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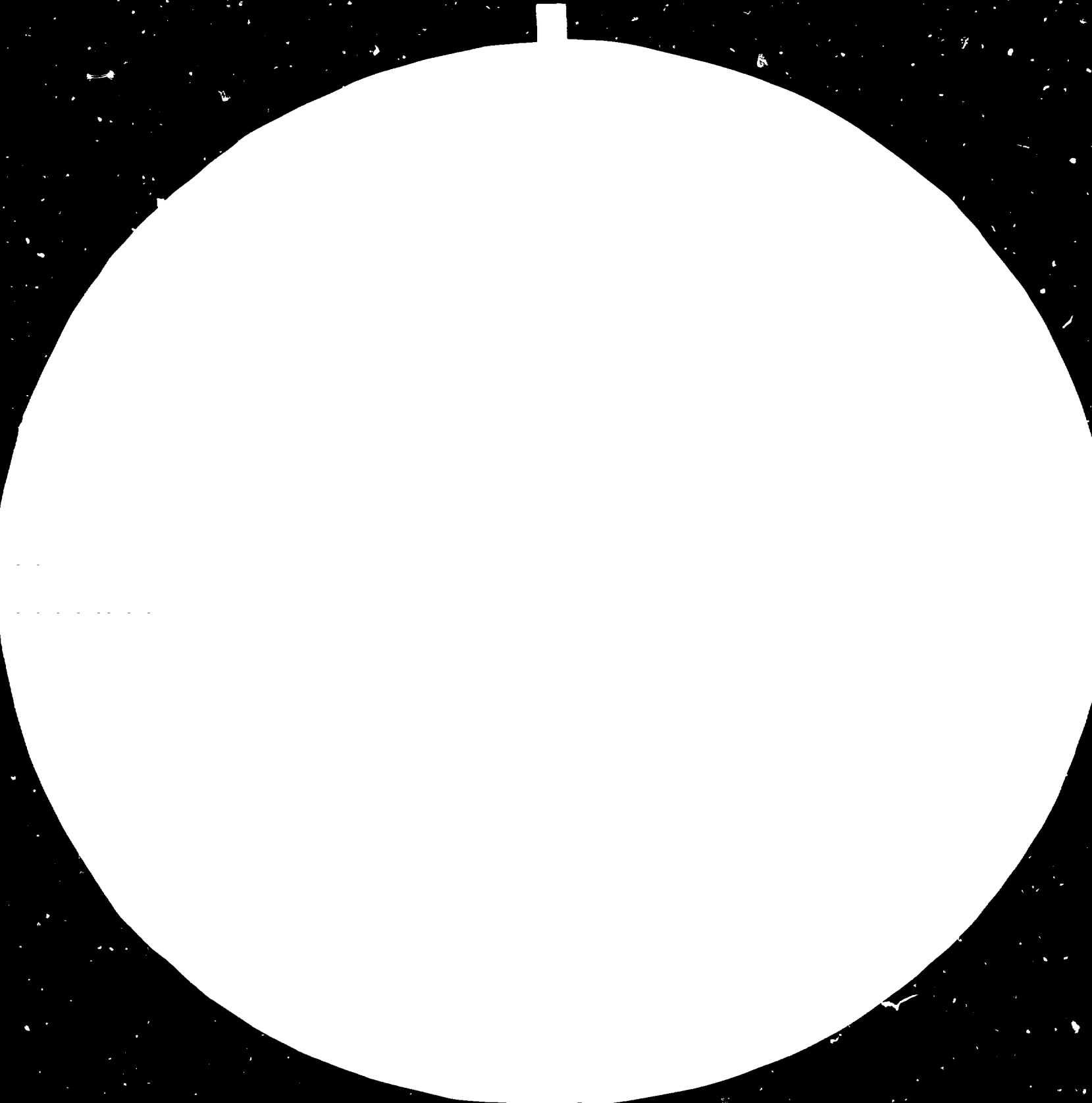
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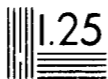
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TECHNICAL ASSISTANCE TO BENTWOOD CHAIR

FACTORIES IN OMDURMAN

SI/SUD/82/805

DEMOCRATIC REPUBLIC OF SUDAN

Terminal report*

Prepared for the Government of the Democratic Republic of Sudan
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Organization

Based on the work of Horatio P. Brion,
Consultant in Bentwood Chair Production

United Nations Industrial Development Organization

Vienna

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EXPLANATORY NOTE

The unit of currency of the Democratic Republic of the Sudan is the Sudanese Pound (S.S) which has two current official rates: a) For Government Purposes: S.S 1.3 = US\$1.00 and b) For Other Purposes: S.S 1.7 = US\$1.00.

The following symbols, acronyms and abbreviations were used in this Report:

sq. m.	-----	square meters
cu. m.	-----	cubic meters
mm	-----	millimeters, 1/1000 of a meter
%	-----	per cent, 1/100 part
i.e.	-----	<u>id est</u> , that is
etc.	-----	<u>et cetera</u> , and so forth
Fig.	-----	Figure
St.	-----	Saint
CCTRU	-----	Cellulose Chemistry and Technology Research unit, a unit under the National Council for Research, Democratic Republic of the Sudan
DRR	-----	Deputy Resident Representative, 2nd highest Official of the United Nations Development Programme in the Sudan
DRS	-----	Democratic Republic of the Sudan
FAO	-----	Food and Agriculture Organization, an agency of the United Nations
JPO	-----	Junior Professional Officer, a position in the United Nations System
U.S.A.	-----	United States of America
UNIDO	-----	United Nations Industrial Development Organization

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TABLE OF CONTENTS

Chapter/ Section	Title	Page
I	I N T R O D U C T I O N	1
1.0	Project Background	1
1.1	Terms of Reference of the Mission	1
II	EL NAGMA BENTWOOD CHAIR FACTORY (STAR FACTORIES)	3
2.0	The Firm and its Operations	3
2.1	Expansion Plans and Foreign Joint Venture	4
2.2	Observations on Current Production Operations	6
2.3	Recommended Remedial Measures	18
2.4	EL NAGMA's Reactions to the Recommendations	20
III	NADIR BENTWOOD CHAIR FACTORY	21
3.0	The Firm and its Operations	21
3.1	Observations on Current Production Operations	21
3.2	NADIR's Reactions to Technical Assistance Services	22
IV	CONSULTATION-SEMINAR AND TECHNICAL ASSISTANCE TO OTHER FURNITURE FACTORIES	23
4.0	Plant Visits to Furniture and Joinery Factories	23
4.1	Observations on Production Operations in Plants Visited	23
4.2	The Seminar-Consultation Clinic	24
V	GENERAL RECOMMENDATIONS	26

Table of Contents, Continued

Chapter/ Section	Title	Page
ANNEX I	Job Description, UNIDO Post No. SI/SUD/82/805/11-51/31.7.A	27
ANNEX II	Design and Fabrication of Bandmill Carriage	29
ANNEX III	Observations and Recommendations, Production Operations and Manage- ment, EL NAGMA Bentwood Chair Factory, Omdurman Industrial Estate	40
ANNEX IV	Bentwood Rocking Chair, A Product for Development Requested by Mosaic International, U.S.A.	52
ANNEX V	Outline of Topics to be Discussed During the Seminar-Consultation Clinic on Wood Processing and Furniture Manufacturing	56
ANNEX VI	List of Participants in the Seminar-Consultation Clinic	59
ANNEX VII	Specifications of Additional New Machinery and Equipment for EL NAGMA Bentwood Chair Factory	60
ANNEX VIII	Resource Documents	62

I - I N T R O D U C T I O N

1.0 PROJECT BACKGROUND

Some years ago, Pietro Borretti, the Regional Advisor in Secondary Wood Industries, stationed with the Forest Industries Advisory Group for Africa, Addis Ababa, Ethiopia, led a mission which conducted a survey of the wood and wood products industry of the Democratic Republic of Sudan. Among other recommendations, the mission submitted a project proposal for technical assistance to two bentwood chair factories located in the industrial estate in Omdurman, a city across the Nile River from Khartoum. The proposed project was approved by UNIDO in mid-1982.

Implementation of the Project was undertaken upon acceptance of a Project Consultant by the government of the Democratic Republic of Sudan early in 1984.

1.1 TERMS OF REFERENCE OF THIS MISSION

The recipients of technical advice under this mission are the EL NAGMA (Star Factories) and NADIR Bentwood Chair Factories in the industrial estate in Omdurman. Both factories manufacture bentwood chairs out of "LALOUB" (Balanchines Species). EL NAGMA also manufactures axe handles out of Red Acacia wood.

The general objective of the mission is to advise the managements of the two factories on measures to improve the productivity and increase the quality level of their products. The more specific details of the mission are enumerated in the attached Job Description (Annex 1). The consultant in Bentwood chair production, Horatio P. Brion, undertook this assignment from 17 March to 17 May 1984.

Certain inadequacies of available data and existing supply practices and facilities prevented a more complete implementation of the objectives of the mission.

To wit:

- i - Parameters on production performance such as waste factors; labour productivity; individual machining outputs; etc., could not be calculated in view of the lack of basic data. For example, the available wood consumption data is based on the number of chairs produced from each piece of log.

Since the actual wood material usage varies from one chair model to another, and the log bolt sizes (average diameters in this case) vary from 180 mm to 480 mm, there was no way to determine the actual wood cost for each chair model) except to revise the existing cost reporting system and gather the needed basic data as each chair model is produced. There was no time available to do this.

Consequently no specific recommendations could be given to improve these parameters.

However, initial steps to revise the costing system to make it more responsive to the needs of expanded operations were recommended in ANNEX III (Section 5.0).

- ii - Production supplies (sanding belts and paper, finishing materials, etc.) are all imported. Only sanding grits and finishing materials commonly purchased by all users in the country are imported and kept in stock by the supplier.

Thus, the furniture and joinery manufacturers in the country do not have any choice but to use whatever production supplies are available. The initial steps to solve this problem were discussed during the Consultation Clinic. Furniture and joinery products manufacturers agreed that they should group together, assess their needs for imported materials and production supplies, and talk to the importers as a group so that their needs can be imported by the suppliers. However, systems of sanding belt types and grit ratings, and finishing materials and application techniques were discussed with key officials of the firms served.

- iii- The locally built wood steaming chambers and the bentwood drying kilns do not have any temperature or humidity controls at all. Hence, it was impossible to set up improved steaming and kiln-drying techniques, without requiring individual observations of each chair component as it is steamed, bent and dried. The length of time required to do this was beyond that available to the Consultant.

II- EL NAGMA BENTWOOD CHAIR FACTORY
(STAR FACTORIES)

2.0 THE FIRM AND ITS OPERATIONS

The Star Factories (EL NAGMA) is a family-owned and operated firm. Mr. Ali Hassan El Sajer, the proprietor-manager, is assisted by two sons: Hassan Ali Hassan, who is responsible for marketing and collection, and Abdil Ali Hassan, who takes charge of deliveries to customers and assists in materials and supplies procurement activities. Another relative, a nephew of Mr. Ali Hassan, Mr. Abd El Raouf Omer, a mechanical engineer, provides assistance in engineering activities on a part-time basis, and at times, ~~ifason~~ work with the firm's banks and government agencies. Mr. Ali Hassan, himself, takes direct charge of production operations.

The factory is located on a 5,000 sq. m. lot, with a total floor area of 720 sq. m.. Office space has a total floor area of 120 sq. m.

The firm manufactures and sells 9 models of bentwood chairs on a regular basis. Living room chairs and divans, dining table and chairs, and limited quantities of office chairs are also manufactured on a case-to-case basis. The factory has a regular manpower complement of 60 workers and an office force of 8 men. The existing equipment complement is capable of producing 80 units of bentwood chairs per day. However, due to the intermittent supply of electric power, current production reaches only about 45 chairs per day, on the average. During the four weeks the Consultant served the firm, power cut-offs amounted to about 40% of the daily working hours, on the average.

There is a minimal amount of finished goods inventory as the products are delivered to customers as soon as enough is produced to fill a truckload.

2.1 EXPANSION PLANS AND FOREIGN JOINT-VENTURE

During the 2nd week of April, El MAGMA sought the advice of this Consultant on its plans to expand its operations. The general objective of the expansion program is to produce about 300 chairs a day and about three times the current production volume of other furniture items. Furthermore, it is hoped to increase the utilization of wood by converting the current production of woodwaste into marketable goods such as chess pieces, staves for walking canes, etc.

A detailed study of the current facilities, manpower skill level, middle management capabilities, production techniques and marketing activities indicated the following:

- i- The current marketing set-up of the firm is not adequate to handle the increased plant output;
- ii- The existing timber resources of the firm (roughly 1,200 cu. m. per annum), will not be able to support the log input requirements of the expansion program;
- iii- Additional machinery and equipment (one unit of diesel-generating set, automatic lathes and sanding machines, among others) will be needed;
- iv- Technical assistance in the re-organization of production facilities (~~changing~~ the layout), improvement of production techniques, installation and operation of the new pieces of machinery and equipment, training of production personnel on the new production techniques, training of knife-grinding and saw filing room personnel, and improvement of the existing drying kiln, coupled with the ~~starting~~ and improvement of the second drying kiln unit, will be needed;

- v- Introduction of more up-to-date finishing techniques and improved finishing materials will also be required to accelerate finishing operations;
- vi- Acquisition of additional knife-grinding and saw filing equipment will also be required;
- vii- Strengthening of the supervisory and management staff, particularly the middle management level, should be started immediately; and
- viii- Approximately £.S 75,000 will be required to finance the completion of roofing of existing buildings, build the foundations for the additional machinery, fabrication and installation of a dust extraction and exhaustion system, and other civil works projects under the expansion programme. Another £.S 100,000 will be required for additional operating capital. Thus, the expansion programme will need a total capital outlay of £.S 175,000 (US\$ 103,000).

By the 3rd week of April the Consultant was informed that EL NAGMA has finalized an agreement with a marketing firm based in California, U.S.A., and its associate firm in Khartoum, on a joint venture arrangement whereby the Sudanese and American partners (with timber licenses covering roughly 250,000 square kilometers of forest areas in Southern Sudan) will supply the required timber output of the expanded production operations, provide the additional capital outlay, and in return, will be the sole marketing agents of EL NAGMA's products both in the Sudan and foreign markets. The operational strategy is to market the products in the Sudanese market while EL NAGMA is in the process of improving its product volume output and quality. The foreign market, mainly the American market, will be tapped when the products attain quality levels acceptable in the foreign market.

2.2 OBSERVATIONS ON CURRENT PRODUCTION OPERATIONS

Among others, the following points merit immediate action by EL NAGMA Factories:

- i- Except in isolated portions with cross-grain wood fiber orientation, "LALOUB" (Balanchnes specie) appears to be quite suitable for rounding operations. Its bending characteristics are adequate, provided the wood has been sufficiently steamed. However, the wood, as delivered to the factory, exhibited numerous end splits and heavy "Blue Stain" infestation, both in logs and lumber form.
- ii- The current practice of milling 2.0 meter log bolts into 50 mm x 100 mm and 75mm x 125mm boards is wasteful, slow and dangerous to the workers. The log bolt, 350 mm diameter by 2100 mm long on the average, is split into slabs on a bandsaw with 50 mm wide sawblade. The log bolt is carried and pushed into the sawblade by six men, without any cutting fixture or guiding fence. The result is a "snaky" cut surface, which is leveled out on the next operation by passing the slab through a 500 mm wide jointer (manual), to obtain two surfaces perpendicular to each other. This particular operation wastes about 10 to 15 mm of the wood surface. Further milling into boards with desired dimensions is done on a 600 mm diameter circular saw, with 6 mm kerf.
- iii- Most of the existing production machinery, including the drying kilns, were designed and fabricated by the owner-manager, Mr. Ali Hassan. In most cases, however, the resulting cutting speed of the cutterheads and chucks are not high enough to obtain smooth turned surfaces. This situation requires a larger cross section of the input stock and heavy sanding operations.

- iv- There is minimal back-tracking in the flow of materials-in-process. This occurs only when components of chair models other than the regular product line are being machined using the same machinery previously laid-out for the standard product line. However, material transfer from one work station to the next is effected through manual handling of the work-pieces, i.e., the work-pieces are picked-up from the floor (where they were thrown after being machined in the previous operation) and then dumped on the floor area adjacent to the machine to be used for the next operation. Nevertheless, the machinery and equipment lay-out can still be improved to provide ample area for the worker and the stock to be machined.
- v- Cutting tools (planer and jointer knives, router bits, drill bits, etc.) are not adequately maintained. In many cases, the required grinding angles are not properly attained, resulting in rough cut surfaces and burn marks on the work-piece.
- vi- There is minimal use of machining jigs and fixtures, resulting to slow and inaccurate machining operations.
- vii- Saw dust and wood shavings and chips are exhausted on the floor, hampering movement throughout the factory, and presenting serious FIRE and HEALTH hazards.
- viii- The general state of HOUSEKEEPING is apallingly bad and needs immediate improvement!
- ix- Long and frequent cut-off of electric power supply reduces the productivity. A stand-by electric generator has not been provided to run the most important machines during such power cut-offs.

The operating conditions described in the preceding paragraphs are better illustrated in Figures 1 to 24 which are pictures of actual operations in the Star Factories (EL NAGMA), Omdurman Industrial Estate.

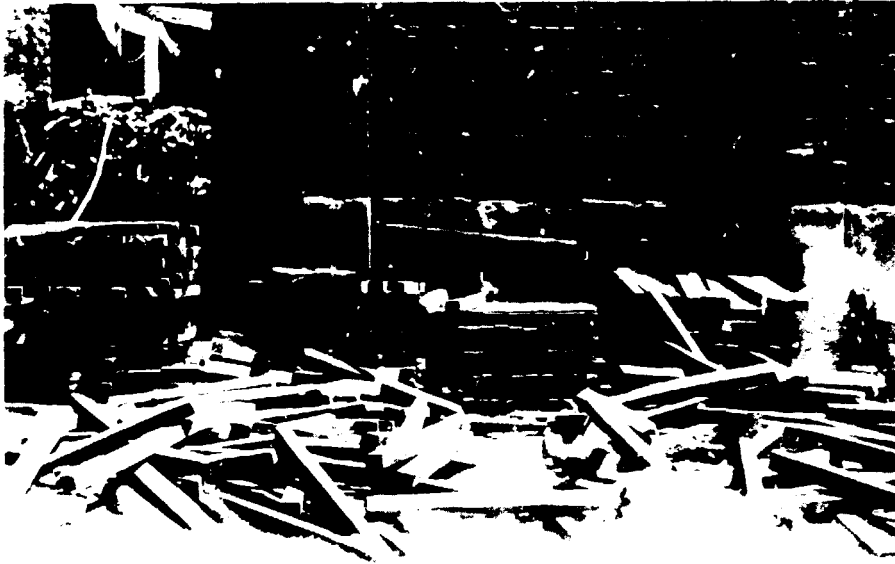


Figure 1
Red Acacia sawn
timber piles in
the lumber yard

Figure 2

"LALOUB" logs and
lumber haphazardly
piled in the lumber
yard



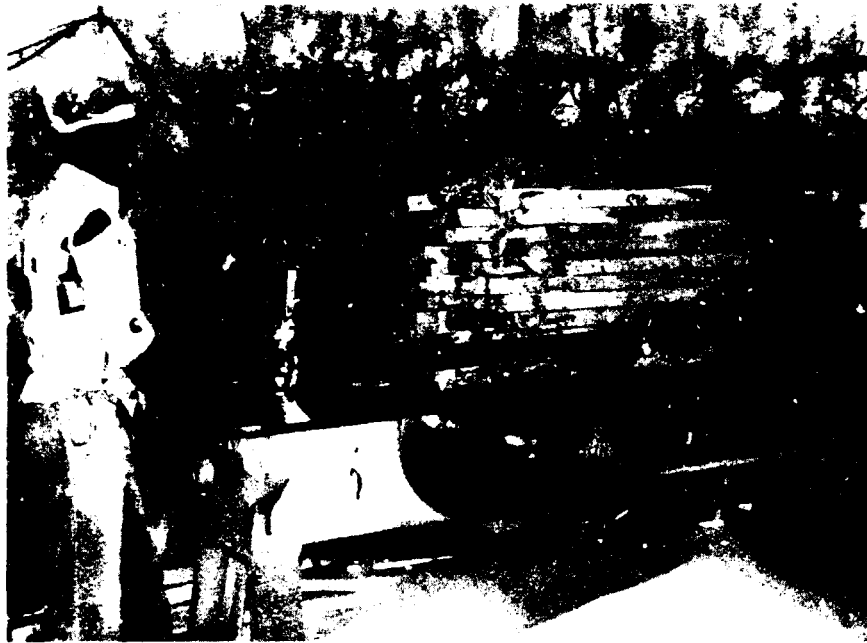


Figure 3
Ripping 50mm x 100mm
planks on a 600mm dia-
meter circular saw



Figure 4
Trimming stock round-
ings on a radial arm
saw



Figure 5
Locally fabricated
steaming chamber for
seat frame blanks



Figure 6
Bending seat frames
on a locally-built
bending machine

Figure 7
Bent seat frames are
piled on the floor
prior to loading in
the kiln. (Note the
special clamps de-
signed and fabricated
by Mr. Ali Hassan,
owner of EL NAGMA.)

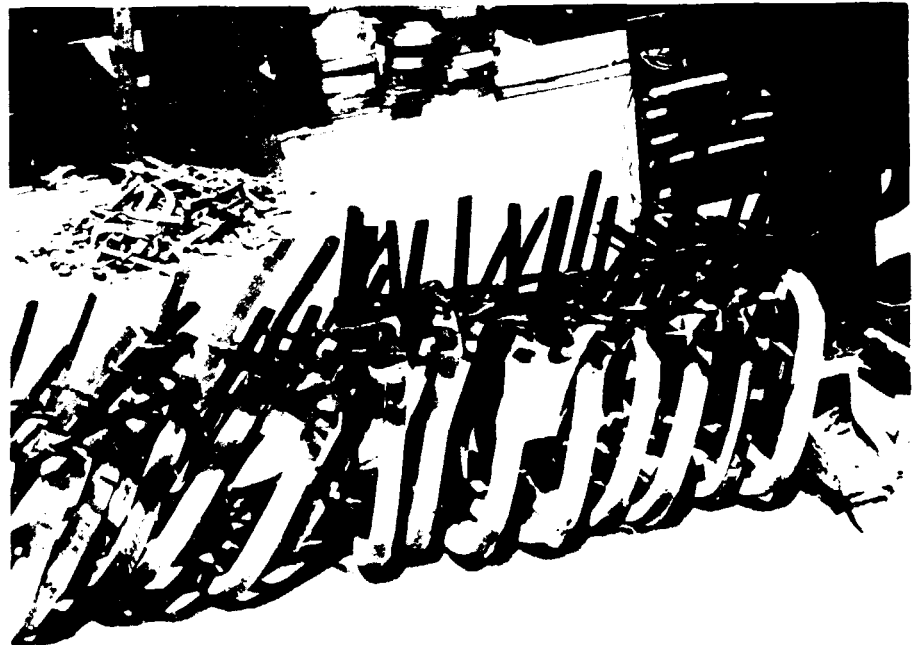


Figure 8
A discarded sterilizer
converted into a steam-
ing chamber for small
chair parts



Figure 9
Bending chair back components on locally-fabricated bending fixture



Figure 10
Newly bent chair back components are piled on the factory floor prior to drying in the kiln.



Figure 11
Loading chair front legs on bending mould



Figure 12

Front leg braces being bent on a locally-fabricated hydraulic bending machine



Figure 13

Woodwastes are burned in this pit (right) to generate heat for the drying kiln.



Figure 14
A view of the interior of the
drying kiln, with stock of
bent parts piled on the shelves
built along the walls of the
kiln



Figure 15
Gluing corner brackets to
seat frames



Figure 16
Drilling anchor holes
for plastic strip
weaving

Figure 17
Levelling top and bot-
tom edges of seat
frames on a 600mm wide
jointing machine



Figure 18
Assembling arm rest
support bracket to
the arm rest and seat
frame of a special
chair model



Figure 19
Assembling legs on a
new model stool



Figure 20
Assembling back rest to rear legs of
regular chair model



Figure 21

Assembling leg support brackets to chair legs, using pneumatic screw driver. (Note pile of leg support brackets on the floor to the left side of the worker.)

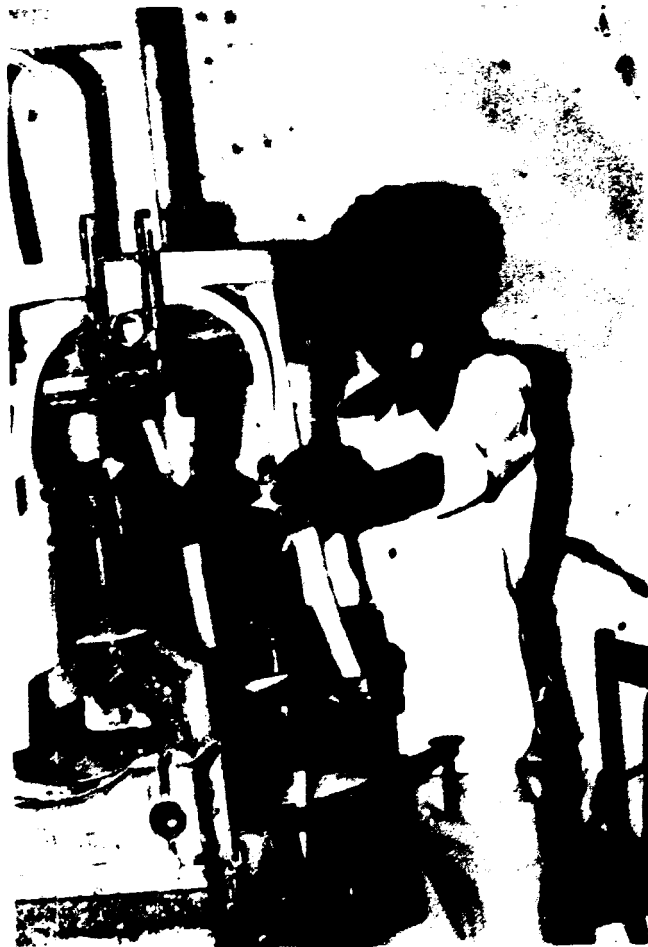


Figure 22

Levelling chair legs on a special machine designed and fabricated by the factory owner



Figure 23
Varnishing the chairs, using
"French" polishing method

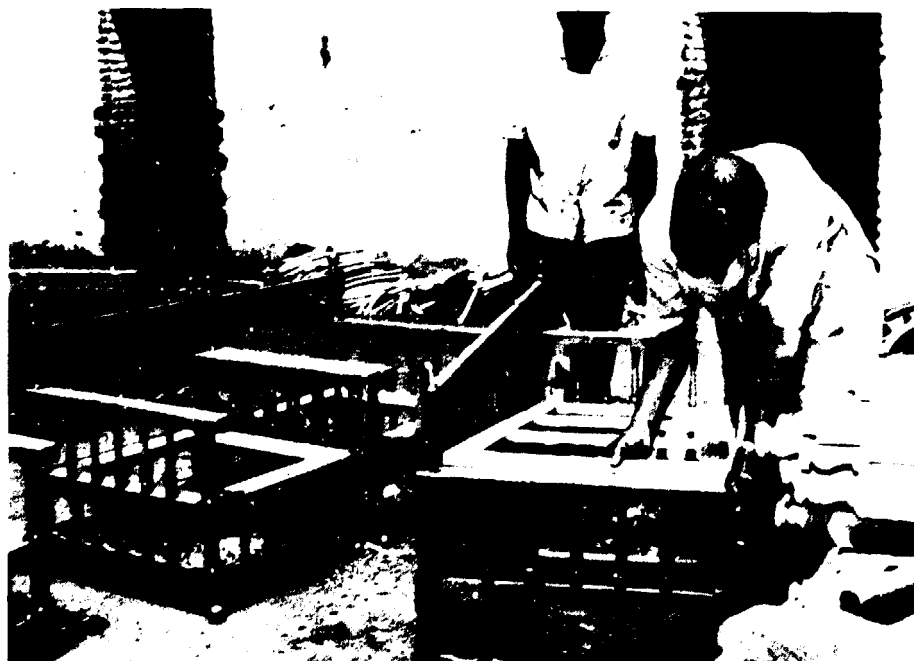


Figure 24
The artisanal type of manufacturing is
best illustrated in this situation where
the seat frames for plastic weaving are
fitted to the assembled sofa by the fac-
tory owner-manager himself.

It can be seen from the preceding pictures that there is a limited amount of serial production being done at the EL NAGMA bentwood chair factory. However, it was noted that adjustments still had to be done on most of the holes, slots and mortises at the assembling section, for the precision of machining operations was still below that required to make chair component parts universally exchangeable.

2.3 RECOMMENDED REMEDIAL MEASURES

Measures to improve the current production operations of EL NAGMA bentwood chair factory have been recommended in three separate memoranda to the manager, copies of which are attached as ANNEX II (Design and Fabrication of Bandmill Carriage), ANNEX III (Observations and Recommendations, Production Operations and Management, EL NAGMA Bentwood Chair Factory, Omdurman Industrial Estate) and ANNEX IV (Bentwood Rocking Chair, A Product for Development Requested by Mosaic International, U.S. A.).

The remedial measures may be summarized as follows:

- i- Minimize splitting in logs and sawwood by proper stockpiling of the materials as shown in the sketches attached to Annex II;
- ii- Minimize "Blue Stain" infestation by shortening the period between timber cutting and sawmilling of the logs, and proper piling of the log bolts in the cutting area, coupled with regular spraying of the log bolts with anti-fungus chemical solution;
- iii- Fabrication, installation and use of a one-man pushed bandmill carriage to attain better productivity and lumber yield rates;
- iv- Use of production carts, trucks and other material handling fixtures to transport goods-in-process from one work station to another;

- v- In line with the expansion programme, implement the recommended modifications to the machinery and equipment layout plans (see Annex II), to attain a much improved flow of materials-in-process:
- vi- Design, fabrication and installation of a sawdust, shavings and chips extraction and exhaustion system, in order to help attain better machining precision, encourage higher productivity as a result of better and healthier working conditions;
- vii- Isolation of the tool grinding section to keep fire hazards at a minimum level, and help assure longer life for the grinding stones and machines;
- viii- More extensive use of machining jigs and fixtures to attain higher precision and accuracy in machining operations and allow interchangeability of parts common to various chair units and models;
- ix- Acquisition of a stand-by electric power generator to minimize the ill-effects of frequent electric power cut-offs;
- x- Revision of existing reporting and cost accounting systems to allow more accurate assignment of costs of labour, materials and supplies to the various chair components; and
- xi- Strengthening of the supervisory and management staff by training capable and qualified workers to compose the middle management level of the plant organization.

In connection with the product development activities of EL NAGMA under the joint-venture arrangement with its new business partners, the Consultant's advice was sought on

the possibility, and if possible, the manufacturing techniques involved in the production of a bentwood rocking chair. During the development and initial production phases, the bentwood rocking chair output will be sold in the local market. Eventually, when the desired quality level is attained, it is planned to export the rocking chair in knocked-down form to the United States of America.

"Annex IV" is a memorandum to the General Manager of Star Factories (EL NAGMA) in compliance to their request for advice on the matter.

2.4 EL NAGMA'S REACTIONS TO THE RECOMMENDATIONS

On the 2nd follow-up visit to the EL NAGMA factory, 3 May, a number of changes were noted, indicating EL NAGMA's positive reactions to the recommendations, such as:

- i- Log bolts and lumber were neatly piled in the lumber yard, on top of skids, and more or less according to the recommended scheme.
- ii- Although workpieces were still dropped on the factory floor beside the machines, transfer from one work station to the next was effected by the use of a wheelbarrow and a small flat-bed cart on four wheels. The Consultant was informed that materials for the fabrication of two more flat-bed carts and two units of the three-tier mobile rack for small parts were either ordered already or have been chosen from the scrap metal piles scattered in the factory yard behind the buildings.
- iii- The Consultant was further informed that the fabrication of the bandmill carriage will be started as soon as the order for some angle irons, welding rods and metal sheets are delivered by their supplier.

These, of course, are very encouraging signs.

III- NADIR BENTWOOD CHAIR FACTORY

3.0 THE FIRM AND ITS OPERATIONS

The NADIR bentwood chair factory, like EL NAGMA'S, is a family-owned and operated firm. The factory is located on a 1,500 sq. m. lot, with shop buildings built all around the perimeter fence (made of clay bricks), with a 5 meter wide gate. There are about 40 workers and 3 office workers. Mohammed, the 2nd son, is the general manager and is also responsible for marketing, while Muataz, the oldest son, is the production manager. Nadir, the youngest son, helps out in the factory whenever his school work allows him to do so. The factory was built and started in 1969 by the father of these three young people. The production facilities could produce 60 chairs per day.

3.1 OBSERVATIONS ON CURRENT PRODUCTION OPERATIONS

The first thing that caught the Consultant's attention upon entering the factory grounds was the huge pile of woodwaste (log ends, slabs, edgings and trimmings) about 2 meters high and roughly 150 sq. m. at the base. This sight was an augury of the wasteful machining operations that were later encountered by the Consultant.

NADIR bentwood chair factory is plagued with the same problems that EL NAGMA was suffering from, although to a more serious extent. The process used is basically the same as that found at EL NAGMA. In fact, even the machine complement is an exact replica of that found at EL NAGMA, but in a worse operating condition, as there is no one in the factory who knows enough about repair and maintenance of machines and equipment.

On the 3rd (and last day) of the Consultant's service to the firm, assistance was rendered in the replacement of planer knives of a 600 mm wide thicknesser-planer. The machine operator had difficulty in installing new knives to replace the used (and abused) set of knives because the knife slots on the cutterhead were full of dirt and solidified sawdust. Even the cutterhead face was coated with solidified resins found in "LALOUB" wood.

It took a good part of three hours of hard work to clean the cutterhead, reset the knife springs, fabricate a knife-setting gauge, and demonstrate to the production manager, himself, the procedure for changing planer knives and keeping the machine in good operating condition (chiefly regular and adequate lubrication and daily cleaning of the machine itself).

3.2 NADIR'S REACTION TO TECHNICAL ASSISTANCE SERVICES

For a firm which is badly in need of technical assistance, the General Manager's reaction to the services provided under this mission was very disappointing, in spite of the eagerness of the Production Manager to learn as much as he can from the UNIDO Consultant. The General Manager, it appeared, was not happy about "other people" intruding into his factory. Questions from the UNIDO Consultant seeking production and machinery data vital to the effective transfer of technical "know-how" were coolly received and evasively answered.

This situation was reported to the Director of Forest Utilization, after which a meeting was held between the UNDP (represented by the Deputy Resident Representative Mr. P. Hargu and Mr. Ismail A. Mohammed, acting JPO) and the Ministry of Agriculture and Irrigation, of the government of Sudan (represented by the Director of Forest Utilization, Mr. Mubarak Ahmed Awad). It was decided at this meeting that the technical assistance services to the NADIR bentwood chair factory be terminated. Furthermore, it was also agreed that the Consultant will render services to the furniture industry of the Khartoum District (Khartoum, Omdurman and Khartoum North cities) through visits to other furniture and joinery factories, making an assessment of the industry in general and holding a seminar-consultation clinic on 9 May 1984.

IV- CONSULTATION-SEMINAR AND TECHNICAL ASSISTANCE TO OTHER FURNITURE FACTORIES

4.0 PLANT VISITS TO FURNITURE AND JOINERY FACTORIES

In order to obtain a realistic picture of the cross-section of the furniture and joinery industry in the Khartoum District, visits to furniture and joinery factories were arranged by the Director of Forest Utilization and the EL NAGMA bentwood chair factory management. A total of six factories and shops were visited: a panel construction type furniture factory and a lumber resawing shop producing joinery products in the industrial estate of Khartoum; two other furniture manufacturing shops in Omdurman and two shops in Khartoum North. The number of shops and factories visited was limited by transportation constraints and the short time available.

4.1 OBSERVATIONS ON PRODUCTION OPERATIONS IN PLANTS VISITED

Except for the EL NAGMA bentwood chair factory and the St. Joseph Technical School panel furniture factory in the Khartoum industrial estate, which operate on a limited serial production basis, all other furniture and joinery shops visited operated on an artisanal basis. The major problems observed were typical of production operations on the artisanal and craftsman level, to wit:

- i- Low productivity and quality levels of the finished product;
- ii- Inefficient use of machinery and equipment;
- iii- Inadequate maintenance of machinery, equipment and cutting tools;
- iv- Machinery and equipment are used as the need for them arise, so that the machine utilization factor is barely 20%;
- v- Adhesive technology is not known (only PVA glue is known in the local furniture industry);

- vi- The proper use of abrasives (sanding belts, grinding stones, etc.) is absent. Any type of abrasive available in the market is purchased and used in the shops and factories, leading to more sanding labour, poorly sanded surfaces (as was observed in the panel furniture factory in Khartoum and the joinery factory in Khartoum North), and excessive allowance for surfacing and sanding wastes;
- vii- Most of the shops and factories visited do not have a middle management staff, so that production operations are directly supervised by the shop owner or the plant manager;
- viii- None of the factories and shops visited have dust collecting and woodwaste disposal system, so that the status of "HOUSEKEEPING" is utterly dismal, thus, hampering flow of materials-in-process and personnel movement within the production areas; and
- ix- There was minimal use of jigs and fixtures, so that "free-hand" machining brings about very low precision and poses a great danger to the machine operators.

4.2 THE SEMINAR-CONSULTATION CLINIC

The seminar and consultation clinic was held on 9 May at the auditorium of the Ministry of Agriculture and Irrigation. There were 32 participants in the affair, including 6 representatives from the private sector (top officials of the EL NAGMA bentwood chair factory and the Industry Cooperatives Association of Khartoum and Omdurman). The government sector was represented by officials from the Ministry and the heads of various woodworking shops operated by the government of Sudan.

Annex V is a list of the topics taken up during the seminar-consultation clinic. Emphasis was laid on the phases of the industry problem where both government and

private sector can work hand-in-hand to bring about appreciable progress in the furniture and joinery sector of the wood processing industry of the Sudan.

The research people from the government institute at Soba, expressed their willingness to re-direct their activities to solving problems which plague the industry, i.e., make their efforts more industry-oriented, provided the industry would help in pin-pointing the problems which it wishes to tackle first.

The following aspects of the industry were discussed during the clinic portion of the seminar:

- i- The need for technical assistance in the training of industry personnel on the proper techniques of grinding cutting tools, sharpening saws and their proper storage and handling;
- ii- The need for technical assistance in the training of industry personnel in the proper and adequate maintenance of machinery and equipment;
- iii- The need for technical assistance in the development of local sources for adhesives, like ANIMAL GLUE as a by-product of the big cattle raising and tanning industry in the Sudan;
- iv- The need to have more industry-oriented information on the properties of the various timber species available in the Sudan;
- v- The potentials of converting woodwastes as fuel for electric energy generating plants to help alleviate the current shortage of electric power; and
- vi- The need for technical assistance in training capable and qualified industry personnel for

supervisory and managerial positions in the industry.

Annex VI is a list of the participants in the seminar-consultation clinic.

V - GENERAL RECOMMENDATIONS

The results of this mission indicate the following general recommendations to the Government of the Democratic Republic of the Sudan:

- i- Seek assistance from outside sources for technical advice, on a continuous basis for at least two years, on the improvement of production techniques in the furniture and joinery industry of the country;
- ii- Seek assistance from outside sources for the development of programs and training of workers for skilled and highly skilled jobs in the furniture and joinery industry;
- iii- Consider the development of an industry for the manufacture of animal glue, as a byproduct of the cattle raising and tanning industries of the country; and
- iv- Consider the establishment of a programme of incentives to encourage the private sector to participate more vigorously in the development of the furniture and joinery manufacturing industry of the country.
- v- Encourage the formulation and implementation of industry-oriented programmes, and provide the necessary financial support therefor, to enable the Forest Products Research Institute in Soba to provide information and services, on a more regular basis, that are immediately beneficial to the growing furniture and joinery products industry of the country.

ANNEX I

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

2 December 1982

Project in the Democratic Republic of
the Sudan for Special Industrial Services

GENERAL DISTRIBUTION

JOB DESCRIPTION

SI/SUD/82/805/11-51/31.7.A

Post Title	Consultant in bentwood chair production
Duration	Two months
Date Required	As soon as possible
Duty Station	Omdurman (near Khartoum)
Purpose of Project	To assist two existing bentwood chair factories to increase their production and productivity, and improve quality
Duties	<p>The consultant shall be attached to the two existing bentwood chair factories (Nadir and El Nagma). He shall advise their management on measures to be taken to improve productivity, increase production and ensure the quality of the products. He will specifically be expected to advise on the following:</p> <ol style="list-style-type: none">1. Raw material suitability and its storage, drying, etc.2. Plant layout and suitability of the installed equipment, drawing up a list of additional equipment that must be acquired. This list should give orders of priority and complete technical specifications, including tooling and spare parts requirements.3. Production process. He will be expected to assess the present production process and recommend changes to streamline this.4. Quality control. He will be expected to assess present quality control procedures and recommend ways to improve it.5. Maintenance of tools and equipment. Similarly, he should advise on improvements in this respect.6. Production planning and control, inventory control and costing. He shall be expected to assess the present procedures and recommend simple methods of ensuring to manage-

ment the basic data needed for efficient operation in these fields.

7. The consultant will train counterparts from each factory in these fields. He shall also prepare two reports (one for each factory) at the conclusion of his mission, outlining the present situation in these factories and recommending measures to be taken by their management for their efficient operation.

The expert will also be expected to prepare a final report, setting out the findings of the mission and recommendations to the Government on further action which might be taken.

Qualifications Engineer or wood technician with considerable experience in the production of bentwood chairs. Experience in plant management and in developing countries desirable.

Language English or Arabic

Background Information Bentwood chairs are manufactured on a semi-line production basis by two small scale factories (Nadir Bentwood Chair Factory and El Nagma Bentwood Chair Factory), both located in Omdurman, which with Khartoum and Khartoum North is the largest urban concentration and market area in the country.

The combined output of the two plants is some 4,000 bentwood chairs per month. Their products are the standard chair in the local market, the present retail price being Sudanese Pounds 12, which is far lower than chairs of standard construction.

A potential improvement is apparent in the Nadir Plant with respect to the locally produced or adapted machines for seat frame bending, steaming and sanding. These and other operations, could be further improved to streamline production and increase productivity. Room for improvement exists inter alia in leg tapering and sanding. Tool maintenance also needs improvement.

CANDIDATES REQUESTED BY 31 DECEMBER 1982

ANNEX II

TECHNICAL ASSISTANCE TO BENTWOOD
CHAIR FACTORIES IN OMDURMAN, SUDAN

UNIDO PROJECT No. EI/SUD/82/805

8 April 1984

To : The General Manager
Star Factories (EL NAGMA)
Omdurman Industrial Estate
Democratic Republic of Sudan

From : H. P. Brion
UNIDO Consultant

Subject : DESIGN AND FABRICATION OF BANDMILL CARRIAGE

Please find enclosed a set of working drawings for the fabrication of a bandmill carriage for use at your factory in the Omdurman Industrial Estate. The main features of the design are as follows:

1. All component parts of the carriage are to be made from items available in your scrap metal yard. (Some of the more important items have been picked out already and set aside for use in the fabrication of the carriage.)
2. The carriage is moved to feed the log into the bandsaw by a man pushing at the push bar handle (See Fig. 2).
3. The carriage can handle log bolts with maximum dimensions of 80 mm diameter x 2100 mm length.
4. The carriage has been designed for use with a 100 mm to 150 mm wide blade bandsaw.

This design is submitted ahead of the other recommendations pursuant to your request in order to start fabrication activities while this Consultant is still available in Sudan. Other recommendations for the improvement of your plant operations and management will be submitted in a separate memorandum which is now being prepared and will be completed shortly.

Please feel free to seek my advice should the need to do so arise during the fabrication activities of the carriage.

(Sgd.) H. P. BRION

cc: P. Harju, DRR,
UNDP-Khartoum, DRS

GENERAL GUIDELINES ON THE FABRICATION AND INSTALLATION
OF THE TWO-MEN BANDMILL CARRIAGE FOR EL NAGMA
BENT LODE CHAIR FACTORY

I- MATERIAL INPUT

- A. The attached working drawing of a two-men operated bandmill carriage indicate the use of components drawn from the scrap metal pile of Star Factories (El Nagma), at the Cndurman Industrial Estate.
- B. Substitute components, or design of components, are allowed, provided the over-all dimensions of the carriage and its moving parts are preserved, and the desired direction and magnitude of movements are attained.

II- RAIL TRACKS FOR CARRIAGE

The rail tracks material matched to the wheels chosen to carry the carriage have a total length of only 5 meters, approximately. These should be installed such that the joint of the 2.5 meter (approximate) sections of the rail track should be after the blunt edge of the bandsaw blade. The balance of the total track length required should be filled with the use of angle irons or other suitable material available at the scrap metal yard.

THE RAIL TRACKS SHOULD BE LAID OUT PARALLEL TO THE BANDSAW BLADE, IN ORDER TO ASSURE TRAVEL OF THE CARRIAGE PARALLEL TO THE BANDSAW BLADE.

THE RAIL TRACKS SHOULD BE INSTALLED WITH PROPER RAIL TIES (SLEEPERS) TO PREVENT INDIVIDUAL OR RELATIVE MOVEMENT OF THE RAILS WHEN THE CARRIAGE IS IN MOTION!

THE RAIL TRACKS SHOULD BE ADEQUATELY GROUTED (ANCHORED) TO THE RAIL FOUNDATIONS (CONCRETE) TO ASSURE DESIRABLE OPERATION OF THE BANDMILL CARRIAGE.

THE RAIL TRACKS SHOULD BE PROPERLY LEVELLED ALL THROUGH ITS ENTIRE LENGTH; IN THE SAME MANNER THAT THE BANDSAW IS INSTALLED TO ASSURE THAT THE BANDSAW BLADE IS PLUMB-TRUE!

THE RAIL TRACKS SHOULD BE INSTALLED AS NOTED IN FIG.1. ATTACHED.

III- ON FABRICATION ACTIVITIES

1. All welded joints should be ground smooth and free of welding flux deposits.
2. Unless bearings used are permanently sealed and lubricated, all bearings should be provided with lubricating plugs, and greased or oiled before actual operations.
3. All square edges of components to be welded together should be properly beveled (chamfered) before they are welded together.

4. Suitable jigs and fixtures should be fabricated and used when welding critical sub-assemblies, for example:
 - a) welding end plates to the dogger guide bar;
 - b) welding dogger post to pedestal runner;
 - c) welding pedestal guide channels to the carriage platform, etc.

5. ALL DIMENSIONS in the attached working drawings are in MILLIMETERS.

(sgd.) H. P. ERION
UNIDO Consultant

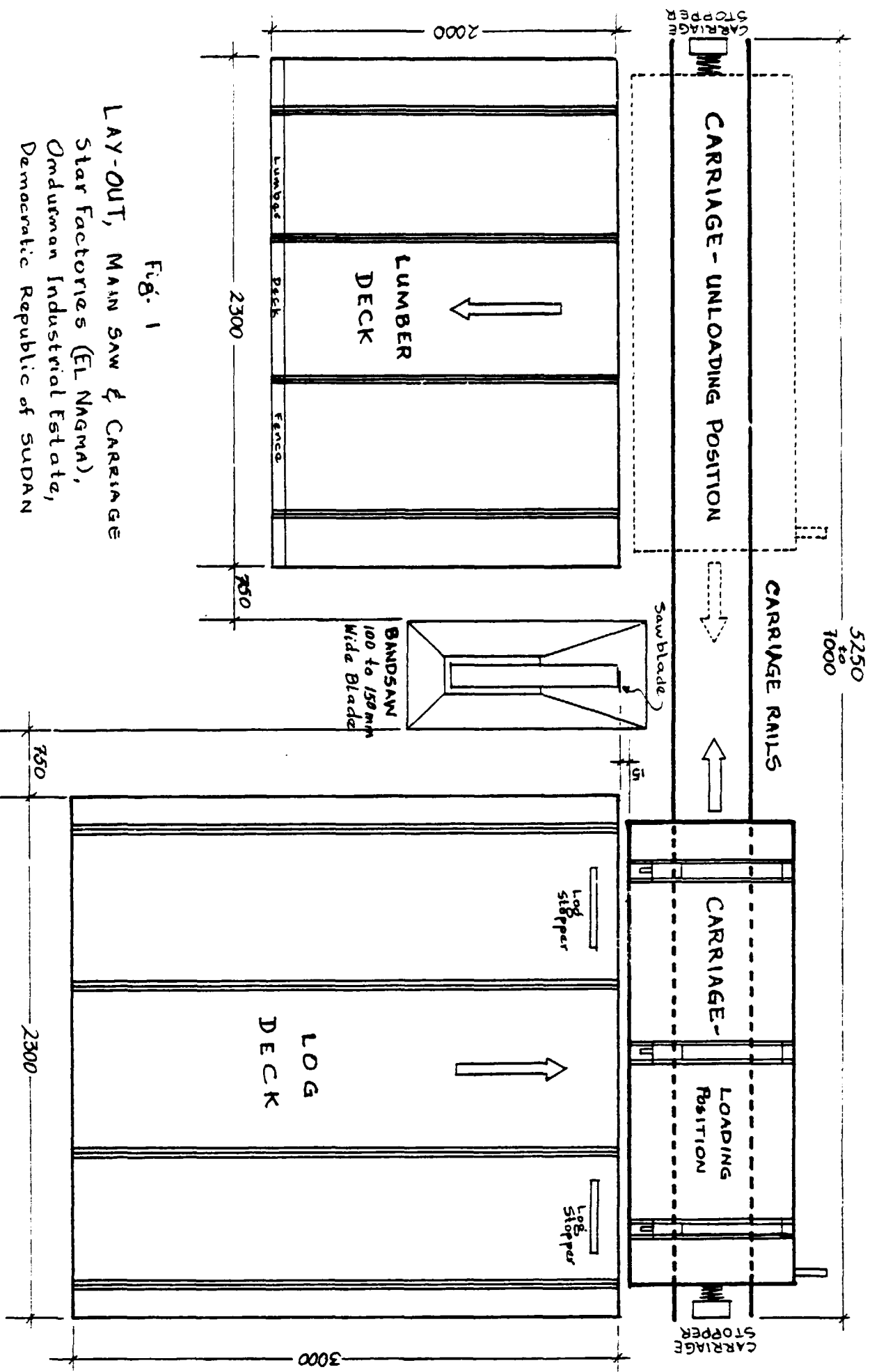
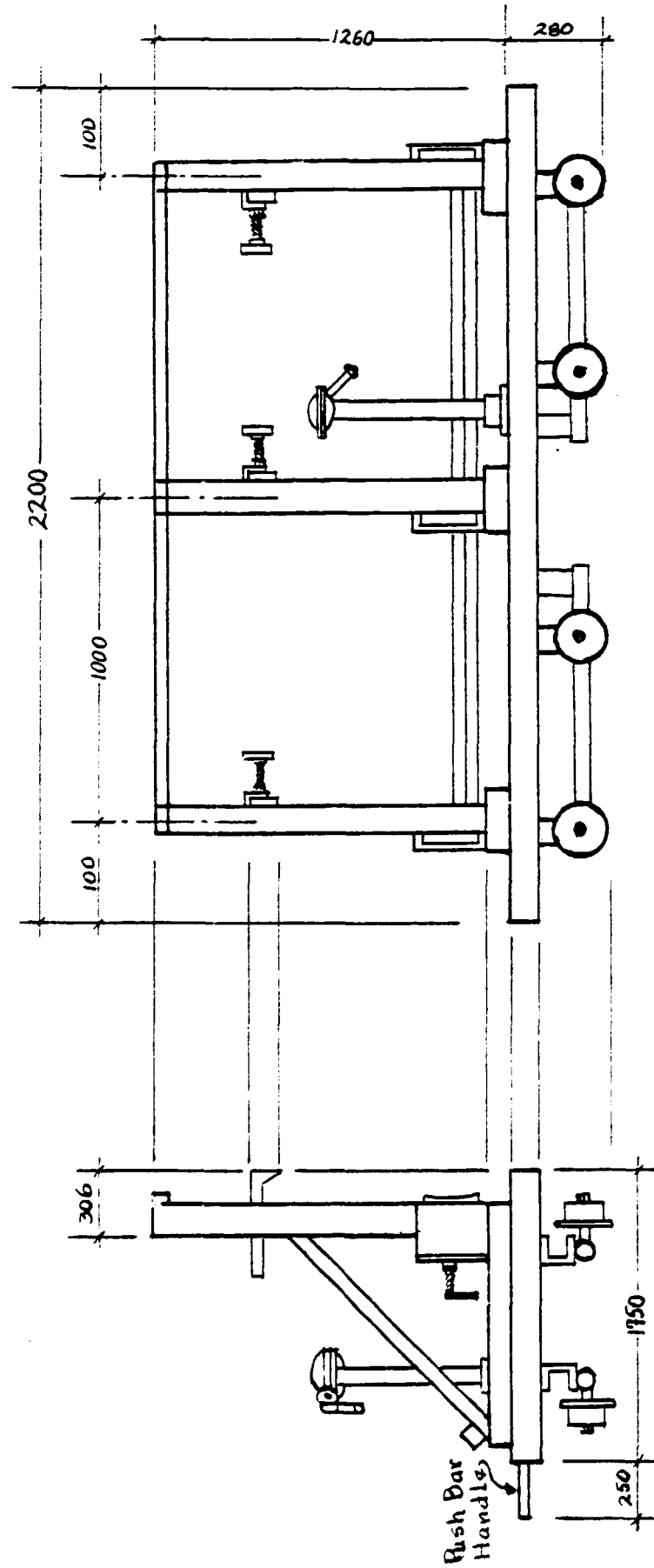


Fig. 1

LAY-OUT, MAIN SAW & CARRIAGE
 Star Factories (EL Nagma),
 Omdurman Industrial Estate,
 Democratic Republic of SUDAN

UNIDO Project No. SI/SUD/82/805

UNIDO PROJECT No. SI/SUD/82/805



CUTTING SIDE VIEW

FRONT END VIEW

Fig. 2

BANDMILL CARRIAGE

Capacity: 60mmφ x 2100 Log Bolts

Power: Pushed by ONE MAN

UNIDO PROJECT No. SI/SUD/82/805

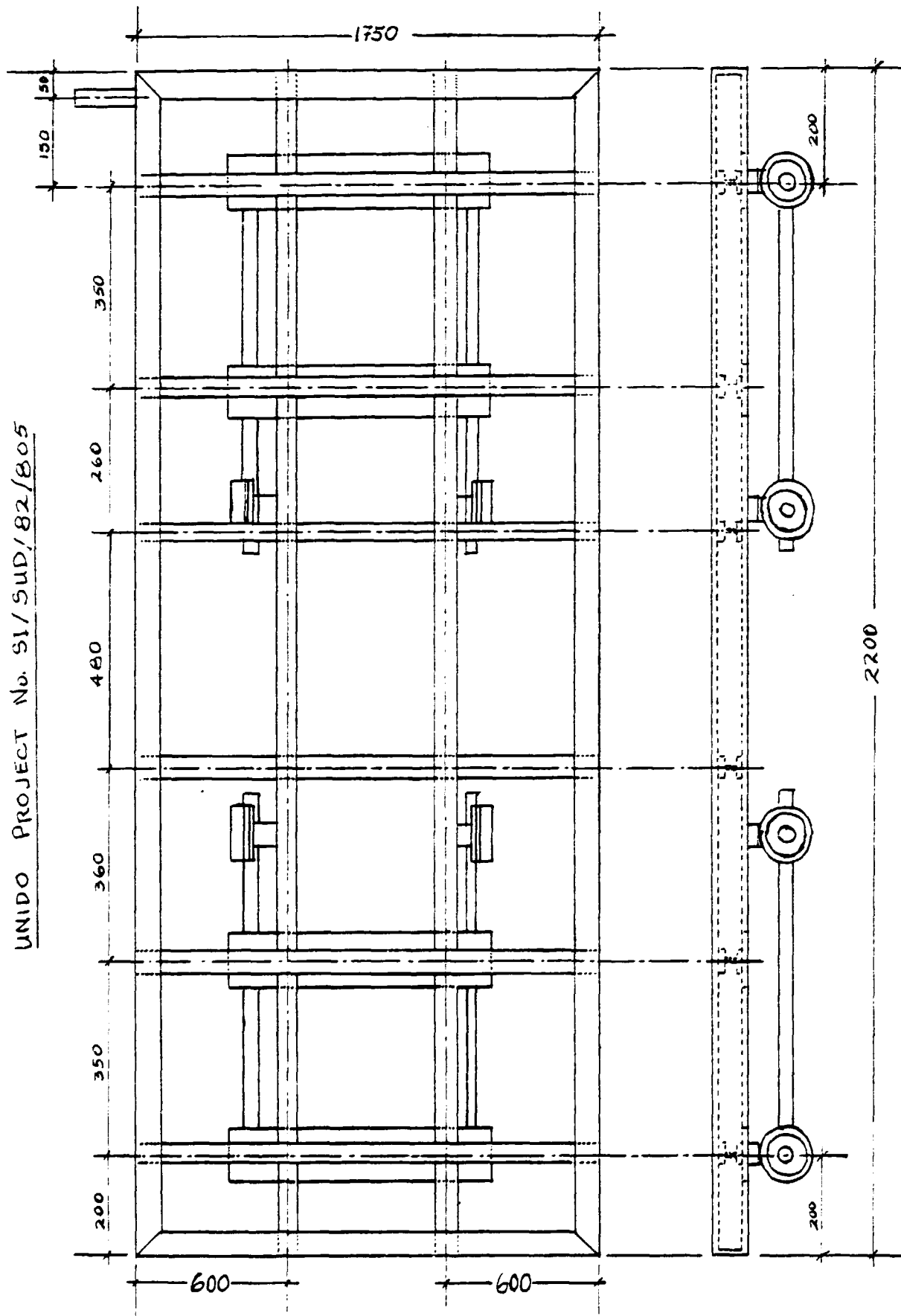


Fig. 3

CARRIAGE PLATFORM FRAMEWORK

Note: Adjustments should be made for dimensions of parts to be chosen from scrap metal pile.

UNIDO PROJECT No. SI/SUD/82/805

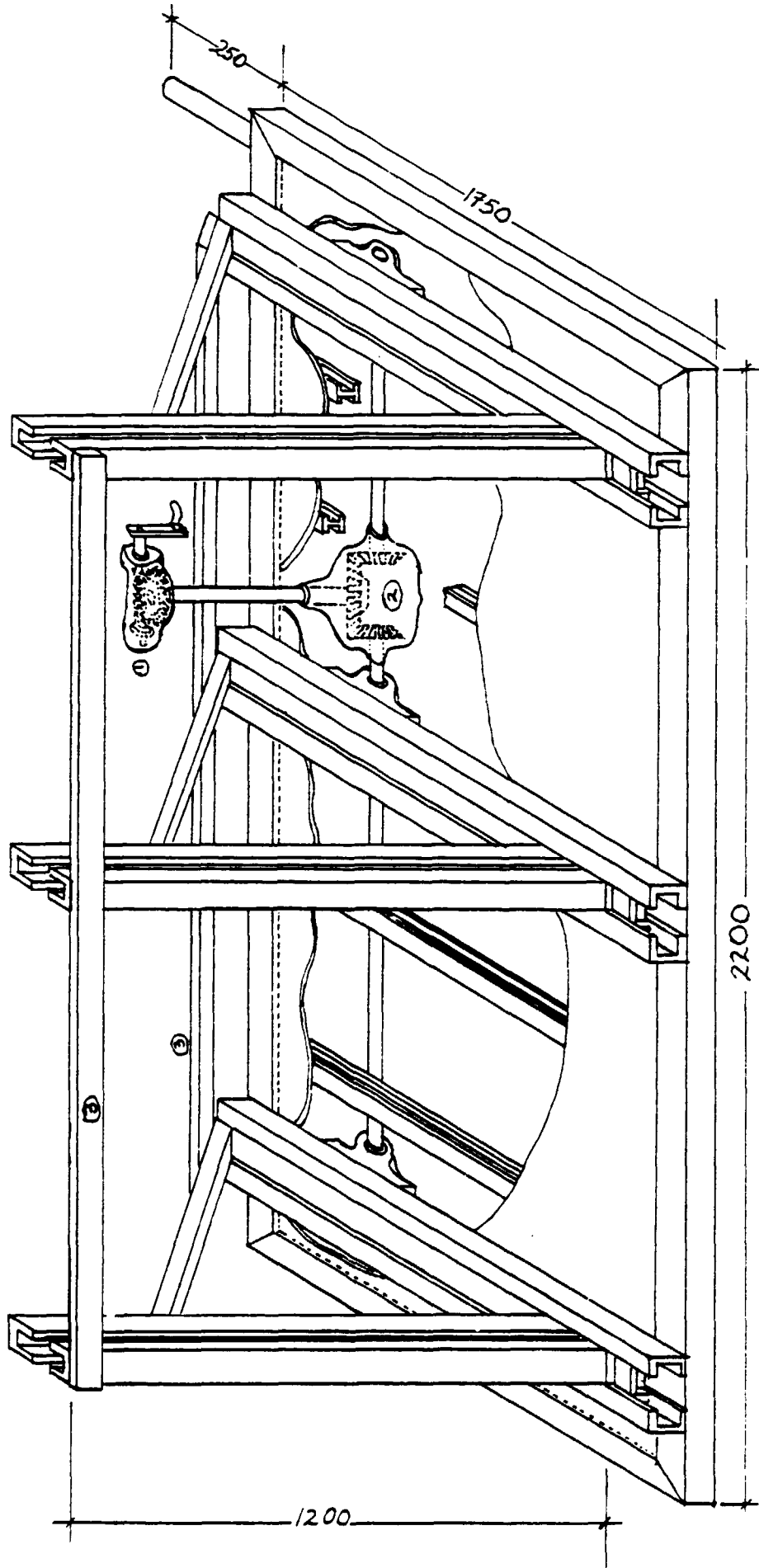


Fig. 4

CARRIAGE PLATFORM AND PEDESTAL DRIVE MECHANISM

SPECIAL FEATURES:

- 1) Worm-Gear mechanism for Manual Drive;
- 2) Bevel-Gear system connecting these Pedestals to Manual Drive Mechanism; and
- 3) TIE BARS to assure simultaneous movement of three pedestals.

UNIDO PROJECT No. SI/SUD/82/805

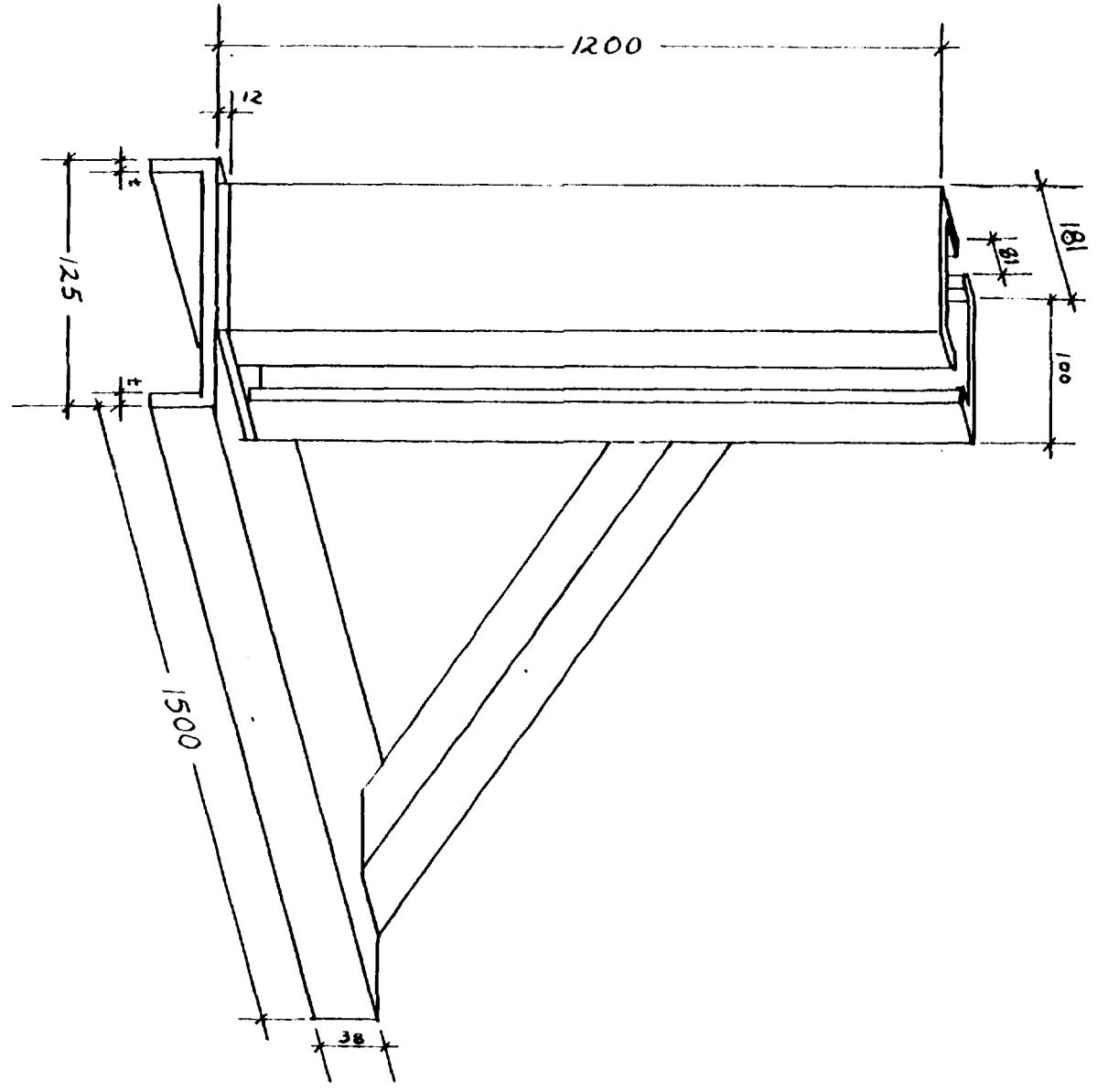


Fig. 5

DOGGER PEDESTAL

Note: a) 3 Units Required,
b) t = Thickness of Channel Lips.

UNIDO PROJECT No. SI/SUD/82/805

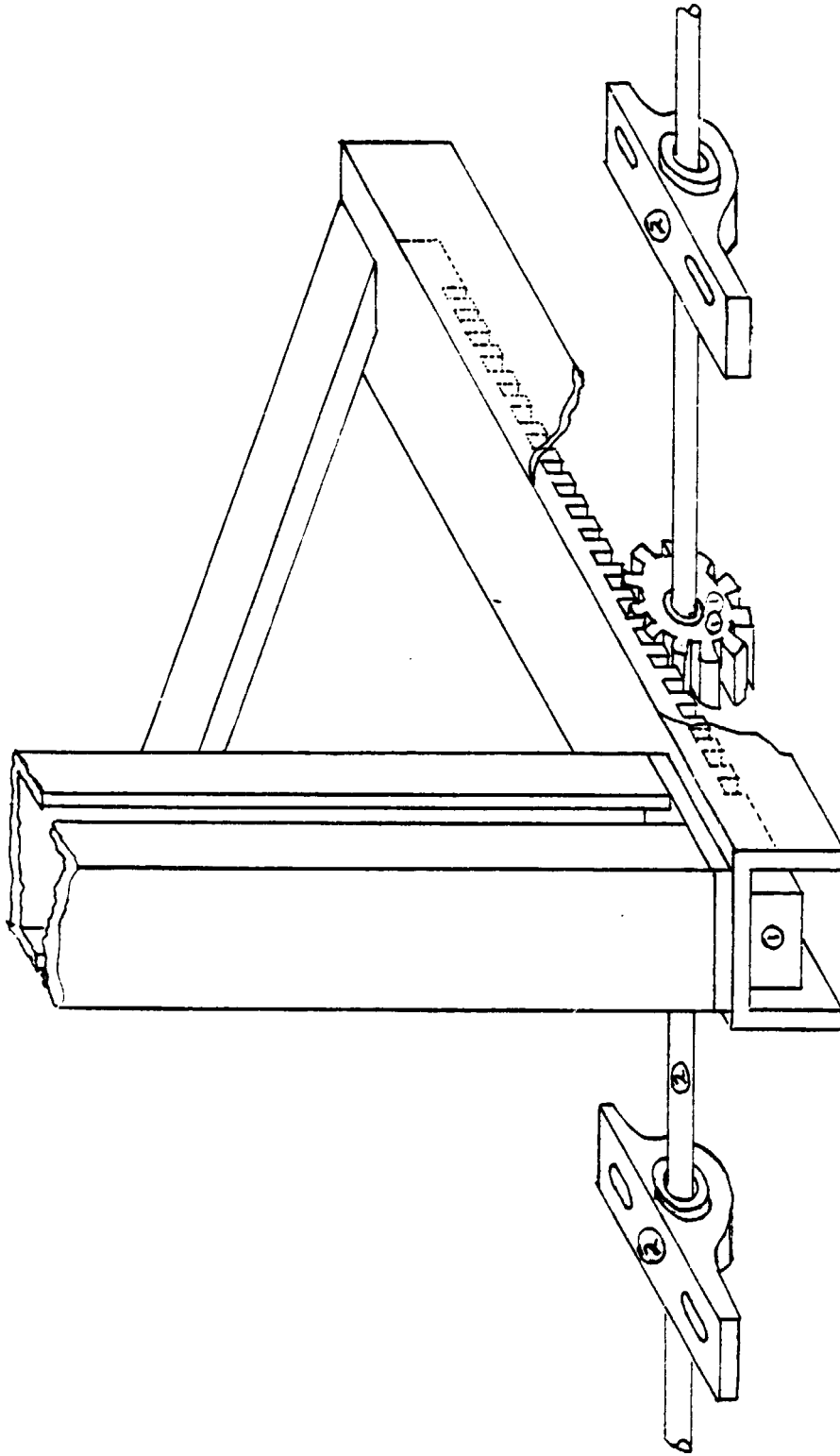
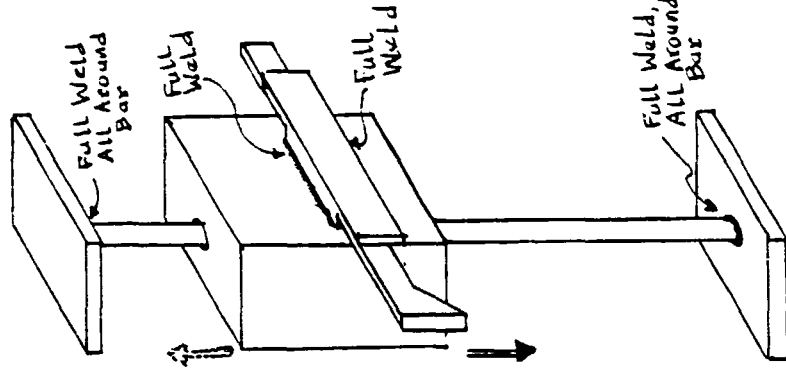
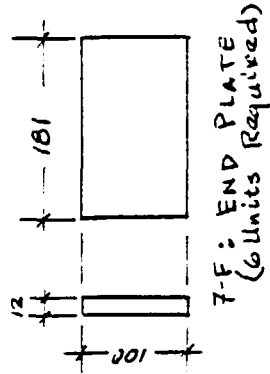
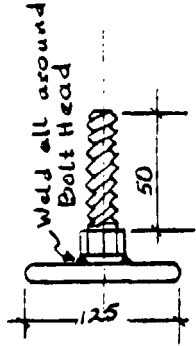
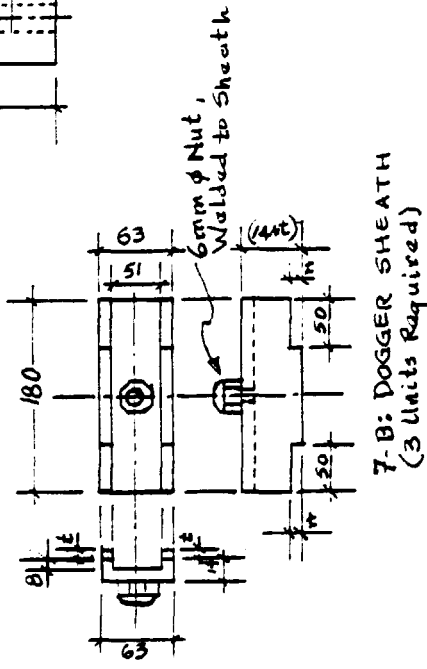
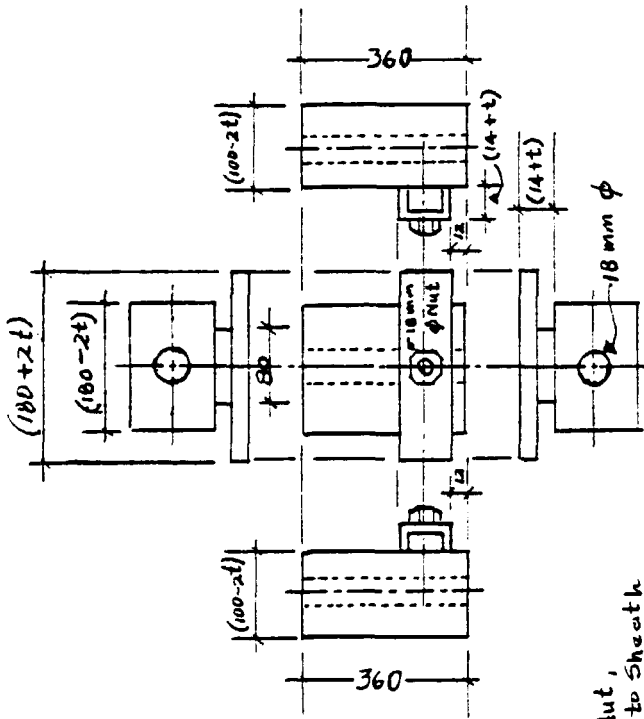
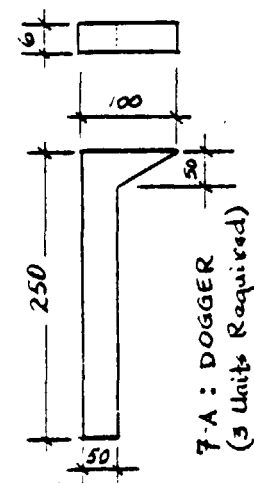


Fig. 6

PINION-RACK DRIVE MECHANISM FOR DOGGER PEDESTAL

- Note:-
- 1) Two Sets Required. One Set each to be installed on left and Right Pedestals; None on Center Pedestal.
 - 2) Common Drive Shaft, supported by Pillow Block Bearings link the two driven Pedestals, Center Pedestal is linked to the other Pedestals by means of TIE BARS (see Fig. 4.)

UNIDO PROJECT No. SI/SUP/82/805



7-E: DOGGER GUIDE BAR (3 Units Required)

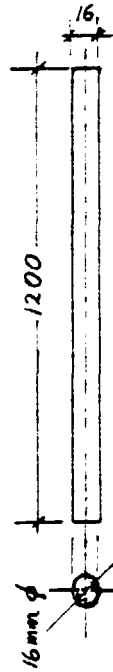
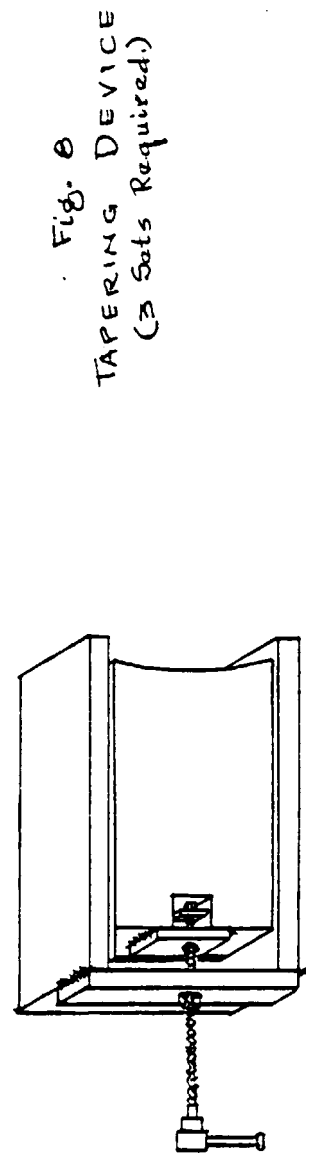
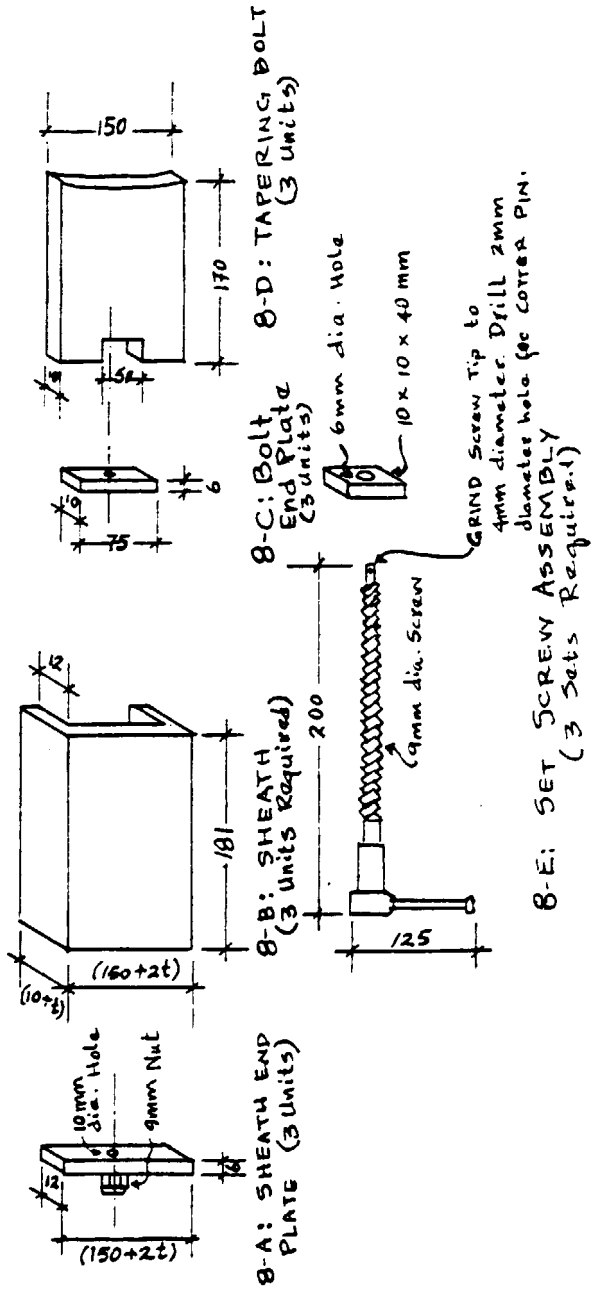


Fig. 7 DOGGING MECHANISM ASSEMBLY

Note: 1) t = Thickness of Channel Lips used for Dogger Posts.
2) 3 Sets Required.

UNIDO PROJECT No. SI/5UD/E2/805



B-F: TAPERING DEVICE ASSEMBLY (3 Sets Required)

Note: xxx indicates full weld

ANNEX III

TECHNICAL ASSISTANCE TO BENTWOOD CHAIR
FACTORIES IN OMDURMAN, THE SUDAN

UNIDO PROJECT No. SI/2UD/82/805

12 April 1984

To : The General Manager
Star Factories (EL NAGMA)
Omdurman Industrial Estate
Democratic Republic of Sudan

From : H. P. Brion
UNIDO Consultant

Subject : OBSERVATIONS AND RECOMMENDATION, PRODUCTION OPERATIONS
AND MANAGEMENT, EL NAGMA BENTWOOD CHAIR FACTORY,
OMDURMAN INDUSTRIAL ESTATE

This will put on record the various observations and recommendations discussed with you and your staff during the last two weeks in connection with your efforts to improve production operations in your bentwood chair factory. The following points were taken into consideration during the detailed study of your plant operations:

- i- Your plans to expand production operations to attain outputs three to four times current plant output;
- ii- Your desire to be able to export your furniture products to neighboring Arab countries, initially, and other countries, eventually, after you have supplied your target share of the local market; and
- iii- The current intermittent supply of electric power, to which an adequate solution is not foreseen in the immediate future.

1.0 LOG AND LUMBER STORAGE YARD

1.1 Observations

- i- All "LALOUÉ" log bolts in the log yard exhibited end splits and "BLUE STAIN" infestation. End splits on log bolts decrease the lumber yield, while "Blue Stain" lowers the quality of the end product. Both defects indicate prolonged exposure to the weather elements, after the log bolts have been cut.
- ii- Further splitting was noticed among the sawwood pieces on top of the lumber piles in the lumber yard, while no significant increase in splitting was noted among the middle and bottom layers of the lumber pile. This indicates that the top layers of the lumber pile dry too fast. Furthermore, the method of stocking lumber prevents free circulation of air between the layers.

- iii- Both log and lumber are piled directly on the ground. Thus, sand particles are usually embedded on the surfaces of logs and lumber in contact with the ground. This condition shortens the cutting life of knives and saws.

1.2 Recommendations

- i- The following practices may help minimize end splitting and "blue stain" infestation of the freshly cut "Laloub" logs:
 - a) In general, fresh cut logs should be milled into lumber as soon as possible. Experience in Thailand, Malaysia and the Philippines should minimize end splits and less "blue stain" infestation when timber of similar species is milled within two weeks from the time the tree is felled and bucked into log bolts during the dry season. The period is reduced to one week during the rainy (wet) season.
 - b) Proper piling of log bolts and lumber also help minimize end splitting and lead to more uniform drying of the lumber from one piece to another. (See attached sketches of piling techniques for logs and lumber.)
 - c) Before the sun rises in the morning, water is sprayed on the log piles, sufficiently to wet the bark and the outer portions of the heartwood. It is also advisable to mix (up to 1.5%) some form of anti-fungus compound, in order to prevent the spread of "blue stain".

2.0 MATERIALS TRANSFER BETWEEN OPERATION STATIONS

2.1 Observations

- i- Furniture parts are dropped on the factory floor after machining operations.
- ii- Work-in-process is moved from one work station to another by picking them up from the floor and dumping the work pieces near the next work station.

These practices cause damage to the wooden parts and lead to wasteful and inefficient use of materials handling labour.

2.2 Recommendations

Machined wooden parts are better handled with the use of production carts, boxes and other carrying fixtures. (See attached sketches of some production carts, trays and materials handling fixtures.)

3.0 FACTORY AND MACHINERY LAY-OUT

3.1 Observations

- i- Too much land area is wasted under the present factory lay-out.
- ii- Smooth flow of materials-in-process is made possible by a well-planned machinery lay-out. The present machinery lay-out gives rise to excessive material handling labour which is non-productive.

While the adverse effects of this situation is not readily felt under the present low levels of production volume, the desired expansion of operations to attain three to four times the current production output will not be possible under the present machinery lay-out.

3.2 Recommendations

The attached sketch of the factory and machinery lay-out is recommended. It is recognized that it will require time and money to implement the change from the present to the recommended lay-out. Thus, this may be done in a number of stages, with an open mind to possible improvement of the recommended lay-out to suit the changing needs of your production operations. However, it is suggested that the factory and machinery lay-out should be revised before any new piece of machinery is installed under the expansion program.

4.0 TECHNICAL ASPECTS OF THE PRODUCTION OPERATIONS

4.1 Observations

- i- The present technique of milling "Laloub" logs on a 50 mm bandsaw, a 500 mm jointer and a 600 mm circular saw is VERY DANGEROUS and WASTEFUL. Based on a limited observation of the milling operations, it is estimated that the lumber (50mm x 100mm planks) yield rate is below 30%.
- ii- Cutting tools (router bits, planer and shaper knives, drill bits, etc.) are not ground (sharpened) properly. Since about 75% of the machines were fabricated by yourselves, the conventional concepts of feed speeds in relation to cutting angles, and the required grinding angles of the cutting tools were not considered in the design and fabrication of the machines. Rough surfaces of turned items arise, and thus require a great amount of sanding to attain the desired smoothness of the turned surfaces.

- iii- It was noted that the cutting tools in all machines are being used though they need sharpening already, resulting to heating of the cutting edge and softening of the cutting tool, and most objectionably, leaving burn marks on the workpiece.
- iv- Tool grinding equipment are located in many places within the factory. Thus, there is no control on who and how the grinding machines may be used. The result is damage to the grinding stones. Furthermore, it appears that the grinding wheels are not regularly and properly dressed.
- v- Chair seat frames and backs are machined on the vertical spindle moulder (shaper) without the aid of machining jigs. This is DANGEROUS and INACCURATE.
- vi- Saw dust and wood chips/shavings are exhausted on the floor. This is a FIRE HAZARD! Furthermore, this leads to low precision in machining work, as the saw dust or wood chips/shavings get into the space between the guide fence (or machine table) and the workpiece. This is also injurious to the health of the workers!
- vii- In several instances, off-cuts and trimming wastes are thrown under the machines, or anywhere convenient to the worker. The general state of HOUSEKEEPING with the factory area during and after working hours needs to be improved greatly.
- viii- Intermittent supply of electric power has reduced plant operating time to about 75% of capacity.

4.2 Recommendations

- i- The use of a sawmilling carriage will eliminate the need to square two faces of the log bolt on the jointer after opening two faces of the log on the 50mm wide bandsaw blade. Wood slabs may also be trimmed to 100 mm wide boards on the bandsaw with the use of the sawmilling carriage. This matter has been thoroughly discussed with you and a design of a small sawmilling carriage, pushed by one man, has been submitted to you in my Memorandum dated 8 April. Most of the component parts of the carriage will come from the pile of scrap metal in your factory yard.
- ii- As demonstrated to you and your knife-grinding man in the case of the 19 mm router bit and a pair of shaper knives, the correct grinding angle of the tool's cutting edge (to obtain the correct grinding angle) should be preserved at all times to ensure acceptable machining work. The use of metal templates and tool holders when grinding the knives and router bits will be of

great help in attaining the above objectives.

However, you will need help from an expert to determine the correct grinding and cutting angles for all the machines in your factory. Standard grinding equipment will also be needed.

- iii- Machine operators should be trained to check the cutting tools regularly and report to Management dull cutting tools. On the other hand, another set of sharpened tools should be ready at all times (for all machines) to replace dull tools. The accepted practice, particularly in mass production operations, is to have three sets of cutting tools for each piece of machinery: one set in use on the machine, the second set sharpened and ready for use, while the third set is being sharpened.
- iv- A tool grinding and maintenance room should be provided. This should be OFF LIMITS to unauthorized personnel.
- v- Jigs and fixtures help increase production and keep machining operations a SAFE activity. (Please refer to UNIDO "MANUAL ON JIGS FOR THE FURNITURE INDUSTRY", ID/265, which I gave for your use.)
- vi- Expansion plans should include the design, fabrication and installation of a saw dust and wood chips extraction system. You will need the help of an engineer or a wood processing expert for this purpose.
- vii- Boxes or containers should be provided for the accumulation and disposal of off-cuts and trimmings.
- viii- Expansion plans should also include the acquisition and installation of a stand-by electric generator. The generating capacity should be sufficient to provide power to all key production and tool maintenance machines, in addition to that required for lighting and air cooling appliances.

5.0 DOCUMENTATION AND INFORMATION SYSTEM

5.1 Observations

- i- Current reporting practice on log input is based on number of pieces of logs, rather than volume. This practice does not give realistic production costs of furniture products.
- ii- Lumber produced out of logs processed at the sawmilling section is not tallied at all.
- iii- Current records of materials and labour usage are inadequate to give realistic

costs of each furniture component. This situation will prevent you from evolving costs which are needed in a very competitive market, as it is now in the Khartoum area, and more so in the international market.

5.2 Recommendations

- i- Attached are suggested formats for LOG SCALING REPORT and LUMBER TALLY SHEET, which have been discussed with your staff.
- ii- Records should be kept of the component parts of each type and model of furniture item produced in your factory. A suggested format for this information is attached.
- iii- There are many other improvements which should be made in order to make your documentation and information system accurate and responsive to the needs of your expansion program. You will need the services of a Production Management Expert and an Accountant for this purpose.

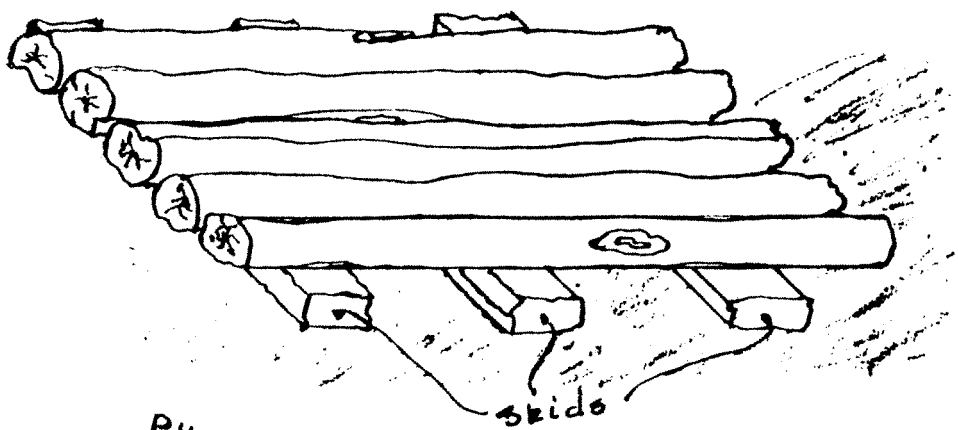
6.0 GENERAL OBSERVATIONS AND RECOMMENDATIONS

- 6.1 Management and supervision activities in your factory are still principally exercised by the General Manager. While this still possible for the present low level of production activities, it will prove very strenuous for you, mentally, physically and emotionally, if the present management style is not revised to suit the requirements of expanded operations. Thus, it is recommended that you delegate some of your powers and authorities to some of your capable and qualified staff members.
- 6.2 Effective decentralization of plant management and supervision activities is possible only if there exists a strong and capable middle supervisory staff. Unfortunately, this does not exist in your present organizational set-up. You will need the assistance of a Production Management expert to develop and train a corps of capable middle management and the supporting crew of lower level supervision (foremen, etc.). Development and training of an effective and capable middle management group takes time. Thus, such a move should be taken as soon as possible, before your expansion programme is implemented fully!

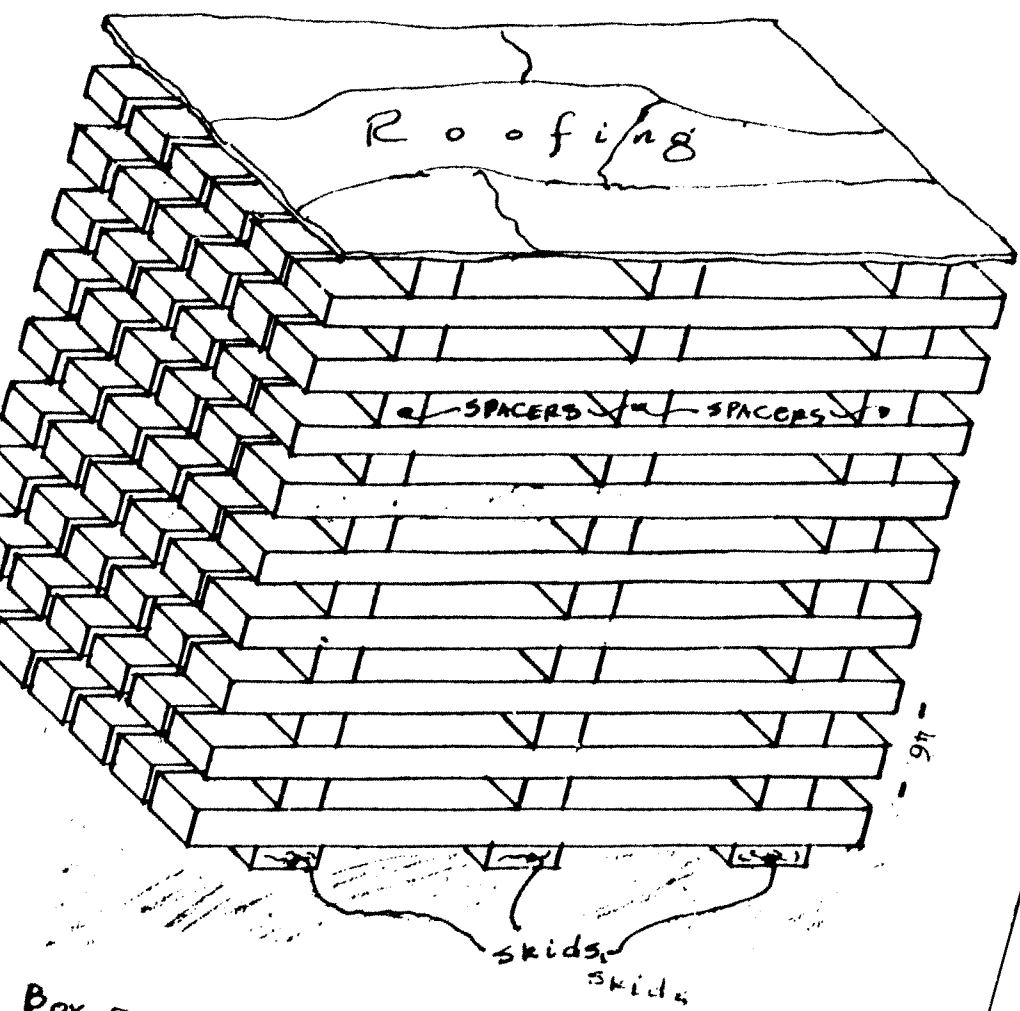
(sgd.) HORATIO P. ERION

Attachments : As stated.

cc: A. V. Bassili, UNIDO-Wienna
P. Harju, UNDP-Khartoum
Director of Forest Utilization,
Democratic Republic of Sudan

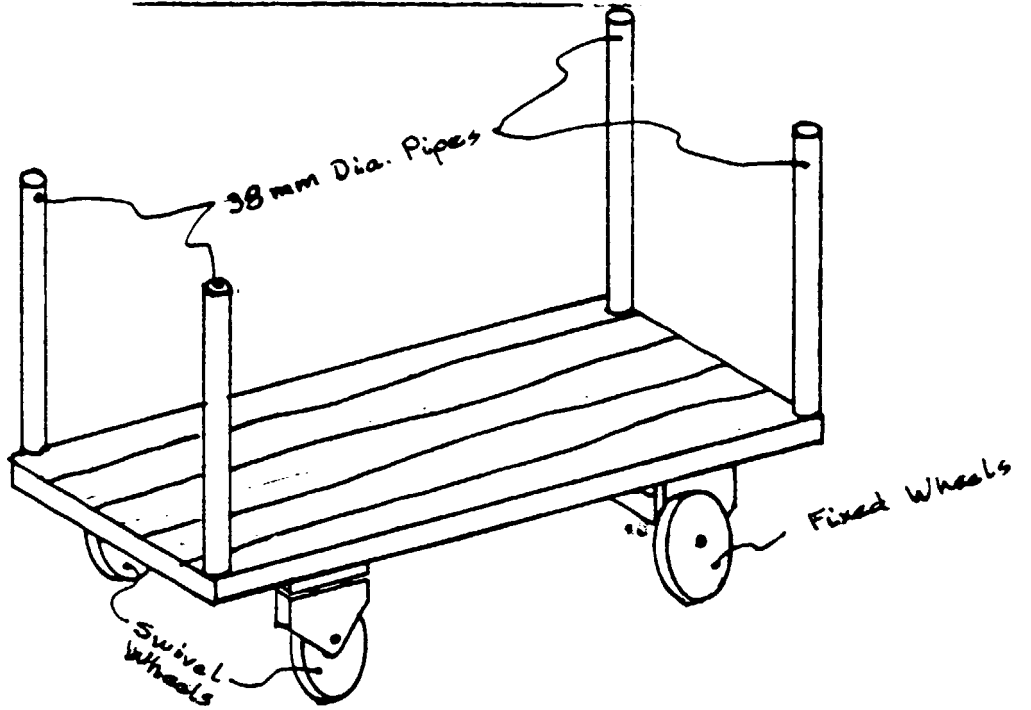


PILING LOG BOLTS on SKIDS

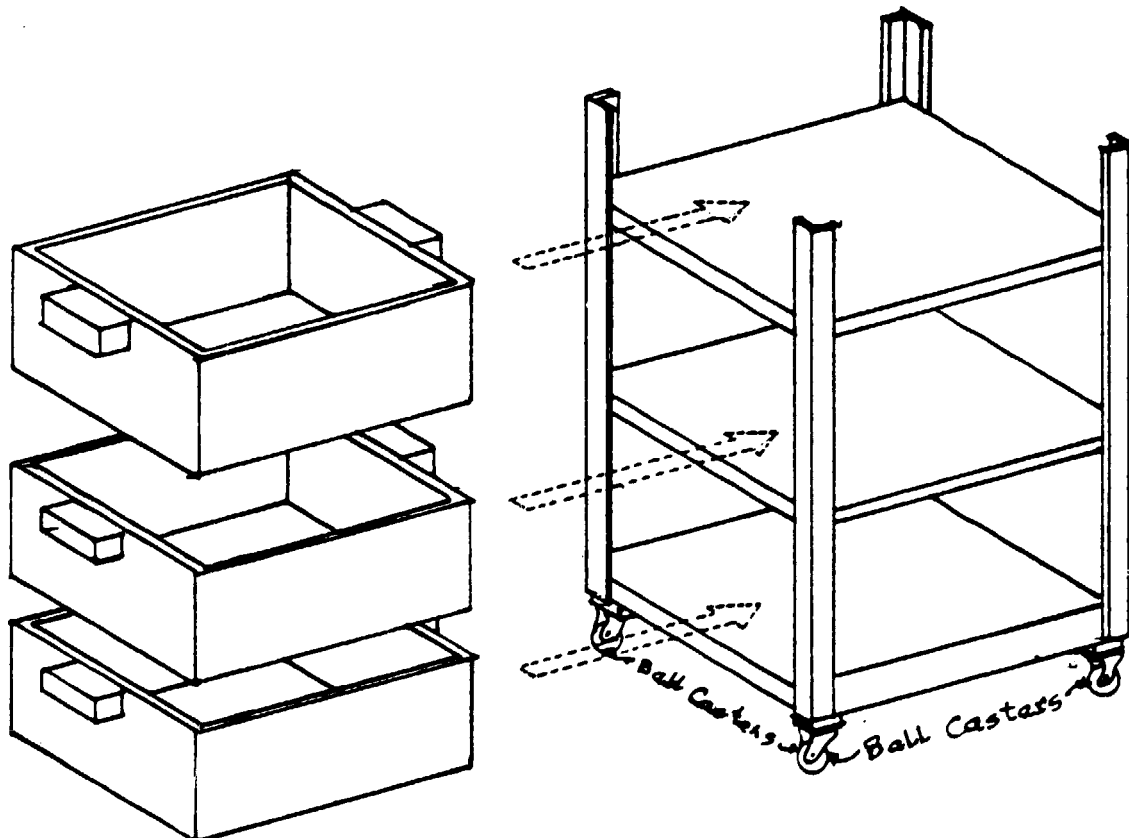


BOX PILING LUMBER ON SKIDS WITH SPACERS BETWEEN LAYERS AND ROOFING OVER TOP LAYER GIVE GOOD PROTECTION TO LUMBER BOARDS AT MINIMAL COSTS

SAMPLE CARTS, RACKS AND FIXTURES FOR MATERIAL
TRANSPORT BETWEEN WORK STATIONS



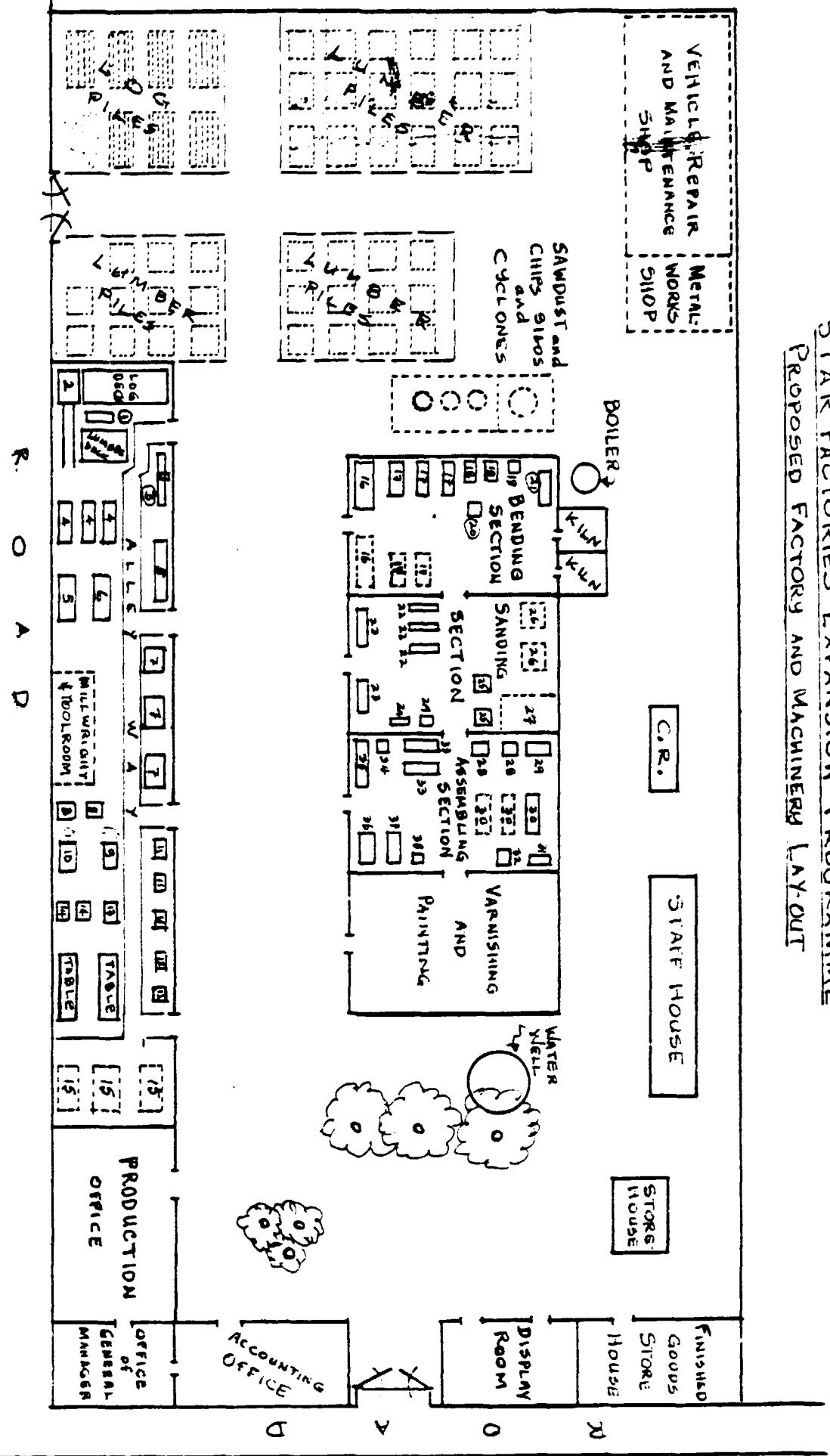
PUSH CART FOR LUMBER & BLANKS FOR TURNINGS



TOTE BOXES FOR
SMALL PARTS

MOBILE RACK FOR
TOTE BOXES

STAIR FACTORIES EXPANSION PROGRAMME
PROPOSED FACTORY AND MACHINERY LAY-OUT



Legend:

[---] - Additional Machinery, Buildings and Structures

Scale: 1cm. = 4m.

Note: See next page for machine identification.

STAR FACTORIES EXPANSION PROGRAMME

MACHINERY IDENTIFICATION
LIST FOR PROPOSED NEW
PLANT/MACHINE LAY-OUT
- - - - -

<u>Machine No.</u>	<u>Name/Description of Machine</u>
1	100mm or 150mm wide BANDSAW
2	BANDMILL CARRIAGE, per recommended design
3	Radial Arm Saw
4	Rip-saw
5	Jointer
6	Planer, single head
7	Rounding Machines
8	Bandsaws
9	Table Saw
10	Dado/Lathe Machine
11	Vertical Spindle Moulders (Shavers)
12	Drill Press
13	Table Saw
14	Horizontal Drilling Machines
15	AUTOMATIC LATHES
16	Seat Frame Bending Machines
17	Steaming Chamber for Seat Frame
18	Steaming Chamber for Legs
19	Steaming Chamber for Small Roundings
20	Bending Machine for Chair Back and Seat Braces
21	Bending Machine for front and Rear Legs
22	Drum Sanders
23	Vertical Belt Sander
24	Vertical Spindle Moulder (Shaper)
25	Cut-off Saw
26	AUTOMATIC SANDERS
27	SANDING BELT SPLICING ROOM
28	Back Rest Assembling and Machining Tables
29	Seat Support Assembling Table
30	Chair Assembling Tables
31	Plywood Seat Moulding Press
32	Chair Legs Levelling Machine
33	Chair Legs Routing Machine
34	Drill Press/Router
35	Horizontal Drill/Lathe Machine
36	Assembling Jig, Back Rest and Legs
37	Assembling Jig, Seat Braces and Legs
38	Back Rest Drilling Fixture

(Note: All machines typed in capital letters are NEW.)

SAMPLE FORMS FOR LOG SCALING REPORT AND
LUMBER TALLY SHEET

STAR FACTORIES
Ondurman

LOG SCALING REPORT

Date: _____

Log No.	Diameters			L	Vol. cu.m.
	Big	Small	Ave.		
Volume of Logs Milled--					

Prepared by:

Log Scaler

STAR FACTORIES
Ondurman

LUMBER TALLY SHEET

Date: _____

No. of Pieces	T	W	L	Volume, cu.m.
Lumber Volume Produced--				

Prepared by:

Lumber Tallyman

ANNEX IV

TECHNICAL ASSISTANCE TO BENTWOOD CHAIR
FACTORIES IN OMDURMAN, SUDAN

UNIDO PROJECT No. SI/SUD/82/825

1 May 1984

To : The General Manager
Star Factories (EL MAGMA)
Omdurman Industrial Estate
Democratic Republic of Sudan

From : H. P. BRION
UNIDO Consultant

Subject : BENTWOOD ROCKING CHAIR, A PRODUCT FOR DEVELOPMENT
REQUESTED BY MOSAIC INTERNATIONAL, U.S.A.

During the last follow-up visit with you (27 April), you requested advice on the possibility and, if possible, techniques of manufacturing a rocking chair, as per sample supplied to you by your new business partners, Mosaic International, U.S.A. The target market for the rocking chairs during the initial production stages will be confined to the domestic market, and if possible, the nearby Arab countries. An initial market volume of 500 chairs per month is contemplated. Eventually, upon attainment of acceptable quality and desired quantity, it is planned to export the rocking chair to the United States of America. At that stage, a production volume of 5,000 units per month is expected.

The more important features of the design, construction and finish of the rocking chair are discussed in the following paragraphs.

1.0 OBSERVATIONS ON THE DESIGN, CONSTRUCTION AND FINISH OF THE
ROCKING CHAIR

1.1 General

The rocking chair is of colonial design and is currently a popular furniture item among American homes. Bedrooms and living rooms are usually furnished with the rocking chair to compliment the other pieces of furniture that are normally found in those rooms. The design and joinery features allow shipment of the rocking chair in "knocked-down" form. The finish is dark mahogany, a shade which easily blends with many types of interior decor motifs in American and European homes. This model could also prove acceptable in the local and other Arabian markets.

1.2 Wooden Components

The rocking chair's wooden components are all made of glue-laminated laths, built up from several plies of veneer, which were bent on a heated pressing machine. There are two components which have ends bent at very

small radii, which may not be possible to do on the "Laloub" wood currently being used at the Star Factories. All other component parts of the chair may be made of "Laloub" wood.

1.3 Seat and Back Rest Weaving

Both the seat and back rest are of split "Rattan" weaving which appear to be machine woven. The "rattan" weaving sheets have their edges embedded in routed grooves on the seat frame and the back rest frame, and held firm by filler strips of round split "rattan". A thermo-setting type of adhesive holds the filler strips and the "rattan" weaving to the grooves on the seat and back rest frames, after pressure and heat are applied to the assembly with the use of a pneumatic press with a heated press platen. The platen temperature is maintained at a level which brings about curing of the glue bond within desired time limits.

1.4 The Furniture Finish System

The finish on the rocking chair is of the lacquer type, either nitrocellulose or polyurethane based. A heavy coat of woodfiller-stain serves as the foundation of the finish system. This also helps hide the laminations which would otherwise be visible on the side faces of the wooden components. Clear lacquer forms the top coating of the finish system. (Note: The finish is applied to the seat and back rest frames before the "rattan" weaving sheets are installed on the two components.) Since the rocking chair was produced for export to the United States of America, it can be assumed that the finishing system used on the chair has been formulated to withstand the cyclic changes in temperature, and the very low humidity usually found in heated rooms of houses in extra-tropical countries. Furthermore, the finishing system must be tough enough to withstand the adverse effects of long distance shipments.

1.5 Screws and Hardware Components

The screws and nuts, woodcrews and hardware components of the rocking chair are anodized or copper-oxidized to match the dark color of the finish. The precision with which the screw holes were drilled, particularly the sizes and depths of the countersunk holes, should be of prime interest to Star Factories. It is quite likely that such types of screws and hardware may not be available in the Sudan.

2.0 REMINDERS, SUGGESTIONS AND RECOMMENDATIONS

2.1 Stability Properties of Wooden Components

The stability of "Laloub" wood species under extra-tropical climatic and weather conditions is not yet fully known. However, it is universally known that laminated wood components (plywood, glue-lam boards, etc.) have better stability characteristics than solid

wood components of furniture items. This matter is of prime importance in bentwood furniture items since the bending process introduces internal stresses in the wooden components of the furniture. Important: Note that even the laminated wood construction of the sample rocking chair did not prevent failure of the glue bond on the back seat frame, left side (as viewed from the back of the chair). This failure could be traced to the fact that the chair was manufactured in Taiwan which has a relatively higher humidity condition than that prevailing in Khartoum, causing differential shrinkage at the glued joint, thus releasing the internal stresses in the laminated wood, causing the joint to fail.

It is suggested that as early as this time, steps should be taken to ascertain the behaviour of "Laloub" wood under climatic and weather conditions simulating those prevailing in the target markets for the products which will be made of "Laloub" wood. In this manner, adjustments can be made in your current steaming and drying techniques to help assure better and satisfactory performance of "Laloub" furniture in the foreign market. The technical assistance of an expert is needed for this purpose.

2.2 On Sharp Bends of Some Component Parts of the Chair

The small radii required on two component parts of the rocking chair may not be successfully achieved with the use of solid "Laloub" wood. Thus, laminated construction of the two components is indicated. However, there is nothing to lose if experiments are conducted to bend solid "Laloub" wood at small radii of curvature equal to that required in the rocking chair. It should be remembered, though, that even if these experiments are successful, the principal factor which should be used in deciding whether to use solid or laminated construction in the production of the rocking chair would be the results of the stability tests suggested in paragraph 2.1 above.

2.3 Plastic Strips Weaving for Seat and Back Rest

While plastic strips material is readily acceptable for use in chair seats and back rests in the Sudan market, this may not be true in the American and European markets. Thus, it is suggested that steps should be taken to ascertain the acceptability of plastic strips weaving before any production of the rocking chair is done using the material. Your marketing partner should be able to help you on this matter.

If it turns out that plastic strips weaving is not acceptable in the foreign market, it is indicated that "rattan" strips weaving material should be imported, and used in the manufacture of rocking chairs programmed for export to the American and European markets. These are available in Taiwan and Hongkong, and probably in Singapore. Your marketing partner should be able to help you on this matter.

2.4 Finishing System for the Rocking Chair

The varnishing system you are presently using on all your furniture production will definitely not be acceptable in the foreign market. Hence, it is suggested that your finishing materials supplier should be consulted on this matter. However, if such technical assistance is not available from your supplier, then assistance should be sought from other sources.

2.5 Adhesive for Joints in Component Parts of the Rocking Chair

You are now using "white glue", polyvinyl acetate (PVA), to join components of furniture parts produced in your factory. This type of glue has its limitations and may not work well under climatic and weather conditions in your target markets. This adverse condition is made more serious when the wood joined by the PVA glue has not been dried sufficiently to withstand the humidity (or dryness) conditions in the country where the furniture is being used. This may seem to be a complex problem to you. But, it can be easily solved with the assistance of a competent technical man.

2.6 Screws and Hardware

Inquiries from local hardware suppliers showed that the types and sizes of screws and hardware required in the manufacture of the rocking chair are not available locally. In view of this situation, it is suggested that your marketing partner be requested to furnish the screws and hardware. **DO NOT MAKE** any substitutions as this may affect the strength and durability of the rocking chair.

Please feel free to consult me further on the above and other related matters.

(Sgd.) E. P. BRION

cc: A. V. Bassili, UNIDO-Vienna
P. Harju, UNDP-KHARTOUM
Ministry of Industry, DRS
Director of Forest Utilization, DRS

ANNEX V

OUTLINE OF TOPICS TO BE DISCUSSED
DURING THE SEMINAR-CONSULTATION CLINIC ON WOOD
PROCESSING AND FURNITURE MANUFACTURING

9 May 1984

PART I --- PLANT OPERATIONS

I. MACHINERY AND EQUIPMENT

- A. Using Appropriate Machinery or Equipment for the Job
 - 1. Specifications for Correct Cutting Edge
 - i- Cutting Angles for Certain Wood Species
 - ii- Wood Hardness and Knife Grinding Patterns
 - iii- Correct Knife Setting
 - 2. Cutterhead Speeds and Feed Speeds
 - 3. Sufficient Power for cutterhead drive and feed systems
 - 4. Use of appropriate jigs and fixtures in machining operations
- B. The Need for Good Machinery and Equipment Lay-out
 - 1. Direct and smooth flow of materials-in-process
 - 2. Safety of Workers
 - 3. Use of conveying fixtures
 - 4. Isolation of operations generating fire (or sparks)
or those using highly volatile and flammable materials
 - 5. Minimize damage to work-in-process
- C. Adequate Maintenance of Machinery and Equipment
 - 1. Regular and adequate lubrication of machines
 - 2. Use of correct lubricants (oil, grease, etc.)
 - 3. Proper maintenance of cutting tools (knives, bits, etc.)
- D. Proper and Adequate Sharpening of Cutting Tools
 - 1. Correct grinding techniques
 - 2. Use of correct grinding stones
 - 3. Saw setting and kerf
 - 4. Proper handling and storage of cutting tools
- E. Dust and Chips Extraction and Exhaustion System
 - 1. The need for extracting and exhausting saw dust
and wood chips and shavings
 - 2. Types of dust extraction and exhaustion systems
 - 3. Safe and precise machining operation
 - 4. Increased production

II- MATERIALS AND PRODUCTION SUPPLIES

- A. Wood
 - 1. Species and machining characteristics
 - 2. Color
 - 3. Stability in service
 - 4. Bill of Materials

- B. Adhesives (Glue)
 - 1. Types and characteristics of adhesives, correct specifications and use
 - 2. Application techniques, economy of use
 - 3. Proper storage and handling
- C. Abrasives (Sanding belts, etc.)
 - 1. Types and characteristics of abrasives
 - 2. Correct specifications and proper use
 - 3. Proper storage and handling
- D. Finishing Materials
 - 1. Varnish
 - 2. Lacquers
 - 3. Finishing systems of materials and application techniques
 - i- Clear Finishes
 - ii- Opaque Finishes
 - iii- Decorative Finishes
 - iv- Decals and appliques
 - 4. Proper storage and handling

III- NAILS, SCREWS AND HARDWARE ITEMS

- A. Correct Nail or Screw Size and specifications
- B. Pilot Holes for woodscrews and nails
- C. Types of Screws and corresponding screw drivers
- D. Hardware Items (hinges, locks, lock-keepers, drawer pulls, etc.)
 - i- Specifications
 - ii- Finish
 - iii- Location on furniture
 - iv- Correct installation

IV- MANPOWER (LABOUR)

- A. Adequately Trained
- B. Sufficient Work Area
- C. Safe Working Conditions
- D. Productivity
- E. Incentives

V- MATERIAL HANDLING

- A. Production carts, trucks, etc.
- B. Conveyors, Dead and Powered
- C. Finishing Trucks and Fixtures
- D. Disposition and deployment

PART II — PRODUCTION MANAGEMENT

I- PRODUCTION PLANNING

- A. Lead Time
- B. Production Schedule
- C. Assignment of Labour (Manning)
- D. Machine Use Schedule
- E. Delivery Schedules

II- MATERIALS CONTROL (MATERIALS MANAGEMENT)

- A. Inventories and inventory control
- B. Requisitions and procurement
- C. Issues
- D. Shipments (deliveries of finished goods)

III- LABOUR USAGE

- A. Effective productive time
- B. Outputs and Productivity
- C. Pay schemes and incentives

IV- DOCUMENTATION AND INFORMATION SYSTEMS

- A. Materials and Supplies Usage
- B. Labour Usage and MachineHours Availability
- C. Product Costing
- D. Product Pricing

V- TABLE OF ORGANIZATION

- A. Levels of Supervision
 - B. Standards of Operations Communication
 - C. Literacy Level of labour and lower levels of supervision
 - D. Effective middle management group
 - E. Non-productive functions
-

ANNEX VI

LIST OF PARTICIPANTS, UNIDO SEMINAR-CONSULTATION CLINIC
ON WOOD PROCESSING AND FURNITURE MANUFACTURING

9 May 1984

PRIVATE SECTOR

The President, Cndurman Industries Cooperative
2 Other Officers, " " "
Ali Hassan El Sager, Proprietor/Gen. Manager, EL NAGMA
Abdel Raouf Omer, Director, EL NAGMA, and Industrial Engineer
Hassan Ali Hassan, Sales Manager, El Nagma

GOVERNMENT SECTOR

Abbas Balla, Deputy Director of Forest Administration
Mubark Ahmed Awad, Deputy Director for Forest Utilization
Hussein Awad, Technician, Forest Research Institute, Soba
Ali Yassin Cagun, Costing Officer, Forest Department
E. Ahmed Mohammed, Technician, Forest Research Institute, Soba
Eltayeb Elhadi Mohd., Researcher, " " " "
El Sheilah Abdalla, " " " " "
Abdel Latif E. Mahmoud, " " " " "
Elsamani Abdalla Fadl, Technician Forest Administration
Zein El Abdin Ibrahim, Forester, Forestry Affairs Dept.
Elfateh Farah Ali, Forester, " " "
Mamoun Casin Musa, " " " "
Abdel Rahman Mohy Eldien, Inventory Section
Abdelwadoud Al Alla, Forest Research Institute, Soba
Salah Alriqa, Forestry Dept.
Abou Obeida Gasn Elseed, Research Officer, Forest Administration
Mohammed Yousif Fadl, Personnel Officer, Forest Administration
Mohamad El Amin Ahmed, Forest Administration
Abdullah Mohd Abuyousef, Forest Research Institute, Soba
Ibrahim Musa Ahmed, A.C.F., Forest dept., Soba
Khalifa Osman Abd el Rahman, Forest Administration
~~Amr~~ Samoudi, Energy Research Council
Murgnani M. H. El Ata, Supply Officer, Forest Administration
Mohamed El Hassan Osman Kerama, Forest Administration
Sid Ahmed Sheik Mohamed, Wood Technologist

UNITED NATIONS

Ismail A. Mohammed, Actg. JPO, Office of the Senior
Industrial Development Field Advisor, UNDP-Khartoum
A. T. Vink, Management Officer, FAO Fuelwood Project

RESOURCE PERSON ----- H. P. Brion, UNIDO Consultant on
Wood Processing and Bentwood Chair
Production

ANNEX VII

SPECIFICATIONS OF ADDITIONAL NEW MACHINERY
AND EQUIPMENT FOR EL NAGMA BENTWOOD
CHAIR FACTORY

No. of Units	Specifications
1	*Automatic Lathe, 100mm x 100mm x 1250mm maximum work capacity, complete with automatic feed mechanism and spindles, profiled knives, motor drive and standard switchgears
1	*Automatic Lathe, 50mm x 50mm x 1000 mm maximum work capacity, complete with automatic feed mechanism and spindles, profiled knives, motor drive and standard switchgears
1	*Automatic Lathe, 25mm x 25mm x 500 mm maximum work capacity, complete with automatic feed mechanism and spindles, profiled knives, motor drive and standard switchgears
1	*Automatic sander for turned items, 100mm x 100mm maximum cross section and 1250 mm maximum length of workpiece, complete with feed mechanism and spindles, sanding belts, electric motor drive and standard switchgears
1	*Automatic sander for turned items, 50mm x 50mm maximum cross section and 1000 maximum length of workpiece, complete with feed mechanism and spindles, sanding belts, electric motor drive and standard switchgears
1	**Universal Grinding Machine, up to 150mm x 600 mm knife size capacity, complete with grinding stones, electric motor drive and standard switchgears
1	*Special Profiled knife Grinder for Automatic Lathes up to 100 mm x 1250 mm knife size, complete with grinding stones, standard knife holding accessories and fixtures, electric motor drive and standard switchgears
1 set	**Bandsaw blade sharpening machine, 150 mm maximum blade width capacity, complete with tooth setting attachment, electric motor drive and standard switchgears

List of New Machinery and
Equipment, page 2

No. of Units	Specifications
1 Set:	**Tungsten Carbide Tipping Equipment
1 Set	**Diesel-electric generating set, 150KW capacity, 220/440 Volts output, 50/60 Herz, 3-phase, complete with required switchgears and accessories
1 Set	**Saw dust, woodchips and shavings extraction and exhaustion systems, to be deisgned, fabricated and installed as required by the equipment comple- ment and lay-out, complete with fans, motor drive systems, pipings, valves and fittings. dust/air separators, separate silos for saw dust and wood chips/shavings, drive motor system.

Legend:

- * To be supplied by foreign partner
- ** To be supplied by EL NAGMA

ANNEX VIII

RESOURCE DOCUMENTS

The following documents, prepared by the United Nations Industrial Development Organization, are recommended as resource materials for EL NAGMA to attain a better understanding and successful implementation of the recommendations herein submitted:

Publication No.	T i t l e
ID/108/Rev. 1	Furniture and Joinery Industries for Developing Countries
ID/133	Selection of Woodworking Machinery. Report of a Technical Meeting, Vienna, 19-23 November 1973
ID/154/Rev. 1	*Low-Cost Automation for the Furniture and Joinery Industry (W. Santiano and H. P. Brion)
ID/223	Adhesives in the Wood Processing Industries. Report of a Workshop, Vienna, Austria, 31 October - 4 November 1977
ID/ 247	Technical Criteria for the Selection of Woodworking
ID/265	*Manual on Jigs for the Furniture Industry (P. Paavola and K. Ilonen)
ID/275	*Manual on Upholstery Technology (D. P. Cody)
ID/298	Value Analysis in the Furniture Industry (A. Juva)
ID/299	*Manual on the Production of Rattan Furniture (D. P. Cody)
ID/300	Production Management for Small- and Medium Scale Manufacturing Firms in Developing Countries (E.Q. Canela)

Note: EL NAGMA was furnished the documents marked *.

