C  (General Purpose Oil)	Oil	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	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	1. Roller chains 2. Friction points ways, slides,

Company Name: PEM WOOD PROCESSING LTD.

Person in Charge: E. ADU ARTHUR

P.O. Box or Street Address: BOX 12585, ACCRA NORTH.

City: ACCRA **Cable Address:** PEM WOOD

Country: GHANA **Phone No.:** 223119, 223016

Telex No.: 2340 GNJ PEM WOOD

TYPE OF BUSINESS:

- [X] Manufacturer
- [X] Retailer
- [ ] Wholesaler
- [X] Exporter
- [ ] Others (Please specify)

Established in Year: 1982

Number of Full Time Employees: 90

Techno-Managerial: 5 **Workers:** 85

Bankers: NATIONAL INVESTMENT BANK: SOCIAL SECURITY BANK

Commercial references:

Member of:

- [X] Local Chamber of Commerce
- [X] Trade Association

State Which: ASSOCIATION OF GHANA INDUSTRIES GHANA FURNITURE PRODUCERS ASSOCIATION

(Special information regarding services, licenses, co-operation, line and range of Products, etc.)

Our Range of products: - Living room furniture; Bedroom furniture; Dinning room furniture; Garden chair Tongue and groove for pannelling, mouldings. Decorative pressed ceiling boards. Office Furniture.

Products Manufactured are:

- [ ] Low-priced
- [ ] Medium-priced
- [X] High-priced

TERMS:

Delivery: 8 weeks **Minimum Order:** One container

Packing: Crates **Fairs:** GIPEX-85, 87

Shipment: Crates in container.

Payment: Irrevocable letters of credit through NATIONAL INVESTMENT BANK, ACCRA

Annex XV

LIST OF ADDITIONAL EQUIPMENT RECOMMENDED FOR PEE WOOD PROCESSING LIMITED

ITEM	DESCRIPTION AND SPECIFICATIONS	QUANTITY
1	Dowel milling machine for spiral grooved dowel rods and non-grooved smooth rods. Dowel diameter: 6-18 mm. Feed rate: 4-7 m/min.	1
2	Dowel cutting and chamfering machine for dowels 6-18 mm diameter.	1
3	Jig saw or very narrow band sawing machine for cutting shaped parts. Throat depth: 500 mm.	2
4	Multi-spindle dowel hole boring-machine with swiveling universal head. Number of spindles: 25, Distance between spindles: 32 mm.	1
5	Double circular cross cutting saw for sizing and squaring up. Max. working width: 2,500 mm. Diameter of main saw blades: 300 mm.	1
6	Bench type manual edge banding machine for curved, round and straight edges with hot melt glue pot and top and bottom trimming units.	1
7	Veneer pack edge shearing guillotine. Cutting length: 2,500 mm.	1
8	Zig-zag veneer splicer. Working width: 900 mm.	1
9	Glue spreading roller for frames and panels. Coating width: 1,000 mm. (For two side glue application).	1
10	Horizontal panel cutting saw. Beam type. Cutting length: 3,200 mm. Cutting width: 2,100 mm. Maximum cutting height: 115 mm.	1
11	Wide belt sanding machine for surface and thickness sanding. Working width: 1,000 mm. Max. working height: 170 mm. Minimum working height: Veneer thickness.	1
12	Conventional type timber drying kiln. Capacity: 25-30 cubic meters / charge.	1
13	Pneumatic carcass assembly press for panel furniture. Size: Width X Height X Length, 500 mm X 2,300 mm X 2,500 mm.	1
14	Pneumatic assembly press for chairs.	1
15	PVAc glue application pump. Capacity: 5 kg. Complete with glue pistol, hose and nozzles.	2
16	Horizontal grinder for butt welded band saw blades.	1

17	Manual cloth punching press for upholstery buttons.	1
18	Manual upholstery button covering press.	1
19	Pneumatic stapler for fixing upholstery fabrics on to frames.	2
20	Toggle clamps for use on jigs. 10 pcs. for up to 15 mm. clamping height. 10 pcs. for up to 22 mm. clamping height. 10 pcs. for up to 31 mm. clamping height.	30
21	Complete dust extraction unit.	1
22	Compressed air purifying, oiling and pressure regulating (Trio) units.	20
23	Water traps for the compressed air system.	5
24	Lacquer spraying booth of water-wash type. Height: 1,950 mm. Width: 2,500 mm.	1
25	Set of quality control equipment. (See Annex X).	1

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

B. 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 overheds 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.

Drawing I: Job Cost Record Sheet

For: ..... Order No. .....

Product: ..... Quantity: .....

Delivery Date:.....Starting Date.....Finished Date.....

Direct Materials				Direct Labour			
Materials	Qty	Unit Price	Total Price	Work centre	Total Hours	Rate	Amount
						Total	
Total							

Applied Overheads			Total Direct Costs	
Basis	Rate	Amount		
			TOTAL	
			Total Factory Costs	
			Factory Cost Per Unit	

COMPANY PROFILE

Company Name: Motkits Ghana Ltd.

Person in Charge: E. F. C. Lawson

P.O. Box or Street Address: 8292, Tema.

City: Tema

Cable Address: Towstry, Tema

Country: GHANA

Phone No.: 0221 - 4738 Tema

Telex No.: 3029 BTHG GH MOTKITS

TYPE OF BUSINESS:

- [x] **Manufacturer**
- [x] **Retailer**
- [ ] **Wholesaler**
- [x] **Exporter**
- [ ] **Others (Please specify)**

Established in Year: 1976

Number of Full Time Employees: 27

Techno-Managerial: 2 **Workers:** 25

Bankers: Ghana Commercial Bank, Industrial Area, Tema.

Commercial references:

Member of:

- [ ] **Local Chamber of Commerce**
- [x] **Trade Association**

State Which: Ghana Furniture Producers Association

(Special information regarding services, licences, co-operation, line and range of Products, etc.)

Wooden Educational Toys & Playthings, Household Articles:-
Pastry & Salad Boards, Flush & Panel Doors, Knock-down furniture etc

Products Manufactured are:

- [ ] **Low-priced**
- [x] **Medium-priced**
- [ ] **High-priced**

TERMS:

Delivery: 6 - 8 weeks

Packing: In cartons at cost

Shipment: In containers

Payment: LC

Minimum Order: US $5,000

Fair: GTTEX '87

LIST OF ADDITIONAL EQUIPMENT RECOMMENDED FOR MOTKITS (GHANA) LIMITED

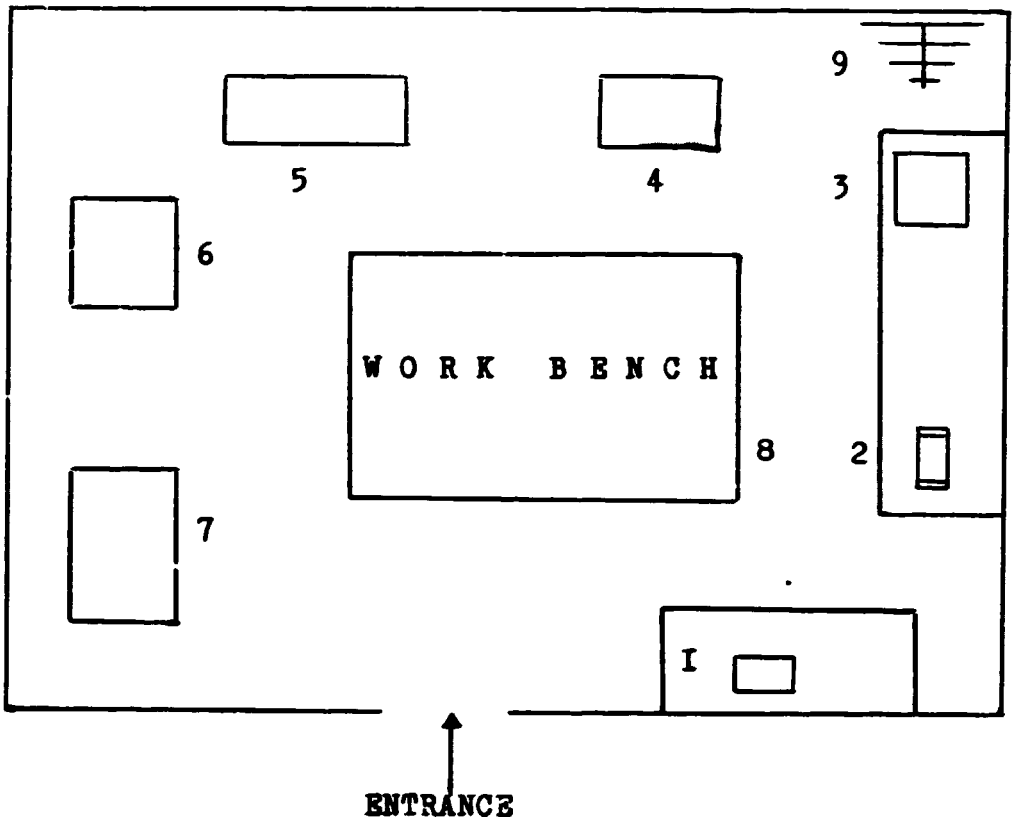
ITEM	DESCRIPTION AND SPECIFICATIONS	QUANTITY
1	Automatic copy turning lathe with hopper, hydraulic copying, sanding and cut-off units suitable for small length pieces. Max. turning length: 800 mm. Max. turning diameter: 180 mm. Spindle RPM.:1,640, 2,630, 3,280, 5,260.	1
2	Automatic rod milling machine to make round and smooth faced wooden rods. Diameter range of rods: 8-65 mm.	1
3	Dowel cutting and chamfering machine for dowels of 8-65 mm diameter.	1
4	Round rod sanding machine. Maximum diameter: 80 mm.	1
5	Multi-blade panel dividing saw with roll infeed and outfeed. Maximum cutting width: 1300 mm.	1
6	Double cross cutting saw with scoring saw units. Max. cutting width: 1,500 mm.	1
7	Automatic staining and lacquer spraying machine with steel mesh belt feeding unit for small size flat pieces. Working width: 1,000 mm.	1
8	Hot air drying tunnel to be connected to staining machine above. Working width: 1,000 mm. Working height: 500 mm. (*)	1
9	Staining machine with dipping tank for small toy parts. Working width: 1,000 mm.	1
10	Oscillating hot air drier with steel mesh feeding belt to be combined with the staining machine above. Working width: 1,000 mm. Working height: 500 mm. (*)	1
11	Lacquer spraying booth of water-wash type. Height X Width of spraying area: 1,950 mm X 2,500 mm.	1
12	Hot air drying tunnel with overhead conveyor for small and assembled items. (*)	1
13	PVAc glue application pump. Capacity: 5 kgs, Complete with glue pistol, hose and nozzles.	2
14	Set of quality control equipment. (See Annex X).	1

(*): Further technical specifications to be determined after consultation with suppliers of coating materials.

Annex XIX

SHARPENING ROOM LAYOUT

SUGGESTED FOR MOTKITS (GHANA) LIMITED



L E G E N D

I: Welding and shearing machine for band saw blades.
2: Grinding and dressing machine for hand tools.
3: Sharpening machine for TCT circular saw blades.
4: Sharpening and swaging machine for band saw blades.
5: Sharpening machine for planer knives.
6: Grinding machine for profile knives.
7: Universal tool grinding machine.
8: Lap grinding machine for butt-welded band saw blades.
9: Circular saw blade storage.

COMPANY PROFILE

Company Name: AKUABA LIMITED

Person in Charge: MRS. H.M. ADUSEI-HERBSTEIN, MANAGING DIRECTOR

P.O. Box or Street Address: P.O. BOX 5784

City: ACCRA **Cable Address:** AKUATOYS ACCRA

Country: GHANA **Phone No.:** 777445

Telex No.: c/o 2173 AIRBRL GH

TYPE OF BUSINESS:

- [x] Manufacturer
- [x] Retailer
- [ ] Wholesaler
- [x] Exporter
- [x] Others (Please specify) CONTRACT FURNITURE

Established in Year: 1973

Number of Full Time Employees: 96

Techno-Managerial: 4 **Workers:** 92

Bankers:
BARCLAYS BANK
GHANA COMMERCIAL BANK
SOCIAL SECURITY BANK

Commercial references: JAMES GALT & CO.
CHEADLE,
CHESHIRE, U.K.

Member of:

- [ ] Local Chamber of Commerce
- [x] Trade Association

State Which: ASSOCIATION OF GHANA IND. FURNITURE MANUFACTURERS' ASSOCIATION

(Special information regarding services, licences, co-operation, line and range of Products, etc.)

Services, Licences, Co-operation: NIL
Line & Range of Products: WOODEN TOYS, EDUCATIONAL EQUIPMENT, SCHOOL FURNITURE, OUTDOOR PLAY EQUIPMENT, FURNITURE, SAWN AND SURFACED LUMBER, ROOF TRUSSES.

Products Manufactured are:

- [x] Low-priced
- [ ] Medium-priced
- [ ] High-priced

TERMS:

Delivery: 6 WEEKS FROM RECEIPT OF L/C
Packing: CARTONS
Shipment: CONTAINER
Payment: IRREVOCABLE L/C

Minimum Order: 1-20FT. CONTAINER

Fair: SPIELWARENMESSE, NUREMBERG
GIFEX, ACCRA
INDUTECH, ACCRA

Annex XXI

LIST OF ADDITIONAL EQUIPMENT RECOMMENDED FOR AKUABA LIMITED

ITEM	DESCRIPTION AND SPECIFICATIONS	QUANTITY
1	Bench type manual edge banding machine for curved, round and straight edges with hot melt glue pot, glue application roller and top and bottom trimming units.	1
2	Horizontal panel cutting saw of beam type. Cutting length: 3,200 mm. Cutting width: 2,100 mm. Maximum cutting height: 115 mm.	1
3	Round rod sanding machine. Maximum diameter: 80 mm.	1
4	Pneumatic drum sander for shaped solid wood parts. Spindle RPM.: ,100 and 1,500. Motor power: 2 HP.	1
5	Wide belt sanding machine for surface and thickness sanding. Working width: 1,000 mm. Maximum working height: 170 mm. Minimum working height: Veneer thickness.	1
6	Vertical multiple boring machine with each head movable in any direction on a mould. No. of boring heads: 10.	1
7	Embossing press for marking of small wooden articles. Plate size: 30 mm X 50 mm.	1
8	Conventional type timber drying kiln. Capacity: 25-30 cubic meters / charge.	1
9	Manually operated hydraulic frame press. Clamping size: 1,000 mm X 2,300 mm.	3
10	Pneumatic assembly press for drawers etc.	2
11	PVAc glue application pump. Capacity: 5 kg, Complete with glue pistol, hose and nozzles.	2
12	Set of quality control equipment. (See Annex X).	1

Annex XXII

COMPANY PROFILE

Company Name: MODERN FURNITURE LIMITED

Person in Charge: TIMOTHY ADJETEY

P.O. Box or Street Address: P. O. BOX 6093

City: ACCRA

Cable Address: MODFUR

Country: GHANA

Phone No.: 227900

Telex No.:

TYPE OF BUSINESS:

[X] Manufacturer

[ ] Retailer

[ ] Wholesaler

[X] Exporter

[ ] Others (Please specify)

Established in Year: 1960

Number of Full Time Employees: 61

Techno-Managerial: 8 Workers: 53

Bankers:

BARCLAYS BANK LIMITED

BANK OF CREDIT AND COMMERCE

Commercial references:

Member of: GHANA FURNITURE PRODUCERS ASSOCIATION

[ ] Local Chamber of Commerce

[X] Trade Association

State Which: G. F. P. A.

(Special information regarding services, licences, co-operation, line and range of Products, etc.)

Product range include:

Chair components and parts.

Products Manufactured are:

[X] Low-priced [X] Medium-priced [ ] High-priced

Delivery: 4-6 WEEKS

Packing: CONTAINERS

Shipment: F.O.B.

Payment: L/C

Minimum Order: AS CUSTOMER REQUIRES

Fair: EUROPE FAIRS

Annex XXIII

LIST OF ADDITIONAL EQUIPMENT RECOMMENDED FOR MODERN FURNITURE LIMITED

ITEM	DESCRIPTION AND SPECIFICATIONS	QUANTITY
1	Dowel milling machine for spiral grooved and non-grooved smooth rods. Dowel diameter: 6-18 mm. Feed rate: 4-7 m / min.	1
2	Dowel cutting and chamfering machine for dowels 6-18 mm diameter.	1
3	PVAc glue application pump. Capacity: 5 kgs Complete with glue pistol, hose and nozzles.	2
4	Lacquer spraying booth of water-wash type. Height X Width: 1,950 mm X 2,500 mm.	1
5	Round end tenoning machine. Tenon length: 4-100 mm. Tenon thickness: 4-30 mm. Tenon depth: 10-90 mm.	1
6	Toggle clamps for use on jigs. 10 pcs. for up to 15 mm. clamping height. 10 pcs. for up to 22 mm. clamping height. 10 pcs. for up to 31 mm. clamping height.	30
7	Complete dust extraction unit	1
8	Compressed air puryfying, oiling and pressure regulating (Trio) units.	10
9	Water traps for the compressed air system.	5
10	Pneumatic assembly press for chairs.	3
11	Manually operated hydraulic frame press. Clamping size: 1,000 mm X 2,300 mm.	2
12	Set of quality control equipment. (See Annex X).	1

COMPANY PROFILE

Company Name: ASHANTI FURNITURE COMPANY LIMITED

Person in Charge: MR. A.K. DANDOH

P.O. Box or Street Address: BOX 1570, RING ROAD WEST INDUSTRIAL AREA, ACCRA

City: ACCRA — Cable Address: FURNITURE

Country: GHANA — Phone No.: 228522 & 227016

Telex No.: 3087 BTH3 GH OR 2289 EXPORT GH

TYPE OF BUSINESS:

- [X] Manufacturer
- [X] Retailer
- [X] Wholesaler
- [ ] Exporter (POTENTIAL)
- [ ] Others (Please specify)

Established in Year: 1960

Number of Full Time Employees: 136

Techno-Managerial: 8 Workers: 128

Bankers: GHANA COMMERCIAL BANK
NATIONAL INVESTMENT BANK

Commercial references: Available in Ghana.

Member of:

- [ ] Local Chamber of Commerce
- [X] Trade Association

State Which: G.P.P.A.

(Special information regarding services, licences, co-operation, line and range of Products, etc.)

DINING FURNITURE
BEDROOM FURNITURE
LIVING ROOM FURNITURE
OFFICE FURNITURE
GARDEN CHAIRS

Products Manufactured are:

- [ ] Low-priced
- [X] Medium-priced
- [ ] High-priced

TERMS:

Delivery:

Packing:

Shipment:

Payment: LETTERS OF CREDIT

Minimum Order:

Pair GIFEX-85,87

Annex XXV

LIST OF ADDITIONAL EQUIPMENT RECOMMENDED FOR ASHANTI FURNITURE COMPANY LIMITED

ITEM	DESCRIPTION AND SPECIFICATIONS	QUANTITY
1	Bench type edge banding machine for curved, round and straight edges with hot melt glue pot, glue application roller and top and bottom trimming units.	1
2	Pneumatic drum sander for shaped solid wood parts. Spindle RPM.: 1,100 and 1,500. Motor power: 2 HP.	1
3	Automatic narrow band saw blade sharpener and swager. Blade width: 10-60 mm.	1
4	Horizontal lap grinding machine for butt-welded narrow band saw blades.	1
5	Semi automatic copy turning lathe. Max. turning length: 1,200 mm. Max. turning diameter: 180 mm. Spindle speeds: 1,640, 2,630, 3,280, 5,260 RPM.	1
6	Manually operated hydraulic frame press. Clamping size: 1,000 mm X 2,300 mm.	1
7	Pneumatic assembly press for settees.	1
8	Pneumatic assembly press for chairs.	2
9	Water-wash type lacquer spraying booth. Height X Width of spraying area: 1,950 mm X 2,500 mm.	1
10	Wide belt sanding machine for surface and thickness sanding. Working width: 1,000 mm. Maximum working height: 170 mm. Minimum working height: Veneer thickness.	1
11	Dust extraction system. (Complete).	1
12	Set of quality control equipment. (See Annex X).	1
13	PVAc glue application pump. Capacity: 5 kgs Complete with glue pistol, hose and nozzles.	2

Annex XXVI

LIST OF ADDITIONAL EQUIPMENT RECOMMENDED FOR KOFASTE FURNITURE AND TRADE COMPANY LIMITED

ITEM		DESCRIPTION AND SPECIFICATIONS	QUANTITY
1		Conventional type timber drying kiln. Capacity: 25-30 cubic meters / charge.	1
2		Radial-arm cross cutting saw. Maximum cutting width: 600 mm , Maximum cutting thickness: 120 mm.	1
3		Band saw machine. Pulley diameter: 800 mm.	1
4		Circular rip sawing machine. Maximum saw blade diameter: 400 mm. Motor power: 4 HP.	1
5	(*)	Four-side moulding machine. Number of heads: 6. Working width X thickness: 230 mm X 140 mm. RPM of spindles: 6,000.	1
6		Surface planer. Working width: 500 mm.	1
7		Thickness planer. Working width: 500 mm.	1
8	(*)	Spindle moulding machine. Table size: 650 mm X 700 mm. Motor power: 5 HP.	1
9	(*)	Double circular cross cutting saw with scribing saw units for sizing and squaring up. Maximum working width: 2,500 mm. Diameter of main saw blades: 300 mm.	1
10		Overhead routing machine with floating head and inclinable work table.	1
11		Chain mortising machine.	1
12		Horizontal boring and mortising machine.	1
13		Narrow belt sanding machine.	1
14		Edge sanding machine with oscillating narrow sanding belt and roll.	1
15	(*)	Calibrating and sanding machine with overhead sanding belt. Maximum working width: 300 mm.	1
16		Pneumatic drum sander for shaped solid wood parts.	1
17	(*)	Lacquer spraying booth of water-wash type. Height: 1,950 mm. Width: 2,500 mm.	1
18		Wooden assembly benches.	4
19		Manually operated hydraulic frame press. Size: 1,000 mm X 2,300 mm.	1
20		Dowel milling machine for spiral grooved dowel rods. Dowel diameter: 6-18 mm.	1
21		Dowel cutting and chamfering machine for dowel 6-18 mm diameter.	1
22		Double end tenonig machine with sizing saw and milling units. Maximum working width: 2,500 mm.	1
23		Automatic band saw blade sha ɔening and swaging machine.	1
24		Band saw blade butt-welding machine with shearing attachment.	1

25	Lap grinding machine for butt-welded band saw blades.	1
26	Grinding machine for TCT cirsular saw blades. Maximum saw diameter: 400 mm.	1
27	Planer knife sharpening machine.	1
28	Manual grinding attachment for mortising chains.	1
29	Universal grinding machine for cutter blocks, cutter knives, boring bits etc.	1

(*): Will be purchased during second stage of investment.

Annex XXVII

PROJECT CONCEPT

1. Title:
   Assistance to export oriented furniture manufacturers.
2. Duration:
   24 Months.
3. Scheduled Start:
   As soon as possible.
4. Counterpart Agency:
   Ghana Furniture Producers Association (GFPA).
5. Immediate Objectives:
   To train technical and production staff of selected furniture manufacturers having potential for export in the immediate future.
6. Background:
   In recent years the Ghanaian furniture industry installed modern machinery to produce furniture and furniture components for export. The domestic market is too small to consume all the furniture manufactured. The export of high value added furniture and furniture components is vital for the utilization of allready installed production capacity, relieve the existing foreign currency shortages, repayment of foreign loans and survival of the young furniture industry. The main advantage enjoyed by the Ghanaian furniture manufacturers over their competitors in Europe are availability of cheap and abundant good quality wood, cheap labour and proximity to the ECOWAS markets in the region.
7. Outputs:
   The outputs of the project will be 45 technical and production staff trained in the following fields:
   -Machine woodworking,
   -Jig making,
   -Tool maintenance,
   (15 National in each field will be trained on-the-job by the international experts).
8. UNDP/UNIDO Inputs:

-Machine woodworking expert. (3 Weeks X 5 Factories)	4 m/m	$ U.S.:40,000
-Jig making expert.	4 m/m	$ U.S.:40.000
-Tool maintenance expert.	4 m/m	$ U.S.:40.000
-Sundries and reporting costs.		$ U.S.: 2.500
TOTAL	: 12 m/m	$U.S.:122.500

Annex XXVIII

LIST OF POSSIBLE TOPICS FOR A TWO-WEEK FACTORY AND PRODUCTION MANAGEMENT / PRODUCTION PLANNING AND CONTROL SEMINAR

-Principles of operating public and private enterprises in Ghana.
-Non-technical aspects affecting productivity.
-Considerations for planning in the furniture and joinery industries.
-Characteristics of marketing furniture.
-Quality control of furniture in production.
-Machine and tool maintenance.
-Design problems in furniture production.
-Raw material appraisal for wood processing industries in Ghana.
-Methodology for feasibility studies in the woodworking sectors.
-Production planning in furniture factories.
-Evaluation of technological options in the production of furniture and joinery.
-Packaging of furniture for export.
-Transfer of technology in furniture industry.
-Classification of woodworking machinery by degree of sophistication
-Selection of appropriate technology and equipment for furniture and joinery industries.
-Techno-economic criteria for the production of doors and windows.
-Techno-economic criteria for the production of solid wood furniture.
-Organization of production control in furniture, door and window production.
-Materials planning and control.
-Stock control.
-Quality control of inputs and finished products.
-Marketing of furniture and problems of export trade.
-Low cost automation.
-Production economics.
-Plant layout.
-Value analysis.
-Technical product design.
-Properties and uses of adhesives in furniture and joinery industries.

Annex XXIX

ADDRESSES OF INSTITUTIONS TEACHING MODERN FURNITURE MANUFACTURING AND WOODWORKING IN ENGLISH

1. School of Art and Design, Furniture and Timber,
   Buckinghamshire College of Higher Education,
   Queen Alexandra Road,
   High Wycombe, Bucks.,
   U. K.

2. Furniture Manufacturing and Management Department,
   North Carolina State University,
   Box: 7906,
   Raleigh, N. C. 27695-7906,
   U. S. A.

3. London College of Furniture,
   41, Commercial Road,
   London, E. 1,
   U. K.

Annex XXX

PROJECT CONCEPT

1. Title:
   Assistance to Ghana Furniture Producers Association.
2. Duration:
   12 Months.
3. Scheduled Start:
   As soon as possible.
4. Immediate Objectives:
   To strengthen the GFPA enabling it to provide specialised technical and trade information to its members.
5. Outputs:
   The output of the project will be a fully functioning documentation unit within GFPA. This unit will maintain a specialized library of related books, reports, journals, directories, standards, manufacturers' and suppliers' catalogues as well as films, slides and other audio-visual material.

   The unit will publish on a regular basis the following specialized information builletins:

(1) A monthly technical bulletin on new processes, products, materials, machinery, designs, furniture standards and other related topics.
(2) A monthly trade bulletin on export markets, regulations and formalities, export enquiries, prices, fairs etc.
(3) A monthly current awareness bulletin on publications received and their contents.
(4) On an ad-hoc basis, specialized technical manuals and reports on various aspects of the furniture industry.

6. ITC/UNIDO Inputs:

		Cost ($ U.S.)
-Technical documentation expert. (Split mission, 2 + 6 weeks)	(2m/m)	20.000
-Furniture marketing expert. (Specialized in international trade)	(2m/m)	20.000
-Training. (Fellowship for a national expert up to 3 months).		15.000
-Technical documentation.		5.000
-Equipment. (For typing, duplicating, copying stapling).		7.500
-Sundries and reporting costs.		2.500
TOTAL :	4m/m.	70.000

Annex XXXI

PROJECT CONCEPT

1. Title:
Development of a solar timber drying kiln.

2. Duration:
Eight months.

3. Scheduled Start:
As soon as possible.

4. Counterpart Agency:
Ghana Furniture Producers Association (GFPA).

5. Immediate Objectives:
To design and develop a solar timber drying kiln suitable for local conditions in Ghana.

6. Outputs:
(a) Set of designs, technical and economic parameters, detailed material cost estimates, instructions for construction, operation and maintenance compiled in a technical report.
(b) An operating prototype solar timber drying kiln suited to local conditions and constructed as much as possible with locally available materials.
(c) A core of national staff from the industry trained in the techniques of kiln drying of wood with special emphasis on solar kilns.

7. Inputs:
(a) Government Inputs:
The Government will provide, through the counterpart agency:
(i) Counterpart staff and secretarial assistance.
(ii) Professional staff such as civil engineers, mechanics, electricians, carpenters and manual workers as may be required for the construction and erection of the kiln structure.
(iii) Trainee kiln operator.
(iv) A site with suitable electric power supply and suitable foundations and all the locally available materials required for the kiln.
(v) Local transport.
(vi) Green sawn timber of various species and thicknesses to ensure the continuous operation of the kiln during the life of the project.

(b) UNIDO Inputs:

	Cost ($ U. S.)
-Solar timber drying kiln consultant. (Split missions, 3 + 3 + 1 + 1 weeks)	18,000
-Non-expendable equipment for solar kiln. (Those that are not available locally)	7,000
-Sundries and reporting costs.	1,500
Total	: 26,500

8. Workplan and Activities:

Phase	Weeks	Activities
1	1-2	Travel to Ghana and collection of data by the expert.
	3	Compilation of interim technical report by the expert at his office base. (Time for preparation of the site, ordering of material is estimated to be about 4 months).
2	1-3	Erection and commissioning of the kiln and training of the kiln operator. Compilation of a solar kiln operator's manual. (The kiln will be operated by the counterpart for at least six months and data compiled).
3	1	Conduction of a seminar for the technical staff from the furniture industry on wood drying and solar kilns and demonstration of the kiln. Compilation of this data in the kiln operators' manual.
	1	Analysis of the results of the operation of the kiln.

Annex XXXII

PROJECT CONCEPT

1. Title:
Assistance in export marketing of Ghanaian furniture.

2. Duration:
Three months.

3. Scheduled Start:
May 1988.

4. Counterpart Agency:
Ghana Furniture Manufacturers Association in cooperation with Ghana Export Promotion Council.

5. Immediate Objectives:
To assist potential Ghanaian furniture exporters exhibiting in the international components and supplies fair (SASMIL in Milan, 1988 or INTERZUM in Cologne, 1989) in introducing and marketing their products and establishing profitable and long term business relationship with potential customers. (If the project cannot be initiated in time for the 1988 fair, it could be held in May 1989 for the INTERZUM fair in Cologne).

6. Background:
In recent years, the Ghanaian furniture industry has installed modern machinery to produce furniture and furniture components for export.

The domestic market is too small to consume all the furniture manufactured.

The export of high value added furniture and components is vital for the utilization of already installed production capacity, alleviate the existing foreign currency shortages, repayment of foreign loans and survival of the young furniture industry.

The main advantages enjoyed by the Ghanaian furniture manufacturers over their competitors in Europe are availability of cheap and abundant good quality wood, cheap labour and proximity to ECOWAS markets in particular.

7. Inputs:

	Cost ($ U. S.)
-Export marketing specialist (2m/m). (Split mission: 3 + 1 + 1 + 2 + 1 weeks). (See activities below).	30,000
-Study tour for 5 participants.	50,000
-Sundries and reporting costs. (Including preparation and printing of company profiles and catalogues).	2,500
TOTAL:	82,500

8. Project Workplan and Activities:

Week	Activities
1-3	Travel to Ghana by export marketing

	specialist to visit selected manufacturers to work out a detailed product catalogue for each potential exporter.
4	Screening by the expert of all the field information collected and working out a detailed itinerary for both the fair activities and the study tour.
5	Travel by the expert to the Fair's location to assist Ghanaian exhibitors during the exhibition and make contacts with potential importers and introduce them to Ghanaian manufacturers and their products.
6-7	Implementation of the study tour.
8	Screening by the expert of all the contacts made and data collected, prepare final report and present findings and recommendations at UNIDO/ ITC headquarters.

Annex XXXIII

LIST OF POSSIBLE TOPICS FOR A 3 TO 4-WEEKS FURNITURE DESIGN SEMINAR (*)

-History of furniture, development of styles and relationship of style to daily life.
-Properties and uses of solid wood.
-Properties and uses of wood-based panels.
-Wood drying.
-Machining of solid wood and wood-based panels.
-Hardware fittings for knock-down construction.
-Furniture construction methods.
-Properties and uses of surface finishes.
-Surface finishing techniques.
-Properties and uses of plastic foams.
-Properties and uses of leathers.
-Properties and uses of textiles.
-Upholstery techniques.
-Properties and uses of metal components.
-Properties and uses of plastic shells.
-Rattan as raw material; frames, seats and production techniques
-Ergonomics.
-Dimensioning.
-Aspects of quality control.
-Testing of furniture and furniture standards.
-Marketing considerations.
-Product development.
-Value analysis.
-Sketches and production drawings.
-Prototype requirements.
-Relation of designers with industry.
-Training of industrial designers.

(*): At appropriate times during the seminar, assignment work and factory visits will also be undertaken. These should represent about 1/4 to 1/3 of the total time.

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