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Workshop on Wood Processing
for Developing Countries
Vienna, Austria,

PRODUCTION IN DEVELOPING COUNTRIES OF WOODEN CASE GOODS FURNITURE (FLATBOARD FURNITURE): AN ANALYSIS OF ALTERNATIVES 1/

by

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INTRODUCTION

This study deals chiefly with the manufacture of box-type furniture made of flat boards, e.g. particle boards, plywood and blockboards, hardboards and the like.

Few components are made of solid wood, for instance plinths and bases, parts of drawers, profile strips, etc.

This study comprises the following types of furniture: bedroom, hotel and guest room furniture, living room wardrobes, sideboards, wall units for bed and living rooms, nursery and teenager furniture, kitchen and office furniture, incidental furniture and hall furniture.

A prior condition is the manufacture of the furniture exclusively from natural wood derivatives. The surface of the furniture should be of wooden materials (veneers) because surface materials like melamine formaldehyde laminates or PVC foil, polyester and similar materials are very expensive to import into developing countries. For inside and inferior outer side parts, nitro-cellulose lacquers have been chosen; for high class outside surfaces (e.g. doors) polyurethane lacquers or acid-catalized lacquers will be used for the top coat. Expensive lacquering materials which would have had to be imported have also been dispensed with.

On account of the variety of construction possibilities and process techniques for the manufacture of box-type furniture, the working operations are manifold and the possibilities of combination almost unlimited. Due to these facts the machines available on the world market vary considerably in construction and quality. With regard to the progressive improvement of processing techniques which are of interest, the development of the machines is almost unlimited and subject to continuous conversions.

Consequently, it is not possible to draw up a standard furniture factory. Despite this fact we tried to elaborate some standard examples with particular reference to developing countries.

This has only been possible by the above-mentioned restriction to box-type furniture manufactured from boards and by restricting the huge variety to the main processing techniques which are of interest for developing countries, as well as on account of the restriction of producing wooden surfaces and using simple finishing methods.

From this study the reader will become acquainted with the problems which arise when manufacturing box-type furniture. It is shown which machinery and plant should be chosen for the given personnel situation and capacities, the order of magnitude of the investment and installation costs, the space requirements and finally the capital requirement for furniture factories of determined capacities.

As the size of furniture factories is limited in almost all countries to factories with an average of 100 employees (labourers), the following examples have been chosen for such a size.

1. BASIC DATA AND MANUFACTURING PROGRAMME OF THIS STUDY

1.1. Study Based on This Manufacturing Programme

The capacity calculations of this study were based on a bedroom unit furniture range in accordance with the attached drawings 1a and 1b. For this bedroom programme the following daily output figures will be reached in terms of basic units:

	Number of units per day
4-door Wardrobe with top sections and 4 drawers in the base, high grade veneer, carcass parts and shelves nitro-cellulose lacquer treated, front part polyurethane or acid-catalized lacquer treated	20 - 22
Double Bed high grade veneer, head boards, polyurethane or acid-catalized lacquer treated, all remaining parts lacquer treated	20 - 22
Pedestals with door or drawer, high grade veneer, carcass parts and inner parts nitro lacquer treated, front parts polyurethane or acid-catalized lacquer treated	40 - 44
Mirror with bracket	20 - 22

This bedroom model has been selected for this study because this prototype has all the manufacturing features occuring in a furniture factory, such as: the processing of high grade veneers, common veneers and cross banding veneers, the processing of particle board, plywood and solid wood plus certain parts of blockboard for supporting elements such as the cabinet base, and the production of drawers and similar items.

The surface treatment includes bleaching or staining before the application of nitro-cellulose, polyurethane or acid-catalized lacquer. The polyurethane or acid-catalized coating has been provided for all polished front parts.

In the assembly section, incidental furniture and big furniture have to be handled.

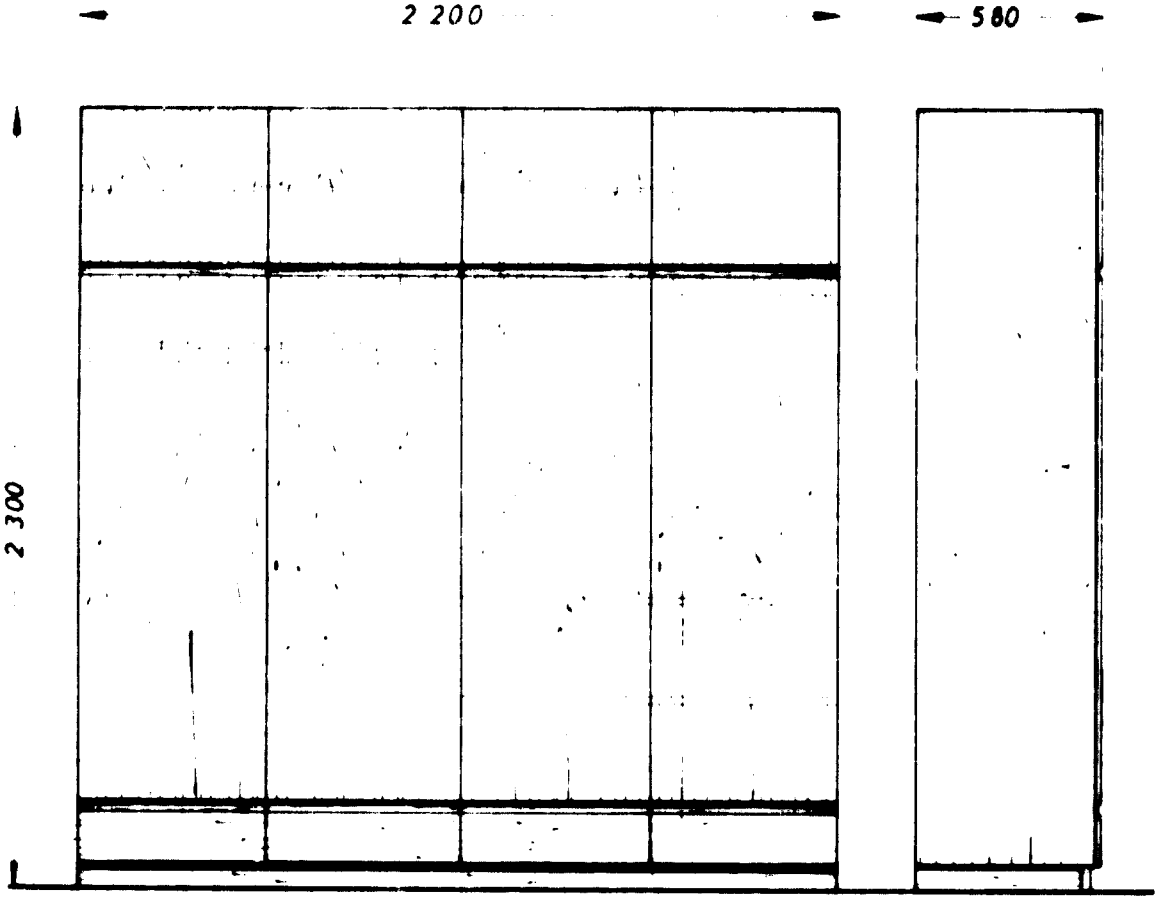
Consequently, this study touches on all the equipment necessary for the above capacity. Depending on the final manufacturing programme, some machinery or units can be eliminated. In case the solid timber parts will be purchased ready cut and processed, the machinery line for the preparation of the timber can be eliminated. When only using particle boards, the machines for manufacturing block cores and for cutting cross band veneers are not needed. Simpler machinery for the lacquering department is sufficient for treating the parts only with nitro-cellulose lacquer.

By the use of further models, other manufacturing possibilities will be demonstrated together with the rated output figures.

1.2 Further Manufacturing Possibilities with Figures of Turnover

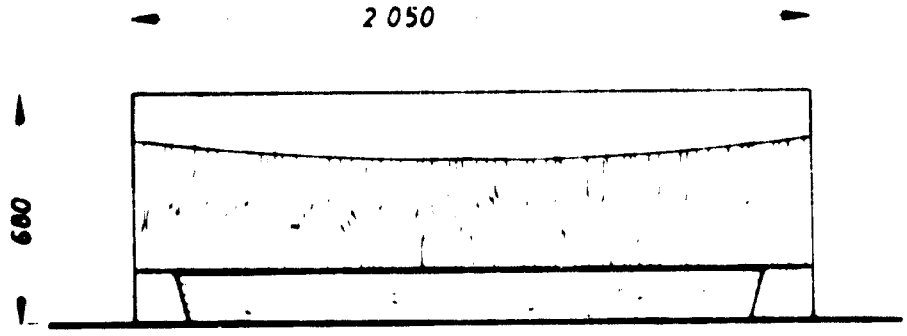
Possibility	Alternatives of the Manufacturing Programme	Drawing No.	Daily Production in Units
1	Bedroom unit furniture consisting of : 1 4-door wardrobe, with base and drawers, top unit 1 double bed 2 pedestals, door respectively drawer, 1 suspended mirror	1a/b/c	22
2	Bedroom unit furniture consisting of : 1 wardrobe, 4 doors, without drawer base, with top part 1 double bed 2 attached cabinets 1 suspended mirror	1a/b/c	26
3	Bedroom unit furniture consisting of : 1 wardrobe, 4 doors, without drawer base and without top part 1 double bed 2 attached pedestals 1 suspended mirror	1a/b/c	30
4	Hotel or Guest Room Suite consisting of : 1 2-door wardrobe 1 single bed 1 dressing table 1 pedestal	2a/b	66
5	1 2-door wardrobe	2a	105
6	Office Desk	3	90
7	Living Room Cabinet	4	70
8	Living Room Wall Units	5	24

Possibility	Alternatives of the Manufacturing Programme	Drawing No.	Daily Production in Units
9	Living Room (1) Wall Units	5	78
10	Living Room (2) Wall Units	5	35
11	Kitchen Units consisting of : 1 Storage Unit 2 Wall Units 2 Sink Units	6	40

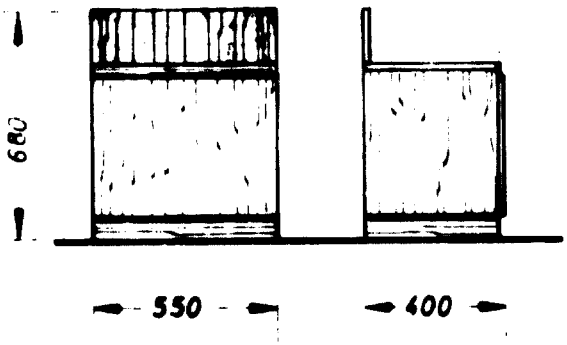


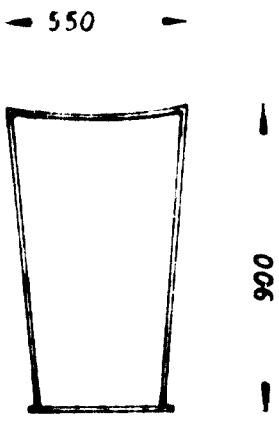
Sides and Front Parts :	Flatboard (particle board or panels), outside high grade veneer
Drawers and Base :	Solid Timber
Lacquering :	Sides and Interiors : Nitro-cellulose lacquer Front Parts : Polyurethane (PU) or Acid-catalized (AC) lacquered
Daily Production :	22 Bedrooms (standard model), with double bed, side tables and suspended mirrors

	day	name	Unternehmensberatung Gerhard Schuler	scale
dwg	17/7/86	Te	Inhaber Gerhard Schuler Dieter Haas Vinzenz Schmatic D-7293 Pfalzgrafenweiler Tel (07445) 20 15, 20 16, 20 17 Telex 764 269	1 : 20
chkd			BEDROOM, Unit Furniture	Drawing no. 1e

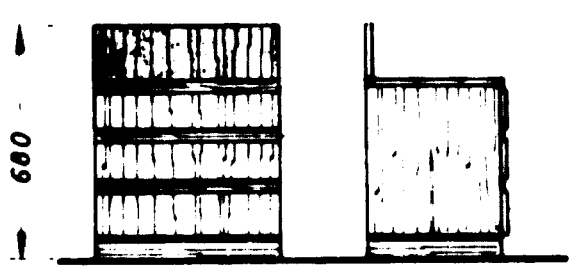


double bed





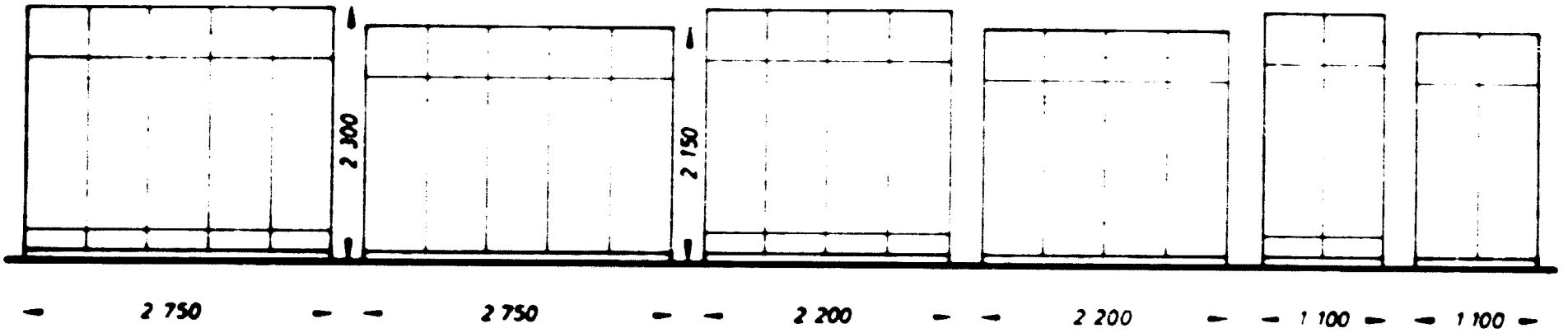
mirror with bracket

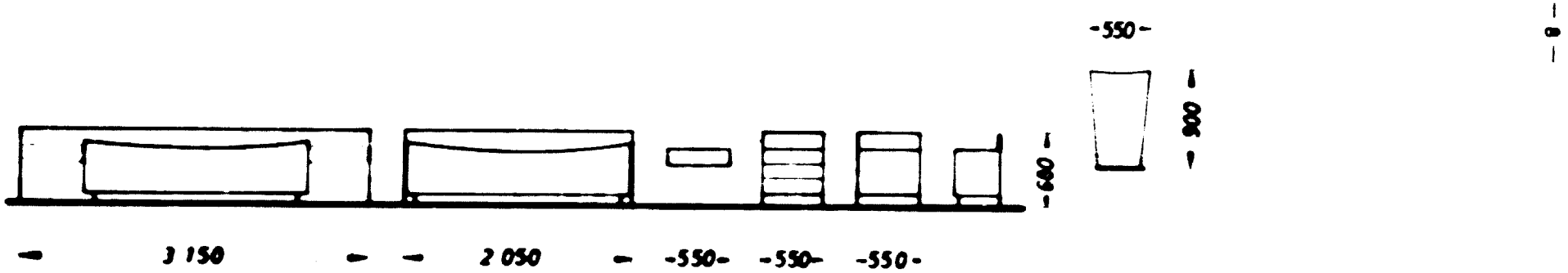


small side table with door or drawer

Side and Front Parts :	Flatboard (particle board or panels) side high-grade veneer
Drawers and Base :	Solid Timber
Lacquer :	Sides and Interiors : Nitro-cellulose Front Parts : PU- or AC-lacquered
Daily Production :	22 Bedrooms with 4-door cabinet

	day	name	Unternehmensberatung Gerhard Schuler	scale
dwg	8/7/74	To	Inhaber Gerhard Schuler Dieter Haas Vinzenz Schimpfle D 7293 Pfalzgrafenweiler Tel. (0 74 45) 20 15, 20 16, 20 17 Telex 764 249 uga d	1 : 20
check			BEDROOM - Double Bed, Side Table, Mirror	drawing-no. 11





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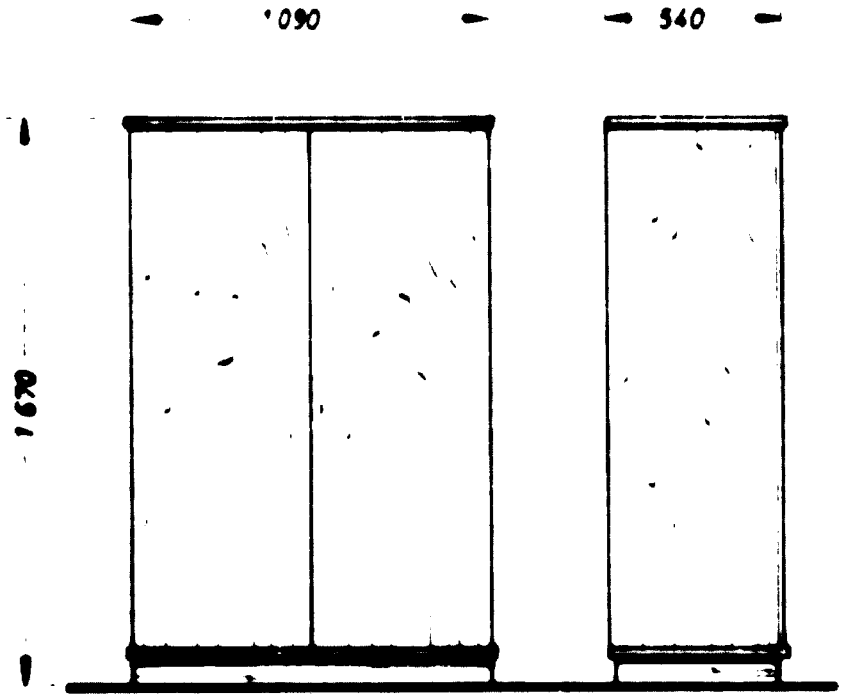
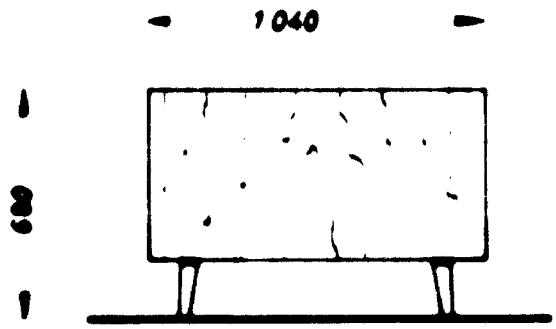
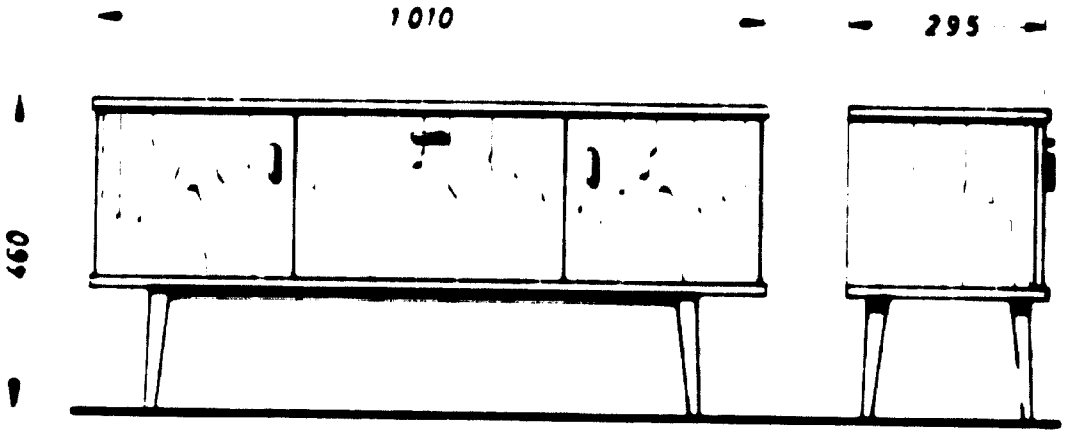
drawn	1/11/86	Te		
check			BEDROOM UNIT FURNITURE, Alternatives	1c

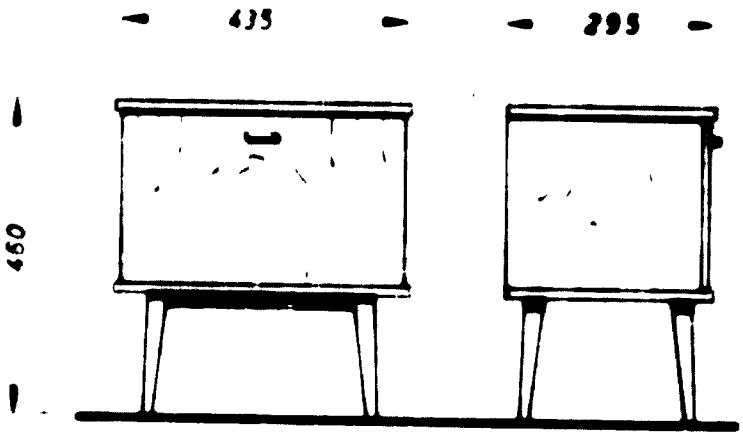




Sides and Front Parts :	Flatboard (particle board or panel) outside high-grade veneer
Base Parts :	Solid Timber
Lacquer :	Nitro - cellulose
Daily Production :	66 Hotel and Guest Rooms each with 1 cabinet, 1 bed, 1 sideboard, 1 side table, or 165 cabinets exclusively

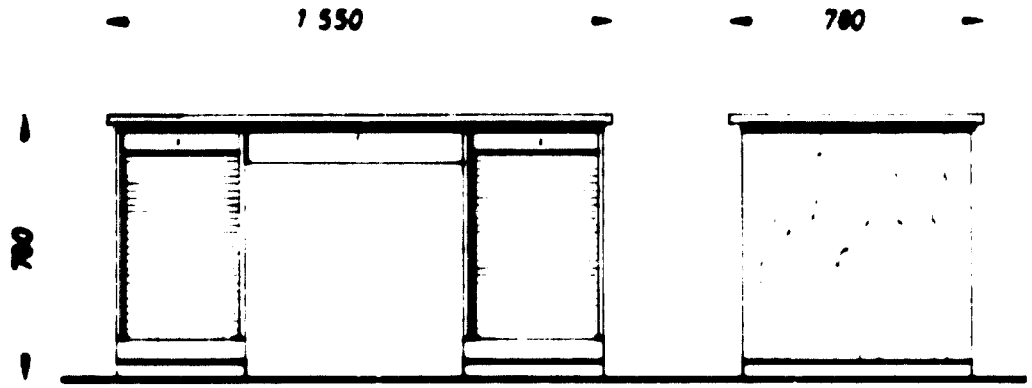
	day	name	Unternehmensberatung Gerhard Schuler	scale
dwg.	8/7/74	To		1 : 20
pr.ch			HOTEL AND GUEST ROOM Cabinet with 2 doors, bed	drawing no. 2a





Side Parts and Front Parts :	Flatboard, outside high-grade veneer
Base Parts and Feet :	Solid Timber
Lacquer :	Nitro - cellulose
Dolly Capacity :	66 Hotel and Guest Rooms, each with 1 cabinet, 1 bed, 1 side table, 1 sideboard

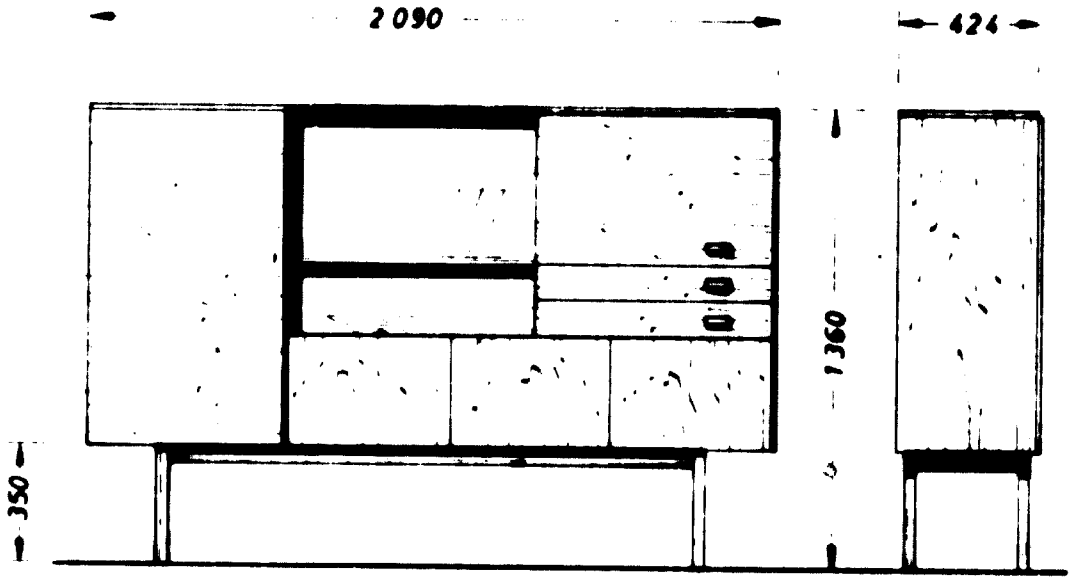
	day	name	Unternehmensberatung Gerhard Schuler	scale
orig.	8/11/84	To	Inhaber Gerhard Schuler Dipl.Ök. Hans Vinzenz Schimpfle D 7293 Pfalzgrafenweiler Tel. (07445) 20 15, 20 16, 20 17 Telex 796 240 schu d	1 : 10
mods.			HOTEL AND GUEST ROOM Side Board and Side Table	Drawing no. 2b



4 Left-hand Drawers
2 Right-hand Drawers
1 Centre Drawer
1 Left-hand and 1 Right-hand Drawer Plate

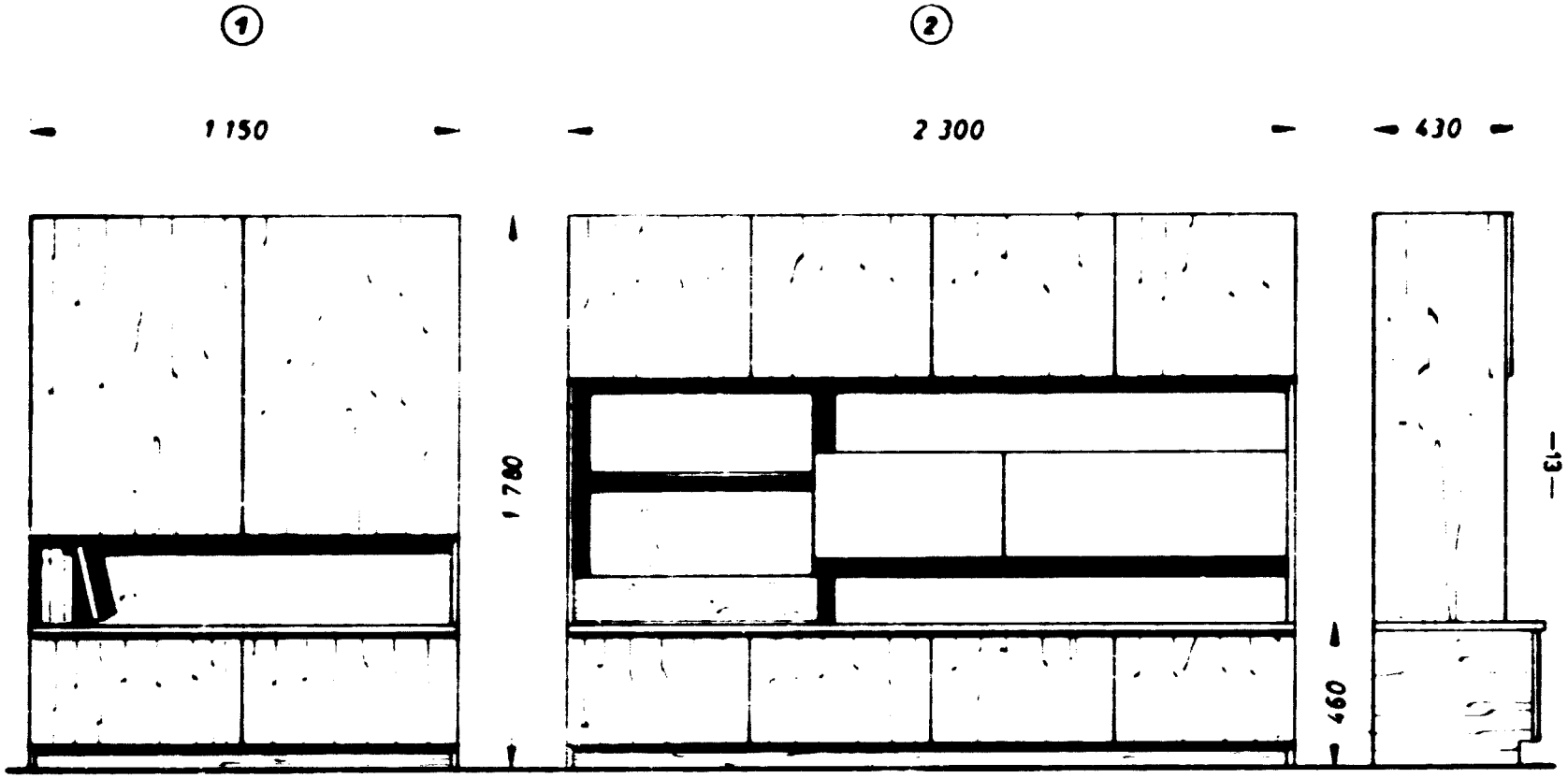
Sides and Front Parts :	Particle board or Panel, outside high-grade veneer
Drawers and Base Parts :	Solid Timber
Lacquer :	Side Parts and Interiors : Nitro-cellulose Top Panel : PU- or AC-lacquered
Daily Production :	90 Pieces

	day	name	Unternehmensberatung Gerhard Schuler	scale 1 : 20
orig	6/11/84	To		
check			OFFICE DESK	drawing no. 3



Sides and Front Parts :	Particle board or Panel, outer side high-grade veneer
Drawers :	Solid Timber
Base :	Solid Timber or Metal
Lacquer :	Sides and Interior : Nitro-cellulose Front Parts : PU- or AC-lacquered
Daily Production :	70 Units

	day	name		
drwg	9/7/74	TB	Unternehmensberatung Gerhard Schuler Inhaber Gerhard Schuler Dieter Haas Wagons Schwarte	1 : 10
check			LIVING ROOM CABINET	4



Sides and Front Parts : **High-grade veneer**, particle board or panel
Drawers and Base : Solid Timber
Lacquer : Side Parts and Interiors : Nitro-cellulose
Front Parts : PU- or A.C-lacquered

Daily Production :

Cabinet (1)	78 units
Cabinet (2)	35 units
Cabinet (1)+(2)	together
	eq. 24 units

	day	name
day	27/7/4	To
check		

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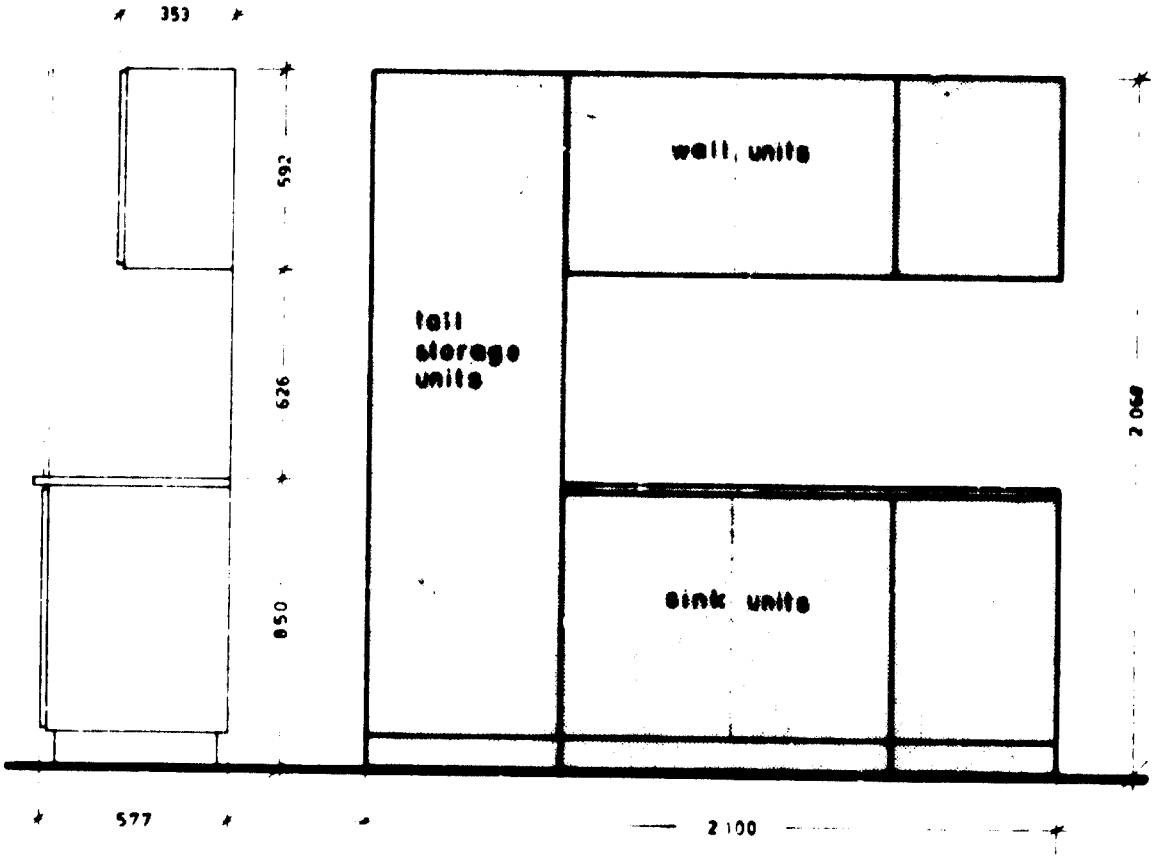
Inhaber Gerhard Schuler Dieter Haas Vinzenz Schimpfle
D-7293 Pfalzgrafenweiler Tel. (07445) 20 15, 20 16, 20 17. Telex 764 240 unig d

LIVING ROOM WALL UNITS

scale 1 : 20
drawing no. 5



Sides and Front Parts :	Particle board or panel, veneered
Drawers and Base :	Solid Timber
Lacquer :	Interiors : Nitro-cellulose Front parts and outsides : Nitro or PU white
Daily Production :	40 kitchens (with 5 units each)

	day	name	Unternehmensberatung Gerhard Schuler	scale
			Inhaber Gerhard Schuler, Dieter Haas, Vincenz Schrmglio	1 : 20
			KITCHEN WALL UNIT	drawing no. 6

1.3 Compilation of Material to be Worked up

Pos.	Kind of Material	Average Requirements in European Countries (daily 8 h) Quant.	DM	US $
1	Particle board 22/19/16 mm or Blockboard	10,0 cbm	2.400,-	
2	Plywood 4 and 6 mm	170,0 sqm	750,-	
3	Softwood	1,2 cbm	300,-	
4	Hardwood	1,0 cbm	400,-	
	Subtotal (Boards and Solid Wood)		3.850,-	1.540,-
5	High-grade veneer 0,7 mm	440,0 sqm	3.000,-	
6	Interior Veneers 0,7 mm	300,0 sqm	700,-	
7	Cross-banding Veneers 1,2 and 1,8 mm	220,0 sqm	180,-	
	Subtotal (Veneers)		3.880,-	1.550,-
8	Synthetic Glues (hot pressing)	200 kg	160,-	
9	PVAC-glues	10 kg	20,-	
	Subtotal (Glues)		180,-	70,-
10	Nitro-Lacquer	175 kg	580,-	
11	PU-Lacquer	140 kg	700,-	
12	Bleaching and Staining Materials		40,-	
	Subtotal (Surfacing)		1.320,-	530,-
13	Fittings	20 sets	1.200,-	
14	Mirrors and Glass	20 sets	300,-	
	Subtotal (Fittings and Glass)		1.500,-	600,-
	Grand Total for Raw Materials		10.730,-	4.290,-

1.4. What Role Does This Furniture Production Play in the Economy of Developing Countries?

The domestic requirements of living room furniture concern in the first phase simple furniture which are not too expensive. Most important are beds and wardrobes. Standardized built-in kitchen furniture come only second and finally are simple, not very large living room wardrobes.

If the country concerned has a good potential for tourism, hotel room furniture and built-in wardrobes will play an important role. Both living room furniture and furniture for hotels can be exported to neighbouring developing countries.

As part of the building up of its own industry, it is quite interesting for a developing country to incorporate an office furniture collections.

For export to industrialized countries, furniture programmes of high standard with exclusive veneers should be manufactured. Particularly furniture ranges of natural wood have very good market potential in these countries. Mainly compact furniture components should be produced for direct export. Wall units and built-in furniture must be excluded, since a lot of time is involved in the assembly at the customer's place. Designs and know-how for manufacturing such furniture should be provided in these countries by experts. In order to keep the costs of transportation as low as possible, the furniture should be in knock-down construction and delivered in parcels.

The co-operation with a furniture factory in an industrialised country would be another possibility for export. Furthermore, high class veneered furniture components for wardrobes and built-in units could be delivered additionally to foreign countries. The components are delivered partly unvarnished. They will be surface treated and assembled according to the customer's wish (colours, type of lacquer) at the partner's factory in the developed country.

Consequently, the furniture production in countries with high class tropical wood could be a quite interesting and profitable industrial activity.

2. PROCESS INVOLVED IN FLATBOARD FURNITURE PRODUCTION

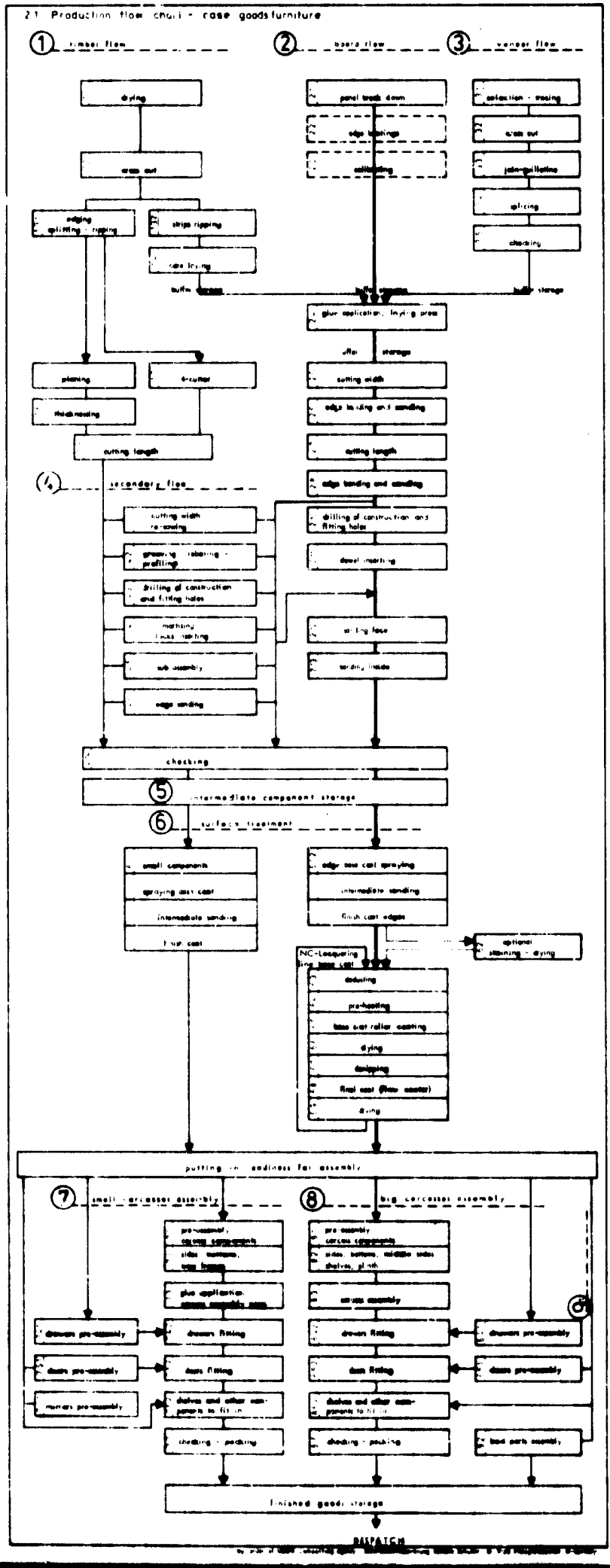
2.1. Production Flow Chart

2.2. Basic Information on the Manufacturing Process

2.3. Description of the Production Flows and Departments

2.4. Working Operations and Possibilities of Machinery for Different Stages of Mechanisation

2.1 Production flow chart - case goods furniture



2.2. Basic Information on the Manufacturing Process

The plant comprises the following flows of main production and manufacturing departments:

a) Solid Timber Flow
b) Veneer Flow
c) Main Machinery Line
d) Ancillary Machine Line
e) Surfacing
f) Assembly

Three main storage facilities have to be distinguished:

a) Raw Material Storage (veneer, lumber, boards)
b) Storage of Semi-finished products (intermediate storage behind the machinery line)
c) Finished Product Storage

The different furniture components will be produced in large series in the machinery section of the plant. After having passed the machinery section, the furniture parts are being stored in an intermediate storage room. From this storage room the parts are going to the surface treatment department and to the assembly department in small portions according to the incoming customer's orders. The small portions comprise similar furniture models and their size corresponds to the production of 1 or 2 days.

In case the manufacturing flow is correctly controlled, all assembly parts for the individual models should be available in the intermediate storage room so that the finishing department can operate independently from the machinery department. The number of parts per one series to be turned out by the machinery and the minimum quantities to be stored in the intermediate storage room have to be determined according to prevailing economic conditions (monthly consumption, frequency of turnover, capital requirements and similar factors).

The intermediate storage room must also contain the reserve furniture parts, while the storage room for finished products must only contain ordered furniture, which are being stored to assure the most economical distribution. Since a certain excess quantity of furniture will eventually accumulate in the finished product storage, owing to the required constant production, pre-determined smaller portions must be maintained. These excess quantities consist of unsold furniture and will be directly disposed of according to the future incoming orders.

2.3. Description of the Production Flows and Departments

2.3.1. Solid Timber Flow

The solid timber flow comprises drawer parts, edge protection strips, legs, base parts, ledges and similar items.

Softwood lumber storage has not been provided for. The disposition of these materials depends on the availability of this material.

Since hardwood is subject to the danger of deterioration and cannot be felled at all times, storage facilities for a 6 month's supply should be available.

The transport of lumber from the kiln drier to the saws is done by a side-loading forklift truck for a factory size of more than 120 labourers.

There should always be a substantial reserve of dried lumber so that the manufacturer will be independent from the drying process. From the cross cut saw, solid timber goes through the trim saw and multiple rip saw, planer and thicknesser to the storage section in front of the main machinery line and the auxiliary machinery line.

Parts which must be joined should pass through the machines a second time. Core ledges are bundled at the gluing station and stored in front of the press. Drawer parts go to the table milling machine after sizing (grooving and dovetailing, partly dowelling). Finally they go to the sanding line. The production of core material is done away with if only particle board will be used.

2.3.2. Veneer Processing

The size of the veneer storage room depends chiefly on the number of high grade veneer species to be used. Veneers for interior parts and cross banding veneers will likely be available promptly so that a large storage area will not be necessary for the latter.

The storage and transport of veneers should be done on special pallets which can be moved by means of a small side-loading forklift truck.

The machinery and equipment within the veneer processing department are to be installed in the following sequence or production as shown below:

selection of veneers
marking
cross cutting
joint-cut
joint-gluing
checking on the glue bond and hand laying
repairing

The veneer processing line ends at the press in the main machinery line.

2.3.3. Main Machinery Line (Flow of Boards)

Here the main quantity of the material has to pass through. Parallel to the solid timber and veneer line, the main machinery line starts at the end of the board storage room at the front of the factory hall. The transport of the boards to the sizer should be done with a side-loading forklift truck.

For the sizing of the boards in small factories with less than 80 persons, a circular bench saw has been provided for. If the factory size exceeds 120 persons, a 1-blade saw with automatically movable saw blade also has to be used.

In small plants a multiple opening aluminium-platen press is sufficient for the veneering of the edges. Furthermore, a through-feed short-cycle press could be used.

The final sizing is most economically done on a well equipped double cross cut saw. Only if the yearly turnover exceeds US$ 2 million is a double-end tenoner and an automatic edge veneering machine of interest.

If the yearly turnover exceeds US$ 3 million, we propose the use of an automatic multi-spindle dowel hole boring machine. Below the yearly turnover of US$ 3 million, simple semi-automatic single dowel hole boring machines must be provided. An automatic dowel hole boring machine can be directly connected to a dowel inserting machine.

The simple sanding machine is quite economic for sanding the surfaces in a small plant with a turnover of up to US$ 3 million. Only if the turnover exceeds this amount should the use of a continuous sanding machine be taken into consideration. In larger factories the automatic machines for sizing, edge trimming and banding, boring and sanding have to be installed so that they can - if the output capacity will be increased - be linked together.

A standard belt sander has been provided for for finish sanding of the delicate veneers. This machine can also be used for repair work eventually carried out after checking. The above-mentioned machine can be used in small as well as in large factories.

2.3.4. Ancillary Machine Line

All solid timber parts and boards of special shape have to be processed in this section. For instance, cutting of narrow work pieces like bases, bed sidings and covers are processed here. Further sizing of plywood strips for edge veneering production of bevelled and irregular parts will be done here like dowelling of small parts and milling of lock holes.

Standard machines like table type circular saw, medium/heavy table type milling cutter, pneumatic edge veneering press with electrical heating, a small dowelling machine and an overhead milling cutter or chain mortiser will be installed in this section.

2.3.5. Surface Treatment

Small quantities have to be bleached and stained manually (sponge, brush). For drying at ambient temperature, wheeled drying racks should be used. For quantities of more than 500 sq.m. per 8 hour shift, drying should be done by forced air circulation in a drying chamber. Only if the quantity exceeds 1,500 sq.m. per 8 hour shift should the use of continuous driers be considered.

The spraying of small parts and edges of panel parts will be done in a water curtain spray booth.

Up to a production of approximately 300 sq.m. per 8 hour shift, the application of lacquer to surfaces is done by spray gun in a spray booth. Above it, the use of lacquer application machines should be considered. In the case mentioned, a roller coater should be provided for the primer coat (nitro-cellulose) and a curtain coater for the top coat. Quantities less than 1,100 sq.m. per 8 hour shift can be treated with only one curtain coater for base and top coats. For drying, multi-deck rack drying trollsys are used for stacking in a simply constructed drying chamber with effective air movement.

The denipping of the base coat is done manually by pneumatic portable hand sanders or by an open belt sander.

Capacities exceeding approximately 1,900 sq.m. per 8 hour shift justify a lacquer drying tunnel. In the case of this study, a flat belt drying tunnel is chosen for the sealer coat and for the top coat (polyurethane or acid-catalised lacquer), a lacquering line consisting of floor type chain conveyor, multi-deck rack drying trollsys and drying tunnel.

Single storage lacquering lines offer the advantage of using through-feed sanding machines for intermediate sanding (denipping).

2.3.6. Assembly

The assembly is divided into three main sections:

a) Assembly line for large furniture
b) Assembly line for incidental furniture
a) Individual working places for bed assembly, mirrors and for carrying out repairs

The assembly lines are divided in a transport and roller conveyor section.

In the transport section, the dowels are inserted, fittings mounted, metal bands screwed on, drawers glued together, etc. These operations have to be done before the actual assembly. For instance, in the case of wardrobe assembly, the preparation is as follows:

Transport line for carcase parts before assembly
Transport of doors before fitting them onto the carcase
Transport of drawers for installation of same

The same principle applies to a similar extent for the assembly of incidental furniture. The assembly lines in small size factories are locally built and consist of sliding benches with tops of tempered hardboard or melamine sheets.

The actual assembly line for large furniture consists of a roller conveyor which has been installed directly on the floor level. The assembly line for incidental furniture can also be made as a sliding bench on which the goods will be moved from work post to work post. A gravity roller conveyor should be installed after the assembly line. The furniture is transported to the ready goods store by making use of gravity.

Working operations and possibilities of Machinery for different stages of mechanization

ode	perations	simple machinery	'000 $	up %	labour	middle machinery	'000 $	up %	labour	...ation machinery	'000 $	up %	labour
		DESCRIPTION REFERRING TO CARCASS FURNITURE MANUFACTURING PROGRAMME											
1	Timber Flo												
1.1	Drying and conditioning	dry kiln a) brick or concrete construction equipment with only semi-automatic controls capacity 6 cbm dff	4,5			dry kiln a) prefabricated all-metal kiln modular construction semi automatic controls capacity 6 cbm dff	14,0			dry kiln a) prefabricated all-metal kiln modular construction fully automatic controls and records capacity 6 cbm dff	19,0		
		b) brick or concrete construction equipment with only semi-automatic controls capacity 18 cbm dff	10,0			b) prefabricated all-metal kiln modular construction semi automatic controls capacity 18 cbm dff	28,0			b) prefabricated all-metal kiln modular construction fully automatic controls and records capacity 18 cbm dff	36,0		
1.2	Cross cutting	overhead cross cut saw locally made infeed and receiving table Quality: good Tolerance: ± 1,0 mm	3,6	20	1 S 1 L	pneumatic undertable cross cut saw with length stops Quality: good Tolerance: ± 0,5 mm	10,0	75	1 S 1 L	pneumatic undertable cross cut saw with length stops and saloer lift infeed side Quality good Tolerance ± 0,5 mm	10,0	100	1 S 1 L
1.2.1	Edging Splitting	circular saw bench with sliding table and rip fence Q: sufficient T: ± 1,0	3,6	20	1 S 1 L	power feed saw bench Q: good T: ± 1,0	5,2	20	1 S 1 L	automatic rip saw Q: very good T: ± 0,5	7,5	100	1 S 1 L
1.2.2	Strips ripping	circular saw bench with rip fence Q: good T: ± 0,4 mm	3,2	10	1 SK 1 L	power feed circular saw with saw spindle extended for 2 saw blades Q: good T: ± 0,4 mm	5,0	20	1 SK 1 L	multiple rip saw with return belt conveyor min. 10 saws Q: very good T: ± 0,3 mm	10,4	100	1 S 1 L
1.4	Core laying	locally made core laying device	6,4	20	1 SK	semi automatic core layer with sizing infeed	4,8	20	1 SK 1 L	automatic core layer with multiple sizing infeed or glueing operations	18,0	100	1 SK 1 L
1.5	Planing	hand feed planer surface capacity 400 mm Q: good T: ± 0,1 mm	2,4	40	1 SK 1 L	planer with feeder surface capacity 510 mm Q: good T: ± 0,1 mm	3,4	70	1 SK 1 L	planer with feeder and edge joiner surface capacity 510 mm Q: good T: ± 0,1 mm	4,0	100	1 SK 1 L

2.4	Working operations and possibilities of Machinery for different stages of mechanization	Note: Capacity refers to stage at 100 % (labour: S = semi-skilled, L = labour)	Date: Nov. % World

Note	simple machinery	1000 US $	cap. %	labour	middle machinery	1000 US $	cap. %	labour	advanced machinery	1000 US $	cap. %	labour
1.6 Thickness planing	thicknesser capacity 450 mm Q: good T: ± 0,1 mm	3,2	100	1 SK 1 L	thicknesser capacity 510 mm Q: good T: ± 0,1 mm	4,6	100	1 SK 1 L	thicknesser capacity 510 mm Q: good T: ± 0,1 mm	4,6	100	1 SK 1 L
1.7 Four-side moulding	four-side moulder type of construction: light 5 spindles Q: good T: ± 0,1 mm	10,0	80	1 S 1 L	four-side moulder type of construction: medium 5 spindles Q: good T: ± 0,1 mm	15,5	90	1 S 1 L	four-side moulder type of construction: heavy with planer equipment and 6 spindles Q: good T: ± 0,1 mm	18,0	100	1 S 1 L
1.8 Cutting to length	saw bench with sliding table saw cant to 45 degrees Q: good T: ± 0,4 mm	4,7	50	1 SK	a) double cross cut saw capacity 2500 x 2500 mm Q: good T: ± 0,2 mm	5,7	100	1 SK	a) double cross cut saw saw cant to 45 degrees capacity 2500 x 2500 mm Q: good T: ± 0,2 mm	6,4	100	1 SK
					b) single sided cross cut saw with dowelling equipment Q: very good T: ± 0,1 mm	8,0	50	1 SK	b) double sided cross cut saw and dowelling machine Q: very good T: ± 0,1 mm	14,2	100	1 SK

2.4 Working operations and possibilities of Machinery for different stages of mechanization

Note: capacity, meters per shift, ... % labour saved ... semi-skilled ... labour

... Nov ...

code	operations	simple machinery	*1000 US $	cap. %	labour	middle machinery	*1000 US $	cap. %	labour	advanced machinery	*1000 US $	cap. %	labour
2. Board Flow													
2.1	Panel break down	a) saw bench extended table equipped with ball casters Q: good T: ± 0,4 mm	3,4	25	1 S 2 L	vertical panel saw with automatic feeder Q: good T: ± 0,4 mm	8,0	25	1 S 1 L	automatic panel cutting saw, light type of construction Q: good T: ± 0,2 mm	26,0	100	1 S 1 SK 2 L
		b) saw bench to cut strip boards and overhead cross cut saw equipped with ball casters	3,4 3,6	50	1 S 2 SK 3 L					further automation possible			
2.2	Edge lipping and trimming	gluing stand hand hydraulic operated and electrical heating bar Q: sufficient	2,4	10	1 SK 1 L	pneumatic jig table with low voltage heating attachment Q: good T: 0,3 mm	3,6	30	1 SK 1 L	single sided edge bander with end trimming and edge trimming units Q: very good T: ± 0,3 mm	11,4	100	1 S 1 L
		portable router Q: sufficient	0,4	10	1 SK	edge trimming spindle single sided Q: good T: ± 0,5 mm	2,5	66	1 SK 1 L				
2.3	Calibrating	combined drum and thickness sander two rollers capacity : 980 mm Q: good T: ± 0,2 mm	12,1	85	1 SK 1 L	combined drum and and thickness sander two rollers capacity : 1100 mm Q: good T: ± 0,2 mm	15,2	100	1 SK 1 L	wide belt sanding machine with pre-sanding and finish sanding equipment degree of hardness adjustable capacity : 1100 mm Q: very good T: ± 0,1 mm	29,6	100	1 SK 1 L
2.4	Glue application	glue spreading machine with apportioning device and two rollers capacity : 1300 mm	2,8	60	1 L	glue spreading machine with doctor roller capacity : 1300 mm bevel made feeding device bevel made dust-removal device	3,8 1,2 0,5	80		automatic feeding unit brush and dust-removal machine glue spreading machine with doctor rollers a) capacity 2200 mm b) capacity 1800 mm disk-trask length 2500 mm	2,4 8,0 12,0 8,6 3,2	100 100 100 100 100	

* in case of series - continuing capacity

2.4	Working operations and possibilities of Machinery for different stages of mechanization	Note: Capacity refers to stage at 100 % Labour S = skilled, SK = semi skilled, L = labourer	Date: Nov 74 Page

code	operations	simple machinery	1000 US $	cap %	labour	middle machinery	1000 US $	cap %	labour	advanced machinery	1000 US $	cap %	labour
2.4.2	Laying	locally made laying table face veneer and inner veneer are provided on locally made rack-type trolleys	0,6	100	1 S 1 SK	locally made laying table face veneer and inner veneer are provided on locally made rack-type trolleys	0,6	100	1 S 1 SK	locally made laying table face veneer and inner veneer are provided on locally made rack-type trolleys	0,6	100	1 S 1 SK
2.4.3	Press	hydraulic 4-opening hot aluminium platen press loading manually electricity heated capacity 2500 x 1250 mm Q: good	16,0	48	1 SK	a) hydraulic 6-opening hot aluminium platen press steam or hot water heated with locally made loading and unloading cage Q: good	20,0	70	1 SK	single opening press through-feed short cycle principle and automatic unloader a) cap. 3600 x 2200 mm b) cap. 3000 x 1800 mm loading out belt Q: very good	24,0 23,2 3,0	100 80	1 L
						b) hydraulic 6-opening press, however steel platen to achieve high pressure cap. 2500 x 1250 mm Q: very good	22,0	70	1 SK				
2.5.1	Cutting width	circular saw bench with sliding table and rip fence Q: sufficient T: ± 0,4 mm	3,4	22	1 SK	double cross cut saw saw cant to 45 degrees with scoring saw cap. 2500 x 2000 mm Q: good T: ± 0,3 mm	6,4	45	1 SK 1 L	double end tenoner with scoring saw hogging saw spindle cutting length 1000 mm Q: very good T: ± 0,1 mm	38,0	100	1 S 1 SK
2.5.2	Rebating	vertical spindle moulder	3,0	30	1 SK	vertical spindle moulder with automatic feeder	3,7	75	1 SK 1 L				
2.6.1	Edge banding and trimming	locally made pneumatic jig table with low voltage heating attachment continuous method and portable router Q: sufficient	3,6	30	1 SK 1 L	single sided edge banding machine with end trimming, edge trimming and edge sanding unit Q: very good	11,4	50	1 S 1 L	a) double sided edge banding machine with end trimming, edge trimming and edge sanding unit Q: very good	24,0	100	1 S 1 L
										a) alternative to 2.5 + 2.6 automatic panel sizing and edge banding machine	48,0	100	1 S 1 SK 1 L
2.6.2	Edge sanding	single sided edge belt sanding machine, continuous method Q: good	10,4	30	1 SK 1 L								

2.4	Working operations and possibilities of Machinery for different stages of mechanization	[illegible]	Date Nov 7[illegible]

ode	perations	simple machinery	1000 US $	%	labour	middle machinery	1000 $	%	labour	sophisticated machinery	1000 $	%	labour
2.7	Cutting length	circular saw bench with sliding table and rip fence Q: sufficient T: ± 0,4 mm	3,4	45	1 SK	double cross cut saw saw cant to 45 degrees with scoring saw capacity 2500 x 2500 Q: good T: ± 0,3 mm	6,4	45	1 SK 1 L	double end tenoner scoring saw hogging saw spindle cutting length 2500 mm Q: very good T: ± 0,1 mm	35,0	100	1 S 1 SK
2.8	Edge banding and trimming	locally made pneumatic jig table with low voltage heating attachment continuous method and portable router Q: sufficient	3,6	30	1 SK 1 L	single sided edge banding machine with end trimming and edge trimming and sanding unit Q: very good	11,4	50	1 S 1 L	double sided edge banding machine with end trimming and edge trimming and edge sanding unit Q: very good	24,0	100	1 S 1 L
2.8.1	Edge sanding	single sided edge belt sanding machine continuous method Q: good	10,6	50	1 SK 1 L								
2.10	Drilling of construction and fitting holes	dowel hole boring machine, vertical and horizontal adjustable unit 19 spindles Q: good T: ± 0,25 mm	4,4	20	1 SK 1 L	heavy construction dowel hole boring machine, vertical and horizontal adjustable unit 29 spindles Q: good T: ± 0,25 mm	6,8	30	1 SK 1 L	automatic dowel machine continuous method 2 horizontal units 4 vertical units capacity length: 2500 mm Q: good T: ± 0,15 mm	36,0	100	1 S 1 SK
2.11	Dowel driving	glue application: manually dowel driving: manually Q: sufficient	0,05	10	1 L	glueing and dowel driving-hand machine Q: good	2,1	40	1 SK	2.10 is linked with 2.11 automatic double sided glueing and driving machine Q: good	16,0	100	
2.12	Sanding face	open belt sander table size: 2500 x 800 mm Q: sufficient	3,0	20	1 SK	a) semi automatic open belt sander table size: 2500 x 800 mm Q: good	10,0	35	1 SK	a) wide belt sander with pressure cushion and roller heavy construction working width 1100 mm top sanding Q. very good	30,0	100	1 S 1 L
						b) wide belt sander with pressure cushion and roller light construction working width 900 mm Q: good	24,0	90	1 S 1 L	b) automatic double belt sanding machine Q: very good	48,0	100	1 S 1 L

by order of UNIDO – Consulting agency Gerhard Schuler [illegible] W Germany

2.4	Working operations and possibilities of Machinery for different stages of mechanization	Note	Date Nov 76 World

Working operations	Simple machinery	Investment US $	Labour %	Skill	Middle machinery	Investment US $	Labour %	Skill	Advanced machinery	Investment US $	Labour %	Skill
2.13 Sanding inside	open belt sander table size : 2500 x 800 mm				a) semi automatic open belt sander table size : 2500 x 800 mm				a) wide belt sander with pressure cushion and roller heavy construction working width 1100 mm bottom sanding			
	a) sufficient	3,0	20	1 SK	Q: good	12,0	35	1 S	Q: very good	26,0	100	1 S 1 L
					b) automatic open belt sander, continuous method table size : 2500 mm							
					Q: good	22,0	50	1 S 1 L				
2.14 Checking	work bench				work bench				work bench			

2.4	Working operations and possibilities of Machinery for different stages of mechanization			
	simple mechanization		medium mechanization			high mechanization		
3. Veneer Plus								
3.1 Selection wacing	locally made table and rack-type trolley	0,5 100 1 S 1 SK		0,5 100 1 S 1 SK		locally made table and rack-type trolley	0,5 100 1 S 1 SK	
3.2 Cross cutting	a) locally made overhead cross cut saw Q: good T: ± 1,0 mm	1,5 75 1 SK	a veneer circular saw cutting length 2100 mm hand feeding Q: good	3100 2,2 75 1 SK		veneer clipper cutting length 1300 mm Q: good	3,6 100 1 SK	
	b) veneer circular saw cutting length 3100 mm hand feeding Q: good	2,2 75 1 SK						
3.3 Veneer splicing	veneer circular splicing saw cutting length 3100 mm hand feeding	2,2 45 1 SK	a) veneer clipper cutting length 2400 mm Q: good	6,2 100 1 SK		veneer clipper cutting length 3100 mm with double cutting device	8,5 100 1 1	
			b) veneer circular saw cutting length 3100 mm automatic feeding					
3.4 Veneer splicing	veneer splicing machine table mounted outreach 750 mm Q: good	1,2 80 1 SK	veneer splicing machine outreach 900 mm Q: good	2,4 90 1 SK		veneer splicing machine zig-zag method outreach 1150 mm Q: good	6,8 100 1 SK	
3.5 Checking	locally made check table illuminated Q: good	0,6 100 1 SK	locally made check table illuminated Q: good	0,6 100 1 SK		locally made check table illuminated Q: good	0,6 100 1 SK	

2.4	Working operations and possibilities of Machinery for different stages of mechanization	Note: Capacity refers to stage at 100 % Labour S = skilled, SK = semi-skilled, L = labourer	Date: Nov 76 Ma/a

note operations	simple machinery	1000 US $	cap %	labour	middle machinery	1000 US $	cap %	labour	advanced machinery	1000 US $	cap %	labour
4. Secondary Flow												
4.1 Cutting width splitting	circular saw bench with rip fence cutting size max. 800 mm Q: good	3,4	70	1 SK 1 L	power feed circular saw bench with rip fence cutting size max. 800 mm Q: good	4,0	100	1 SK 1 L	power feed circular saw bench with rip fence cutting size max. 800 mm Q: good	4,0	100	1 SK 1 L
4.2 Rebating grooving profiling	vertical spindle moulder Q: good	3,0	40	1 SK	vertical spindle moulder with infeed unit Q: good	3,6	100	1 SK 1 L	vertical spindle moulder with infeed unit Q: good	3,6	100	1 SK 1 L
4.3 Drilling of construction and fitting holes	locally made drilling device Q: sufficient	0,5	40	1 SK	multi-spindle drilling machine, vertical Q: sufficient	1,8	50	1 SK	dowel hole boring machine, vertical and horizontal adjustable unit Q: good T: ± 0,25 mm	4,4	100	1 SK
4.4 Mortising locks inserting	a) mountable locks are recommended b) otherwise hand operated machines Q: sufficient	0,3	20	1 SK	a) simple lock mortising machine for furniture locks b) router Q: good	2,0 1,8	100 90	1 SK 1 SK	a) simple lock mortising machine for furniture locks b) router Q: good	2,0 1,0	100 50	1 SK 1 SK
4.5 Sub assembly	gluing jig table hand operated	0,4	60	1 SK	pneumatic jig table	1,8	90	1 SK	pneumatic jig table locally made, additional pressing units	1,8	100	1 SK
4.6 Edge sanding	hand sanding machines Q: sufficient	0,2	20	1 SK	single sided edge belt sanding machine hand feeding Q: good	4,8	100	1 SK	single sided edge belt sanding machine hand feeding Q: good	4,8	100	1 SK
5. Intermediate Component Storage												

2.4	Working operations and possibilities of Mochinery for different stages of mechonization	Note	Date

work operations	simple machinery	$	%			middle machinery	$	%			high-performance machinery	$	%		
6. Surface Treatment															
6.1 Incidental parts spraying of base coat and finish coat	water curtain spray wall with turning table working width 2500 mm	6,4	100	1	SK 1 L	water curtain spray wall with turning table working width 2500 mm	6,4	100	1	SK 1 L	water curtain spray wall with turning table working width 2500 mm	6,4	100	1	SK 1L
intermediate sanding	locally made work bench portable hand sander	0,3	30	1	SK	locally made work bench portable hand sander	0,3	30	1	SK	intermediate lacquer sanding machine with rollers or oscilating cushion table size: 2500 x 800 mm	10,0	100	1	SK
6.1.2 Edge spraying base coat and finish coat	water curtain spray wall with turning table working width 2500 mm	6,4	100	1	SK 1 L	water curtain spray wall with turning table working width 2500 mm	6,4	100	1	SK 1 L	water curtain spray wall with turning table working width 2500 mm	6,4	100	1	SK 1 L
intermediate sanding	hand sanding	0,2	80	1	SK	locally made work bench and portable hand sander	0,3	100	1	SK	locally made work bench and portable hand sander	0,3	100	1	SK
6.2 optional staining drying	manually with sponge and brush Q: sufficient	0,1	20	1	SK 1 L	water curtain spray wall with turning table Q: good	6,4	25	1	SK 1 L	roller staining machine with dispersing brush working width 1400 mm Q: very good	8,0	100	1	S 1 L
	stain drying in rack-type trolleys drying at ambient temperature					stain drying in rack-type trolleys drying in air-conditioned room					stain-drying in rack-type trolleys drying in air-conditioned room				
6.3 Dedusting	manually with brush and exhaust fan	0,1	20	1	L	brushing machine linked with 6.4	5,2	100	1	S 1 L	brushing machine linked with 6.4	5,2	100	1	S 1 L
6.4 Pre-heating	ambient temperature					a) pre-heating tunnel steam heated with recirculating air	18,4	100			a) pre-heating tunnel steam heated with recirculating air	18,4	100		
						b) pre-heating tunnel infra-red-heating linked with 6.5					b) pre-heating tunnel infra-red-heating linked with 6.5				
6.5 Base coat roller coating	water curtain spray wall with turning table working width 2500 mm	6,4	30	1	SK 1 L	lacquer roller coating machine roller length 1400 mm simple type of construction	6,0	100			lacquer roller coating machine heavy type of construction roller length 1400 mm	16,0	100		

2.4 Working operations and possibilities of Machinery for different stages of mechanization

Note: Capacity refers to stage at 100 %
Labour: S = skilled, SK = semi skilled, L = labourer

Date: Nov 74 Made

note	operations	simple machinery	1'000 US $	cap %	labour	middle machinery	1'000 US $	cap %	labour	advanced machinery	1'000 US $	cap %	labour
6.6	Drying	lacquer drying in rack-type trolleys drying at ambient temperatur Q: sufficient		30		lacquer drying in rack-type trolleys drying in air-conditioned room Q: good		75	1 L	lacquer drying tunnel (flat conveyor) width 1400 mm vapour extraction zone drying zone cooling zone Q: very good	18,0	100	
6.7	Denipping	open belt sander Q: good	3,0	30	1 SK	Intermediate lacquer sanding machine with smoothing and dedusting rollers or oscillating unit working width 1400 mm Q: very good	12,8	100	1 SK	intermediate lacquer sanding machine with smoothing and dedusting rollers or oscillating unit working width 1400 mm Q: very good	12,8	100	
6.8	Final coat (flow coater)	a) water curtain spray wall with turning table working width 2500 mm	6,4	30	1 SK 1 L	lacquer curtain coating machine one head Q: very good	10,0	80	1 SK 1 L	lacquer curtain coating machine double head working width 1300 mm Q: very good	12,8	100	
		b) one head curtain coating machine working width 1300 mm Q: very good	10,0	80									
6.9	Drying	lacquer drying in rack type trolleys drying at ambient temperature Q: sufficient				a) lacquer drying in rack-type trolleys drying in air-conditioned room Q: good				floor chain conveyor for rack-type trolleys drying in tunnel with vapour extraction zone drying zone cooling zone	20,0	100	1 SK 1 L
						b) floor chain conveyor for rack-type trolleys drying in tunnel with vapour extraction zone drying zone cooling zone Q: very good	20,0	100	1 SK 1 L	destacking			1 L

Working operations and possibilities of Machinery for different stages of mechanization

Note: ... apply, refers to stage of ... %
... labour, S ... saving, ... per ... worker, ... labour

Date: Nov. ...

Code	operations	simple machinery	1000 $	cap. %	labour	middle machinery	1000 $	cap. %	labour	... machinery	1000 $	cap. %	labour
7.	Incidental Carcass Assembly												
7.1 7.2	Pre-assembly carcass components: sides, bottoms, base, frames	locally made pre-assembly table and hand tools table size 2000 x 600 mm	0,3	75	1 SK	locally made pre-assembly table with electrical tools and automatic screwdriver table size: 2000 x 600 mm	2,0	100	1 SK	... made pre-assembly table with electrical tools and automatic screwdriver table size: 2000 x 600 mm	2,0	100	1 SK
		locally made lift rack	0,2	100		locally made lift rack		100		... made lift rack		100	
7.3	Glue application carcass assembly press	... made simple pneumatic carcass press manually adjustable two pressing possibilities glue application manually size: (2 x 1400) x 600 mm	4,0	80	1 SK 1 L	locally made simple pneumatic carcass press manual, adjustable two pressing possibilities glue application manually size: (2 x 1400) x 600 mm	4,0	80	1 SK 1 L	pneumatic carcass press mechanized, adjustable glue application with glue gun size: 2600 x 600 mm	6,0 0,5	100	1 SK 1 L
7.4.1	Drawers pre-assembly	locally made drawer-gluing device pre-assembly table hand tools table size: 1600 x 600 mm	0,2 0,3	80	1 SK	locally made drawer-gluing device	0,2	80	1 SK	pneumatic gluing press pre-assembly table and electrical tools table size: 1600 x 600 mm	1,6 0,8	100	1 SK
7.4.2	Drawers fitting	assembly on sliding bench locally made hand tools	0,1	90	1 SK	assembly on sliding bench	0,05	90	1 SK	assembly on gravity roller bench electrical tools	0,15	100	1 SK
7.5.1	Doors pre-assembly	locally made pre-assembly table hand tools table size: 2000 x 600 mm locally made lift rack	0,3	25	1 SK	locally made pre-assembly table electric tools table size: 2000 x 600 mm locally made lift rack	1,2	50	1 SK	locally made pre-assembly table electric tools and automatic screwer locally made lift rack	2,0	100	1 SK
7.5.2	Doors fitting	assembly on sliding bench locally made hand tools	0,05	90	1 SK	assembly on sliding bench locally made electric tools	0,05	90	1 SK	assembly on gravity roller bench electric tools	0,1	100	1 SK
7.6.1	Mirrors pre-assembly	locally made pre-assembly table hand tools locally made lift rack	0,2 0,2	25 100	1 SK	locally made pre-assembly table electric tools locally made lift rack	1,2 0,2	50 100	1 SK	locally made pre-assembly table electric tools and automatic screwer locally made lift rack	2,0 0,2	100 100	1 SK
7.6.2	Shelfs and other components to fit in	assembly on sliding bench, locally made hand tools	0,05	90	1 SK	assembly on sliding bench, locally made electric tools	0,05	90	1 SK	assembly on gravity roller bench electric tools	0,1	100	1 SK
7.7	Checking packing	assembly on sliding bench, locally made hand tools	0,05	90	1 SK	assembly on sliding bench, locally made electric tools	0,05	90	1 SK	assembly on gravity roller bench electric tools	0,1	100	1 SK

by order of ... - ... agency ... worker ... year ... reproduction ... forbidden

24	Working operations and possibilities of Machinery for different stages of mechanization	Note: Capacity refers to single shift ... Labour: S = skilled, SK = semi-skilled, L = labourer	Date: Nov 74 Mark

Work operations	simple machinery	'000 DM/$	cap. units %	middle machinery	'000 DM/$	cap. units %	advanced machinery	'000 DM/$	cap. units %
B. Big Carcass Assembly									
B.1 Pre-assembly B.2 carcass components: sides, bottoms, middle sides, shelves	locally made pre-assembly table hand tools table size: 2400 x 800 mm	0,4	75 1 SK	locally made pre-assembly table electric tools and automatic screwer table size: 2400 x 800	2,0	100 1 SK	locally made pre-assembly table electric tools and automatic screwer table size: 2400 x 800	2,0	100 1 SK
	locally made lift rack	0,2	100	locally made lift rack			locally made lift rack		
B.3 Carcass assembly	assembly on sliding bench, locally made hand tools	0,1	90 1 SK 1 L	assembly on sliding bench, locally made hand tools	0,1	90 1 SK 1 L	assembly on gravity roller bench electrical tools	0,15	100 1 SK 1 L
B.4.1 Drawers pre-assembly	locally made drawer gluing device pre-assembly table hand tools table size: 1600 x 600 mm	0,2 0,3	80 1 SK	locally made drawer-gluing device	0,2	80 1 SK	pneumatic glueing press pre-assembly table and electric tools table size: 1600 x 600 mm	1,6 0,8	100 1 SK
B.4.2 Drawers fitting	assembly on sliding bench, locally made hand tools	0,1	90 1 SK	assembly on sliding bench, locally made hand tools	0,1	90 1 SK	assembly on gravity roller bench electric tools	0,15	100 1 SK
B.5.1 Doors pre-assembly	locally made pre-assembly table hand tools table size: 2400 x 800 mm	0,4	75 1 SK	locally made pre-assembly table electric tools and automatic screwer table size: 2400 x 800 mm	2,0	100 1 SK	locally made pre-assembly table electric tools and automatic screwer table size: 2400 x 800 mm	2,0	100 1 SK
B.5.2 Doors fitting	assembly on sliding bench, locally made hand tools table size: 1600 x 600 mm	0,1	90 1 SK	assembly on sliding bench, locally made hand tools table size: 1600 x 600 mm	0,1	90 1 SK	assembly on gravity roller bench electric tools	0,15	100 1 SK
B.6.2 Shelves and other components to fit in	assembly on sliding bench, locally made, hand tools table size: 1600 x 600 mm	0,1	90 1 SK	assembly on sliding bench, locally made, hand tools table size: 1600 x 600 mm	0,1	90 1 SK	assembly on gravity roller bench electric tools	0,15	100 1 SK
B.7 Checking packing	assembly on sliding bench, locally made, hand tools table size: 1600 x 600 mm	0,1	90 1 SK	assembly on sliding bench, locally made, hand tools table size: 1600 x 600 mm	0,1	90 1 SK	assembly on gravity roller bench electric tools	0,1	100 1 SK
	packaging device	0,2	1 L	packaging device	0,2	1 L	packaging machine	3,8	1 L

By order of decree - Processing agency ... 5 Year Plan ... Germany

24 **Working operations and possibilities of Machinery for different stages of mechanization**

Note: Capacity refers to stage 3 = 100 %
Labour: S = skilled, SK = semi-skilled, L = labourer

Date: Nov 76, Mark

Code	Operations	simple machinery	'000 US $	Cap. %	Labour	middle machinery	'000 US $	Cap. %	Labour	advanced machinery	'000 US $	Cap. %	Labour
9.	**Bed and Component Assembly**												
9.1	Bed and component pre-assembly	locally made pre-assembly table	0,4	75	1 SK	locally made pre-assembly table	2,0	100	1 SK	locally made pre-assembly table	2,0	100	1 SK
		hand tools	0,2	100	1 L	electric tools and automatic screwdriver	0,2	100	1 L	electric tools and automatic screwdriver	0,2	100	1 L
		table size: 2000 x 800				table size: 2000 x 800				table size: 2000 x 800			
		locally made lift rack	0,2	100		locally made lift rack	0,2	100		locally made lift rack	0,2	100	
9.2	Beds and components packaging	manually	0,1	40	1 SK 1 L	manually	0,1	40	1 SK 1 L	packaging machine	3,5	100	1 SK 1 L

By order of [illegible] - Forwarding Agency [illegible] Factory [illegible] Plant Organization [illegible] Ministry

3. ANALYSIS OF SPECIAL FACTORIES

3.1 Analysis of Individual Operations/Processes

3.2 Investment Costs for Installation (approx.) and Auxiliary Operations

3.3 Labour Requirement

3.4 Buildings and Size of Premises

3.5 Total Capital Requirement

31 Analysis of individual operations / processes
for the chosen product programme

Code	operations / processes	I Simple machinery machine plant	No.	investment 1000 DM	labour	II middle machinery[1] machine plant	No.	investment 1000 DM	labour
		DESCRIPTION REFERRING TO CARCASS FURNITURE MANUFACTURING PROGRAMME							
1.	Timber Prep								
1.1	Drying and conditioning	dry kiln a) brick or concrete construction equipment only semi automatic controls capacity 6 cbm dif.	1	4,9	1	dry kiln a) prefabricated all-metal kiln modular construction fully automatic controls and recorders capacity 6 cbm dif.	1	19,0	1
1.2	Cross cutting	overhead cross cut saw locally made infeed and receiving table	1	3,6	1 2	pneumatic undertable cross cut saw with length stops	1	10,0	1 1
1.3.1	Edging Splitting	circular saw bench with sliding table and rip fence	1	3,6	1 1	power feed saw bench	1	5,2	1 1
1.3.2	Strips, ripping	power feed circular saw with saw spindle extended for 2 saw blades	1	5,8	1 1	power feed circular saw with saw spindle extended for 2 saw blades	1	5,8	1 1
1.4	Core laying	locally made core laying device	1 1	0,4 0,4	1 1	semi automatic core layer with string infeed	1	4,0	1 1
1.5	Planing	hand feed planer surface capacity 400 mm	1	2,8	1 1	planer with feeder surface capacity 510 mm	1	3,4	1 1
1.6	Thickness planing	thicknesser capacity 400 mm	1	3,2	1 1	thicknesser capacity 510 mm	1	4,6	1 1
1.7	Four-side moulding	four-side moulder type of construction light 5 spindles N.B.: Not economical for the small quantities involved	1	10,0	1 1	four-side moulder type of construction light 5 spindles	1	10,0	1 1
1.8	Cutting to length	saw bench with sliding table saw cant to 45 degrees	1	4,7	1	a) double cross cut saw capacity 2000 x 2000 mm	1	5,7	1
	Subtotal			39,0	2 7 8	Intermediate over machinery		67,7	3 5 0

3.1	Analysis of individual operations / processes for the chosen product capacity	Note: production capacity as per chapter 1	Date: Nov 74

Code	Operations refer to chapter 2	I Simple machinery — machine - plant	No.	Investment 1000 US$	labour	II middle machinery 1/ — machine - plant	No.	Investment 1000 US$	labour
2	**Board Flow**								
2.1	Panel break down	saw bench extended table equipped with ta casters	2	3,4 3,4	1 2 3	automatic panel cutting saw, light type of construction	1	26,0	1 1 2
2.2	Edge lipping and trimming	gluing stand hand-hydraulic operated and electric heating bar	2 2	2,4 2,4 0,4 0,4	2 2 2	pneumatic jig table with low voltage heating attachment	1 1	3,6 2,5	1 1 1 1
2.3	Calibrating	combined drum and thickness sander two rollers capacity : 900 mm N.B. Necessary because of hint flat board tolerances.	1	12,1	1 1	wide belt sanding machine with pre-sanding and finish sanding equipment adjustable degree of hardness capacity : 1100 mm	1	29,6	1 1
2.4.1	Glue application	glue spreading machine with apportioning device and two rollers capacity : 1300 mm	1	2,8	1	automatic feeding unit brush and dust-removal machine glue spreading machine with doctor rollers a) capacity 2500 mm	1 1 1 1	2,4 8,0 12,0 3,2	
2.4.2	Laying	locally made laying table face veneer and inner veneer are provided on locally made rack type trolleys	1	0,6	1 1	locally made laying table face veneer and inner veneer are provided on locally made rack type trolleys	1	0,6	1 1
2.4.3	Press	hydraulic 6 opening hot hot aluminium platen prope steam or hot water heated with locally made loading and unloading cage	1	20,0	1	single opening press throughfeed short cycle principle and automatic unloader b) cap. 2500 x 1000 mm	1 1	40,2 3,0	1
2.5.1	Cutting width	double cross cut saw saw unit to 45 degrees with scoring saw cap. 2500 x 2500 mm	2	6,4 6,4	2 2	double end tenoner with scoring saw hogging saw spindle cutting length 1000 mm	1	35,0	1 2
2.5.2	Rebating grooving	vertical spindle moulder	1	3,0	1				

1/ Intermediate level machinery

3.1	Analysis of individual operations / processes for the chosen production capacity	Note production capacity as per chapter 1	Date Nov 76 Rev.

code	operations refers to chapter 3.1	I Simple machinery machine - plant	No.	investment '000 US$	labour	II middle machinery 1/ machine - plant	No.	investment '000 US$	labour
2.6.1	Edge banding and trimming	locally made pneumatic jig table with low voltage heating attachment continuous method and portable router	2	3,6 3,6	2	double sided edge banding machine with end trimming, edge trimming and edge sanding unit	1	24,0	1
2.6.2	Edge sanding	single sided edge belt sanding machine, continuous method	1	10,6	1				
2.7	to Cutting/length	double cross cut saw saw cant to 45 degree with scoring saw cap .2500 x 2500 mm				double end tenoner with scoring saw dagging saw spindle cutting length 1800 mm			
2.8	Edge banding and trimming	locally made pneumatic jig table with low voltage heating attachment continuous method and portable router				double sided edge banding machine with end trimming, edge trimming and edge sanding unit			
2.10	Drilling of construction and fitting holes	heavy construction dowel hole boring machine, unit adjustable vertically and horizontally	2	6,8 6,8	2	automatic dowel machine continuous method 2 horizontal units 4 vertical units capacity length=2500 mm	1	36,0	1
2.11	Dowel driving	Hand machines for gluing and driving dowels	2	2,1 2,1	2	Hand machines for gluing and driving dowels	2	2,1 2,1	2
2.12	Sanding face	open belt sander table size : 2500 x 600 mm	3	3,8 3,8 3,8	3	wide belt sander with pressure cushion and roller Right construction working width 900 mm and open belt sander for high Quality finish	1 1	24,0 3,0	1 1

1/ Intermediate level machinery

3.1	Analysis of individual operations / processes for the chosen production capacity	Note production capacity as per chapter 1	Date Nov 76

code	operations refers to chapter 2.1	I Simple machinery machine plant	No.	investment '000 US$	labour skilled	labour semi-skilled	labour unskilled	II middle machinery 1/ machine - plant	No.	investment '000 US$	labour skilled	labour semi-skilled	labour unskilled
2.13	Sanding inside	open belt sander table size : 2500 x 800 mm						wide belt sander with pressure cushion and roller light construction working width 980 mm					
2.14	Checking	work bench			1		1	work bench			1		1
2.	Subtotal			188,3	5	22	15			288,3	8	16	9

1/ Intermediate level machinery

3.1	Analysis of individual operations / processes for the chosen production capacity	Note production capacity as per chapter 1	Date Nov 76 m/a

code	operations refers to chapter 3.1	I Simple machinery machine - plant	No of	investment '000 US$	labour skilled	labour semi-skilled	labour unskilled	II middle machinery 1 machine - plant	No of	investment '000 US$	labour skilled	labour semi-skilled	labour unskilled
3.	Veneer Flow												
3.1	Selection Grading	locally made table and rack-type trolley	1	0,6	2	1		locally made table and rack-type trolley	1	0,5	2	1	
3.2	Cross cutting	locally made overhead cross cut saw	1	1,5		2		veneer circular saw cutting length 3160 mm hand feeding	1	2,2		1	1
3.3	Jo nt guillotine	veneer circular jointing saw cutting length 3160 mm hand feeding	2	2,2 2,2		2	1	veneer clipper cutting length 3160 mm with double cutting device	2	8,5 8,5		2	
2.4	Veneer splicing	veneer splicing machine table mounted outreach 700 mm	2	1,2 1,2 1,2		2	1	veneer splicing machine zig-zag method outreach 1150 mm	2	6,8 6,8		2	
3.5	Checking	locally made check table illuminated	2	0,6 0,6 0,6		2		locally made check table illuminated	2	0,6 0,6		2	
3.	Subtotal			11,8	2	11	2			34,5	2	8	1

1 Intermediate level machinery

3.1	Analysis of individual operations / processes for the chosen production capacity	Note production capacity as per chapter 1	Date Nov 76 Rev.

code	operations (refers to chapter 2)	I Simple machinery — machine - plant	No.	investment '000 US$	labour	II middle machinery 1/ — machine - plant	No.	investment '000 US$	labour
4.	Secondary	Flow							
4.1	Cutting width splitting	circular saw bench with rip fence cutting size max.800 mm	1	3,4	1 1	power feed circular saw bench with rip fence cutting size max. 900 mm	1	4,8	1 1
4.2	Rebating grooving profiling	vertical spindle moulder	1	3,0	1 1	vertical spindle moulder with infeed unit	1	3,6	1 1
4.3	Drilling of construction and fitting holes	locally made drilling device	2	0,5 0,5	2	dowel hole boring machine, vertical and horizontal adjustable unit	1	4,4	1
4.4	Mortising inserting locks	a) mountable locks are recommended b) otherwise hand operated machine	2	0,3 0,3	2	simple lock mortising machine for furniture locks	1	2,8	1
4,5	Sub assembly	glueing jig table hand operated	1	0,6	2	pneumatic jig table locally made, additional pressing units	1	1,8	1
4.6	Edge winding	glueing jig table hand operated	2	0,2 0,2	2	pneumatic jig table local made, additional pressing units	1	4,8	1
4.	Subtotal			9,8	10 2			30,6	6 2

1/ intermediate level machinery

1) order of ... - consulting agency - ... - ... - ... - ...

3.1 Analysis of individual operations / processes for the chosen production capacity

Note: production capacity as per chapter 1

Date: Nov. 74

Code	operations (refers to chapter 2.1)	I Simple machinery — machine plant	No.	Investment '000 US$	Labour: a	b	c	II middle machinery [1] — machine plant	No.	Investment '000 US$	Labour: a	b	c
	Surface Treatment												
6.1.1	Small parts spraying base coat and finish coat	water curtain spray wall with turning table working width 2500 mm	1	6,4		1	1	water curtain spray wall with turning table working width 2500 mm	1	6,4		1	1
	intermediate sanding	locally made work bench portable hand sander	2	0,3 0,3		2		locally made work bench portable hand sander	2	0,3 0,3		2	
6.1.2	Edge spraying base coat and finish coat	water curtain spray wall with turning table working width 2500 mm						water curtain spray wall with turning table working width 2500 mm					
	intermediate sanding	hand sanding						locally made work bench and portable hand sander					
6.2	optional staining drying	manually with sponge and brush drying at ambient temperature	2	0,1 0,1		2	2	roller staining machine with dispersing brush working width 1400 mm drying in air-conditioned room	1	8,0	1		1
6.3	Dedusting	manually with brush and exhaust fan	3	0,1			3	brushing machine	1	5,2	1	1	
6.4	Pre-heating	ambient temperature						pre-heating tunnel steam heated with recirculating air	1	16,6			
6.5	Base coat roller coating	lacquer roller coating machine roller length 1400 mm simple type of construction	1	6,0		1	1	lacquer roller coating machine heavy type of construction roller length 1400 mm	1	16,0			
6.6	Drying	lacquer drying in rack-type trolleys drying in air-conditioned room	10	6,0			1	lacquer drying tunnel (flat conveyor) width 1400 mm vapour extraction zone drying zone cooling zone	1	18,0			
6.7	Dustpicking	intermediate lacquer coating machine with sanding and dedusting roller or oscillating unit working width 1400 mm	1	12,8	1	1		intermediate lacquer coating machine with sanding and dedusting roller or oscillating unit working width 1400 mm	1	12,8			

[1] Intermediate level technology

a) degree of mechanization - b) conveying equipment - c) workers/shift - d) year manufacture - e) remarks

31	Analysis of individual operations / processes for the chosen production capacity	Note production capacity as per chapter 1	Date Nov % Nov 4

Code	operations (refers to chapter 7)	I Simple machinery machine - plant	No.	investment '000 US$	labour	II middle machinery 1/ machine - plant	No.	investment '000 US$	labour
6.8	Flood coat (flow coater)	lacquer curtain coating machine one head	1	10,0	1	lacquer curtain coating machine double head working width 1300 mm	1	12,0	1 2
6.9	Drying	a) lacquer drying in rack-type trolleys drying in air-conditioned room b) floor chain conveyor for rack type trolleys drying in tunnel with vapour extraction zone drying zone cooling zone	10	6,0	1	floor chain conveyor for rack-type trolleys drying in tunnel with vapour extraction zone drying zone cooling zone destacking	1	20,0	
6.	subtotal			40,1	1 0 9			117,4	2 3 4

1/ Intermediate level machinery

31 **Analysis of individual operations / processes** for the chosen production capacity

Note production capacity as per chapter 1

Date Nov 76 Rev.4

Code	Operations (refers to chapter 2.1)	I Simple machinery — machine - plant	No.	Investment '000 US$	labour: skilled	semi-skilled	unskilled	II middle machinery 1/ — machine - plant	No.	Investment '000 US$	labour: skilled	semi-skilled	unskilled
7.	**Small Carcass Assembly**												
7.1 7.2	Pre-assembly carcass components sides, bottoms, base, frames	locally made pre-assembly table and hand tools table size 2000 x 600 mm locally made lift rack	2	0,3 0,3 0,2 0,2		2	1	locally made pre-assembly table with electric tools and automatic screwdriver table size 2000 x 600 mm locally made lift rack	2	2,0 2,0		2	
7.3	Glue application carcass assembly press	locally made simple pneumatic carcass press, manually adjustable two pressing possibilities glue application manually size (2 x 1400) x 600 mm	1	4,0		1	1	pneumatic carcass press mechanized, adjustable, glue application with glue gun size 2000 x 600 mm	1	6,0 0,5		1	1
7.4.1	Drawers pre-assembly	locally made drawer-gluing device pre-assembly table hand tools table size 1400 x 600 mm	2	0,2 0,2 0,3 0,3		2		pneumatic gluing press pre-assembly table and electric tools table size 1400 x 600 mm	1	1,5 0,0		1	
7.4.2	Drawers fitting	assembly on sliding bench locally made hand tools length of sliding bench 15 m	1	1,5 0,2		1		assembly on sliding bench length of sliding bench 15 m electric tools	1	1,5 0,0			
7.5.1	Doors pre-assembly	locally made pre-assembly table hand tools table size 2000 x 600 mm locally made lift rack	2	0,3 0,2 0,2 0,2		2	1	locally made pre-assembly table electric tools and automatic screwer locally made lift rack	2	2,0 2,0		2	
7.5.2	Fitting doors	assembly on sliding bench locally made hand tools	1	0,2		1		assembly on sliding bench locally made electric tools	1	0,7		1	
7.6.2	Shelves and other components to be i	assembly on sliding bench locally made hand tools	1	0,2		1		assembly on sliding bench locally made electric tools	1	0,7		1	
7.7	Checking packing	assembly on sliding bench locally made hand tools	1	0,2	1	1		assembly on sliding bench locally made electric tools	1	0,7	1	1	
7	Subtotal			9,3	1	11	3			21,2	1	10	1

1/ Intermediate level machinery

by state of build - [illegible] capacity [illegible] 2 shift working 3 [illegible]

31 Analysis of individual operations / processes

Note: production capacity as per chapter 1

Date: Nov 76 Rev

Code	operations (see chapter IV)	I Simple machinery: machine / plant	No.	Investment ('000 DM)	labour	II middle machinery 1/: machine / plant	No.	Investment ('000 DM)	labour
3	**Big Carcass Assembly**								
3.1	[illegible]	locally made pre-assembly table	2	0,4 0,4	2 1	locally made pre-assembly table	2	2,0 2,0	2
3.2	carcass components: sides, bottoms, middle sides, shelves	hand tools table size: 2400 x 800 mm locally made lift rack		0,2 0,2		electric tools and automatic screwdriver table size: 2400 x 800 mm locally made lift rack			
3.3	Carcass assembly	assembly on sliding bench, locally made hand tools length of sliding assembly bench 15 m	1 1	1,5 0,2	1 1	assembly on gravity roller bench electric tools length of gravity roller assembly bench 15 m	1 1	2,2 0,2	1 1
3.41	Drawers pre-assembly	locally made drawer-gluing device pre-assembly table hand tools table size: 1600 x 600 mm	2	0,2 0,2 0,3 0,3	2	pneumatic gluing press pre-assembly table and electric tools table size 1600 x 600 mm	1	1,6 0,8	1
3.42	Drawers fitting	assembly on sliding bench, locally made hand tools	1	0,2	1	assembly on gravity roller bench electric tools	1	0,8	1
3.51	Doors pre-assembly	locally made pre-assembly table hand tools table size: 2400 x 800 mm locally made lift rack	2	0,4 0,4 0,2 0,2	2 1	locally made pre-assembly table electrical tools and automatic screwdriver table size 2400 x 800 mm locally made lift rack	2	2,0 2,0	2
3.52	Doors fitting	assembly on sliding bench, locally made hand tools	1	0,2	1	assembly on gravity roller bench electric tools	1	0,8	1
3.62	Shelfs and other components to fit in	assembly on sliding bench, locally made hand tools	1	0,2	1	assembly on gravity roller bench electric tools	1	0,8	1
3.7	Checking packing	assembly on sliding bench, locally made, hand tools table size 1600 x 600 mm packaging device	1 1	0,2 0,1	1 1 1	assembly on gravity roller bench electric tools packaging device	1 1	0,2 0,2	1 1 1
3.	Subtotal			6,0	1 11 4			10,0	1 10 2

1/ Intermediate level equipment

3.1 Analysis of individual operations / processes

Operations refers to chapter 2.2	I Simple machinery			II middle machinery [1]		
9. Bed and Component Assembly						
9.1 Bed and component pre-assembly	locally made pre-assembly table hand tools table size: 2400 x 800 mm locally made lift rack	1 1	0,4 0,2	1	1	locally made pre-assembly table electric tools and automatic table size 2400 x 900 mm locally made lift rack	1	2,0	1	1
9.2 Beds and components pre-assembly	manually	2	0,1 0,1	1		packaging machine				
9 Subtotal			0,8	2	1			2,0	1	1
Total										

	I Simple machinery				II middle machinery [1]			
1 Subtotal	Timber Flow	39,0	2	7	8	67,7	3	8
2	Board Flow	108,3	5	22	15	260,4	8	10	9
3	Veneer Flow	11,8	2	11	2	34,5	2	8	1
4	Secondary Flow	9,0	-	10	2	20,6	-	7	-
6	Surface Treatment	48,1	1	8	9	117,4	2	5	4
7	Small Carcass Assembly	9,3	1	11	3	21,2	1	10	1
8	Big Carcass Assembly	6,0	1	11	4	18,9	1	10	2
9	Bed and Component Assembly	0,8		2	1	2,0		1	1
Total		232,3	12	82	44	582,6	17	55	28

1 Intermediate level machinery

3.2 Investment Costs for Installations and Auxiliary Operations (approximate

Pos.		Model I DM	Model I US $ 1/	Model II DM	Model II US $
1	means of conveyance and storage equipment (trolleys, gravity roller conveyors, shelves, stacking racks)	110.000,-	43.000,-	190.000,-	75.000,-
2	electrical installations	115.000,-	45.000,-	150.000,-	59.000,-
3	heating installations (excluding room heating, because it is not necessary in subtropical and tropical countries)			60.000,-	23.500,-
4	installation for chip and dust exhaust	35.000,-	14.000,-	50.000,-	20.000,-
5	compressed air installation (excluding compressor plant)	12.000,-	4.800,-	14.000,-	6.500,-
6	equipment for tool maintenance and grinding shop as well as van	50.000,-	20.000,-	60.000,-	23.500,-
7	installation and equipment for commercial and technical administration (office furniture, office machinery, telephone, means of organization and similar)	45.000,-	18.000,-	55.000,-	22.000,-
	Total	367.000,-	144.000,-	581.000,-	229.500,-

1/ based on an exchange rate of 1 US$ = DM 2.53

3.3 Summary of Labour Requirements

according to the stage of mechanization

Pos.		I Simple Machinery S	SK	L	N Intermediate Level Machinery S	SK	L
1	timber processing	2	7	8	3	5	8
2	panel processing	5	22	15	8	10	9
3	veneer processing	2	11	2	2	8	1
4	auxiliary machinery line		10	2		6	2
6	surface treatment	1	8	9	2	5	4
7	incidental screws assembly	1	11	3	1	10	1
8	big screws assembly	1	11	4	1	10	2
9	bed assembly		2	1		1	1
		12	82	44	17	56	28
	subtotal in production		138			100	
	overhead labour and substitute labour		28			20	
	total in production		166			120	

S = skilled, SK = semi skilled, L = labourer

	I Simple Machinery Foreman Chargehand	II Intermediate Level Machinery Foreman Chargehand
timber yard and timber break down	1	1
machining	1	1
veneer dep	1	1
Ancillarymachining line	1	1
component storage	1	1
surface treatment	1	1
assembly	1	1
despatch	1	1
sharpening and maintenance	4	4
factory manager	1	1
production planning and organisation	4	4
administration	10	10
Subtotal	31	31
GRAND TOTAL	197	151

3.4 Buildings (areas and costs) and Size of Premises

Pos.	Buildings (simple construction without heating and special heat insulation)	sqm	Price per Unit US $	Total US $
1	Machine Shop	2.100	100,-	210.000,-
2	Storage Rooms	1.680	75,-	122.000,-
3	Auxiliary Rooms	580	140,-	82.000,-
4	Chip Silo (built in accordance with safety rules)	30	233,-	7.000,-
5	Garages and similar (calculated including levelling and foundation)	130	70,-	9.000,-
	Total for Buildings	4.500		430.000,-
6	+ other costs: planning fees payable to local authorities 15 percent site preparation water and power supply roads and similar			60.000,-
	Total costs excluding premises			490.000,-

Required Size of Premises :

The premises should be on level ground and of such a size that possibility of expansion at least 3 times is assured (for long term planning, approximately 30 years).

Size of premises for possibility of expansion 3 times = 23.000 sqm
Size of premises for possibility of expansion 2 times = 16.000 sqm

3.5 Total Capital Requirement (own or outside capital including working capital)

Pos.		Model I US $	Model II US $
3.1	machinery	222.300,-	342.600,-
3.2	installation and auxiliary equipment	140.000,-	229.500,-
3.4	buildings, premises (estimated)	490.000,- 60.000,-	490.000,- 60.000,-
	working capital :		
	raw material 80.000,-		
	semi-finished goods 150.000,-		
	finished goods and outstanding liabilities 280.000,-	510.000,-	510.000,-
	total capital requirements	1.440.300,-	1.840.000,-
	possible yearly turnover	2,6 million to 3,1 million	3,0 million to 3,6 million

4. SUMMARY OF PROCESS COMBINATIONS

4.1. Possibilities of Different Production Capacities

4.2. Criteria for Selection of Alternative I or Alternative II

4.3. Conclusion

4.1 Possibilities of Different Production Capacities

	capacity turnover Mio US $	investment US $	covered area sqm	labour requirement	total capital US $
1. study I	2,6 - 3,1	930.300	4.500	197	1 440.300
2. study II	3,0 - 3,6	1 330.100	4.500	151	1 840.100
3. capacity double of alternative II	6,0 - 7,2	2 217.500	8.000	275	3 250.000
4. capacity 4 times of alternative II	12,0 - 12,8	3 547.680	20.000	360	5 342.800
5. study II - automated production	6,5 - 7,5	2 950.000	8.000	188	3 700.000

Investments : machinery + installations and equipment + auxiliary operations + buildings + premises

Total capital : investments + circulation capital

4.2. Criteria for Selection of Alternative I or Alternative II

The decision about the size, the investment as well as the labour forces of an industrial undertaking is to be considered from two points of view:

1. Point of View of Economics

There is the demand to create simultaneously with the erection of a factory also work posts, and to produce with a minimum of invested capital and a great number of labourers.

For developing countries factory model I has been chosen from the economic viewpoint due to:

1. the minimization of the invested capital, the equipment of the machines, installations and buildings have been kept in a simple form and
2. the low level of education and the low level of wages of the labourers available is to be taken into account.

2. Point of View of Industrial Management

It has to be guaranteed that the invested funds will be used efficiently for an increase of the productivity to assure the competitive capacity and the profitability of the company.

The amount of funds invested depends on the level of wages of the location where the factory will be erected.

If one compares the total invested funds and the labour forces of factory model I and factory model II

	total invested funds	labour force
factory model I	US$ 1,440,300	197
factory model II	US$ 1,840,100	151

one finds that in model I the invested capital is greater by US$ 400,000; however 46 fewer jobs are created. On the assumption that an application of high quality installations (model II) should amortise within 4 years with an interest payment of capital of 10%, the annual surplus charge of model II would be US$ 110,000.

When choosing model II, the personnel costs must be reduced annually by this amount.

Model II employs 46 persons less than model I.

$$\frac{\text{US\$ 110,000}}{\text{46 labourers}} = \text{US\$ 2,400}$$

One should decide on model I, provided that the annual average cost of a labourer is below US$ 2,400. In case these costs considerably exceed US$ 2,400 per year, model II should be chosen.

CONCLUSION

The example by means of this study shows the comprehensive volume of tasks and jobs for planning a furniture factory.

The first building phase of a new factory is the most expensive because of the important investments which become necessary, e.g.

site development with roads, water and electric supply, drainage, transformer station, boiler house (if necessary) and compressor plant, silo for shavings and dust extraction, administration and welfare rooms.

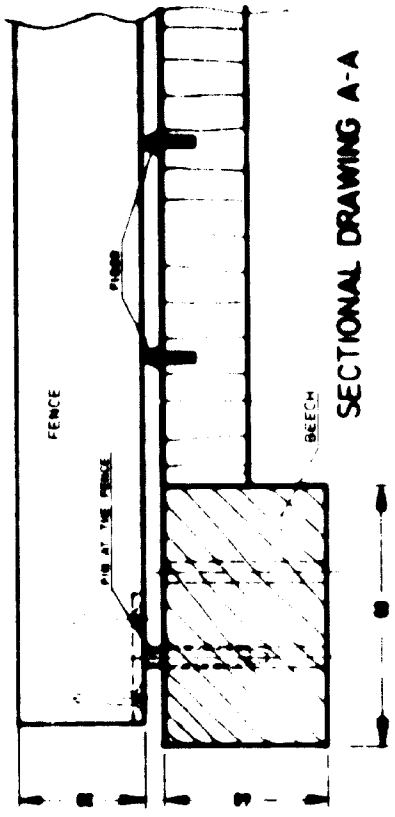
Those investments form the basis for all further factory and capacity extensions. The first building phase should be chosen so that an organic development and extension will be possible at any time. Firms specialized in industrial planning have comprehensive know-how for this.

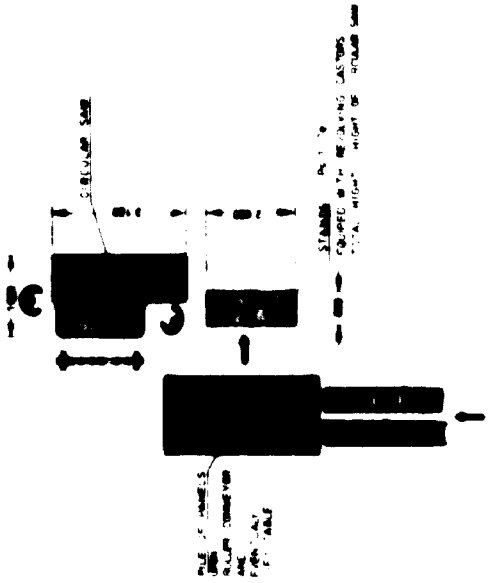
Important studies must be carried out before planning a factory, e.g.

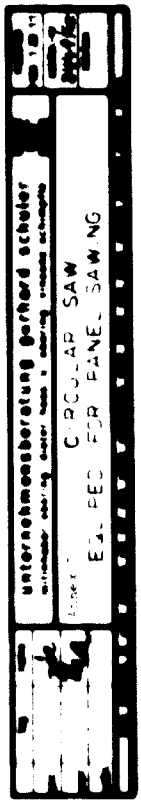
- market surveys
- analysis of choice of site
- analysis of industrial structure

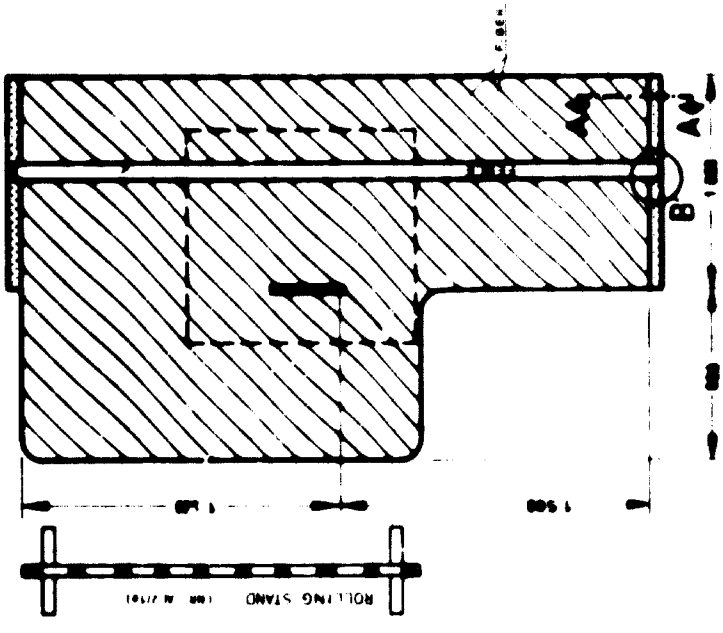
To this belong details like location of the site to main traffic, raw material sources sales markets, provision of labour force and training of employees, etc.

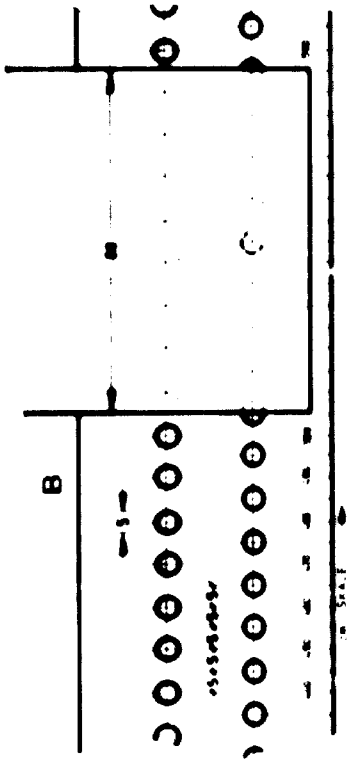
For these jobs, as well as product planning and the corresponding process techniques, layout planning, installation plans (electric, compressed air, shaving and dust extraction systems, means of conveyance, etc.), improvement of work posts, instruction of personnel and commissioning of the factory, only specialized consultants should be engaged.

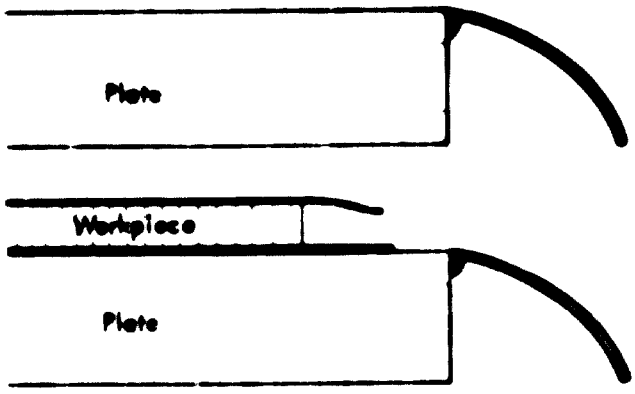

SECTIONAL DRAWING A-A
FENCE
BEECH



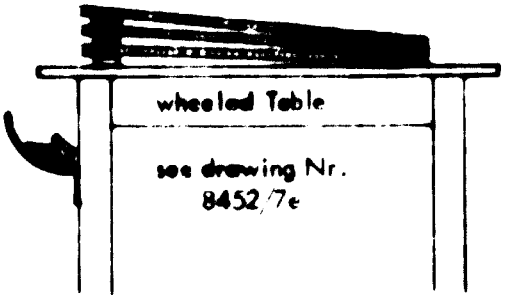

unternehmensberatung gerhard schuler
CIRCULAR SAW
FOR PANEL SAWING


ROLLING STAND


B

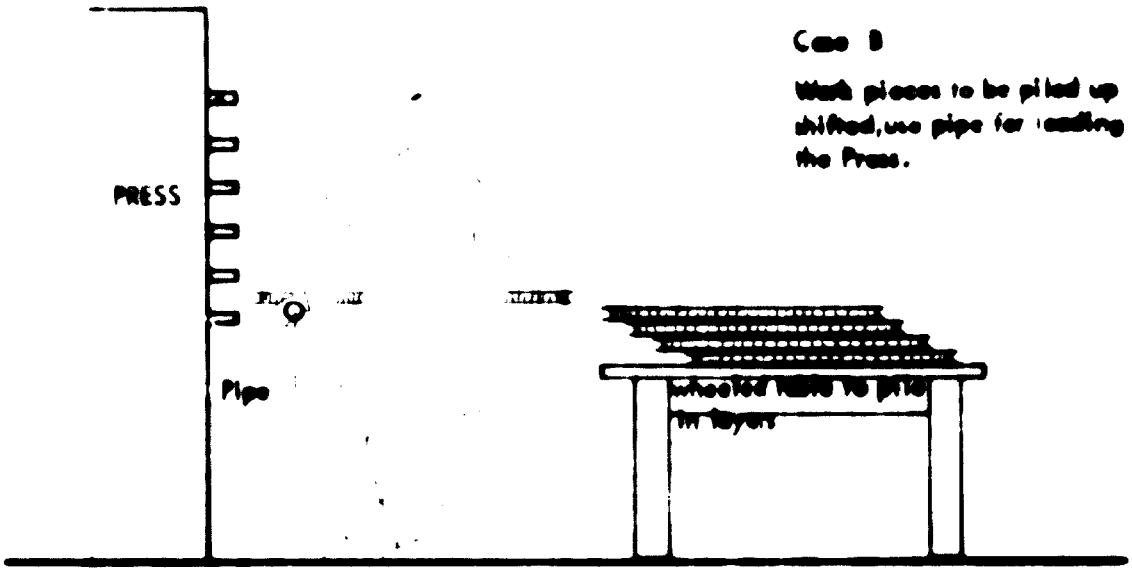


1 Sheet metal welded on to Plates in order to avoid to tear away veneer whilst loading



Case A

Putting distance sticks in between whilst piling,sticks projecting in length and used as handles

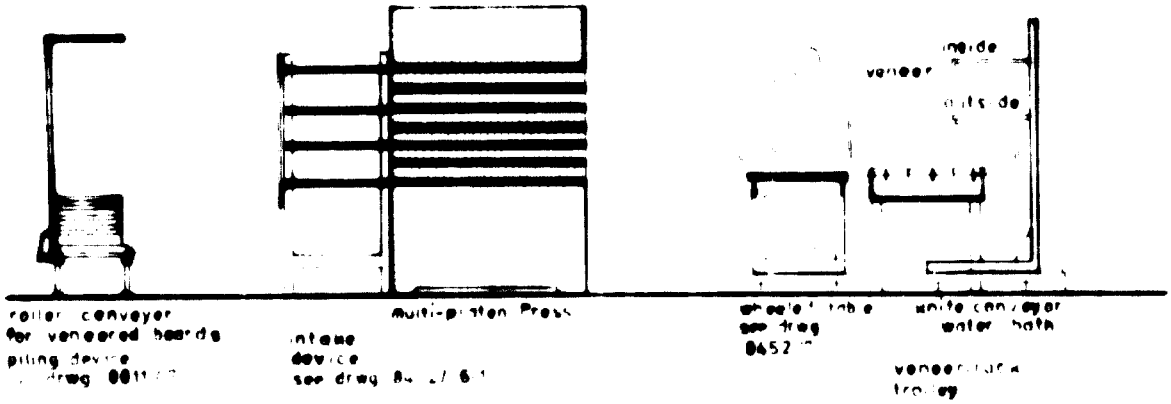


Case B

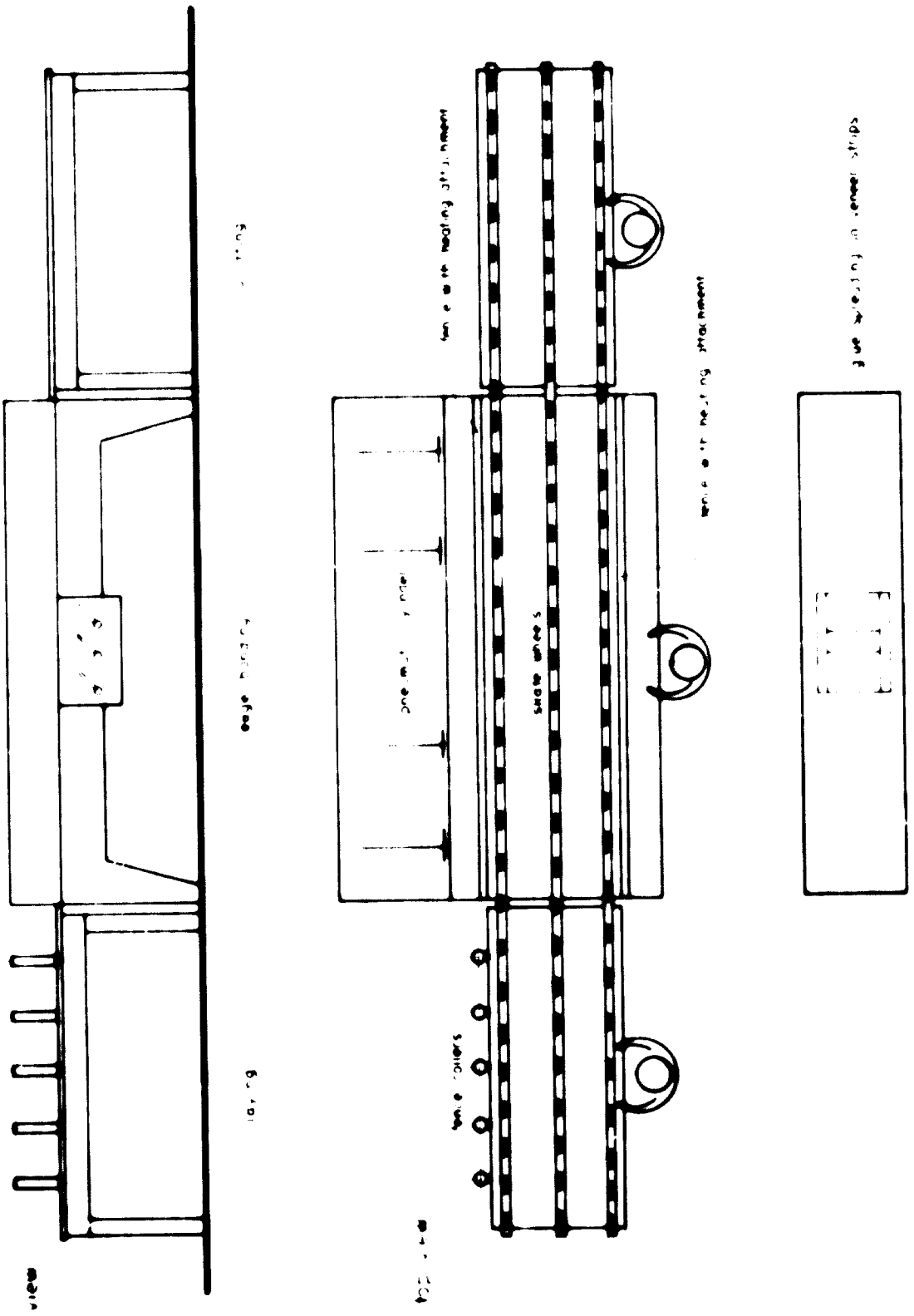
Work pieces to be piled up shifted,use pipe for loading the Press.

tag	name	unternehmensberatung gerhard schuler	
	Mo	mitinhaber: ebering dieter haas u. ebering vinzenz achimpfis	
		Simplification for manually loading of a multi-platen Veneering Press	8452/3
		Annex	6

Elevation



tag name date 13.5.1971 HD page index	unternehmensberatung gerhard schuler mitinhaber obering dieter haas u. obering vinzenz schmatlo **Production flow set-up** Annex 3 at a multi-platform Press	mailbox 50 zeichn. nr 8459/5 zeichnen



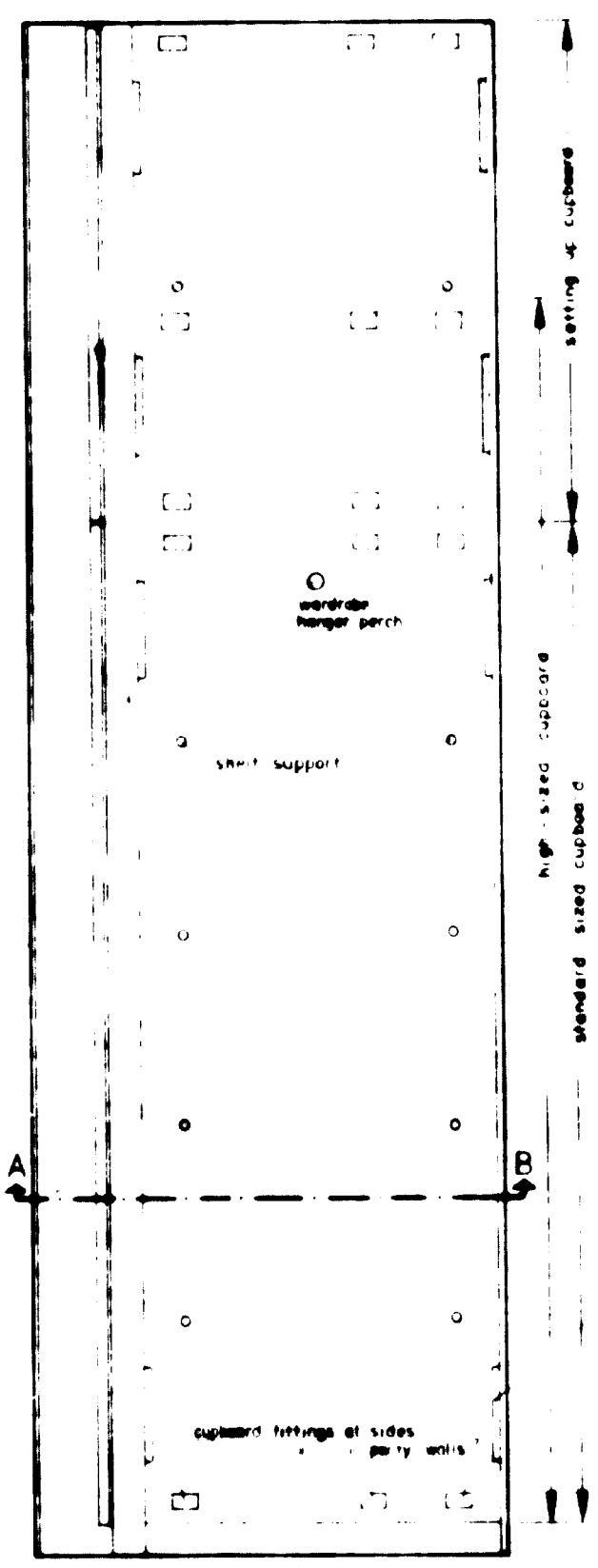
Tag	Name
27.11.74	

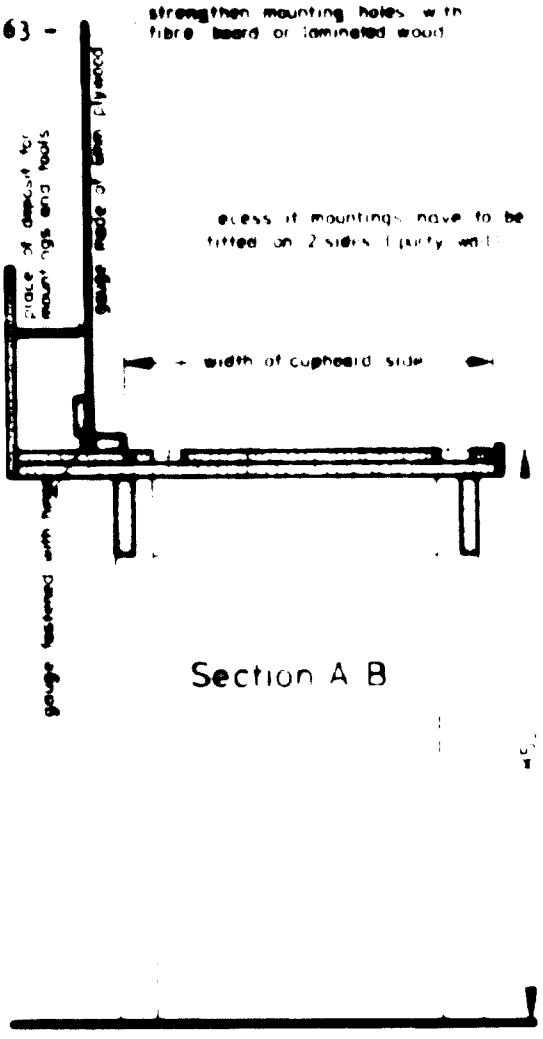
Unternehmensberatung Gerhard Schuler
Inhaber Gerhard Schuler Dieter Haas Vinzenz Schimpfle
8 7293 Pfalzgrafenweiler Tel. (0 74 45) 20 15, 20 16, 20 17 Telex 784 240 ugs d

PNEUMATIC JIG TABLE WITH LOW VOLTAGE HEATING ATTACHMENT - CONTINUOUS METHOD

Anage 4

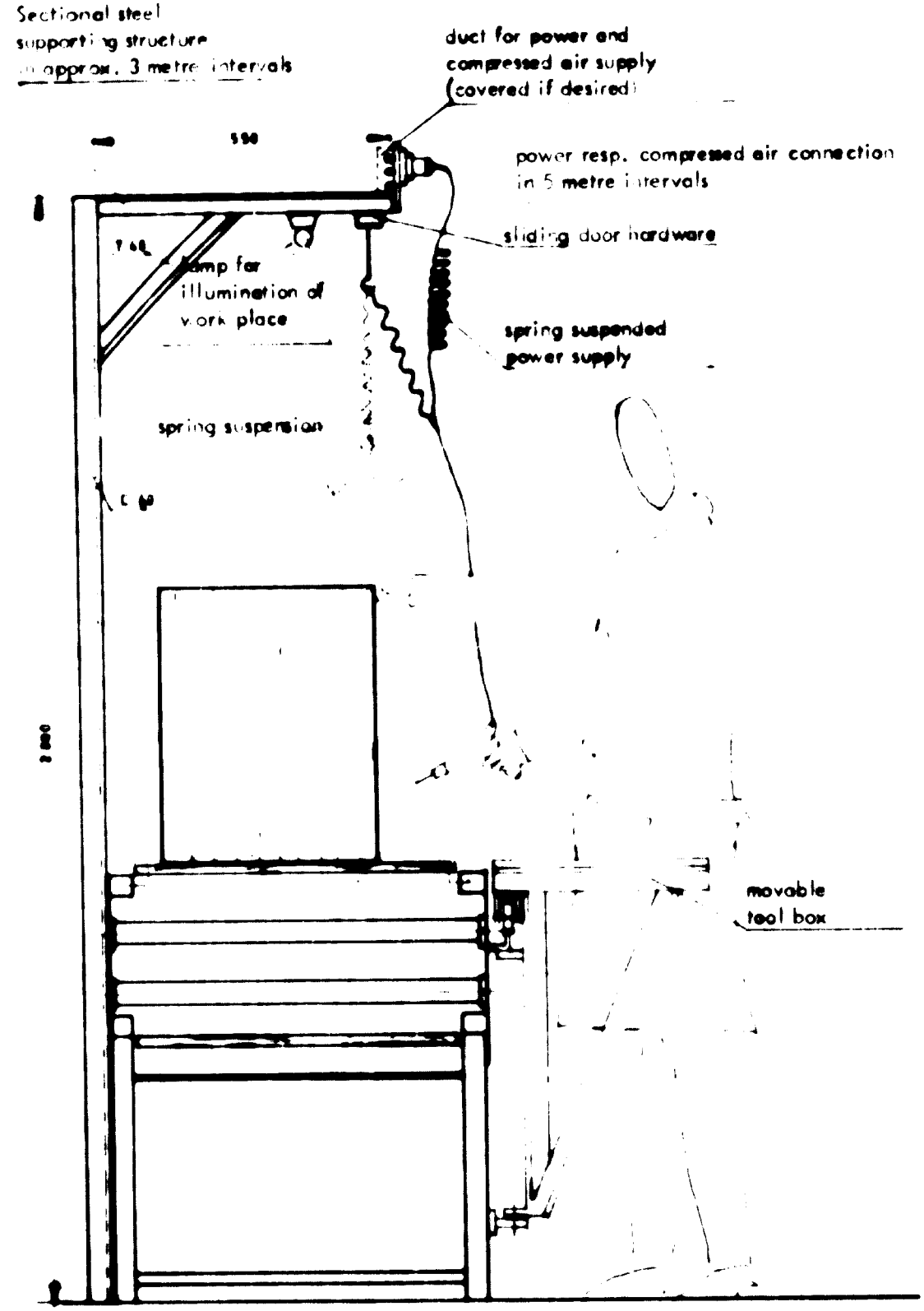
Maßstab 1 : 50
Zeichn.-Nr. 86.56/b
Datum





in case of cupboard party walls fit strips according to thickness of back - wall

		unternehmensberatung gerhard schuler mitinhaber ebering dieter haas u ebering vinzenz schimpfle	
	Annex 5	TABLE FOR THE FITTING OF FURNITURE MOUNTINGS TO CUPBOARD SIDES AND PARTY WALLS	

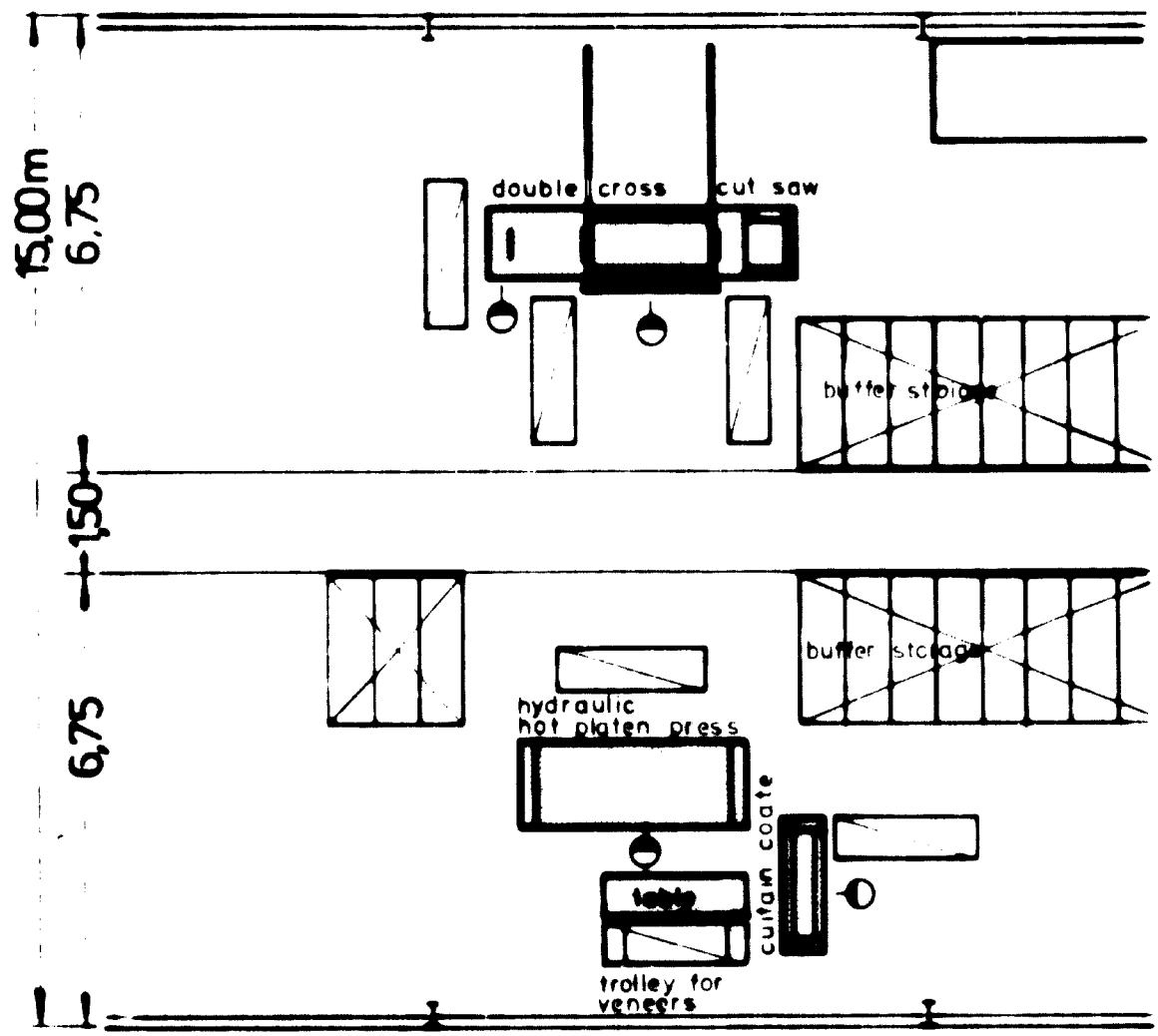


unternehmensberatung gerhard schuler

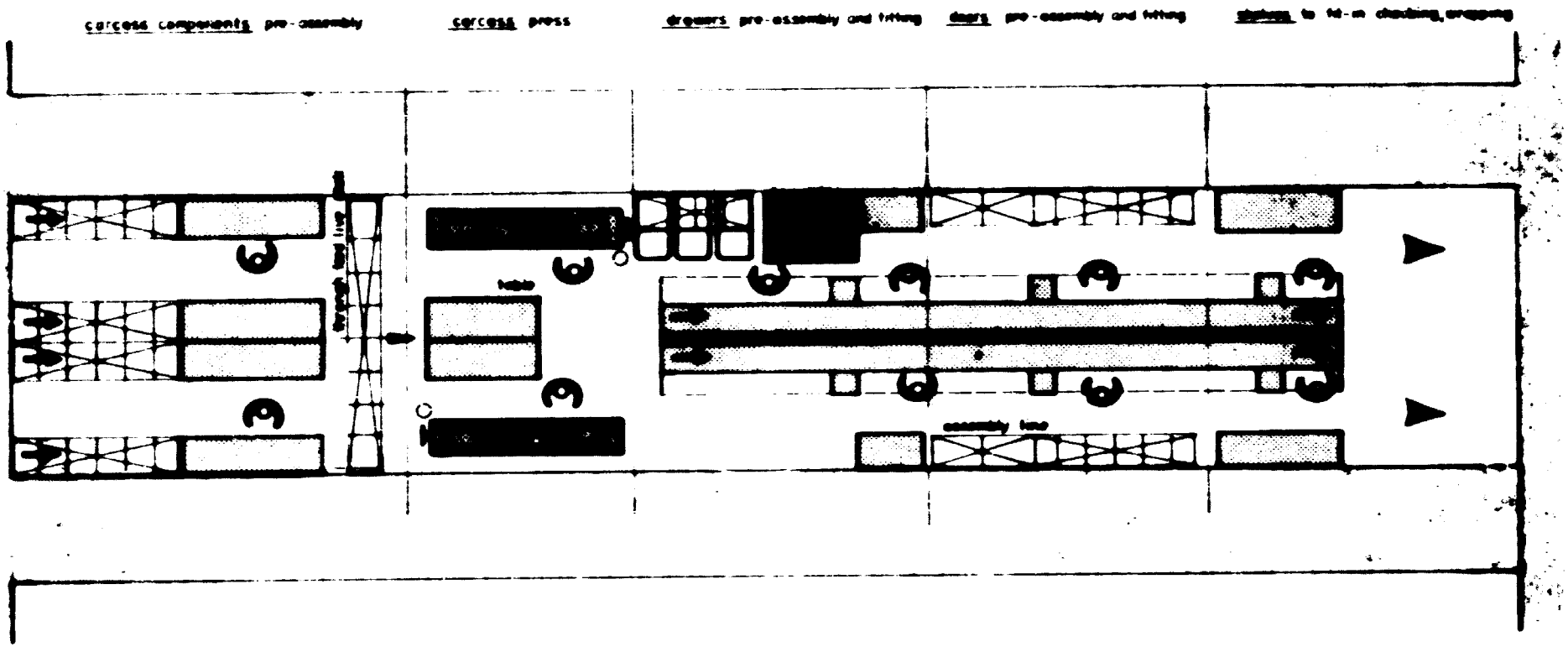
Annex 6

Energy Supply Equipment For Assembly Line

Car



Nov. 76	Unternehmensberatung Gerhard Schuler	scale 1 : 100
	Mounting of double cross cut saw and press	912 / 1



	log	name

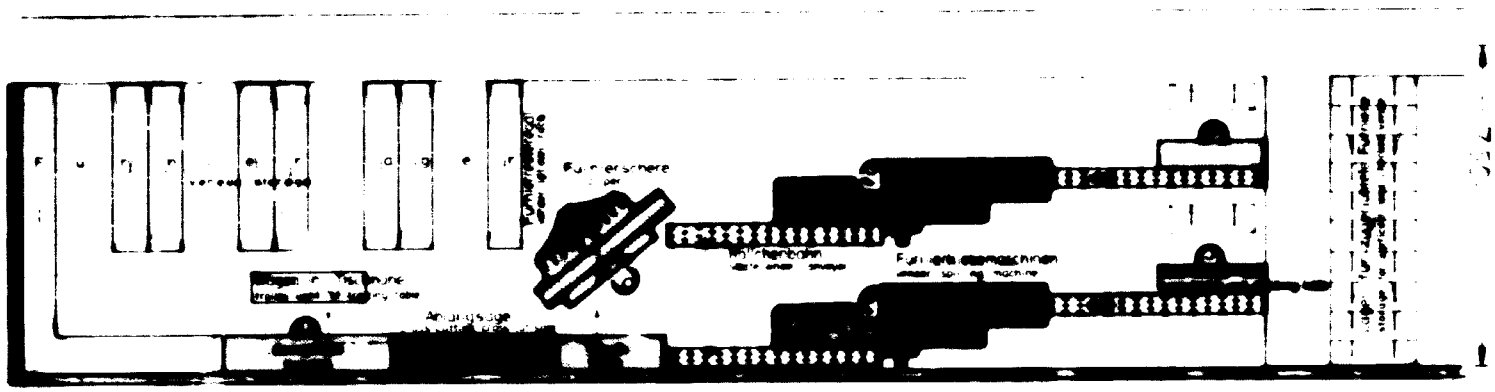
unternehmensberatung gerhard schuler
inhaber obering dieter haas u. obering wiesaw schimpfle

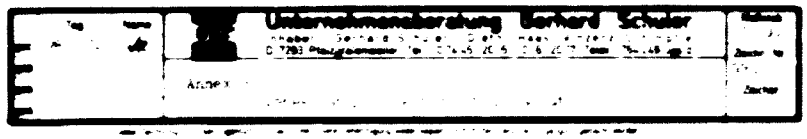
Annex 8

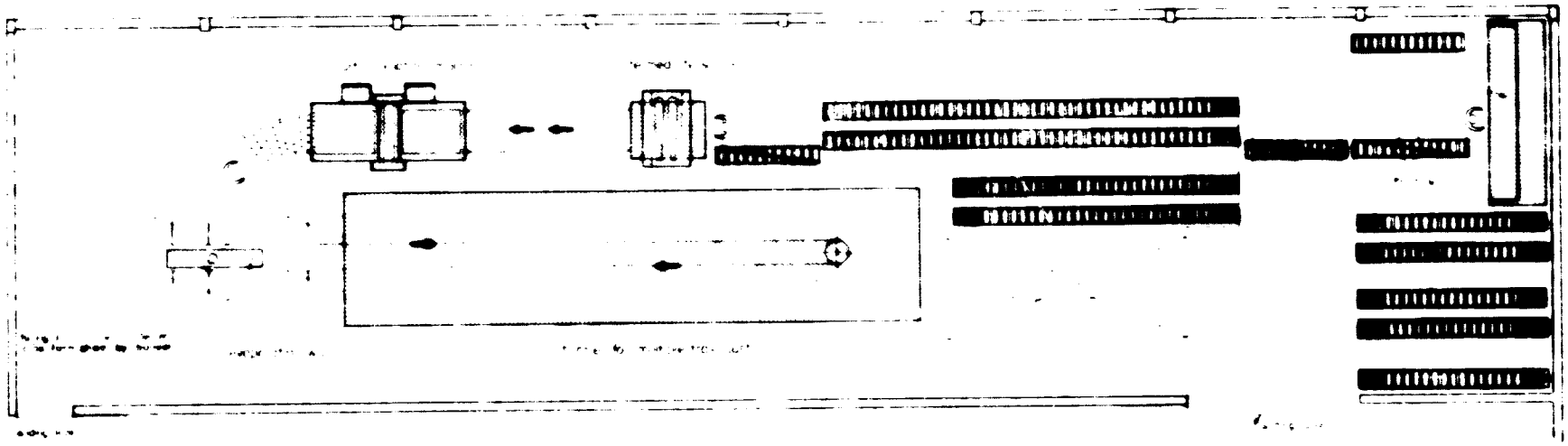
Assembly line with pre-assembly for incidental box-type furniture

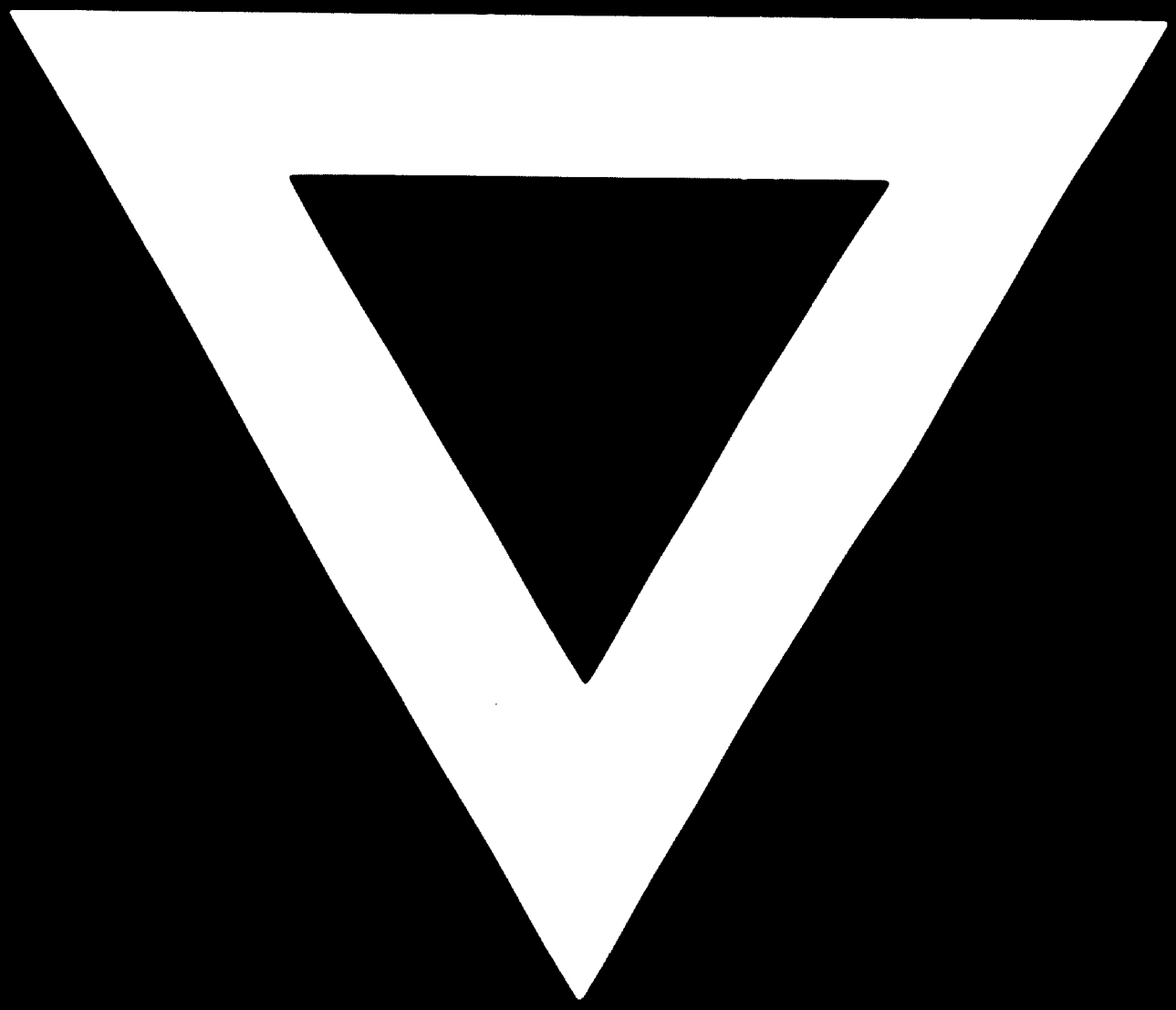
1 : 100

9409/2




Unternehmensberatung Gerhard Schuler





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