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(R) DEVELOPMENT OF THE FURNITURE AND JOINERY INDUSTRIES AND CREATION OF A CENTRE.

DP/YUG/73/006.

YUGOSLAVIA.

Technical report: Assistance in industrial engineering.

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

Based on the work of Desmond P. Cody, expert in industrial engineering

United Nations Industrial Development Organization
Vienna

id.78-5825

Explanatory notes

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

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

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

The monetary unit in Yugoslavia is the dinar (Din). During the period covered by the report, the value of the dinar in relation to the United States dollar was $1 = 18.46.

The following abbreviations and symbols are used in this report:

BiH	Bosnia and Herzegovina
IRC	Istraživački Razvojni Centar (Research and Development Centre)
JUS	Yugoslav standard
N	newton
OOUR	Osnovna Organizacija Udruženog Rada (Basic Associated Labour Organization)
PVC	polyvinyl chloride
RO	Radna Organizacija (Working Organization)
SWG	Standard Wire Gauge

ABSTRACT

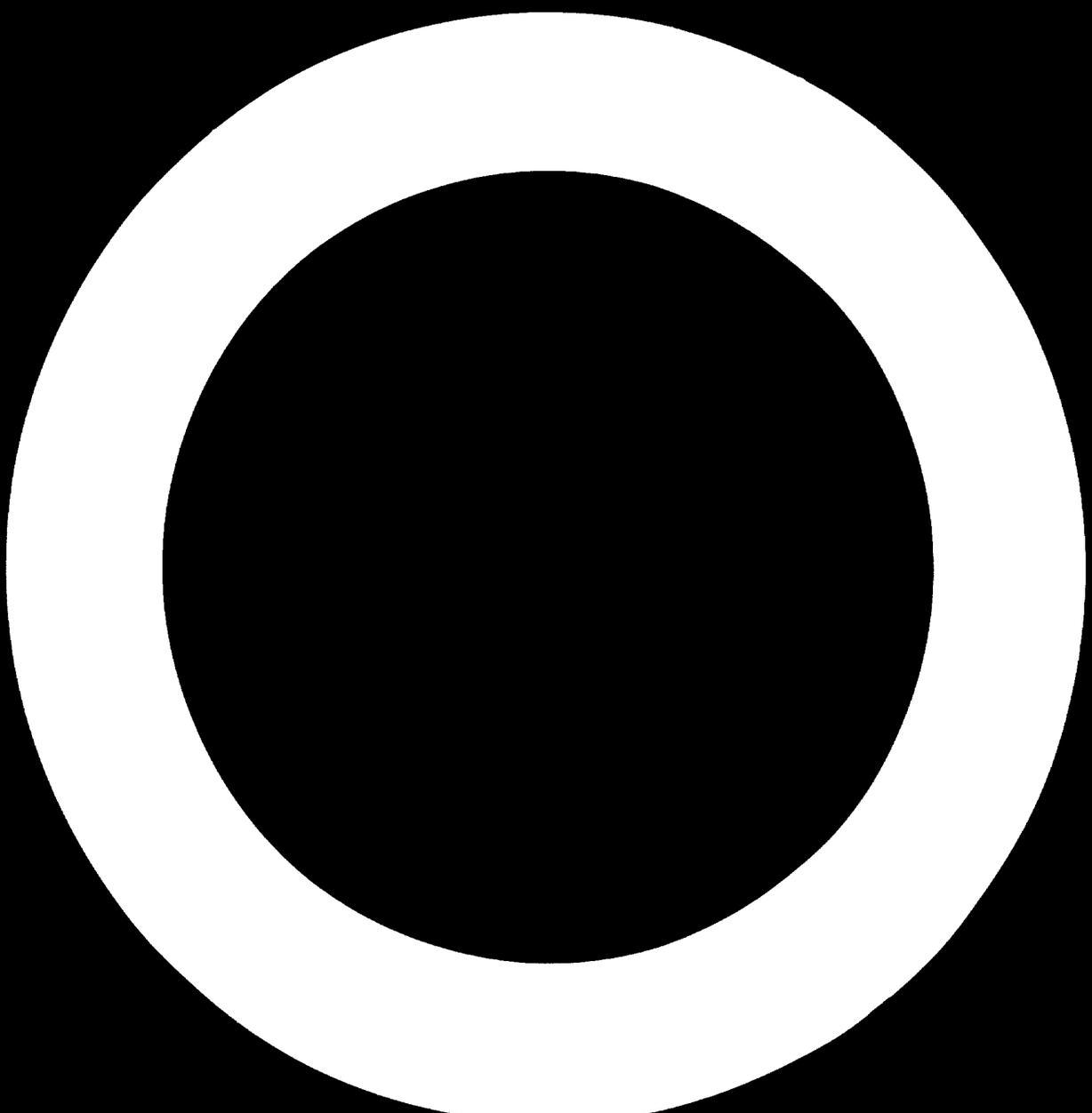
The mission covered by this report formed part of a larger project entitled "Development of the furniture and joinery industries and creation of a centre" (DP/YUG/73/006), which was requested by the Government of Yugoslavia in December 1973 and approved by the United Nations Development Programme in August 1974, with the United Nations Industrial Development Organization (UNIDO) designated as executing agency and ŠIPAD, a co-operative forestry organization, as government co-operating agency. The mission was carried out from 27 February to 11 June 1978.

During his mission the expert assisted in the implementation of various aspects of the recommendations made in his previous technical reports,[1/] particular attention being devoted to two working organizations, namely RO Majevica, Brčko, and RO Vrbas, although his findings and recommendations may be applied, as appropriate, to other RO, in order to achieve a more closely integrated system of product design, production and marketing.

One of the main conclusions of the report is that a full understanding and appreciation of design and production rationalization at working organization level has not yet been achieved, and that this aspect of development requires greater attention and support from the service and consultancy sectors of ŠIPAD.

The report contains a number of specific recommendations relating to factory reorganization, design management, quality standards and industrial training, all of which are framed to meet the basic need of a more integrated, coherent and streamlined approach to industry policy in the areas concerned.

1/ DP/ID/SER.A/106 and DP/ID/SER.A/120.



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INTRODUCTION

The mission covered by this report was part of a larger project entitled "Development of the furniture and joinery industries and creation of a centre" (DP/YUG/73/006), which arose from a request submitted by the Government of Yugoslavia in December 1973 and approved by the United Nations Development Programme in August 1974. The United Nations Industrial Development Organization (UNIDO) was designated as executing agency and ŠIPAD, a co-operative forestry industry organization comprising 126 factories, employing 55,000 persons and accounting for 65% of the saw-milling and 85% of the final products of the wood industries of the Republic of Bosnia and Herzegovina (BiH), as government co-operating agency. The project was initiated in September 1974, with a budget involving a contribution of $585,825 by UNDP, and of Din 19,247,900 by the Government of Yugoslavia. This report is the result of a mission carried out from 27 February to 11 June 1978 within the framework of the larger project.

The long-range objectives of the project are to enable the furniture and joinery industries in BiH initially, and in all of Yugoslavia eventually, to make a greater contribution to the economy. Immediate objectives are to help the industries to increase the value of their products, to improve quality, to reduce production costs, to design new products and to forecast market requirements.

The furniture and joinery industries in BiH contribute about 8% of the goods and services produced in that Republic and represent 4% of its exports. An ambitious five-year development plan is being implemented to double the production of furniture to attain a value of Din 2,000 million and to increase the work force from 6,000 to 9,000 persons. This plan calls for an investment of Din 800 million. Joinery production will increase from a value of Din 200 million to Din 650 million, and the work force will triple to reach 4,500 persons. Investment of Din 950 million is foreseen for joinery plants.

This report is the third prepared by the expert in industrial engineering assigned to the project. Assistance in industrial engineering is being provided to the RO and the OOUR within the ŠIPAD organization through the RO Research and Development Centre (IRC) and in conjunction with the ŠIPAD Computer Centre. In the case of RO Vrbas, which is independent of ŠIPAD, the expert provided direct assistance.

Basic information concerning the industry as a whole is contained in the first technical report (DP/ID/SER.A/106), which made specific recommendations related to the improvement of the industrial engineering function. The second report (DP/ID/SER.A/120) concentrated on the first stage of implementation of the recommendations, with particular reference to one working organization, namely, RO Majevica - ŠIPAD, and was particularly concerned with integration and rationalization within the RO under the following main headings: products and product design; production; manufacturing facilities; factory organization; productivity; management; standard specification and quality control; research and development; and general inter-OOUR co-operation.

The main purpose of the mission covered by this report was to assist in the detailed implementation of various aspects of the recommendations made in the previous technical reports. Particular attention was devoted to two working organizations, namely ŠIPAD Radna Organizacija Majevica, Brčko, and RO Incel Vrbas, Banja Luka, although the findings and recommendations of the report may be applied, as appropriate, to other ROs, with special reference to a more closely integrated system of product design, production and marketing.

Before the beginning of the mission, the expert was appointed to lead and advise a group of engineers and other management personnel from the furniture industry in BiH on a trip sponsored by the ŠIPAD organization during the period 16-21 January 1978 to the Sixteenth International Furniture Fair in Cologne, Federal Republic of Germany. Annex I contains a summary of the results of the visit.

Towards the end of his mission, the expert, at the request of the National Project Director, held a seminar to review the work carried out during his assignment. The seminar covered the topics dealt with in this report, and was attended by factory directors, production management personnel, designers and technical representatives of the ŠIPAD service agencies concerned with the organization and planning of the factories.

I. PLANT REORGANIZATION AND DEVELOPMENT

The second report on industrial engineering emphasized the areas requiring immediate attention in respect of one working organization, namely ŠIPAD Majevica. These included: new product design; improvement of quality; better management and factory organization; better industrial training; improved productivity and profitability; better marketing and sales; closer factory co-operation based on a common product policy and the sharing of appropriate production facilities; and better new factory planning.

The subsequent work programme concentrated on evolving common design and production programmes, and the current programme was a further development of this, with particular emphasis on the following matters:

(a) Reorganization of the corpus factory of Bosna and the application of the principles of work study in the areas of layout, designing of work stations, materials handling and transport; the introduction of production planning and control documentation; planned maintenance of machinery and equipment;

(b) Reorganization of the upholstery factories of Brčko, Budućnost and 29 Novembar in terms of product design and rationalization, the introduction of more up-to-date upholstery production techniques, the selection of new equipment, the sharing of certain production facilities and the introduction of production documentation;

(c) Implementation of a design programme for RO Vrbas from the preparation of the design brief to the stage when full production commences;

(d) Preparation of a handbook concerned with standard specifications for the production of domestic and contract furniture for use in each enterprise;

(e) Preparation of an outline proposal for the establishment of a scheme for in-factory industrial training for personnel in the ŠIPAD and Vrbas organizations.

This work programme was in line with the expert's recommendations concerning future co-operation with UNIDO, which suggested that particular emphasis should be placed on the following:

(a) Design and implementation of a comprehensive production planning and control system which would be suitable with minor amendments for all factories;

(b) Preparation of detailed standard specifications for the design and production of both domestic and contract furniture;

(c) Introduction of quality control systems at individual factory level;

(d) Provision of advice and assistance in the planning and operating of chair and upholstery factories;

Table 1. Amended proposal for product policy and design rationalization for RO ŠIPAD Majevica

Products	Factory								
	Bosna	Brčko	Budućnost	29 November	Jadrina	Srbobran	Srebrenik	Stolar	Namjestaj
A. Bedrooms with edge-veneered panels								x	
B. Bedrooms with solid edge-lipped panels								x	
C. Styled bedrooms			x						
D. Free-standing sideboards for storage and display							x		
E. Wall units with edge-veneered panels	x						x		
F. Wall units with solid edge-lipped panels	x								
G. Styled wall units			x						
H. Shelving system and room dividers						x			
K. Kitchens									x
P. Partitioning system (plain and with storage)						x			
J. Sleeping couches and armchairs				x					
L. Fully upholstered settees and armchairs a/		x			x				

Table 1 (continued)

Products	Factory								
	Bosna	Brcko	Budućnost	29 November	Jadrina	Srbobran	Srebrenik	Stolar	Namjestaj
M. Show-wood settees and armchairs a/			x		x				
N. Solid wood frames for product M			x		x				
O. Solid wood frames for product L		x	x		x				
R. Upholstered bedheads		x							
S. Painted bedrooms and corpus wall units b/									
T. Nursery and children's furniture							x		
U. Occasional furniture (pull-out beds)							x		
V. Bedrooms with solid elements or panels								x	
W. Living-room corpus with solid elements or panels					x				
Y. Home-office storage units							x		

a/ With loose cushions.

b/ Corpus-painted, foil-covered bedrooms, wall units and shelves for living-rooms (with product D).

Table 2. OOUR profiles: ŠIPAD Majevica

Item	Factory organization and operation			
	Bosna	Brčko	Budućnost	20 Novembar
Products	Corpus	Upholstery	Upholstery	Upholstery and corpus
Main materials	Sheet	Upholstery material	Upholstery material	Upholstery materials solid wood
Annual output (units)	21 134	19 892	57 878	24 837
Stock held - finished goods (value in Din)	8 046 000	4 508 000	15 279 000	2 369 000
Factory area covered (m^3)	7 893	4 630	4 600	3 290
Machinery and equipment	Medium-aged	Old	Old and new	Old
Directors, executives	3	3	5	7
Engineers, supervisors	10	2	3	5
Workers	350	142	498	175
Value of sales in 1977 (Din)	97 781 000	44 443 000	139 250 000	30 690 000
Exports (destination)	Jordan United States	Kuwait	Germany, Federal Republic of Hungary	-
Value of output per worker, per year (Din)	238 977	319 453	296 580	199 177
Annual timber consumption (m^3)	30	2 200	1 938	2 000
Annual board consumption (m^3)	8 068	418	1 193	400
Shifts	2	2	2	2
Development plans	New factory	New factory	New factory	New factory

Table 3. Total board requirements for each OOUR

Material	Thickness of material (mm)	Annual OOUR requirements								Totals	
		Bosna		Srebrenik		Stolar		Namjestaj			
		(m^2)	(m^3)	(m^2)	(m^3)	(m^2)	(m^3)	(m^2)	(m^3)	(m^2)	(m^3)
Particle board	19		644		-		320		-		964
Particle board	18		4 285		2 927		920		-		8 132
Particle board	16		141		3		1 300		6 602		8 046
Particle board	13		211		18		-		898		1 127
Particle board	10		107		-		-		-		107
Blockboard	20		162		50		-		108		320
Ivokal	21		277		-		-		-		277
Ivokal	18		1 395		747		1 600		-		3 742
Ivokal	12		353		257		-		-		610
Plywood	12		18		-		-		7		25
Plywood	10		-		-		-		3		3
Plywood	4		17		67		-		3		87
Fibreboard	4	63 399	253.6	45 330	184.3		-		-	108 729	434.9
Fibreboard	3.2	29 553	94.6		-	97 120	311.3	149 744	430	276 417	885.9
Fibreboard	4	13 102	52.4	21 000	84	22 000	88	-	-	56 102	224.2
Totals			8 010.6 ($29.4\ m^3$/day)		4 337.3 ($15.8\ m^3$/day)		4 539.3 ($16.8\ m^3$/day)		8 101 ($30\ m^3$/day)		24 985 ($92\ m^3$/day)

(e) Assistance in the design and establishment of in-plant training programmes for all levels of personnel;

(f) Training counterparts in management procedures, work study and the organization of production;

(g) Providing further advice and assistance in factory integration and production rationalization.

Table 1 shows the amended version of the expert's recommendations concerning product design and rationalization for RO ŠIPAD Majevica. This differs only marginally from that included in the previous report and had been agreed to by the individual OURs subsequent to the completion of the previous mission. It formed the basis for the work described in the present report. Table 2 contains basic data concerning the new factories.

A. RO Majevica, OOUR Bosna, Brčko

Panel sizing department

A new automatic panel-sizing machine should be installed with sufficient capacity to service the panel requirements of the other corpus factories within ŠIPAD - Majevica. These requirements are summarized in Table 3.

The raw-materials storage requirements are outlined in table 4.

Table 4. Raw materials storage requirements

Material	Thickness of material (mm)	Material requirements		Size of standard materials (m x m)	Number of stacks	Storage space a/ (m^2)
		Per day (m^3)	Three-days stock (3^3)			
Particle board	18	30.0	90	5.5 x 2.3	5	63.0
Particle board	16	30.0	90	5.5 x 2.3	5	63.0
Ivokal	18	14.0	42	1.7 x 2.3	6	24.0
Fibreboard	4	1.5	4.5	2.8 x 2.3	1	6.5
Fibreboard	3.2	3.2	9.7	2.8 x 2.3	2	13.0
Lesomal	4	0.8	2.5	2.8 x 2.3	1	6.5
Other materials required	12.8	12.8	38	5.5 x 2.3	2	25.0
Totals		92.3	276.7			201.0

a/ Storage space = Size of standard materials x No. of stacks.

The machine selected (Teutomatic 150 or similar), which is fully automated and controlled from one location, should conform to the following specifications:

Size:	20.5 m x 5,7 m
Longest panel size:	5500 mm x 2500 mm
Flow speed:	20 m/min
Accuracy:	1 m
Machine capacity:	Scheme D
Working area:	28 m x 10 m = 280 m^2

The following are the requirements for the storage of cut panels:

Average panel size:	1000 x 500 mm = 0.5 m^2
Average panel thickness:	18 mm, so 0.018 m x 0.5 m^2 = 0.009 m^3
Per package of 50 panels:	0.45 m^3

Required Number of packages for a half day's production: $\frac{92\ m^3 \times 1.5}{0.45\ m^3}$ = 138/0.45 = 306 (for full day),

and $\frac{306}{2}$ = 153 (for $\frac{1}{2}$ day)

Storage size: 28 m x 12 m = 336 m^2

Transport should be by forklift truck (type VD 2002-0102 or similar)

One vertical wall saw should be retained for special sizing

Provision in the panel sizing department should also be made for foil lamination to be installed at a later date and for the storage of veneers

Roller conveyor transport should be used throughout this department.

Veneer preparation

The machines in the veneer preparation department should be given a new layout. Provision should also be made for the free flow of materials. Machines which are not in use should be removed in order to provide more space. There should be adequate dry storage for veneers located close to the veneer preparation. Veneers should be transported on pallets or bogeys whose dimensions are suited to those of the veneers. The veneering area should be properly ventilated and

the flooring in this department improved. Veneer glue-jointing machines should have the connecting work tables re-arranged.

Machining department (panel line)

The machining department should always operate in accordance with a system which ensures maximum utilization of machinery and equipment. This means establishing achievable production targets and ensuring that all the required facilities are available to attain them. It also means that all machines should be fully operative when required, including all linking and feeding equipment. There should be a system of planned maintenance in operation which ensures minimum downtime as well as minimum setting-up time. There should be adequate supplies of essential spare parts. The drum sanders and edge-banders should be immediately overhauled. This alone should have the immediate effect of increasing capacity substantially (projected capacity: 18 m/min; current level: 3-6 m/min). Figure I which shows a comparison of machines under actual and optimum conditions.

Production planning and control documentation described elsewhere in this report should continue to be introduced and maintained for all models in the production programme. There should be a system of calibration and dimensional control which is based on tool gauges and other accurate measuring devices (see annex II). Reject and repair rates now alarmingly high, should be reduced substantially as a result of the foregoing measures. Wood-grain imitation PVC foil edge banding should be introduced immediately as an acceptable substitute for natural veneer edge banding. The flooring in this department should be improved, and there should be greater use of roller conveyor transport.

Finishing (surface coating) department

The finishing department is not sufficiently well equipped to deal with either the existing flow of work or an increased flow of work consequent upon the reorganization of the machining department.

The following additional machines and equipment should be acquired immediately: pre-sander before lacquering, second curtain coating machine, additional spray booth for veneer edges and special finishing, spare rollers for the curtain coaters, temperature gauges and viscosity cups. The floors should be in good condition so that the conveyor system may operate smoothly. Heating and ventilation should be improved and there should be a draft-proof curtain at the entrance to the machining department.

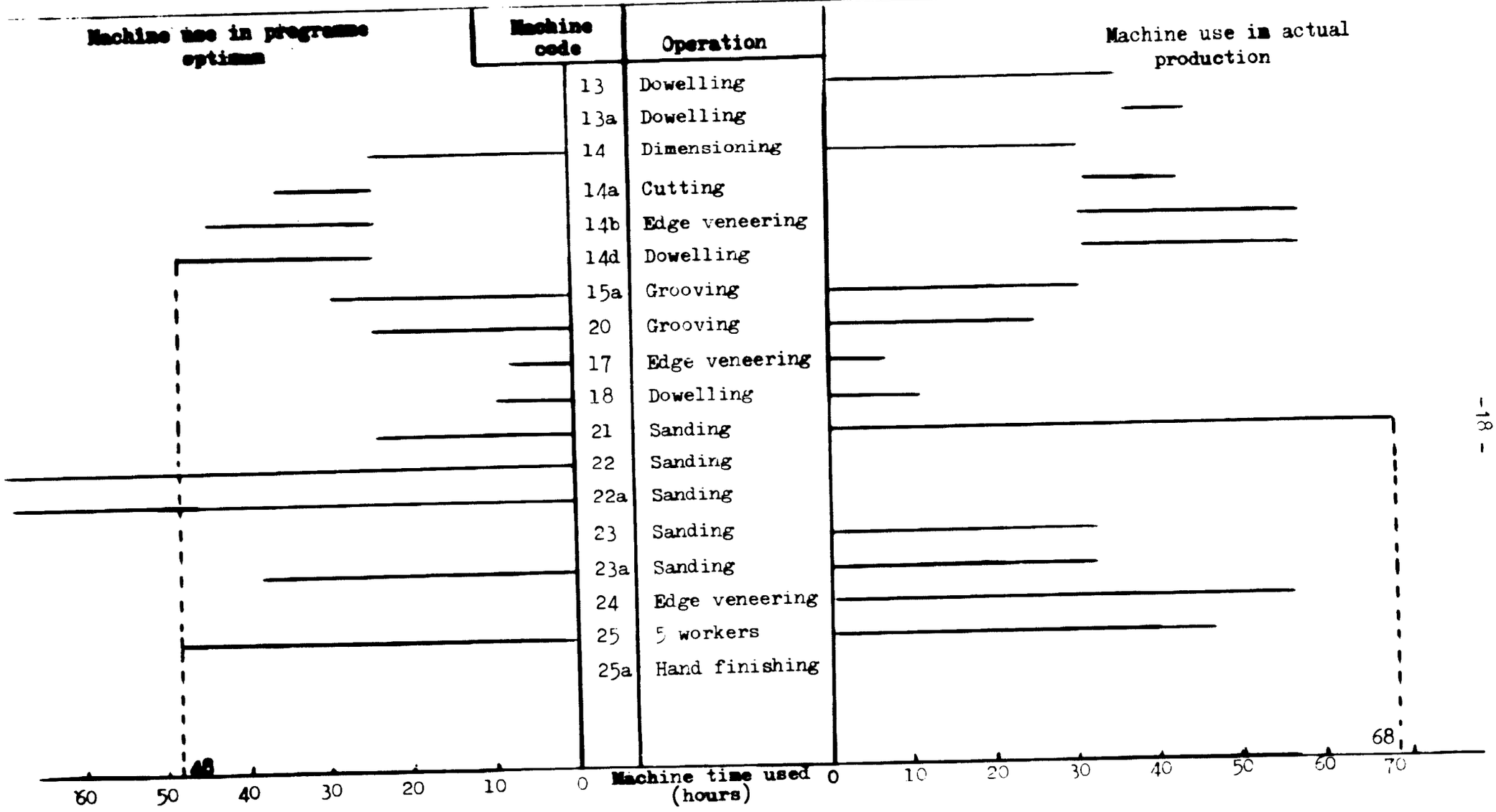


Figure I. Comparison of machine use under actual and optimum conditions

Assembly department

The layout of the assembly department should be revised in accordance with the relevant drawings. There should be special work stations for drawer assembly, small corpus assembly, and assembly and fitting-up of large elements. Assembly benches should be adapted to tne needs of particular assembly arrangements. Each bench should be fully serviced with appropriate electric and pneumatic tools preferably by over-head spring-loaded suspended connectors. All elements and components should be transported on pallets designed to suit individual items. These may be fitted with castors or used in conjunction with a hand-lift pneumatic or hydraulic truck. Matters should be so arranged that assembly operations are fully serviced and work is always readily available.

General

Weekly production targets should be set for each department. There should be weekly meetings between the production director and the supervisor of each department in order to ensure that the work throughout the factory is fully co-ordinated and production targets are achieved. The OOUR director should visit each department in the factory daily. There should be greater product rationalization and more interchangable components. The factory should commission an outside designer and have a suitable drawing studio and a proper prototype workshop. Full use should be made of the documentation for production planning and control. Technical supervisory personnel should be trained in method and time studies. There should be a training workshop for young workers and this should be properly outfitted and have a competent instructor. The factory should immediately adopt the new handbook of standard specifications for furniture.

B. RO Majevica, OOUR Budućnost, Bosanski Šamac

The factory should be given a new layout and re-equipped in accordance with the proposed Budućnost reorganization programme. The "Luna" suite, which includes a three-seater settee, a two-seater settee, an armchair and stool, and the "Romantica" suite, which includes a three-seater settee, a two-seater settee, and an armchair, will be representative of the planned production programme. The projected monthly output of suites is as follows: Luna - 600; Romantica - 900. Present output is 800 suites and 1,700 settees. The total production area includes space for the following operations: inspection, storage, laying and cutting of fabrics - 702 m^2; sewing and cushion make-up - 470 m^2; foam and frame preparation - 400 m^2; storage for fabrics and finished goods - 1060 m^2; dispatch - 860 m^2.

The total list of production machinery and equipment required is given below.

Trolleys for fabric rolls
Inspection table for incoming fabrics
Storage shelving system
Fork-lift (high reach) and shelving apparatus
Fabric-laying and spreading machine
Two fabric conveyors on cutting table
Machine for fine cutting of fabrics
Cross-cutting knife for fabrics
Trolleys for transporting bins containing cut fabrics
Shelving system for cut-fabric bins
Sewing machine
Conveyor for cut fabrics
Quilting machine No. 1
Quilting machine No. 2 (Mammoth)
Quilting machine No. 3 (Matramatic)
Storage and inspection table for patterns
Storage and inspection table for quilting
Foam infill
Cushion fixing
Roller conveyor
Cushion-closing machine
Buttoning machine
Machine for button imitation
Storage for trolleys and conveyors
Button-covering machine
Shelves for foam storage
Work table
Spray booths for adhesives
Tensioning machine for webbing
Frame storage
Shelves for storage of sewn covers
Trolleys for prepared frames
Upholstery assembly benches
Assembly press

Assembly press for gluing
Trolleys
Work benches for assembly
Trolleys for transportation of finished elements
Pneumatic gun for finishing of accessories
Pneumatic drill for accessories
Machine for final cleaning of upholstery

Provision has been made in this plant for the cutting of fabrics for the other upholstery plants in ŠIPAD Majevica. This consists of a line for cutting, sewing and quilting, with a storage area for textiles, a cutting machine and a cutting table.

C. RO Majevica, OOUR Brčko, Brčko

The factory should be given a new layout and re-equipped in accordance with the proposed Brčko reorganization plans (see annex III). The plant will specialize in modern upholstery production based on up-to-date springing systems, sectionalized elements and individual cushioning systems. There is a projected output of 15,000-18,000 suites per year (current output is 8,000 per year). Production would be in two shifts, with 100 workers in each. The plant will have departments for the following operations: sorting and storage of cut fabrics (from OOUR Budućnost); laying and cutting of special fabrics; sewing, quilting and cushion make-up; foam preparation; frame preparation, including springing-up; storage for fabrics and finished goods. Additional production and storage space will be provided.

The total list of machinery and equipment required is given below.

Laying, marking and cutting table
Sewing machines for straight and curved sewing
Special sewing machine for cushions and seams
Sewing machine for zip fasteners
Two quilting machines (Matramatic and Mammuth)
Button-imitation machine
Straight-quilting machine
Foam-cutting machine
Foam-profiling machine
Two button-covering machines
Cushion-filling machine
Cushion-sizing machine

Folding machine for cushions and other upholstered elements
Press for armchair upholstery
Press for armchair assembly
Press for settee assembly
Pneumatic air tackers (BEA and Trudbenik)

Transport arrangements will be similar to those proposed for OOUR Budućnost. Production will be organized on the basis of the Brčko reorganization plan (see annex III), to which the following layout description is keyed.

1.0. Line for cutting, sewing and quilting

1.1. Storage area for textiles
1.2. Cutting machine
1.3. Cutting table
1.4. Trolleys for cut textiles
1.5. Standard sewing machines
1.6. Sewing machine for folds
1.7. Sewing machine for zippers
1.8. Portable bins for cut and sewn textiles
1.9. Table for preparation of quilting
1.10. Mammuth quilting machine
1.11. Storage for quilted textiles
1.12. Machine for imitation of buttons
1.13. Machine for fine quilting
1.14. Trolleys for prepared textiles
1.15. Inspection of prepared textiles

2.0. Line for foam

2.1. Storage of foam
2.2. Machine for cutting of foam
2.3. Storage of cut foam
2.4. Machine for profiling of foam
2.5. Storage of profiled foam
2.6. Machine for cutting and shaping of cardboard profiles
2.7. Storage for cardboard profiles
2.8. Trolleys for foam and cardboard

3.0. Line for frames

3.1. Tables for assembly of frames
3.2. Tables for fixing webbing and sprung units
3.3. Tables for application of glue and for gluing foams
3.4. Press for covering materials
3.5. Table for completion of coverings
3.6. Table for covering of small elements
3.7. Press for couch assembly
3.8. Trolleys for transport of frames

4.0. Line for arms

4.1. Tables for fixing and screwing of cardboard to sides
4.2. Tables for applying glue and putting foam on arms
4.3. Tables for covering of arms
4.4. Trolleys for transport of arms

5.0. Line for cushions

5.1. Machine for button-covering
5.2. Machine for cushion-filling
5.3. Machine for button sewing
5.4. Machine for closing of cushions
5.5. Storage of cushions
5.6. Trolleys for cushions

6.0. Line for armchairs

6.1. Fixing of webbing
6.2. Application of glue and gluing of foam
6.3. Press for covering of armchairs
6.4. Auxiliary machine for covering
6.5. Table for completion of covering
6.6. Trolleys for armchairs
6.7. Press for assembly of armchairs

7.0. Storage area

7.1. Trolleys for transport of finished goods

8.0. Storage area

9.0. Office for supervisor

10.0. Area for manufacturing of samples and prototypes

10.1. Universal sewing machine
10.2. Standard sewing machine
10.3. Table for cutting
10.4. Work bench

11.0. Offices

12.0. Toilet facilities

D. RO Vrbas design programme

The participation of RO Vrbas in the project involved the implementation of a design programme based on the principles of design management as described and illustrated in annex IV.

The programme covered the design and development to the production stage of two ranges of furniture, namely "Rita", a range of interchangable seating suitable for domestic and contract use, and "Programme 78", a range of storage units for bedroom, living-room and kitchen based on total interchangeability of production. The ranges are outlined in the drawings entitled Rita and Programme 78 (see annex IV).

There were two teams involved in the project and each included the designers, marketing personnel and senior technical directors from solid wood and panel production respectively. The timetable for the completion of the programme was as follows:

Activity	Time required (days)
Setting of enterprise objectives	5
Preparation of outline design proposals	3
Preparation of preliminary drawings and sketches	7
Presentation and adoption of design proposals	1
Making of working drawings, details and models	20
Adoption of models for prototyping	10
Production of prototypes	14
Adoption of prototypes	1
Production of trial batch	20
Production planning for pilot series	30

The entire programme was directed and co-ordinated by a designer manager specifically appointed for that purpose. The designs were submitted at various stages to a governing council which acted as final arbiter in respect of the objectives of the programme. This council was made up of senior members of the Vrbas management organization. A profile of the Vrbas organization is given in table 5.

Design No. I - "Programme 78": completely interchangeable system of storage units

Aims of the enterprise

The project is being undertaken to expand the present product range, which is identical with existing competitor ranges, to stimulate sales, which have shown a tendency to stagnate or decrease, to take advantage of improved technical know-how, to raise living standards, and to achieve and maintain a 25% increase in sales throughout the whole year. The main results are expected to be to change and diversify the existing product range, reduce costs, improve productivity and product quality, achieve an 8% profit on sales, and reduce delivery dates. Desirable secondary effects would consist in the establishment of new markets, the creation of elements of home design, and making the range difficult to copy. The criteria for the assessment of success are profitability, high quality, short delivery dates, better productivity and increased sales.

Marketing

The products should be suitable for home and export markets, have a distinctive appearance, reflect characteristics of other models in the range, maintain continuity with the present product range, introduce new design concepts in selected markets, and have appropriate methods of promotion and distribution.

Additional information from the market concerning product design will be available after further market research, during the first stage of the implementation of the project.

Production

The desired materials are as follows: particle board, fibreboard, solid wood (domestic species), natural veneers, plastic foils (artificial veneer),

Table 5. RO Vrbas, Banja Luka

Item	Factory organization and operation[a]		
	Veneered-furniture factory	Solid-wood furniture factory	Upholstered-furniture factory
Products	Corpus, living-room, dining-room, wall units	Chairs, tables, dining-room	Suites
Main materials	Steamed beech boards		Textiles, wooden frames, wooden elements, foam
Yearly production	13 200 suites (wall units, bedrooms, dining-room)	334 650 chairs	8 680 club suites
Finished-goods stock (number of weeks)	4	4	6
Factory area (m^2)	6,400	10 132	3 477
Machines and equipment	Old and new	New	Old
Directors, executives	1 director	1 director	1 director
Engineers, supervisors	1 technical product manager (university graduate), 14 supervisors (secondary school graduate)	1 technical product manager, (university graduate), 2 managers of product stages (university graduates), 11 supervisors (secondary school graduates)	1 technical product manager, (university graduate), 8 supervisors (secondary school graduates)
Manpower	264	418	182
Value of sales (DIN)	106 870 625	66 930 277	108 357 729
Exports (DIN)	8 400 395	37 016 242	5 945 793

Table 5. (continued)

Item	Factory organization and operation[a]		
	Veneered-furniture factory	Solid-wood furniture factory	Upholstered-furniture factory
Value of production (Din per worker per year)	379 712	160 516	702 612
Consumption of wood (m^3 per year)		6 500	
Consumption of boards (m^2 per year)	Particle board (5 499) veneer (870 366), various boards (1 450)		
Shifts	2	2	2
Development plans	Modernization	Reconstruction	Modernization

a/ Technical preparation of production is centralized, with a total employment of 46, including 22 engineers.

laminated wood, nitrolacquers, fittings for easy assembly of corpus, plastic profiles, plastic boards, decorative and functional fittings, plate and ordinary glass. Undesirable materials are solid wood (tropical species), polyester and polyurethane lacquers, stain and imported lacquers. Forbidden materials are "ultrapas" board and high-gloss polyester. Technological processes for manufacturing veneered boards with natural veneer and veneer lamination, for finishing with nitrolacquers and for solid wood production are to be preferred, while those for adding value to particle board with artificial veneer, and for finishing with polyesters and polyurethanes should be avoided.

Skilled labour is limited, although the size of the labour force is adequate. Existing technology with possible variations will be employed, and the quality control standard will be based on the new handbook of standards.

Design

The facilities available to the designer include a design office, complete technical and marketing information, a fully equipped prototype workshop, and all appropriate materials and processes. The designer also has access to information on previous and current products, including advertising material and catalogues, technological documentation, and existing product ranges.

The components and elements of the programme should have optimal combination characteristics, and the product design should have functional advantages in every detail in relation to competitor products. It should be easy to combine, alter and clean, and delivery should be possible in assembled or unassembled form.

Project administration

Responsibility for making decisions in each phase will be exercised by the council for the programme, and the design manager, whose authority may be delegated, will be responsible for initiating action, project secrecy and restriction of information. Outside consultants will be unnecessary, and existing facilities should be sufficient for services within the enterprise, although outside services and facilities may be resorted to if necessary.

Budget

A budget for all stages of development will be defined after the establishment of costs and a programme of action based on market research and product promotion plans.

Design No. 2 - "Rita": range of demountable seating units

Aims of the enterprise

The project is designed to promote the introduction of a new range of upholstered furniture using available raw material (beech), the completion of production capacity for solid-wood furniture, the broadening of the "Vrbas" programme to include a wide range of domestic furniture, and the establishment of new markets. The project is also expected to achieve increased income and sales, a higher quality level and a lower reject rate. Other positive side-effects would consist in the development of exports, emphasizing certain characteristics through functional use, and making the products difficult to copy. The criteria for judging the success of the programme are that the products must be inexpensive, have a favourable market response, and conform to high quality standards.

Marketing

The products should be original and aesthetically pleasing, present features in common with all "Vrbas" products while being distinct from existing products on the market, and have appropriate methods of promotion and distribution. Additional information through feedback from the market concerning product design will be available after further research to be carried out during the first phase of implementation of the project.

Production

The preferred materials are as follows: beech, fir, ash, clear lacquers (colourless or semicolourless), paints with flat texture, woven textiles (in one colour, striped or with flower pattern), leather, cushion filling (foam in blocks, cut foam - extra soft, ground foam - defined granulation) and fittings suitable for all combinations. Forbidden materials are solid wood (tropical species), polyester lacquers, polyurethane lacquers (high gloss), metal, traditional textiles, silk, velvet, and cushion filling (hard foam). A technological process for solid-wood production is preferable, while high-gloss surface treatment and panel or board processing should be avoided.

With regard to labour, machinery, quality standards, design, administration and budgeting, the same conditions prevail as in the case of "Programme 78".

E. Planned maintenance

Objectives

Planned preventive maintenance may be described as a procedure for the systematic inspection, servicing and overhaul of plant and equipment, so as to maintain it in a condition in which it can perform consistently the function for which it was designed.

The aims of planned maintenance may be briefly summarized as follows:

(a) To eliminate all avoidable breakdowns or stoppages of plant;

(b) To increase plant utilization and obtain maximum production capacity;

(c) To keep cost of overhauls and repairs due to plant deterioration to a minimum;

(d) To improve the standard of maintenance and control over the maintenance personnel;

(e) To standardize the maintenance procedure; to establish routine inspection, adjustments and overhauls to ensure that no unit is overlooked, or conversely overmaintained; and to ensure that spares and replacements are ordered at such times that they are available when required;

(f) To ensure that, as far as possible, maintenance work is planned to fit in with production requirements.

Essential requirements

The three fundamental requirements for any planned maintenance scheme are as follows:

(a) A programme of operations covering inspection, lubrication, adjustment, rectification of faults and periodic overhaul;

(b) The means of ensuring that these operations are carried out in accordance with the programme;

(c) A method of simply recording the work done and assessing the results, so that maintenance is kept under continuous review and the level of maintenance adjusted either more or less, to meet the needs of the plant concerned.

For further information on planned maintenance, the Furniture Industry Research Association's (FIRA) publication on the subject, issued in February 1973, should be consulted.

II. STANDARD SPECIFICATIONS FOR FURNITURE PRODUCTION

The quality of a product may be defined as the sum total of its most essential characteristics which determine its degree of suitability for a particular purpose. The role of those responsible for the establishment and maintenance of quality control is to provide and co-ordinate a system which ensures that the operation will produce an optimum quality product at minimum product cost. Their actual responsibilities are to define, plan, co-ordinate and measure the quality efforts of the enterprise, as well as to perform those activities normally associated with the quality control function. Quality cannot be inspected into the product but must be designed and built into it. It is essential therefore that the organization responsible for quality control should have the organizational freedom to identify and evaluate quality problems and to initiate, recommend and provide solutions.

It has been proved in practice that quality and standard specifications are becoming more and more interdependent and complementary. The most important tendencies in this respect are as follows: standards containing quality requirements and test methods are increasing; the level of quality requirements stipulated in standard specifications is rising; quality improvement increasingly necessitates that quality requirements regarding materials and final products should be stated; quality requirements presented in standard form are playing an ever-increasing role in the exchange of goods and technical processes.

Countries are now interested in quality to a very significant extent. This can be regarded as the result of a connection between balance of trade and exports on the one hand, and, on the other, the fact that the most decisive pre-requisite for successful export is product quality. Investment alone will not ensure a speedy development of exports unless it is accompanied by appropriate technical know-how, skilled workers and management to operate the enterprise, and above all the existence of effective quality control based on established standard specifications.

In the case of the furniture industry in Bosnia and Herzegovina, the responsibility for evolving such standards rests with the Institute of Technology in Sarajevo. It is currently outfitting, with international assistance, a standards and testing department which will have the function of testing the quality aspects of furniture and its various materials and accessories and will

advise on the elaboration of standards for furniture, joinery and their components, including textile materials, upholstery materials, adhesives, surface coatings and plastics. This department will also assist in the establishment of quality control procedures among the many furniture plants in the Republic and will train others in their application.

The definition of an acceptable level of quality in relation to furniture production is based on a number of existing standards, including those prepared by the Yugoslav Standards Institute (JUS). These standards have been adopted, and in some instances elaborated upon, for use by the industry in the form of a standards handbook. The work done by the expert and the select committee set up to prepare the handbook should be regarded as only a beginning. The committee itself should be given permanent status and the task of further developing the handbook on the basis of industry reaction and support. The committee should also be further strengthened by the inclusion of representatives of every sector of the industry, particularly at policy-making level, and it should be given the full support and encouragement of top management.

A. Furniture quality

Furniture is classified into three quality groups. In the first group is furniture that complies with the requirements for fundamental quality. Furniture in the second group complies with requirements for higher quality. The third group is for furniture that complies with requirements for particularly high quality.

Quality wooden components used for furniture production are classified at four levels:

Level A: the component must not have any defect or imperfection which could influence the use and appearance of the furniture;

Level B: the component must not have any defect or imperfection which could influence the use of the furniture, but it may have a small number of defects provided it affects appearance only;

Level C: the component must not have any defects or imperfections which could affect usage, but it may have additional defects or imperfections provided they affect appearance only;

Level D: the component must comply with hygiene requirements and must not have any sharp projections which could cause damage or hurt. This requirement applies to parts of furniture that are hidden or covered with another material.

Changes in the given quality levels may be introduced only for special aesthetic reasons. Certain levels may include requirements defined for other levels. For example, level A covers all special requirements defined for levels B, C and D. Requirements for materials and quality of performance for one product may be different for different parts.

B. Materials for furniture production

Table 6 lists defects and imperfections that are permitted or forbidden for certain quality levels of sawn timber.

Table 6. Possible defects and imperfections for different quality levels of sawn timber

Possible defects and imperfections	Quality group			
	A	B	C	D
Bark	1	1	1	1
Bast	1	1	1	1
Damages caused by insects	1	1	1	1
Decay	1	1	1	1
Dead knots	1	1	1	1
Pitch pocket	1	1	1	1
Knots	1	1	1	2
Scar	1	1	1	2
Fustiness	1	1	1	2
Sapwood[a/]	1	1	1	2
End check	1	1	4	2
Surface check	1	1	4	2
Inner check	1	1	3	3
Cluster knots	1	6	2	2
Wild grain	1	6	2	2
Wood in compression and tension	1	6	2	2
Water-saturated wood	1	6	2	2
Variations in colour of wood	1	6	2	2
Knots	8	7	5	2
Repaired knots and holes	1	1	2	2
Honeycombing	1	1	2	2

Note: (1) No; (2) Yes; (3) Permitted only if they do not affect mechanical characteristics; (4) Only small or filled checks are permitted; (5) Permitted for surfaces on projecting parts with non-transparent coverings; it must not have knots that are visible after treatment; holes must be repaired and sanded, including intergrown knots of less than 20 mm; (6) Permitted at one place only; (7) Only knots of less than 20 mm in diameter are permitted; (8) Projecting parts must not have knots, while other parts may have only intergrown knots of less than 7 mm.

a/ Broad-leaved species with evident sapwood and medulla (oak, poplar, mahogony, palisander, but not walnut).

Face veneers must comply with the following requirements:

Level A: same requirements as for timber and furniture parts;

Level B: same requirements as for timber and furniture parts, differences in colour and texture not permitted;

Level C: same requirements as for timber and furniture parts, darker and lighter shades also permitted, different textures, holes or open checks not permitted but may be repaired;

Level D: same requirements as for timber and furniture parts.

Laminated wood must comply at all levels with the same requirements as for timber and veneer.

Veneered boards must comply with following requirements:

Level A: same requirements as for timber and face veneer, sheets of veneer must be jointed in such a way that differences in colour and texture are not visible;

Level B: same requirements as for timber and face veneer;

Levels C and D: must comply with JUS D.C5.041 requirements.

Particle board and fibreboard must comply with the following requirements:

Level A and B: rough or other spots are not permitted;

Levels C and D: must comply with JUS D.C5.031, grade I requirements.

Laminated plastics and upholstery materials must comply with the manufacturers' requirements. Webbing should be made from flax, hemp or jute. Alternatively, polyester fibre webbing of 50 mm in width may be used. If rubberized webbing is used, it should have a breaking strength of not less than 14 N per mm of width. Rubber webbing should have a breaking strength of not less than 20 N per mm of width. Webbings should be used in accordance with the manufacturer's instructions.

All the foams are tested according to the following standards: JUS G.S2.410-1967, JUS G.S2.423-1966, JUS G.S2.421-1966, DIN 53420, DIN 53577, DIN 53572 and DIN 53571. Polyurethane-foam trade marks should be tested

in accordance with the above-mentioned standards. Crumbed foam should be well bonded and free from skin. Latex foams should be tested in accordance with the above-mentioned standards and conform to the requirements of British standard 3129 : 1595 concerning latex foam rubber components for furniture. Flock for upholstery filling shall not contain more than 1.3% soluble extractable matter when tested by British standard 1425 : 1960 concerning cleanliness of fillings for bedding, upholstery, toys and other domestic articles.

Sewing thread for upholstery should have a breaking strength of at least 20 N and be suitable for the upholstery fabric with which it is used. Other upholstery materials such as webbing, cotton, textiles, various regenerated materials etc. should be used in accordance with manufacturers' instructions. All springs should be manufactured from hard-drawn carbon-steel wire and given a heat treatment at approximately 250°C in order to relieve the stresses set up during cooling.

Adhesives consist of dry matter, solvent, filling, hardener as well as some other elements that make them resistant in various conditions of utilization.

Phenolic glue, urea-formaldehyde and polyvinyl acetate should be used for the gluing of wood. Phenolic glue is a mixture of phenol-formaldehyde resin in water or organic solvent (acetone, ethanol) with or without hardener and eventually with other additives. It is primarily used in the production of water resistant plywood and wood in layers. The glue should comply with the requirements of JUS H.K2.024-1964. Urea-formaldehyde is a mixture of water solvent of urea-formaldehyde resin with hardener and eventually with other additives. It is used for gluing of assemblies and in board manufacturing. Adhesive should comply with standard JUS H.K2.023-1964. Polyvinyl acetate dispersional glue is a colloidal dispersion of PVC synthetic resin in water with chemical additives. It is primarily used for the gluing of assemblies. The adhesive must comply with the requirements of JUS G.K2.031-1964.

C. Quality standards

Performance

Timber for furniture production must have a moisture content of 8± 2% with regard to shrinkage, and should be somewhat longer than planned in the finished product. Permitted tolerances are ± 1 mm for level A,

and ± 1.5 mm for levels B, C and D. The following deviations from the right angle are allowed: level A, - 0.4 mm for 400 mm or 1 mm for whole length between two angles; levels B, C and D - 0,6 mm for 400 mm or 1.5 mm for whole length between two angles. Imitation of wood is permitted (if pre-determined in the technical description).

With regard to elements, the following requirements must be fulfilled:

Level A: joints must be strong and close-fitting, discoloration caused by glue is not allowed: jointing fixtures - nails, screws, tenons etc. - must not cause bad jointing, and must be accessible and visible in half-hidden places;

Level B: joints must be strong, even poorly fitted joints are permissible to a reasonable extent; materials for jointing must be treated like those for level A, except when used as decoration, in which case they must have rounded edges and be well protected; lesser discoloration and, to a small extent, the appearance of glue on the joints are allowed;

Level C: small clearances are allowed; materials for jointing must not be visible on the surface;

Level D: clearances caused by tensions during construction or by shrinkage are allowed under special conditions.

Furniture intended for use in the open air must be made of materials that can withstand such conditions.

With regard to veneering, the following requirements must be fulfilled:

Level A: glue must not be visible on the joints; penetration of glue, repairing and correcting of veneer and sanding through are not allowed;

Level B: veneering must be strong, glue must not be visible except to a small extent; texture, structure and colour of veneer must be approximately the same as other wood components; changes in colour of veneer because of penetration of glue are permissible to a small extent; sanding-through of veneer is not permissible; it may occur only on hidden places and even then must be carefully corrected;

Level C: veneering must be well done so that veneer is glued to the total surface; broken parts of veneer, splits and blisters are not permissible.

Edges must comply with the following requirements:

Level A: edge veneer must be of the same species of wood and, if possible, the same colour as the surface; glue must be applied evenly on the whole surface; it is best to protect edges by using the same species as the surface,

Level B: painting of edges is permissible only if the surface is painted or if an aesthetic effect is needed; particle board and fibreboards must not have damaged edges;

Level C: edges that can be broken must be protected with edge veneer.

Outside surfaces are subject to various requirements. Bow specifications are indicated below:

Level A: 0.2% space between two angles, up to 2 mm;

Level B: 0.2% space between two angles, up to 3 mm;

Level D: no part of furniture should have honeycombing so insufficient as to cause it to be unusable

Allowed deviation from the surface is measured by ruler. At level A, visible traces of sanding and rough surfaces caused by distortion of the fibres are not allowed.

Twist specifications are as follows:

Level A: 0.2% from longer outer edge to 2 mm;

Level B: 0.3% spacing between two angles to 3 mm;

Level D: no part of furniture should have honeycombing so insufficient as to cause it to be unusable

Allowed deviation from surface measured with ruler: at level A, 0.4 mm for 200 mm ruler, or 0.2 mm for 50 mm ruler; at level B. 1.0 mm for 200 mm ruler, or 0,2 mm for 50 mm ruler.

With regard to evidence of processing, the following points should be noted:

Level A: visible traces of sanding and rough surfaces caused by distortion of the fibres are not allowed;

Level B: marks of tools and materials for sanding are not allowed; wooden arm rests must have rounded edges;

Level C: surfaces must be smooth; tool marks and material for sanding are allowed only to a very small extent.

Controls

Before testing and measuring, products must be kept in the air at a temperature of 20°C (±2°C), and in humidity of 60% (±5%). For control measurement, various measuring instruments and calibrators are used. The accuracy

of measuring instruments must be greater then 1/5 of the permitted tolerances where the object is measured. When the width of the joints is measured, the object is put on a horizontal base whose deviation from the surface must not be greater than 0.05% of the distance between two angles. Given measures are recorded in the report on testing with all limit values.

Measuring of straight lines is controlled by calibration or steel meters. The smallest and largest width of a joint is measured with an auxiliary measuring instrument such as a comparator, calibrator and similar devices; the difference between these two measurements gives the measured deviation.

Clearances of the same kind are measured in the above manner; the middle value of these two measurements is used for comparison purposes and gives the degree of accuracy. The biggest difference in width is recorded in the report as the difference between joints of the same kind.

For angle control, a protractor of 90^{o} is used with a side of 400 mm. Angles are not controlled if edges are shorter than 400 mm.

For bow control, a ruler with two feet and a comparator are used. The ruler is placed in a position so that one foot is at an angle to the board and the other is moved so that distances between two adjacent edges are measured. Measuring is done at all outside edges as well as on the diagonal. On surfaces without angles, four defined points are selected. On straight lines of less than 200 mm, a ruler of 50 mm is used.

For twist control a straight edge with two feet and a comparator are used. The surface is measured so that lines of edges are in the horizontal or vertical face. Deviations from horizontal or vertical faces of particular edge lines are measured with a straight edge and a comparator and given as a measure of outside twist. For surfaces without angles, four defined points are selected.

For outside rough points, a straight edge of 50 mm and 200 mm, a comparator and similar instruments are used. The straight edge must be parallel to surfaces at different places and in different directions as long as the largest deviation is shown.

Other applicable standards are indicated below:

JUS D.C5.031: particle board, boards for general use

JUS D.C5.041: veneered block boards - structure, characteristics and classification

JUS D.E2.042: samples for testing furniture quality

JUS D.E2.042: furniture quality requirements

JUS D.E2.060: furniture for storage - durability of drawers

JUS D.E2.061: furniture for storage - stability.

III. FURNITURE MANUFACTURE

The manufacturer ensures that all the production materials comply with specification standards, and, for inspection purposes, maintains documentary evidence of such compliance. He must have adequate facilities for the storage of materials and furniture production, and satisfy himself by regular periodical tests that the furniture conforms to specification requirements.

If requested by the purchaser, the manufacturer should make good or replace without charge any article in which defects appear within a period defined from the date of delivery, provided that in the meantime the article has been subjected only to fair wear and tear and reasonable storage conditions. Official regulation 38/77 defined the guarantee period and conditions and requirements for testing.

A. Cabinet furniture

The carcass of cabinet furniture shall generally be constructed using one of the following three methods of construction or a combination of these: frame, stool and box. The measurements given in this chapter are minimum finished dimensions unless otherwise stated.

Framed construction

A framed construction consists of components which are jointed together. The components are made from frames to which facings are glued or to which panels are set in.

The frames are of solid hardwood 45 mm x 18 mm in cross-section. The joints of the frame are mortized and tenoned or dowelled; for double-faced frames, corrugated fasterners of galvanized steel may be used. Cross rails of 38 mm x 16 mm hardwood are used if the area within the frame members is over 0.75 m^2 and 3 mm plywood is used as facing. Alternatively, if a 5 mm plywood facing is used, the area may be up to 1.1 m^2 without a cross rail.

The facings are of plywood or faced hardwood of 3 mm thickness. Where frames are double-faced, the closed spaces are ventilated. Where glass is used in panelling, the frame is made of show wood. The glass is held in place by slips pinned or screwed to the frames. The adhesive used to attach the facings to the frames is of polyvinyl acetate or urea formaldehyde type.

The components are joined together by one of the following methods: knock-down fittings, not more than 300 mm apart; slips of 18 mm x 18 mm, glued and screwed to both stiles; pocket screws, not more than 300 mm apart; dowelling and glueing.

The length of screw used is such that, when inserted, about half the length is located in each component joined; the point of the screw must not come closer to the face than 6 mm.

The corners formed by the components are finished in such a way that the framing, if not made of show wood, is covered by a lipping or edge veneer. When facings meet at a corner, they are mitred to show a clean arris. Components forming projecting tops, unless made of show wood, have lipped or veneered edges. The edges of all plywood apron pieces, mouldings, shaped tops or bottoms are supported all around.

Stool construction

A stool construction consists usually of four main corner posts to which rails are attached, thus giving a rectangular framework. The joints of the legs to the frame or top are of one of the following types: mortice and tenon, bridle joint, halving joint, mitre joint, dowelled joint, housing joint, combed joint or knock-down fitting.

For stool supports for carcasses the legs are jointed securely to a base frame or form an integral part of the carcasses or, alternatively, are securely attached to a specially-strengthened part of the carcass. The size and cross-section of the legs and rails are related to the type of furniture and to its end use. The stool bases are fixed to the carcasses by pocket screws, dowels or glue blocks.

Box construction

Usually a box construction is used for carcasses. It consists of wide boards jointed at the ends to form a rectangular box-like structure. Board of one of the following types is used: 20 mm solid timber, 16 mm particle board, 16 mm blockboard or 12 mm plywood. Nails are used for fixing the structural components together. Fixed divisions are not housed into the face of particle board but may be dowelled or glued into it. Internal divisions

are fixed to the outer shell in such a way that the strength of the sides of the carcass is not adversely affected. Backs are grooved in, rebated and screwed or pinned and glued. Unsupported backs of up to 0.75 m^2 are of 3 mm plywood or hardboard, and unsupported backs of up to 1.1 m^2 are of 5 mm plywood. Backs of greater area are supported by muntins (hardwood reinforcing members) or by extruded metal H-sections.

Lipping of edges with wood is done in one of the following ways: veneered or edged using at least 0.5 mm veneer; hardwood lip glued to the edge; edge foils.

Bedsteads

Head boards of bedsteads are of solid timber of 18 mm thickness or consist of single- or double-faced frames of 40 mm x 14 mm solid timber glued to 5 mm plywood. Where the frame is shaped, the rail must be not less than 40 mm at any place. Cross rails are spaced at not more than 450 mm from centre to centre. The frames are mortized and tenoned, dowelled or tongued and grooved. Legs measure 38 mm x 38 mm and are attached to the head boards by dowels or screwed with at least three countersunk screws.

The rails, if made out of solid timber, measure 100 mm x 25 mm and are attached to the legs by knock-down fittings. Rails for spring or upholstered bases will have timber of 38 mm x 25 mm screwed and glued to the inside to serve as a support for the spring or upholstered base.

Webbed frames will be made of rails of 75 mm x 50 mm. Two steel U-bars or two 50 mm x 50 mm hardwood rails, reduced in section to allow for depression of the mattress, will be provided to hold the side rails apart.

Tables

The cross-section of legs for tables having no underframe is as follows: 45 mm x 45 mm for table tops of less than 1 mm^2; 50 mm x 50 mm for table tops of 1 to 1.5 m^2; 60 mm x 60 mm for table tops of more than 1.5 mm^2. The cross-section of the frame rails for tables having no underframe is 90 mm x 22 mm.

Extendible tables will have a locking device to lock the extension into place. Frames for extendible tables and frames of tables with solid timber tops will be fitted with corner blocks. Rails of extendible tables will be supported by corner braces or corner blocks. Tables fitted with drawers will have rails of 115 mm d[illegible]n.

Table tops

Table tops of solid timber are connected to the frame by a method which permits lateral movement (expansion or contraction).

The thickness of table tops is 18 mm for solid timber tops, 12 mm for plywood tops, and 18 mm for unveneered particle board tops. Cross rails are used to support the top when the unsupported area of the top is over 0.75 m^2. Tops are secured to the rails by screws.

Edges of plywood or particle-board table tops will be edge-veneered with solid hardwood lips of 3 mm thickness.

Components

Shelves

All loose shelves will be reversible. Solid timber shelves of up to 900 mm in length will be 25 mm thick. Shelves of 900 - 1,200 mm in length will be 28 mm thick, and longer timber shelves will be provided with an intermediate support. The thickness and maximum lengths of shelves of plywood or particle board will be as recommended by the manufacturers.

Drawers

Front. The front will be of solid hardwood or plywood of 12 mm thickness, or of 16 mm-thick particle board.

Sides and back. For an internal drawer area of less than 5 dm^2, 6 mm-thick solid wood is used, for an area of 5 dm^2 to 16 dm^2, 9 mm-thick solid wood or plywood, and for over 16 dm^2, 12 mm-thick solid wood or plywood. If the side of the drawer is grooved to take a runner, the side is 12 mm thick and the depth of the groove is not greater than half the thickness of the side.

Bottom. For internal drawer area of less than 5 dm^2, 3 mm plywood or hardboard is used, for an area of 5 dm^2 to 16 dm^2, 4 mm plywood or hardboard, and for over 16 dm^2, 5 mm plywood or hardboard. The bottom of drawers wider than 600 mm are reinforced with a central muntin (hardwood member) of 45 mm x 16 mm solid hardwood. Grooves will be provided in the sides and front to retain the bottom in place. The depth of the groove will be not more than half the thickness of the sides. Alternatively, drawers may have the bottom grooved half-way into a 9 mm fillet (hardwood strip) glued to the sides.

Joints. Front-to-side joints are dovetailed, lock-jointed, comb-jointed or dowel-jointed. Back-to-side joints are dovetailed, lock-jointed or comb-jointed; the back may also be held in grooves of a depth which is half the thickness of the sides; the grooves are 12 mm in from the ends of the sides.

Kickers and runners. Kickers and runners will be of hardwood to resist wear. Runners underneath the drawer will be at least of such thickness as will support fully the drawer sides. Inserted-type runners are to project into the grooves to not more than half the thickness of the sides. They will be pointed and glued to the carcass and extend the full length of the drawer. The depth of runners, whether below or grooved into drawer sides, will be 6 mm for drawers of an area of less than 5 dm^2, 12 mm for drawers of an area of 5 dm^2 to 16 dm^2, and 18 mm for drawers of an area greater than 16 dm^2.

The wearing surfaces of runners, kickers and drawer sides will be treated with wax or some other suitable material to improve the sliding properties.

Pulls or handles. Pulls or handles must be of adequate strength and may be of either the sunken or plant-on type. Drawers of over 600 mm width will be provided with two-handed-grip plant-on handles.

Stops. One stop will be fitted at each side of the drawer within 50 mm from the corner at the front or at the back of the drawer.

Clearance. The clearance between the back of the drawer and the carcass will be not more than 25 mm, unless the overall depth of the drawer is more than 400 mm.

Doors and falls

The thickness of doors and falls will be the following: 15 mm for particle board and an area of up to 36 dm^2; 18 mm for particle board and an area of over 36 dm^2; 12 mm for plywood and an area of up to 36 dm^2; 16 mm for plywood and an area of over 36 dm^2; 15 mm for blockboard; 20 mm (finished thickness) for double or single flush doors; and 18 mm for solid-timber framed panelled doors. Particle board, if hinged on the edge, will be fitted with a 12 mm lipping. Three hinges will be provided for doors with a height of over 900 mm; alternatively, a single piano hinge may be used for all doors, in which case particle board need not be lipped.

Closures. Doors over 1,200 mm high will be fitted with one closure at the top and one at the bottom, or one at or near the centre. Falls will be similarly fitted with closures.

Sliding doors. If possible, sliding doors should have a height-to-width ratio of 9 to 5. The sliding mechanism should operate smoothly. The bottom of the doors will be fitted with wear-resistant smooth-running fitments and the upper surface of the bottom frame is to be similarly equipped.

All unframed glass, such as that for shelves, sliding doors or table tops, will be of 6 mm plate or float glass.

Dimensions of cabinet furniture

Wardrobes will have a clear internal depth of 480 mm for face hanging of garments and 530 mm for side hanging. They will have a hanging height of 1,500 mm; for men's wardrobes, the hanging height will be 1,350 mm.

Chests of drawers and dressing tables of at least 900 mm in width will have an internal depth of 430 mm, and those less than 900 mm wide will have a depth of 400 mm.

The length provided for sleeping will be 1,930 mm for all types of bedsteads, and the width of the sleeping space will be 900 mm.

B. Chairs

Construction

Dining chairs

In the construction of dining chairs, mortice and tenon joints or combed joints should be used wherever possible; in joining the side rail to the back leg, however, only mortice and tenon joints should be used. Dowel joints may be used to connect the side rail to the front leg and for front and back rails, provided that a joint using three dowels can be achieved.

If the chair legs are of less than 625 mm^2 in cross-section, an underframe should be used, preferably all around, but at least joining the back to the front legs. For chairs with arms, however, no underframe is needed.

If the chair leg is attached to one rail only it should be joined by a mortice and tenon joint which is pinned by a dowel perpendicular to the joint.

The underframing connecting the back and front legs should be mortised and tenoned at both joints and have a cross-section of 560 mm^2.

Drop-in and covered seats should be constructed of 6 mm-thick laminated timber or of a dowelled frame having a cross-section of 48 mm x 16 mm. The gap between the seat and the chair frame should not exceed 1.5 mm when the seat is in place. If a laminated seat is stuffed over it should be vented.

All dining chairs, except those with solid seats, should have corner blocks fixed by rebating or by gluing and screwing, or have gussets glued into grooves.

If an unupholstered seat forms part of the fixed structure of the chair, it should be made of 6 mm-thick laminate supported by rails. If edge-jointed solid timber is used, it should form part of the structure and the legs should be fixed to it directly by dowelling or tenoning.

Easy chairs

Dowel joints may be used for all joints provided the height of the seat rails of the chair does not exceed 350 mm. Where the seat rails are higher than this, the side rail will be connected to the back by mortice and tenon joint.

All rails carrying springing or webbing should be constructed from close-grown hardwood with good tack-holding properties, at least comparable to beech or birch, and should be 35 mm x 22 mm in cross-section.

Settees

Timber for rails must be 47 mm x 47 mm x 32 mm.

Dowel joints, preferably with three dowels, may be used; where two dowels are applied they should be situated at the top and the bottom of the rail. All joints must be braced, preferably by corner blocks which should be glued and nailed, or by metal braces.

For settees of a width of 900 mm to 1,350 mm, a cross rail of 75 mm x 32 mm or 48 mm x 48 mm cross-section must be inserted at the centre of the base. The cross rail should be dipped to allow for depression of the springing or webbing. Settees that are wider than 1,350 mm should be fitted with at least two dipped cross rails and an extra pair of legs forming an integral part of the frame structure.

All load-bearing rails should be made of close-grained hardwood similar to beech. Arms on fully-upholstered settees should be planed and all arrises rounded to prevent wear of the filling and cover. Backs should form an integral part of the structure and be fixed at least at three points. Dowel joints should be used throughout. The rails should be 44 mm x 44 mm and the section of bearing members at ground level 38 mm x 38 mm.

Dimensions and jointing

For dining chairs the height of un-upholstered or fully-depressed upholstered seats should be 430 mm to 460 mm. Easy chairs should have a width of 460 mm and a depth of 495 mm. With regard to settees, the width of seat at the front, excluding the arms, should be 900 mm for two-seater settees and 1,350 mm for three-seater settees. The depth of the seating area should be 460 mm.

For chair joints, a gap-filling urea formaldehyde adhesive should be used in accordance with the manufacturer's instructions. Other adhesives may be used, provided they have equivalent properties of strength and durability.

Upholstering

The edges of the front, arm and back frame should be covered with 25 mm foam, with paper or wadding to prevent wear of the covering. Where loose cushions are used over serpentine or tension springs which might damage the cushion or covers, a layer of felt with quilted-on upholstery fabric should be attached to the webbing.

Arms should be padded inside and on top. The covering material on the inside arms of fully upholstered settees should be supported by webbing.

The fabric used to upholster all parts of chairs and settees, with the exception of the bottoms, should conform to the requirements of Irish Standard 169: 1969 concerning upholstery fabric.

The jute, hemp or flax webbing should be attached to the frame with five 12 mm-long tacks, and at least two of the tacks should be driven through a double layer of the webbing. By means of a web strainer, the webbing should be stretched to the full limit.

The number of webbings used for a settee or chair seat is as follows: for settees - not less than twelve lengths of webbing from back to front and five from side to side; for easy chairs - not less than five lengths of webbing each way; for spring-seated dining chairs - slip-in type (not less than two lengths of webbing each way), and stuff-over type (not less than three lengths of webbing each way).

Rubberized webbing or rubber webbing must be used in accordance with the recommendations of the manufacturer or supplier, particularly with regard to the method of attaching, tensioning and spacing of strands.

Springs

Serpentine (no-sag) springs

Springs are attached to the front and back rails, i.e. transversely. All steel fixing clips are wrapped with fabric to avoid metal-to-metal contact nd to prevent squeaks. Brass clips may be used without fabric insulation.

The number of springs to be used will depend on the product, its dimensions and diameter, and the quality of the wire used for the production of springs.

At present, the central distance between springs is 10 - 12 cm, which is in accordance with fundamental furniture quality.

The following number and size of strands will be used in serpentine springing for any chair or settee:

(a) For dining chairs, there will be a minimum of three strands 11 SWG (2.95 mm); the strands need not be cross-clipped;

(b) Easy chairs will require a minimum of five strands 9 SWG (3.66 mm) for seats and a minimum of four strands 12 SWG (2.64 mm) for the back. Only the strands of the seats need be counter- or cross-clipped;

(c) For seats of settees measuring 1,400 mm between the arms, a minimum of twelve strands 10 SWG (3.25 mm) are used. For each 125 mm of length below or above 1.400 mm, the number of strands are reduced or increased by one. All strands should be counter or cross-clipped. For the backs of settees measuring 1,400 mm between the arms, a minimum of eleven strands 12 SWG (2.64 mm) are used. For each 125 mm of length below or above 1,400 mm, the number of strands are reduced or increased by one. These strands need not be counter- or cross-clipped.

Tension springs

Tension springs should be fixed securely to ensure adequate strength and to avoid damage to the upholstery. They should be continuous between the points of fixing to the frame and no metal extensions should be substituted for any portion of the spring. The amount of stretch in a spring, when fixed, is between 38 and 50 mm.

The wire used in tension springs is at least 16 SWG (1.63 mm) for seats and at least 20 SWG (0.91 mm) for backs. The coil diameters of tension springs are given in table 7.

Table 7. Dimensions of tension springs

Furniture element	Coil diameter (mm)	Wire dimensions (SWG) a/
Seats	12	14 (2.03)
	9	16 (1.63)
Backs	9	18 (1.22)
	6	20 (0.91)

a/ Figures within parentheses indicate corresponding values in millimetres.

The following number of tension springs should be used for chairs or settees:

(a) Easy chairs. For seats, at least nine tension springs should be used. If the springs are attached to a steel frame, the number of springs may be reduced to six for seats of 500 mm x 500 mm and under, and to eight for seats of a size up to 580 mm x 580 mm. For backs, at least eight tension springs should be used. If the springs are attached to a steel frame the number of springs may be reduced to five;

(b) Settees. For seats of settees measuring 1,200 mm between the arms, at least 21 tension springs should be used. For each 150 mm of length below or above 1,200 mm, the number of springs should be reduced or increased by three. For backs of settees measuring 1,200 mm between the arms, at least 16 tension springs should be used. For each 150 mm of length below or above 1,200 mm, the number of springs should be reduced or increased by two.

Spring cushion units

The minimum number of compression springs for open-type spring cushion units should be 24 springs of 100 mm x 13 SWG (2.34 mm); for bagged or

pocketed units a mimimun of 30 springs of 125 mm x 14 SWG (2.03 mm) should be used, either clipped or sewn.

Latex or polyurethane foam cushions should be not less than 12 mm from the edges of the sewn cushion material, and the thickness of the foam units should be the same as that of the sewn cushion borders. Where rubberized hair is used in conjunction with latex or polyurethane foam, it should be firmly attached with adhesive solution to each surface of the foam unit.

C. Workmanship and finishing

The factory should be clean and well lighted, and provision should be made for the removal of dust and chips and for measuring the moisture content of the air.

The machining of woods and construction of joints should be done precisely and carefully.

All joints should be close, without gaps, and free from visible splittings, cracks or other defects as a result of jointing. They should also be hand-tight and well glued using the required adhesive and following any instructions provided by the manufacturer. All surplus adhesive should be wiped off.

It is important that the room where veneering is done should have dry air and be free from dirt, dust and draught. All veneered man-made boards should have a balancing backing veneer of similar weight, with the grain running in the same direction. Joints in veneers should be free from filler.

The finishing area should be kept free from dust and dirt. All furniture should be free from direct saw marks or rough wood, even in places not normally visible. All surfaces are planed, except the carcase of upholstered furniture, and all interior surfaces sanded and coated with sealer, lacquer, or an equally suitable finish to ensure cleanliness and ease of cleaning. Upholstered frames should have clean surfaces and all edges must be rounded.

D. Foam thickness

In accordance with Irish Standard 159 : 1967, the Institute for Industrial Research and Standards gives proposals for thicknesses of foam

with regard to their indentation hardness. For seating, the most suitable thickness of foam of given indentation hardness will depend on a number of factors, e.g. nature of use (cinema seating, private use, etc.), nature of support (rigid base, sprung base, etc.), which must be assessed by the furniture manufacturer.

The following are suggested minimum cushioning requirements for private use on a reasonably rigid base.

Cushioning requirements

Type of foam	Slab thickness (mm)
UF 15	125
UF 18	100
UF 22	75
UF 27	50
UF 33	25

IV. INDUSTRIAL TRAINING

A. Principles and planning

In Yugoslavia education is carried on at two different levels, high and medium, after which certificates are issued to those completing the courses. Those certificates are officially recognized as assurances of competency. Despite the fact that this education is spread over many years, those who complete it are still unable to go directly into production because their training is not appropriate to this end. At the same time, there is a continuing shortage of skilled workers which would indicate that the training referred to should have some relevancy in this respect. It also places greater emphasis on training within industry, not only in respect of new entrants, but also for experienced workers and management at all levels. This is further emphasised by the continuous rate of technological change, the need to keep abreast of new developments and the clear indications that because of lack of training productivity does not compare favourably with other countries.

Industrial training differs from normal school education in two respects, namely, it is short and it is utilitarian. The length of training will normally depend on the complexity of the job itself, but will usually be completed within one month. The training is limited to one or two jobs which the trainee will ultimately perform under factory conditions and at a predetermined pace.

No business can operate successfully without planning and efficient training instructions. To plan effective training, an appreciation should first be made of the organization's training needs along the following lines:

Study of needs. The aim is to produce a plan showing the members to be trained in different types of work, the standard to which each worker should be trained, and the priorities for implementing the plan. There are a number of factors to be considered, for example, age, labour turnover, and changes in production methods, machinery and processes.

Policy decision. The top management of the organization should decide what the training priorities will be and then make this clear to all sections of management, particularly at OOUR level. Otherwise they will not know what the priorities and aims are and will be unable to co-operate in their implementation.

Preparation of training specifications and programme. Teaching will be found by a comparison between what the worker needs to know for effective performance and the knowledge of the job likely to be known by potential trainees.

B. Organizing a training programme

The steps involved in planning a training programme are outlined below.

Job requirements

Description

The purpose of the job description is to define the job itself as fully as possible in terms of what has to be done and how it is done. It must be written on the basis of direct observation of the job being performed, to ensure that no important features of the job are omitted.

The job description therefore consists of a broad statement of the purpose of the job and its scope, duties and responsibilities.

Analysis

The job, having been outlined in the job description, must then be broken down into its detailed content. The purpose of the job breakdown is to establish how the skilled operator performs the job. This can best be done by preparing a rough, step-by-step list of the operations in sequence. This may be prepared "off the job" with the assistance of a skilled operator. This list must then be checked "on the job" and revised where necessary to ensure that nothing has been left out, the sequence is correct, and actions are correctly described. The detailed steps are then grouped in logical stages for purposes of instruction.

Specifications

The job specifications provide a statement of what exactly has to be learned. For this purpose, it is useful to make a distinction between skills and knowledge. Skills are the means by which the worker actually does the job. They are usually physical acts such as operating a stapling gun, setting a machine etc. Knowledge is the background which enables the worker to take

decisions when applying his skill (for example, the nature of the material which he is working, the theory of measurement, or the use of the finished product). A study of the job analysis will enable a list of skills and knowledge to be compiled, and this is the basis of the job specification.

Whenever possible, standards should be applied to each item of skill and knowledge and these should be precise. For example, it is not sufficient to say that seams should be sewn to the satisfaction of the supervisor. Instead, it should be stated that in sewing straight and curved seams to defined patterns, the permitted margin of error is ± 2 mm for certain materials. The amount of definition needed will vary with the job, but it should include everything that is important in terms of quality and output. At this stage the skill and knowledge which the trainee already has must be considered. This can be compared item by item with the skill and knowledge stated in the job specification. The difference will be the training specification, or statement of what has to be taught if the required standard of performance is to be reached. This is the information used to compile the syllabus and training programme.

Syllabus

A detailed syllabus covering the subject to be taught and the time required has to be prepared for each job. It is important that the time allowed is the time required and not the time available.

The detailed syllabus is prepared in the following manner. The items in the job specification are listed in the order in which they will be taught. The time thought necessary to instruct to the standard required is allowed for each item. How, where and by whom instruction is to be given is stated for each step. It should be noted that knowledge is normally gained by reading, watching or listening (explanation), while skills are gained by explanation, demonstration and practice. Time is allowed for likely interruptions, for example when essential equipment is not available, or rest periods are taken.

In the case of long training periods, such as that involved in a craft apprenticeship, many jobs are involved. Each job requires its own syllabus. These may be summarized on a block syllabus to show the time required to teach each job and the total time required for training.

Timetable

The final stage is to arrange the lessons to be taught in a logical sequence related to the availability of equipment. From this, weekly or daily timetables are worked out, so that instruction proceeds in a logical order.

At first the time required to teach each stage of the job will be estimated. As training experience is gained and instructors become more proficient, it will be possible to set accurate target times for training. The time has then to be divided into two categories, namely time spent under direct construction and time spent gaining planned experience.

The former is the period during which the trainee requires the full-time attention of the instructor. The latter takes into account the fact that once the trainee has gained skill and knowledge he will have to practice until he reaches the required standard of the fully experienced worker. He will require less and less supervision and to an increasing extent will be productive.

Instruction will usually start with the tools and materials to be used. Following this, their use on job elements will be taught until the complete job is built up. In compiling the timetable it is important to note the following points:

(a) Additional periods to cater for slow progress or other interruptions are best grouped at the end of the syllabus;

(b) The introduction of too many new subjects together should be avoided. This may confuse the trainee. Variety can be obtained by changes in the method of presentation, or by spending a short period on a background subject;

(c) Allowance should be made for initial training at something approaching the speed required in actual production. At the end of each stage or in the case of lengthy training periods, perhaps weekly, it is best to make some assessment of progress and capability.

Instructional plans

The instructor must decide how he is going to teach the trainee and will therefore need to prepare detailed plans for each period of instruction. The most common methods of instruction are as follows: lessons, which include practice; lectures, which are more formal and more suited to the imparting of background technical knowledge; demonstrations, exercises and practice (this is particularly suitable when teaching special skills); and films or film strips.

It is important that trainees should take an active part in training. This serves four purposes: skills which involve action can only be learned by practice; it will help to maintain the trainees interest; it is only from demonstration by the trainee or a feedback of knowledge that the instructor can confirm that the lesson has been learnt; the trainee must be able to see that he is making progress.

Points to note when planning an instructional period include the following: tools and materials should be listed so that they can be checked before instruction starts; revision of previous instruction should be allowed for; teaching should be conducted in limited stages, each complete in itself; the aim should be to achieve experienced worker standards at each stage; the various stages should be linked until the job is complete; training should be designed to ensure that experienced worker standards are maintained over lengthening periods; time should be allowed for correction and questions; vital points should be emphasized and revised; an attempt should be made to end each period with a test. The foregoing provides a means of easuring the progress made against the standard to be reached.

Examples of a job analysis, job specification and syllabus, together with job descriptions of a production director and furniture technician, are given in annex V.

C. Implementing the training programme

Training of workers for all levels should be carried on throughout the country and should be the responsibility of an independent training authority set up specifically for that purpose. The size and scope of the wood and woodworking industries in BiH would justify these industries having their own training board.

The responsibilities of this board may be summed up as follows: evolving policy - financial, administrative and technical - on industrial training; directing and monitoring training activities; establishing liaison with other training and educational authorities; planning future training development; and supervising the work of a full-time training institute.

The board would operate within the framework of the self-management system. The day-to-day industrial training activities designed to ensure the implementation of the policies adopted by the training institute would be carried out at working organization (RO) level, and ultimately at factory or plant (OOUR) level. This is schematically illustrated in figure II.

Industrial Training Institute

The Industrial Training Institute would be established on a full-time basis, and would have its own director and a staff of experienced technical and administrative personnel. The duties of the Institute would include the following:

(a) Collection, collation and recording of statistical data concerned with industrial development, employment, industrial training and education in BiH;

(b) Preparation and supervision of industrial training programmes in factories and at appropriate technological training schools;

(c) Carrying out special training programmes concerned with technical and management training;

(d) Organizing special courses and training programmes for factory personnel concerned with new technological developments;

(e) Advising on syllabuses for the technical training of engineers, technicians and others;

(f) Remaining abreast of the latest technological advances in the wood industries;

(g) Providing a technical information service to the factories in collaboration with the technological institute;

(h) Co-operating with medium- and high-level educational institutions in the exchange of technical services and facilities;

(i) Maintaining close relations with other industrial training institutes in Yugoslavia and abroad.

Training centres at RO level

Training centres would carry out at working organization level the programmes prepared by the Training Institute. Each RO would be responsible for training in its own OOUR, and, to do this effectively, would have at least one training officer, an experienced engineer or technologist, appointed for that purpose.

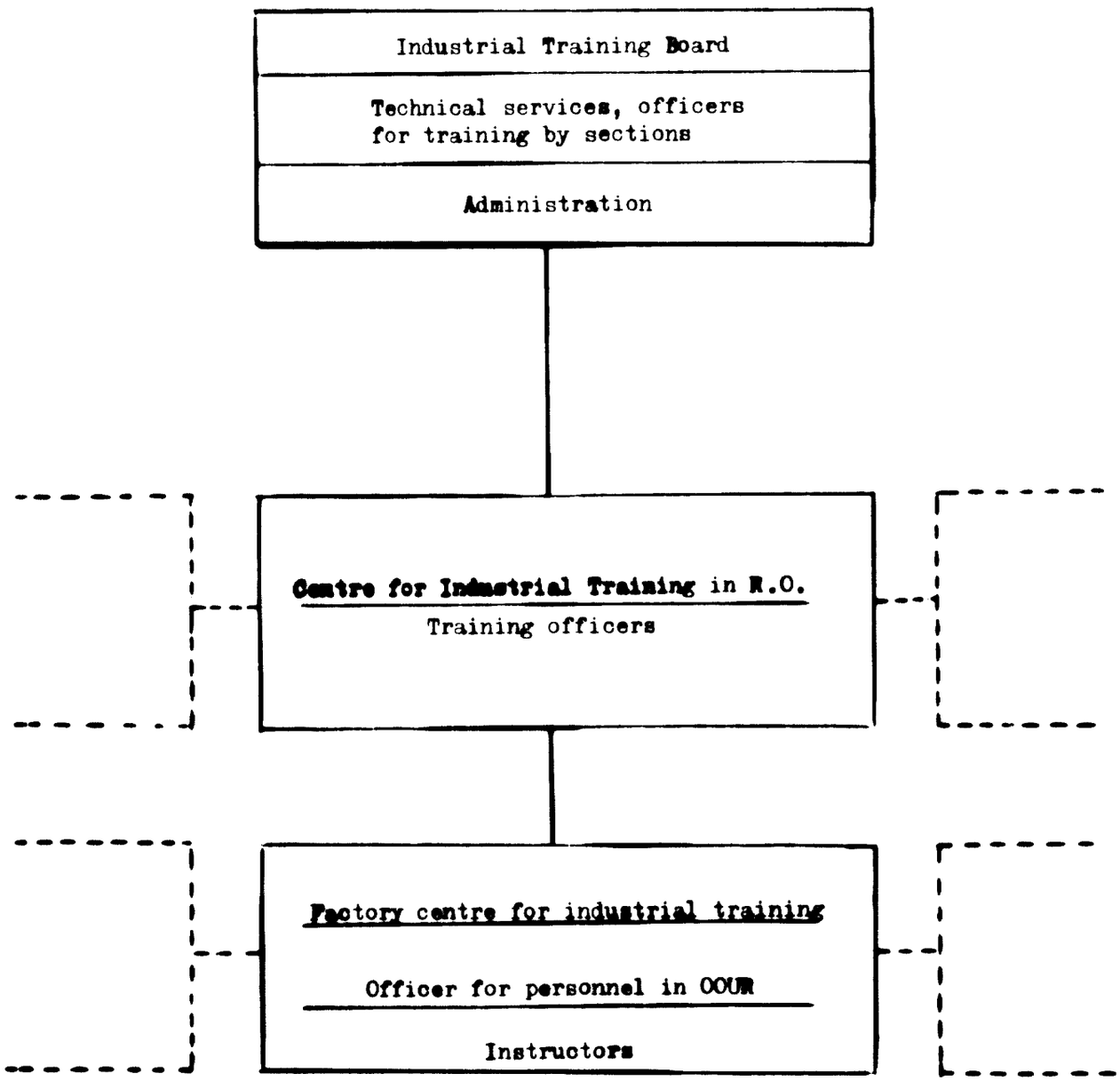


Figure II. Industrial training organisational scheme

The main functions at RO level would include the following: collection of data from OOUR concerning employment and training needs; preparation of training programmes; selection and placement of personnel; liason with the Industrial Training Institute; co-ordination of activities with other educational and training establishments; arrangements (financial and others) for the transfer of workers to specific training locations; liason with RO IRC and its various departments concerned with industrial development, factory establishment and training for all levels of personnel; improvement of existing training programmes and training facilities.

Factory training centres

Each factory should have its own fully-equipped training centre staffed by experienced and qualified instructors. For some sectors of the industry, or where the factory is too small to have its own training workshop, it may be possible and practicable to share common training facilities, especially when participating factories are close to each other. The main functions of the training centres at OOUR level should include the following: provision of direct training both to the newly-employed and to workers of longer standing; provision of training instructors and all essential training facilities; careful integration over an appropriate period of all trainees into full production; maintenance of good working and safety conditions; setting of periodic tests relating to skill requirements.

V. FOLLOW-UP ACTION

A. International co-operation

The expert recommends that further international assistance in the field of furniture production should be provided along the lines recommended in this and in previous reports. Assistance should in particular be directed towards two working organizations, namely RO Kozara and RO Vrbas.

In the case of RO Kozara, it should involve the following: product rationalization and design engineering; factory layout and replanning of individual work stations; internal factory organization, including materials handling and internal transport; introduction and establishment of production planning and control system, including product development and all appropriate documentation; establishment of quality control procedures, including physical aids to accurate production; introduction of up-to-date technology in upholstery production; familiarization of management staff with work study techniques applicable to furniture production; establishment of training programmes in new school furniture plant.

In the case of Vrbas, it should include the reorganization of the upholstery OOUR, involving plant layout, introduction of up-to-date production technology, product rationalization and standardization, production programming and quality control.

The programme in both RO could be carried out during a two-month mission and would be similar in methodology to that carried out in RO SIPAD - Majevica.

B. Study tours

Study tours should be organized for selected production personnel from the various OOURs. Subjects of study and some countries where tours could be organized are as follows: chair, table and upholstery factories in the Federal Republic of Germany, France and the United Kingdom (two-week period); furniture materials and woodworking equipment in the Federal Republic of Germany (two-week period); industrial training organizations and training institutes in the Netherlands, Scandinavia and the United Kingdom (one-week period); research institutes concerned with quality standards and product testing in the Netherlands, Scandinavia, particularly Norway and Sweden, and the United Kingdom.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

1. Management at all levels in the furniture industry is relatively inexperienced and therefore does not function as effectively as it should. This is particularly evident in the lack of direction at top management level, and results in those at lower levels feeling leaderless and sometimes frustrated.

2. There is much more that individual OOURs can do to make their plants efficient and profitable.

3. The exercise of management control in relation to the design function is not done effectively.

4. The level of technology in upholstery production is low and the end-product is consequently unnecessarily expensive to produce.

5. Upholstery factories need more advanced equipment, and there is plenty of scope for the sharing of certain production facilities.

6. There is a continuing need for upgrading the quality of end-products and for the establishment of quality control procedures in each plant. In this connexion, the Institute of Technology at Sarajevo has yet to make its full contribution towards a solution of this problem.

7. There is little evidence of a planned approach to quality control at individual plant level, and, in consequence, the reject rate is high or repair time excessive.

8. Industrial on-the-job training is largely carried out on an ad hoc basis by some OOURs, but there are many others which provide no training. The absence of such training for all levels of personnel is reflected in lower productivity and the unsatisfactory quality of finished goods.

9. There is little if any documentation available concerning national or international standards relating to materials and technology in furniture production.

10. Rationalization of design and production at working organization level is still neither fully understood nor appreciated. This aspect of development is not receiving sufficient attention or support from the service and consultancy sectors of SIPAD.

B. Recommendations

Many of the recommendations made by the expert in previous reports, though still valid and requiring immediate attention, are not repeated in this report. Those which are included refer in particular to the activities carried out during the mission and to their relevance to the industry as a whole.

Factory reorganization

1. Individual OOURs should recognize that factory reorganization and development is an integral and continuous part of the management function. This reorganization may on occasion be of a general nature, but most often will be related to a particular department or work station, and should always have a specific objective to be achieved within a given time.

2. The reorganization work should be preceded by a careful analysis of the subject matter based on the principles of method study and work measurement. Production management personnel should therefore be familiar with these techniques, particularly in their application to furniture production. They should also be given refresher courses in them from time to time.

3. A primary aim of factory reorganization should be to make better use of existing resources, and further investment in new machinery and equipment should only be contemplated as a last resort.

4. If it is found necessary to employ a team of outside consultants, the management should prepare and monitor the implementation of a reorganization scheme on the basis of which the consultants should work.

5. When changes in systems and procedures are being introduced as a result of a reorganization programme, account should be taken of the need to maintain full production during the period of the change, to inform fully everyone involved, and to ensure that adequate training is provided in the new techniques.

6. Engineers should endeavour to adapt standard machines and equipment to satisfy special design needs or highly individualistic processes.

7. Effective documentation concerned with systems and procedures should always be maintained. This would make it possible quickly to alert management to potential weaknesses in the production cycle and to ensure remedial action without delay.

8. Reorganization should not only be concerned with the physical means of production, but also with the products themselves in terms of quality and value analysis.

9. Since the level of technology in upholstery production is low, engineers and others involved in the direction of production for this range of products should receive further training in it, and avail themselves of the opportunity to undertake studies abroad on up-to-date technologies in upholstery production and equipment. They should also visit factories where such equipment may be seen in production conditions.

10. There should be established procedures for the pre-setting, setting-up and maintenance of machines. In this connection the possibility of sharing production facilities should enable high performance machinery to be purchased at considerable cost benefit.

Design management

11. Design management, as an integral part of the design programme, should be treated as any other aspect of management. It is best exercised by a senior executive who should be in neither the design nor the production function. Effective design management will ensure that the design programme is carried out efficiently, economically, and within an agreed time-table, and that it incorporates appropriate marketing, materials, structural, functional and quality characteristics.

12. The prototype of the design programme is the design model, which should be put into production initially on a limited pilot basis, and subsequently into series production.

13. Design management should also include such considerations as packaging design, labelling and point-off-sale presentation.

Quality standards

14. There should be a systematic approach to the introduction and establishment of quality standards in every plant and they should extend to every aspect of the plant's activities.

15. Those responsible for quality control should provide and co-ordinate a system which ensures that it will produce an optimum quality product at minimum product cost.

16. In order to achieve suitable quality standards, the standard specifications incorporated in this report should be understood and consistently applied.

17. At individual factory level, effective quality standards should include an inspection system of incoming materials and at various stages during the manufacturing cycle.

18. Dimensional control and surface quality control should be an integral part of a quality standards system. This should be achieved through an effective tool and gauge control system.

19. There should be a master part for each component in production, which, together with a full-size working drawing, should be the basic standard for deciding on appropriate tolerances.

20. The ad hoc committee which worked with the expert on the preparation of a handbook of quality standards should be appointed on a permanent basis. It should be further strengthened by the inclusion of additional members from SIPAD and Vrbas top management as well as the OOURs. The work to be carried out by this committee will be a development and a detailing of that undertaken during the assignment referred to in this report.

21. There should be a library of standards concerning furniture and furniture technology at the Institute of Technology at Sarajevo. This library should be available for the work of the standards committee referred to and all relevant standards should be translated into Serbo-Croat.

22. The handbook produced during the current assignment should be regarded as a first draft for consideration by the industry, and should receive further detailing and amendment on the basis of the reaction of the industry.

Industrial training

23. Industrial training is an integral part of the policy of a manufacturing organization and should be regarded as such by both SIPAD and RO Vrbas. The practical implications of this are that there will be established procedures for every aspect of industrial training and that responsibility for carrying them out will be delegated to those who are qualified to do so.

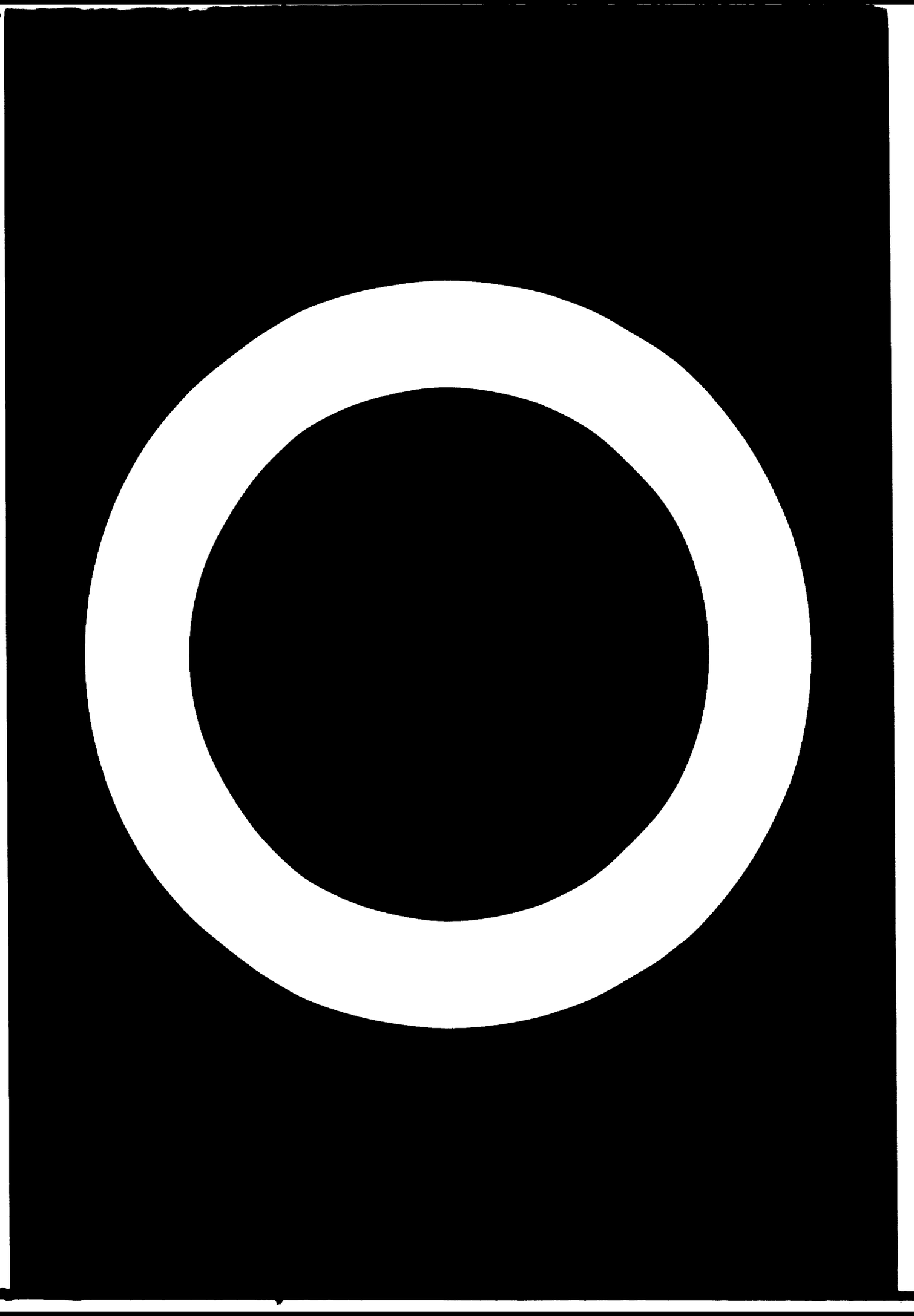
24. Training should be regarded as one of the best means of increasing the profitable use of manpower. It should therefore be based on a careful assessment of training needs, which in turn is directly related to the insufficiency of personnel with adequate skills, or to the ineffective use of the knowledge and skill of existing personnel.

25. Industrial training should be established on a nation-wide basis, and in the case of BiH should be concerned specifically with training in the wood industry. Hence there should be an Institute for Industrial Training in the Wood Industry, which should be concerned with preparing and monitoring training programmes for all levels of personnel in all aspects of primary and secondary woodworking. This Institute should be directed by a board of management representative of all sectors of the industry and of the various training institutes. There should also be special training committees for the sectors of saw-milling, joinery, furniture and board production; the OOURs should have adequate representation on these committees.

26. The training institute should be staffed with personnel who are fully experienced in all aspects of production and production technology, and in preparing and supervising training programmes. It should work closely with, but be separate from, the technological institute.

27. The ad hoc committee which worked with the expert on industrial training should be appointed on a permanent basis and should be further strengthened by the inclusion of additional members from the OOURs of each of the sectors referred to. The committee should be given the task of preparing detailed proposals for the establishment and implementation of industrial training along the lines recommended in this and previous reports.

28. Further international assistance should be sought in carrying out work arising from the foregoing recommendations.



Annex I

INTERNATIONAL FURNITURE FAIR, COLOGNE, 1978

On 16 January 1978 the SIPAD organization sponsored a trip to Cologne, Federal Republic of Germany, by a group of engineers and other management personnel from the furniture industry in BiH to attend the Sixteenth International Furniture Fair.

The visit had earlier been recommended to SIPAD by the expert, who was appointed to lead and advise the party during the period of the fair. The object of the visit was to acquaint marketing design and production personnel with the latest trends in furniture design and production, with particular reference to the following: product rationalization; raw materials selection and utilization; developments in carcass and frame construction; appropriate plastic and metal movements and fittings; upholstery materials techniques and equipment; quality standards.

Findings

Design

Competition throughout the industry in Western countries continues to grow. An immediately evident result of this was the high standard of design achieved by most exhibitors. In consequence, there is now a vast choice of attractive, well-designed furniture being offered the consumer. Prices were also keen, further reflecting this competition.

The names of the designers were almost always featured on the furniture on display.

The trend towards almost total rationalization of models and components was also manifest. Thus, within a given range many models had interchangeable elements, and in some instances this was achieved in such widely varying items as tables and chairs.

The tendency towards lighter and more elegant styling continues without any sacrifice of strength of stability.

The functional aspect of design also appeared to have received further attention, and furniture, in addition to having a pleasant appearance, also fulfilled its purpose of seating more comfotably or storing more adequately.

Furniture was generally lighter in weight and thus more mobile. Whenever practicable, furniture was fitted with castors for easy movement.

The large and cumbersome wall unit with its integrated elements is now being replaced by a more flexible system enabling greater individuality of design and lay out.

A feature of corpus furniture was the softening of flat surfaces and straight edges by increased usage of "plant-on" and fixed mouldings (both wood and plastic) and metal and plastic accessories.

Everywhere there was greater emphasis on craft aspects of furniture design as a means of achieving a high degree of individuality.

Colours for upholstered furniture revealed a marked tendancy towards lighter shades, varying between white and yellow, and sand and salmon-pink.

The separation and division of the surfaces of upholstered furniture was given greater emphasis by seams of varying shape and intensity.

Many firms showed ranges of bedroom and living-room furniture whose designs were inspired by peasant and rustic traditions.

There was also evident considerable growth in the number of firms exhibiting panels and panelled room dividers incorporating storage and shelving areas. A feature of this panelled work was its prefabrication and ease of fitting.

The upholstery "set" or group of seating elements still continued to predominate, and, with the emphasis on lightness and mobility, two-seater settees continued to be in greatest demand.

It was also evident that manufacturers were paying increased attention to health aspects of furniture production, especially in beds, many of which incorporated slatted frames and adjustable head and foot sections.

There was increased use of solid wood and veneers for the facing panels of kitchen units, while plastics showed their versatility in surface shapes and interesting designs and colours.

Many kitchen manufacturers also had related bathroom furniture on offer, showing how this sector of the industry is diversifying.

Children and "teen-age" furniture showed the most dramatic and interesting changes and developments. The corpus ranges were more functional and flexible, with such features as convertibility, extendibility and well-thought-out space-saving combinations of living-room, bedroom and work-room functions coupled with hard-wearing surfaces.

Raw materials

Wood was more firmly entrenched as the major raw material of the industry in both its natural and reconstituted state.

The most important species were oak, mahagony, teak, ash and beech, particularly for medium-priced furniture, while rosewood is still the most important of the more exotic hardwoods.

Light-coloured conifers, particularly pine, were used to a considerable extent in the production of contemporary functional styles, especially those derived from rustic or peasant sources.

Because oak and ash lend themselves to staining, much of the furniture made from them was finished in such colours as green and deep red.

There was evidence of a very definite increase in furniture manufactured from fibre-board.

Plastic and metal fittings continue to play an important but secondary role in production.

There were many variations of the studio-couch or convertible to be found incorporating a variety of springing and mechanical movement systems. All were characterized by ease of operation, lightness and strength, and enabled the production of a much more attractive and usable product than that produced at present in Yugoslavia.

Covering materials for upholstery were mainly high-quality closely-woven flat fabrics as well as rayons and velours. Patterns were small and more refined with a definite gobelin influence.

Plastic laminates in an assortment of colours and textures and superbly wood-grain-simulated polyvinyl chloride foils were much in evidence in kitchen, living-room and bedroom furniture.

Technology

Furniture produced from veneered particle board showed the greatest concentration of innovative technology. This was particularly evident in veneering and edge-treatment, where the efforts made to depart from austerity of flat panels was best achieved by accentuating characteristics of fine craftsmanship.

Knock-down techniques as a means of construction and assembly were much in evidence and reflected the increased harmonization between the demands of production technology and design. Plastic and metal fittings have been simplified and improved to the extent that they are now worthy successors to the more traditional types of construction. Knock-down techniques have also been extended to the production of solid-wood furniture, particularly dining-room chairs, tables and show-wood seating. The fittings are simple and robust, and, because they allow for final assembly at the point of delivery, enable considerable savings in packaging and dispatch.

Surface seatings, including laminates and foils, are finished in matt and satin, and the high-gloss finish has practically disappeared. The materials were mainly polyurethanes and acid-catalyzed lacquers.

Many manufacturers had incorporated wood bending and laminating particularly for chair elements with compound shapes.

There was good variety in the ranges of finished chairs, but closer examination revealed high usage of standard and common elements.

Ranges of seating on show, with the exception of traditional designs, reflected the continuing trend towards further simplification of upholstery production techniques. This sector of the industry, with the exception of cutting and sewing, now involves chiefly a component assembly activity and the possible use of a bewildering variety of systems of cushions and cushioning, springing and webbing, with special accessories enabling simplification of boxing, seaming, quilting, buttoning and stitching.

Leather technology and its application in upholstery production was a particular feature especially in the exhibits from the Federal Republic of Germany, Italy and Scandinavia.

Quality standards

Standards of workmanship and finish were generally found to be high throughout the entire fair.

Many exhibitors stated in their promotional literature that their products were manufactured to quoted national and international standards.

Some furniture carried a special quality mark given it by the relevant national bureau of standards.

All furniture had some form of guarantee covering repair or replacement within a reasonable period.

The expert was informed by many exhibitors that the emphasis on high standards was perhaps more the result of improved living standards and keener competition among producers, than the imposition of formal standards by a statuary organization.

Generalities

Despite the continuing economic recession, the furniture market in Western Europe remains fairly bouyant.

Design and styling continue to improve and overall standards of workmanship and finish are extremely high.

There is a definite trend towards the production of craft-accentuated furniture indicating greater added-value at sources.

The use of wood has, if anything, increased, with oak, beech, mahogany, ash and pine being among the more popular species.

The austere lines which have up to recently characterized much corpus furniture are now being softened by greater use of moulded and rounded surfaces.

Upholstered furniture is recording the largest increase in sales and is closely followed by kitchen furniture.

Most corpus furniture is manufactured and assembled using knock-down techniques, and there is increasing use of such systems in solid-wood furniture production.

Wood bending and lamination also feature prominently in chairs and show-wood seating.

The production of bathroom furniture has now been added to that of kitchen furniture.

There is a considerable increase in the use of leather in upholstery.

Productivity continues to be high in the industry in the Federal Republic of Germany. For example, in a kitchen factory visited during the period of the fair, a total of 250 employees produce 1,000 units in a single eight-hour shift.

There appears to be excellent sales potential for SIPAD-produced chairs and seating provided standards of design and quality are introduced and maintained.

Annex II

DIMENSIONAL CONTROL

Control of quality in wood-machining operations

Dimensional control and surface quality control can generally be made more effective in most operations if certain basic concepts are understood and if proper organization for quality is instituted.

The prevalent belief among woodworking personnel that close tolerances are applied only in the metal trades and cannot be applied to woodworking is a most serious deterrent to obtaining effective dimensional control. Much of this is a carry-over from the craft type of manufacturing, where extensive hand fitting was considered normal and necessary. Facts indicate, however, that relatively close dimensional control can be obtained with modern, well-maintained woodworking equipment.

If tolerance is to be considered in wood-machining operations, knowledge of the basic accuracy and precision of the equipment to be used is necessary. This can best be determined by calculation of the standard deviation of measurements taken on successive pieces produced by the equipment.

Dimensional variation from equipment such as moulders, tenoners, ripsaws, and planers - assuming they are first-class pieces of equipment and are well maintained - will be generally found to stem from two sources:

(a) Machine variation. The dimensional variation reflected in successive parts coming from the machine in the same set-up;

(b) Set-up variation. The differences from set-up to set-up in the departure of the average part dimension for a set-up from the nominal or specified dimension. These differences reveal not only the ability of the set-up man to obtain from the machine the dimension he wishes, but also the quality of gauging equipment available to him, and the accuracy of the adjusting mechanisms on the machine.

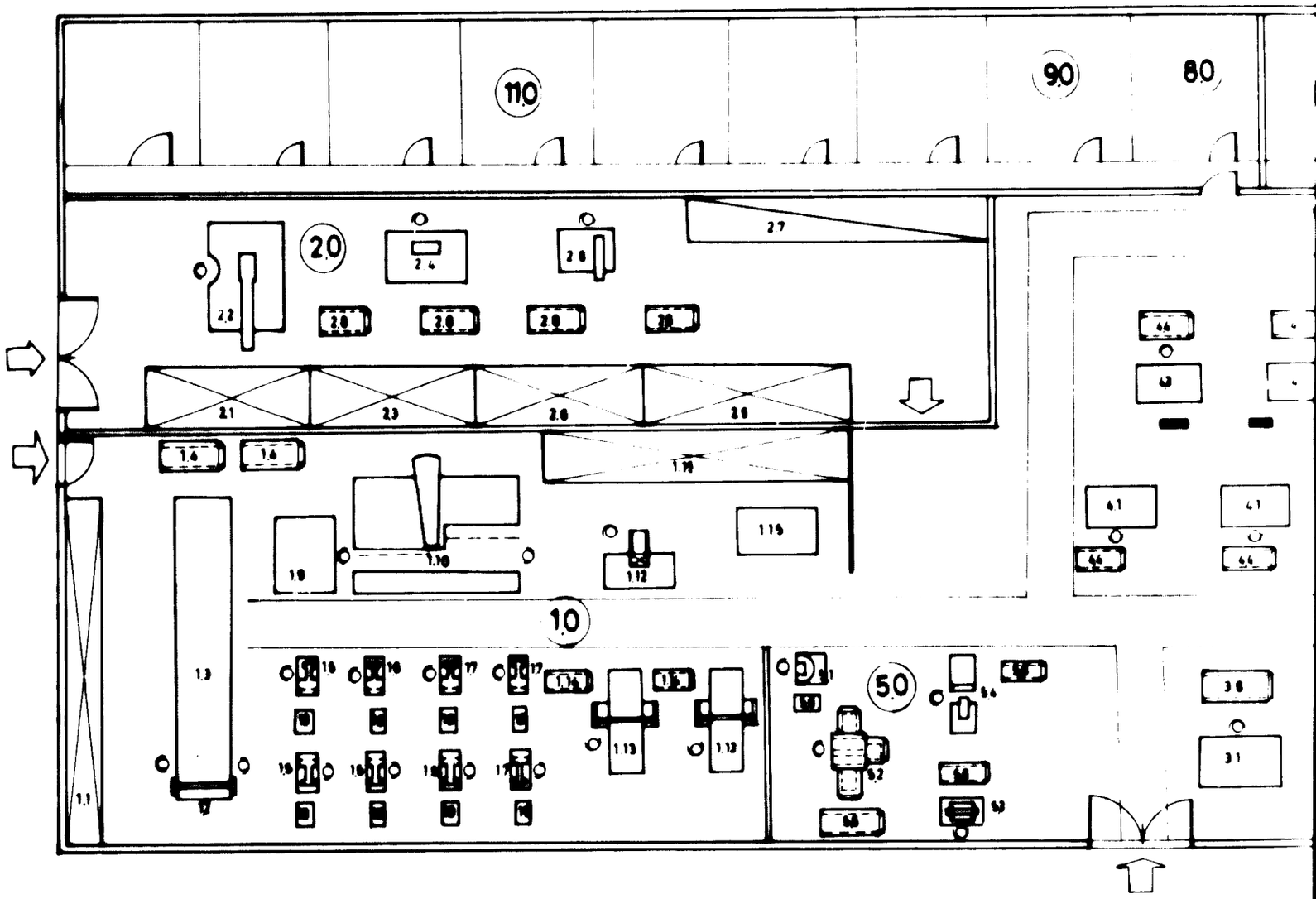
Control of tools and gauges

The quality of a product depends, to a large extent, upon the accuracy and reliability of the tools, gauges and test equipment used in the manufacturing, inspecting and testing operations. Tools and gauges provide the physical means

of attaining volume production and at the same time the manufacture, inspection and testing of parts, components and assemblies to the required degree of uniformity.

To ensure that tools are capable of producing uniform parts and that gauges will control the dimensional and functional characteristics of the product within prescribed tolerances, it is necessary that they be initially inspected and tested in relation to specification requirements. New, modified or reworked tools and gauges must be inspected and evaluated with reference to the tool or gauge drawing as well as to the engineering drawing for the part prior to release for service.

An effective tool and gauge control system cannot exist without precision control over the basic standards and measuring and calibrating instruments that are used to determine the accuracy of tools, gauges and test equipment. Precision gauge blocks, masters, setting gauges, length measuring rods and similar items form the basis of control over dimensional inspection equipment. Standard cells, dead-weight tests, manometers and similar items form the basis of control over functional testing equipment. Without accurate reference standards, inspections and calibrations of tools, gauges and test equipment are of little value.



SECTION 1

Annex III

BRCKO REORGANIZATION PLAN

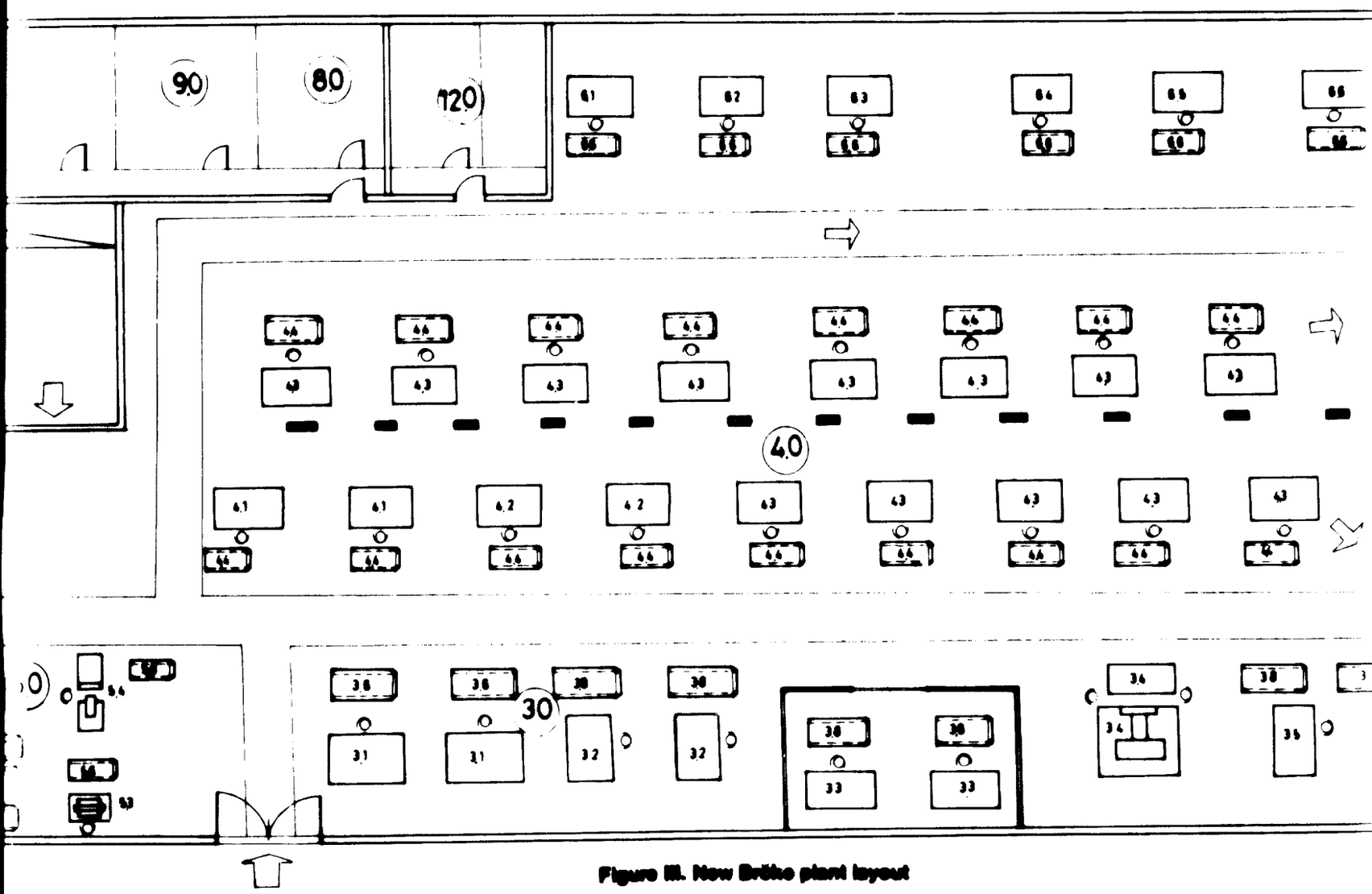
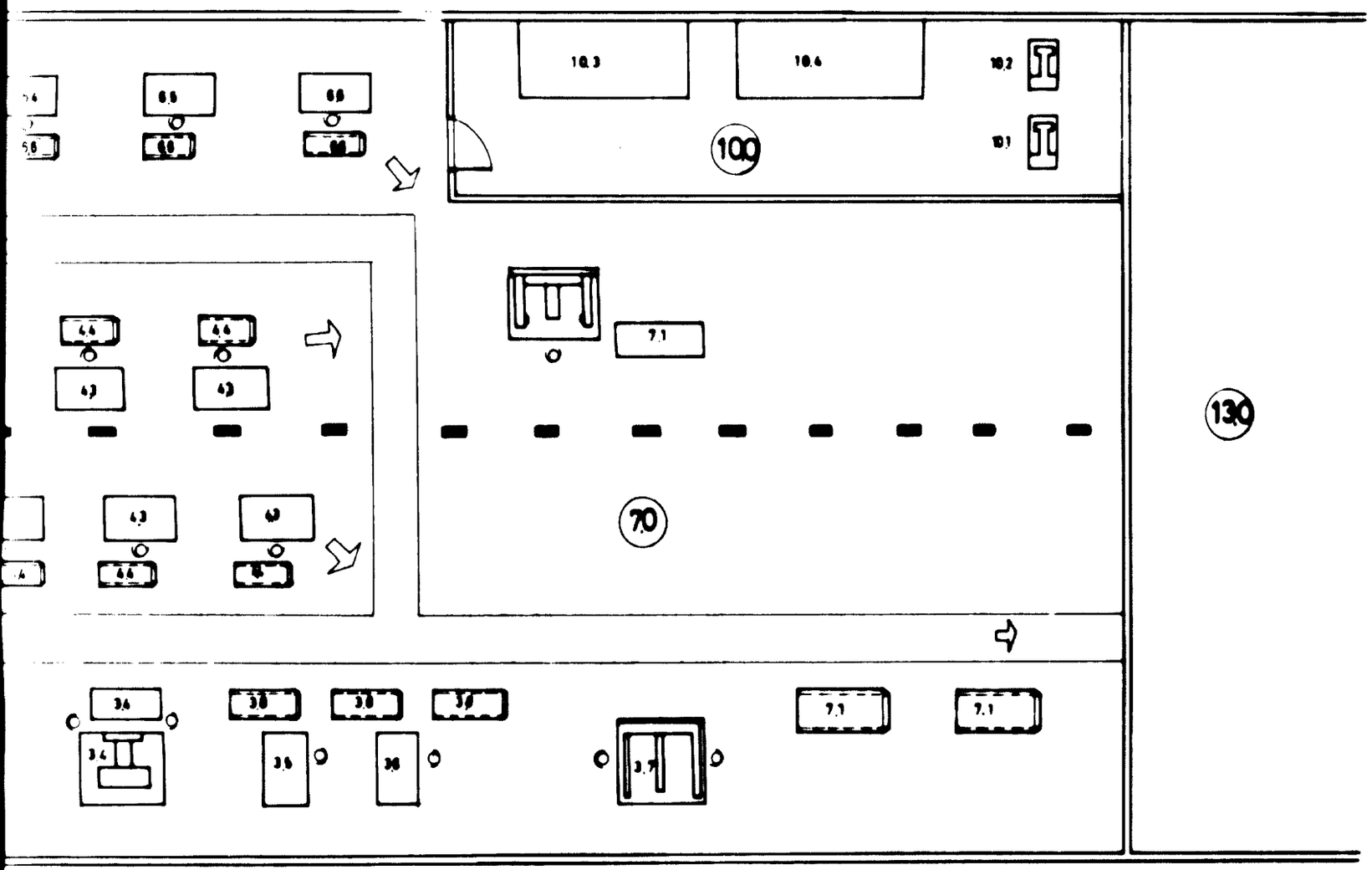
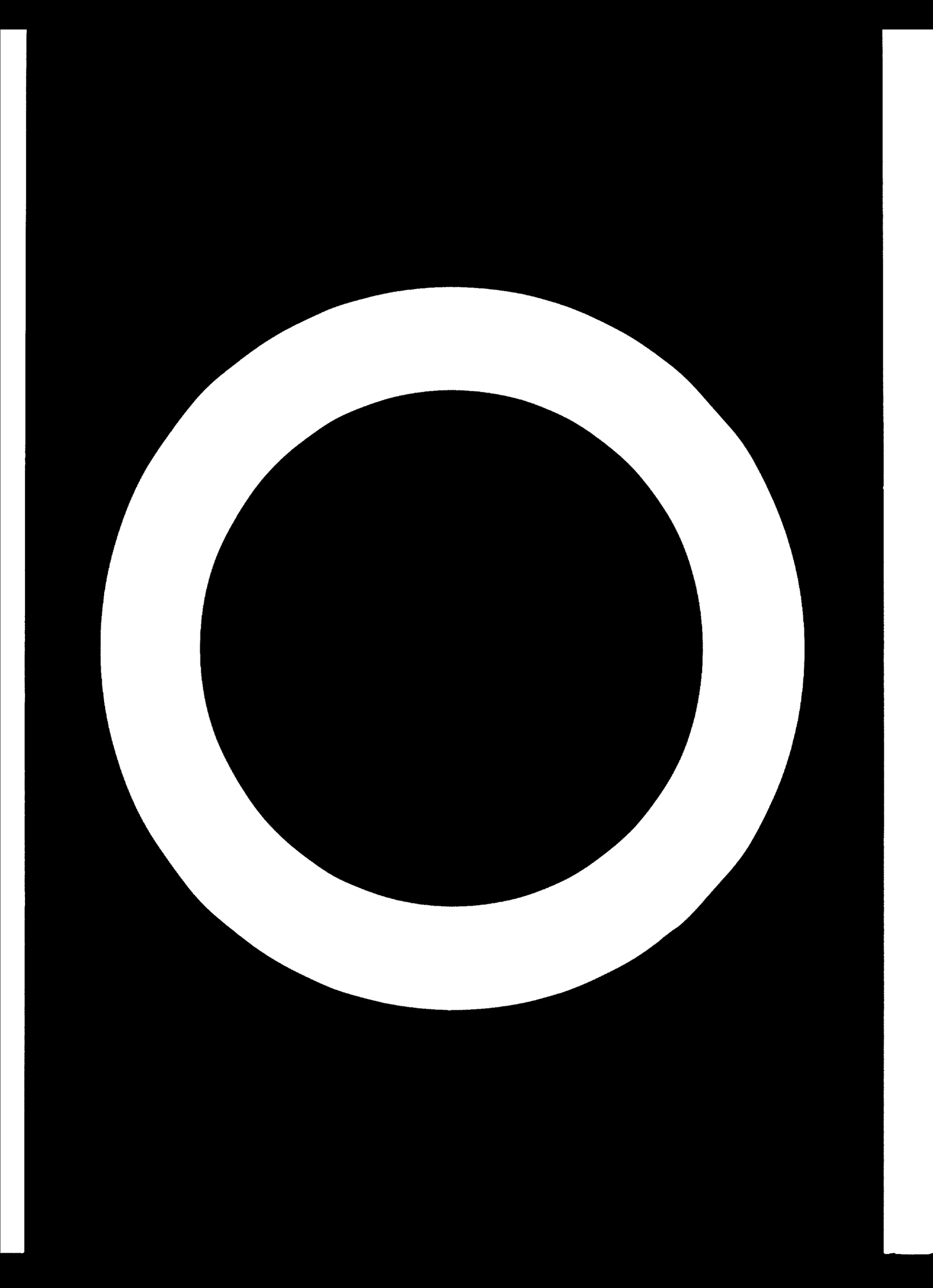


Figure III. New Brčko plant layout

SECTION 2



SECTION 3



Annex IV

MANAGEMENT OF DESIGN AND DESIGN DEVELOPMENT

Design management

This is the function of defining a design problem, finding the most suitable designer and making it possible for him to solve it on time and within an agreed budget. To be effective, the management should rest squarely on the shoulders of one person who will have the authority and backing from the enterprise to plan and carry through design programmes. This person is usually known as the designing manager.

Systematic design method

All design programmes can be beneficially guided by a basic sequence of events which must be agreed on at the outset. The development programme must be "on target" and the product "right the first time". This is best achieved by indicating the series of studies and reports to be built up step by step until a project brief is formed. This is the enterprise's working document and from it is derived the designer's brief.

Goal or objectives

It is important to write down and secure agreement for the ultimate goal to be achieved. If possible, it is best to define this by describing the criteria by which the design will be judged. With this clear statement of the aim of the enterprise it is now possible to formulate the method and agree on how and by whom it should be carried out.

Method

It is important to determine at the outset who is responsible for approving each stage of the project. If it is the Director, it should be determined to whom and in what circumstances this function may be delegated. If it is a committee, its terms of reference should be defined. Who is to create the project brief and co-ordinate the work? This is the function of the design manager, whose job description should be defined and made known together with a statement determining the degree of priority to be accorded by everyone to the project. The design manager then holds an open discussion for all concerned in the project in order to hear all their suggestions. This will include the managers of production, sales, marketing and those directly involved in creating the designs.

Planning

Planning is the responsibility of the design manager. He will first draft a timetable, working backwards from an agreed date, on which the product should be launched on the market. In doing this he will build into the timetable - but not necessarily disclose - whatever safety factors the circumstances permit and he considers necessary in the light of his experience. In general, his timetable would be organized along the lines described below.

On day 2, agreement should be reached on the outline budget for launching the new project. On day 5, all aspects of the project should be described and defined in sufficient detail to disclose any missing information. This description, variously called "new product programme", "feasibility study", or "project appraisal", would become the enterprise's basic project brief. This project investigation and new product programme may be summarized as follows:

Company goals: reasons for undertaking project; achievements expected from project; desirable and undesirable side effects; criteria for judging success of programme.

Product sale characteristics: intended market and product image; features of present brand image for retention; continuity with present products; specific appearance characteristics; present leaders in selected market; methods of promotion and distribution .

Product manufacturing characteristics: preferred and forbidden materials and processes; availability and skill of labour; availability and limitations of machinery; materials (handling and distribution methods); stock or bought-in parts to be incorporated; regulations or standards to be observed; quality control standards

Project administration: responsibility for decision-making and initiating action at each stage; permitted delegation of responsibility; non-executive advisors to be consulted; project secrecy and restriction of information; services and facilities required inside enterprise; outside services and facilities; controlling dates/exhibitions, seasons etc.

Budget: total inception costs; maximum tooling cost; production forecast; amortization rate for tooling and inception costs; allowable total works cost per item.

On day 10, there should be a selection of the product design or designer team and presentation of the design brief. The briefing at this stage will probably be oral, but it is most important that at the end of the session the designer is given a written design brief. This will establish the criteria by which his design work will be judged and will remove the possibility and danger of future misunderstandings. Reliance on the purely oral briefing can lead to differences of interpretation and consequent confusion and loss of confidence.

Design brief. The written design brief would be based on the enterprise's project brief and should set out all the information which the designer will require. The following are the headings which should be included in a design brief: statement of objectives; list of people involved in project; list of facilities available to designer (drawing office, prototype workshop etc.); information on previous and current products; results of market research; timetable for design work; detailed definition of work required; appearance factors; user needs; function; materials and costs; presentation; opportunities and constraints.

Design stage 1. This is the busiest time for the designer. He will have close liaison with the design manager and, more importantly, direct collaboration with the production director.

On day 15, at approximately the mid-part of stage 1, the designer and the design manager would meet for what is a vital discussion. The designer will outline his scheme with sketches. Knowing the enterprise's goal and the meaning of the brief, the design manager should respond accurately to whatever the designer shows him. His job is to convey enterprise reaction, and if the design manager believes that the proposals could be improved, the designer still has time to amend his ideas. Once this mid-stage revision is completed the designer proceeds to prepare his designs in finished form for presentation.

On day 20, the designer's work in the form of drawings or models is presented for approval. In general, it may be said that providing the designer accurately follows the brief, the probability of achieving a speedy and conclusive result increases in direct proportion to the degree of skill with which the presentation is conducted. This is the design manager's role. He must present the facts in a non-biased manner, and see that all valid

criticism is answered or accepted. It is preferable that the designer should come up with only one solution to the problem set. Two or more designs produced in response to a detailed brief which called for one, often suggests confusion somewhere. Furthermore, most designers dislike furnishing their clients with alternatives, such tactics divide their interest and waste everybody's time.

Design stage 2. After the presentation, a few days should elapse to allow the design to be thoroughly considered, especially by the sales and promotion personnel, since there will be no opportunity for them to question fundamentally the direction, the designer has now undertaken. Within three days the design manager should be able to confirm the agreement to proceed and to publish the fact.

Stage 2, which is the production and development stage, then starts. During the early part of this stage, the design manager should concentrate more on keeping the enterprises engineer's and executives to their promises to collaborate fully, and be less concerned with the project's practical development, which is best handled by the production director in liaison with the designer. The design manager therefore keeps a watch on progress, the timetable being his major responsibility at this stage. It will be noted that this annex deals primarily with the job of design management, the technical aspects being given only superficial attention. However, it must be recognized that it is both likely and often desirable, that the design will further evolve during the technical development treatment. Unforeseen improvements can be made to its appearance, function and cost, when the design and the production team together deal with every detail. Inevitably, differing views will have to be resolved and some compromises made. In order to ensure that the enterprise's goal is kept in mind and to respect the timetable, the design manager can act as arbiter if real difficulties emerge.

In all projects a point of no return will be reached. This pertains to stage 2, and should be defined by the design manager very shortly after development work has commenced. After this point has been reached, new ideas, no matter how good, cannot be used in the current design. When the designer and the production director are satisfied that the product functions properly and can be made for the predicted total factory costs, the design manager will register the design if this is appropriate. He will then demonstrate the finished design to the enterprise director, the sales or marketing director

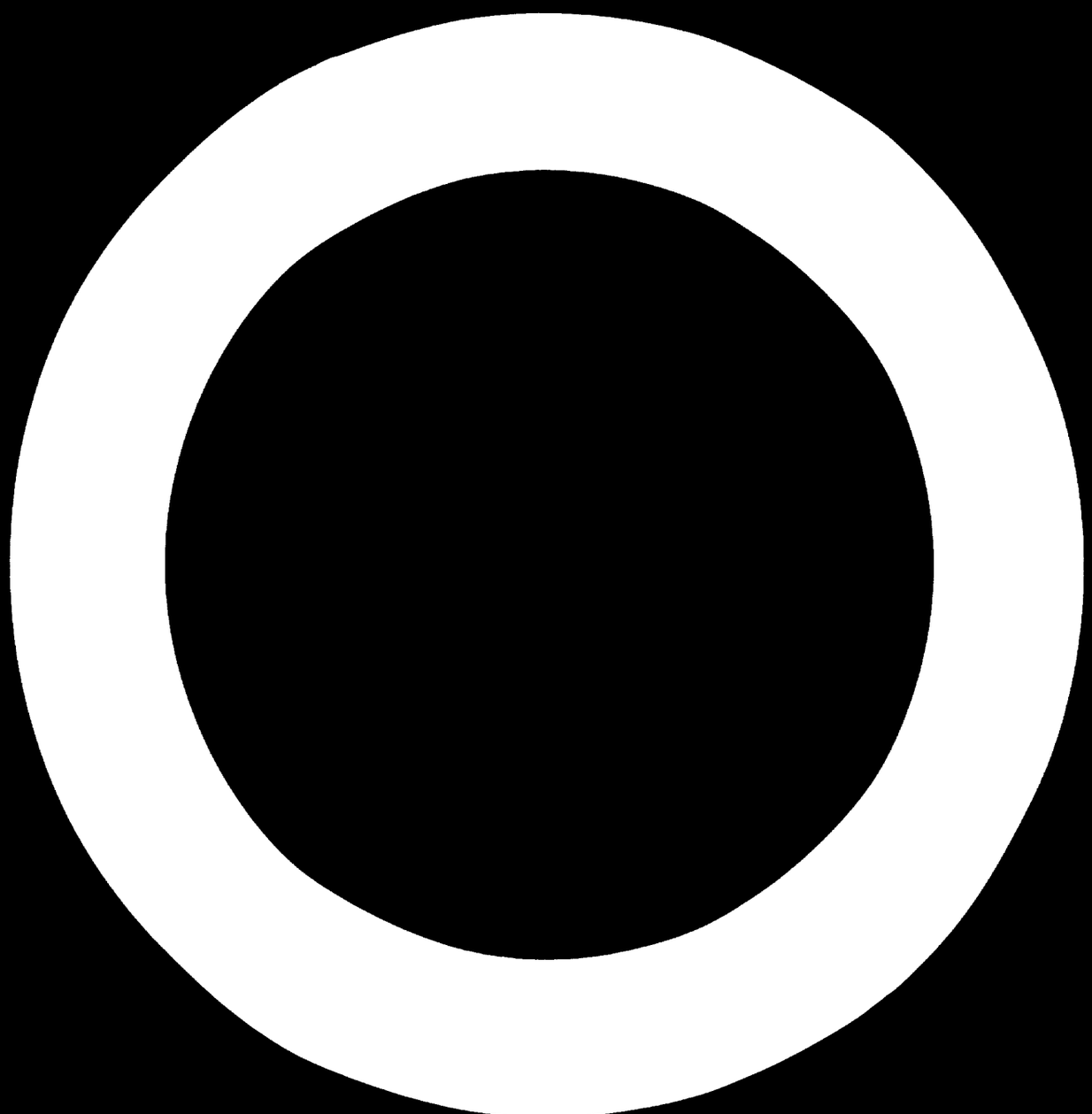
and all those who are going to be concerned in its future promotion. The design manager is also responsible for setting up and conducting "validation studies", or value analyses based on prototypes. Their purpose is to check the suitability and value of the product against all the real life eventualities which the enterprise has the time and facilities to consider. The results of these studies can sometimes lead to improvements which may be incorporated; they can also be useful when compiling handbooks and technical data. When all appropriate personnel are satisfied, the product will be released for tooling and ultimate production.

Design stage 3. At this stage, which in some cases can start as soon as the product has been approved at the end of stage 1, the design manager would be concerned to see that the appropriate advisors consider the design aspects of marketing and retail promotion. The design manager would also have to commission or at best to co-ordinate the design required for packaging, labels, showcards and point-of-sale aids. The enterprise should have a well-thought-out, up-to-date house style, an image of its own which can be used to identify its products. The management of graphic and packaging design programmes should be conducted along the lines sketched out above; the requirements analysed and set down; an appropriate designer engaged and briefed, and the development of designs and their supervision ensured by one person, the design manager. Provision would be made in stage 3 for writing, editing and designing a leaflet giving a general description of the newly-designed product.

Conclusion

A description has been given of design planning which would apply almost entirely to any kind of furniture. However, it must be stressed that the emphasis has been placed more on the plan than the product, and every enterprise must tailor this plan to its own specific needs and its available finance. During the sequence of events from project planning to point of sale, the design manager is the only person to be fully informed on all the designing done. It is his task to ask the right questions early enough for their answers to be worked out and checked; to construct a realistic timetable and keep others to it; to ensure that decisions are taken and acted upon. Above all it must be his singleminded concern to see the project through to a sucessful conclusion.

Figure IV shows an outline chart for the management of design, and figures V and VI illustrate two new furniture ranges designed by Vrbas.



project investigation | design team selection | stage

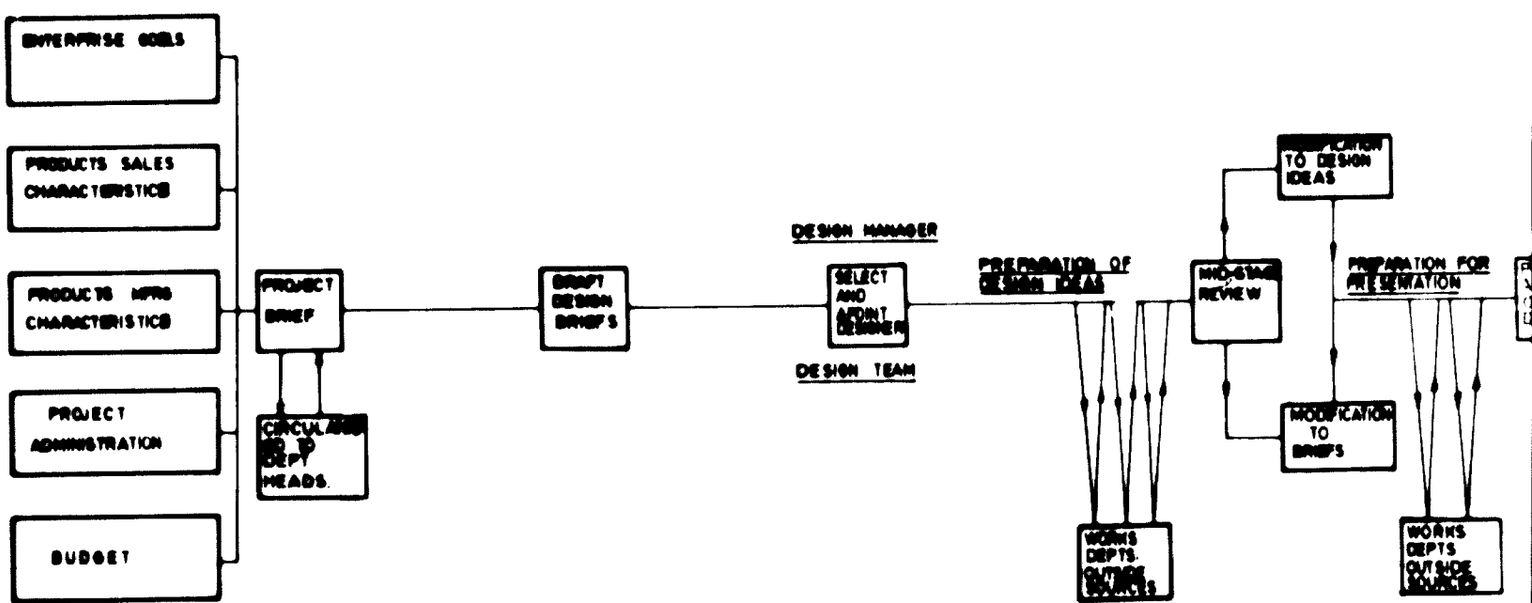


Figure 51. Planning a design proc

SECTION 1

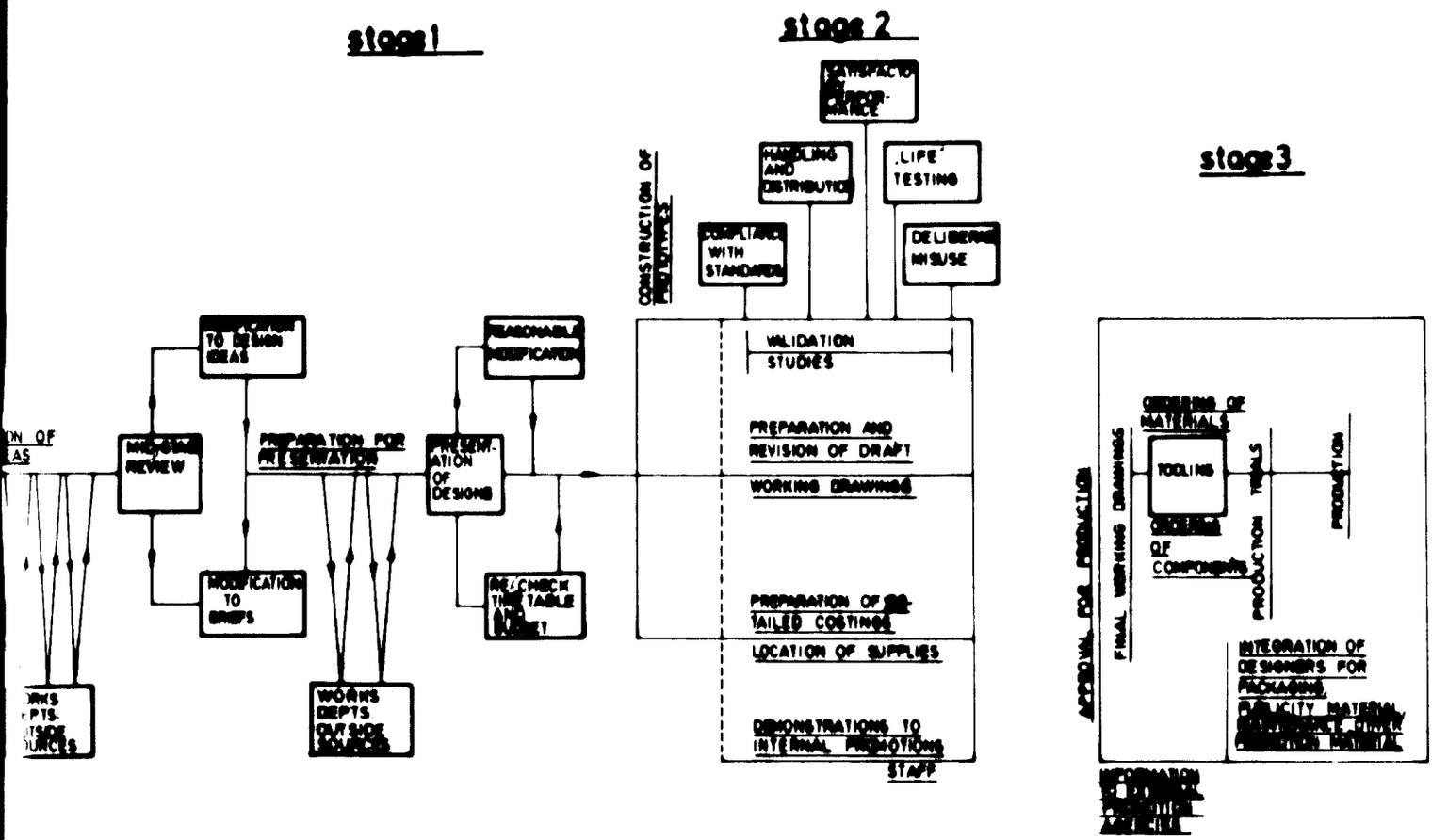
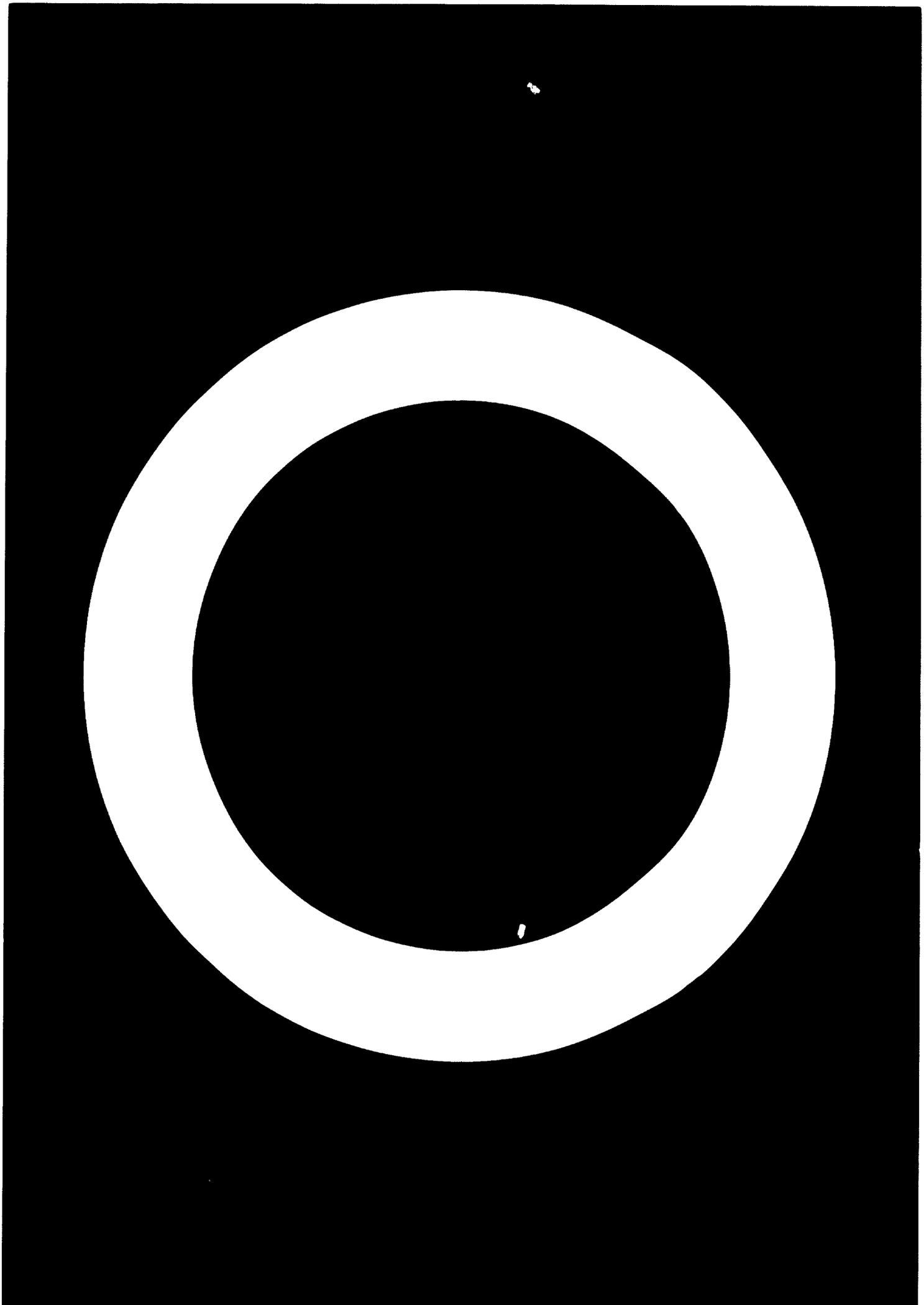
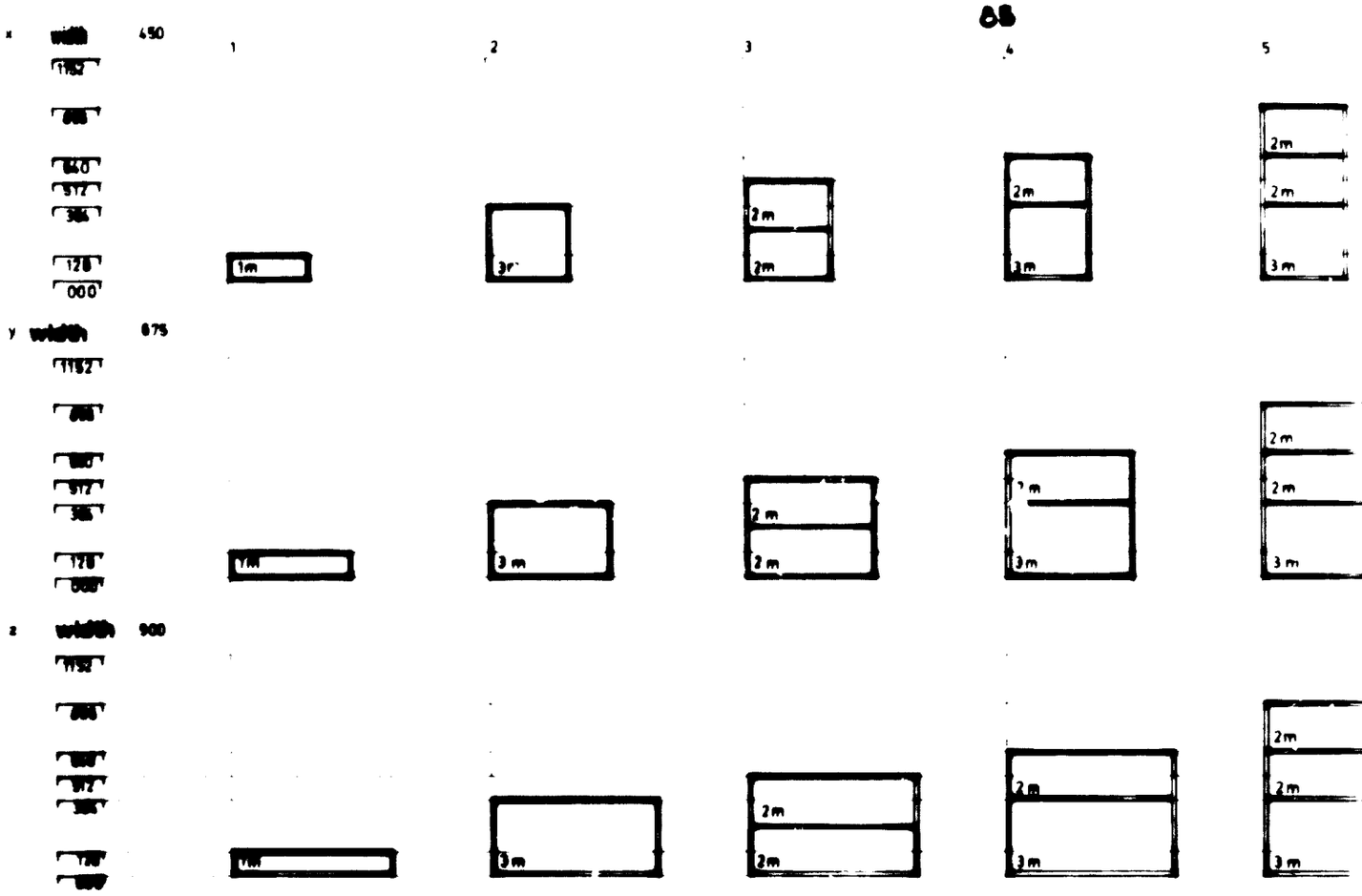
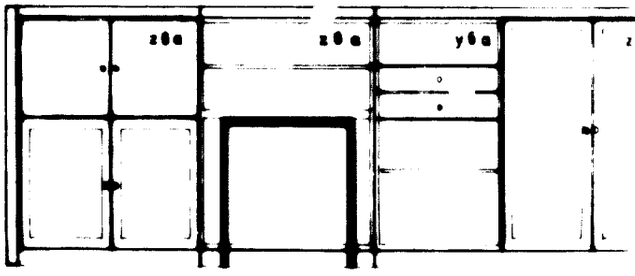
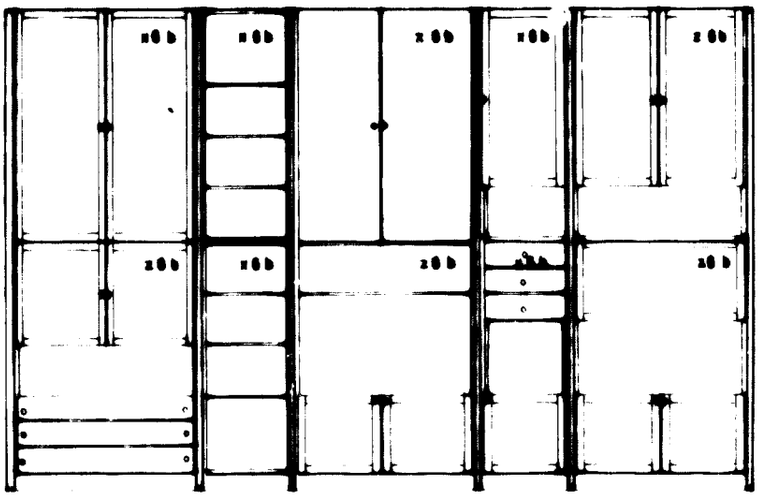


Figure 61. Planning a design programme



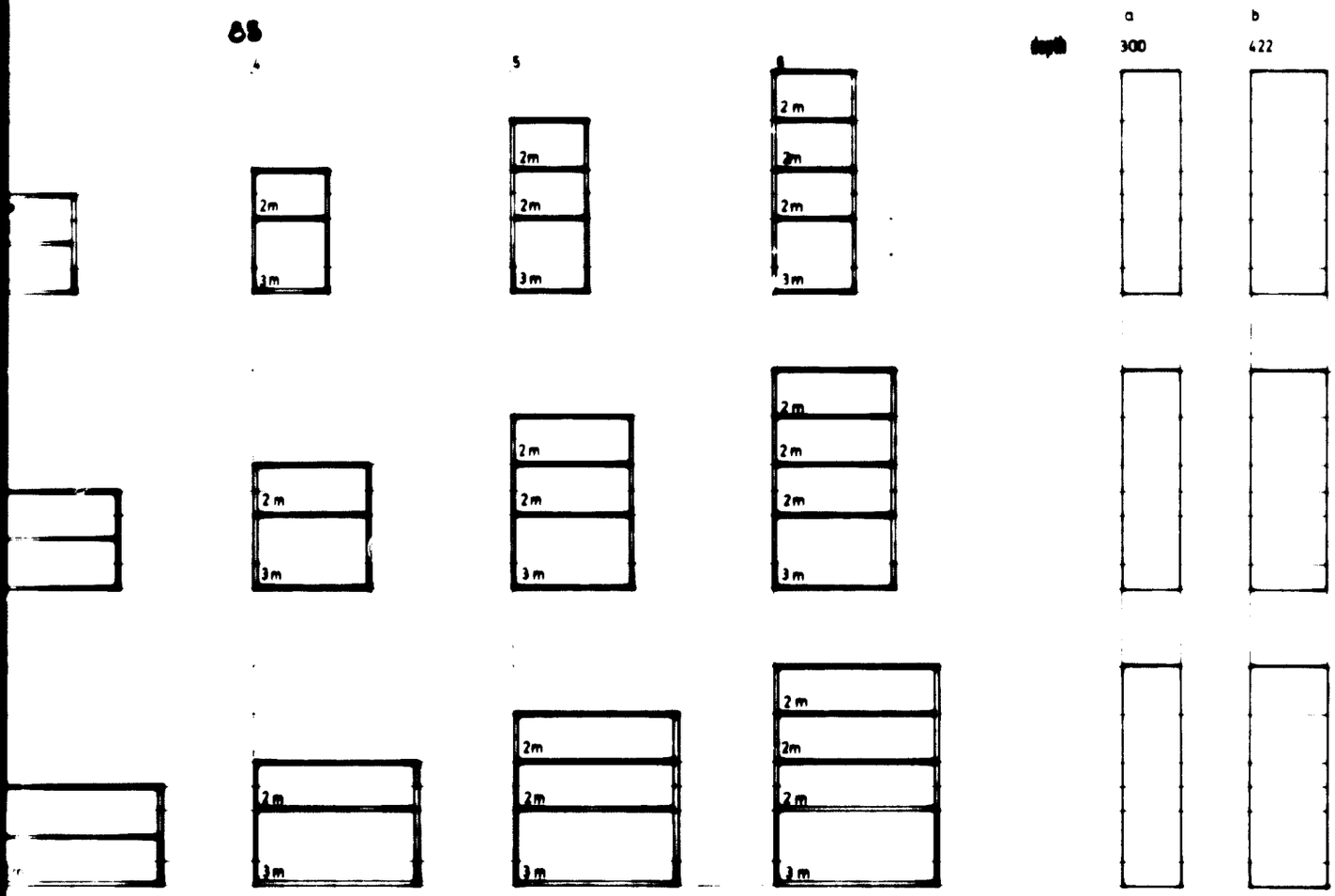


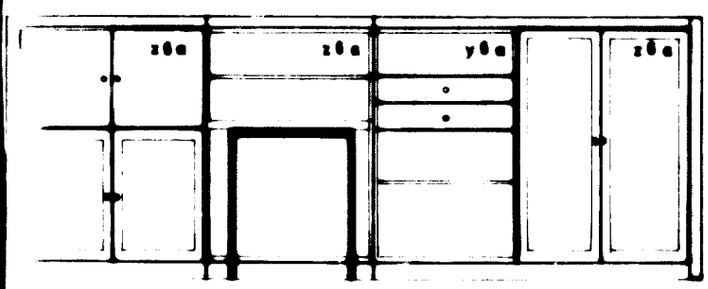




SECTION 1

Figure V. "Programme 78" design plan.





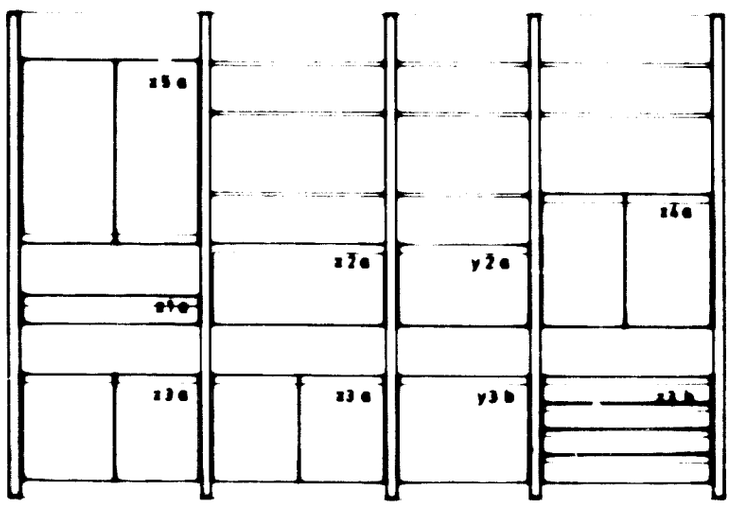
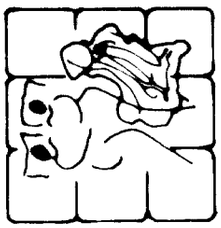
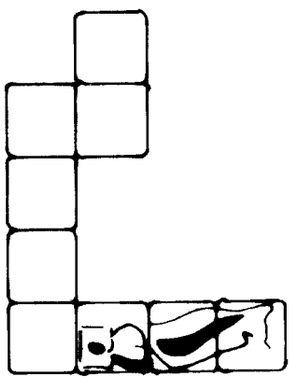
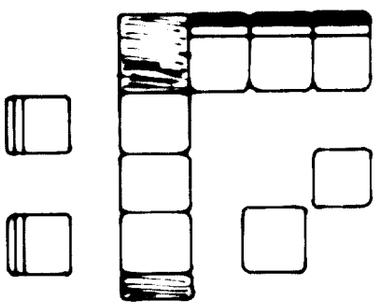


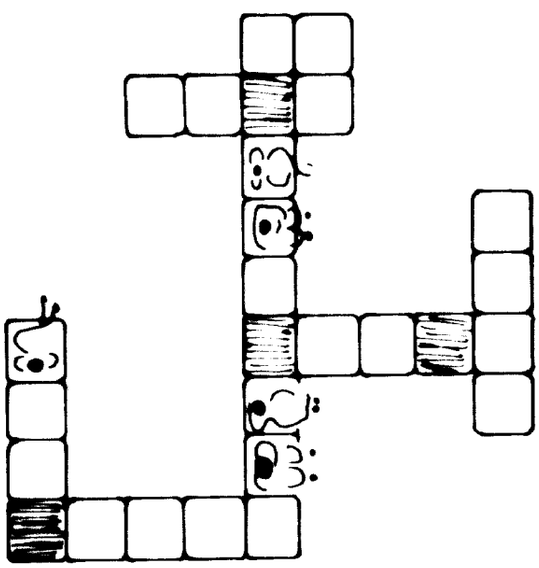
Figure V. "Programme 78" design plan.

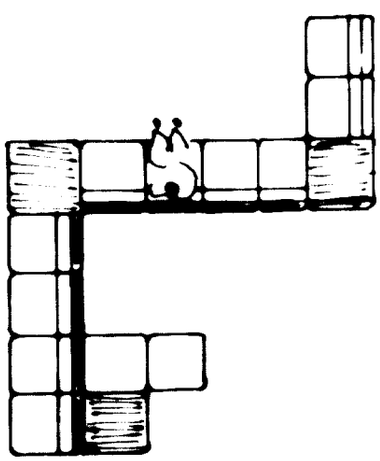
SECTION 2

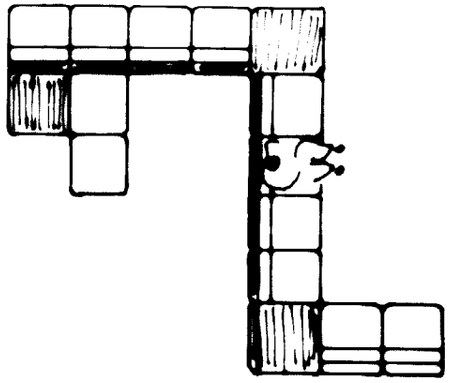


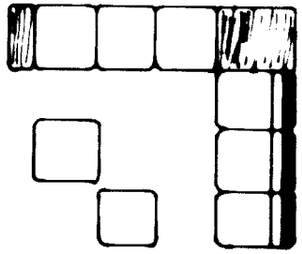












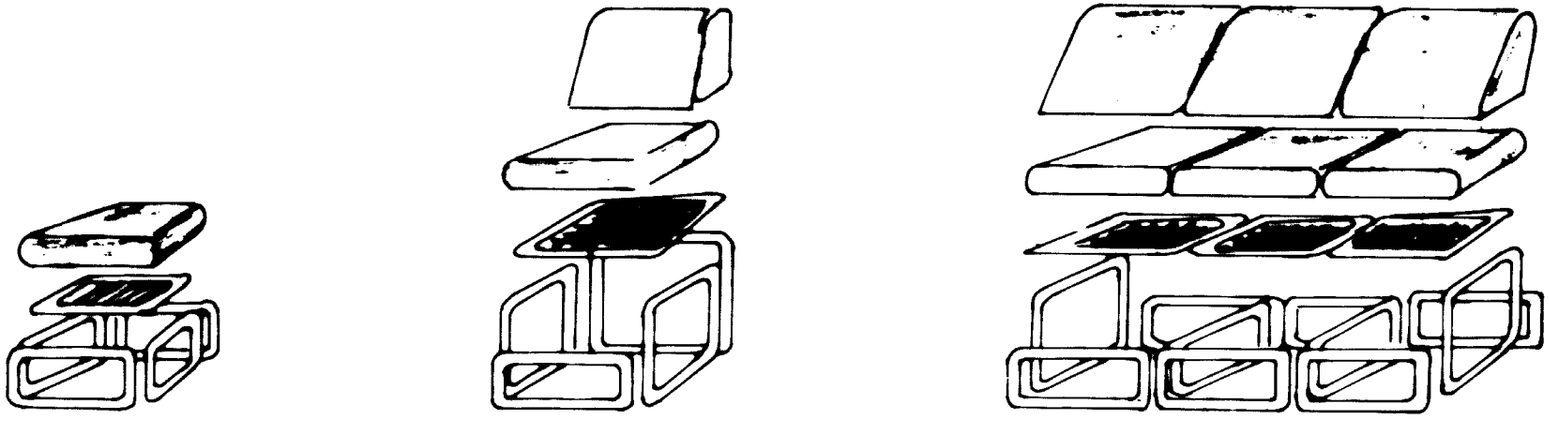


Figure VI. "Villa" design plan.

Annex V

PROFILE OF AN INDUSTRIAL TRAINING PROGRAMME

A. Job analysis for dimension saw bench operators

Stages or steps	Key features	Faults/comments
1. Receiving the material	Checking the cutting list, measuring and selecting material	Knots, splits, timber discoloration
Master and fuse switches are set in off position		
2. Preparation prior to setting the machine	Assembling equipment and devices, i.e. material support trestle, cross-cutting saw blade, fences and stops	Correct selection of saw blade; quality of fences and stops
3. Clearing the machine for setting	Removal of material from machine work table; release of table locks; opening machine table; clearing top saw guard	No material or tools to be left on machine
4. Replacing the saw blade	Unlocking saw-spindle locking nut; removal of outside saw retaining plate and of saw blade; fitting cross-cutting saw blade and outside retaining saw plate; replacing saw-spindle locking nut; setting riving knife in position; setting top saw guard in position	Safety regulations and rules to be observed when setting riving knife and top guard; safe method of handling saw blade to be emphasized
5. Pre-operation checking and examining	Examination of machine moving table; closing machine table; examining saw packings; checking free running of machine moving table; checking free movement of saw blade; examining vertical position of saw blade	Do not leave dirt and sawdust in moving parts; lubricate machine parts

Stages or steps	Key features	Faults/comments
6. Setting of stops and fences	Selecting and fitting back fence and location stops; selecting saw blade clearance stick/push stick	Clearance stick must be used when clearing saw blade of material
7. Preparing the work-place layout	Examining work area; positioning output trolley or pallet and supporting trestle	Ensure clear and unobstructed work area
8. Trial cutting	Return of master and fuse box switches to on position; starting machine; cutting into back location fence	
9. Operating, selecting and making first, second and third cuts. Inspecting	Selecting material; positioning material; starting and operating machine; inspecting cut material; stacking material on output trolley; stopping machine	
10. Inspecting and correcting setting	Examining the quality and squareness of saw cut and the correctness of length; adjusting fences, stops and saw as required	

B. Job specification of dimension saw bench operator

The operator must be conversant with the statutory regulations relating to the use of woodworking machinery and all safety aspects. He will require the skills and knowledge indicated below.

Skill	Knowledge
Handling of safety devices Judging safe working limits	Purpose and design of push sticks and holding blocks Limits of safe handling
Measuring to an accuracy of within 1/32 inch (1 mm) (linear), and within ½ degree (angular)	Measuring rules, vernier scales and machine scales
Judging by visual perception when selecting material to minimize defects and waste	Minimum quality standards; material free from wind; knots in one face and one edge to be less than ½ inch (13 mm) in diameter Characteristics of the following woods: (list of the types of wood in common use in the factory).

Skill	Knowledge
Comprehending working drawings to compile cutting lists	Working drawings, including their conventions and scales
Adjusting saw spindle, fence, moving table, mitre fence and stop bars	Machine adjustments Correct settings for top saw guard Selection and setting of riving knife Purpose and fixing of under-bench fencing
Selecting correct saw blade	Range of saw blades and their uses Designs of saw teeth and their uses Effect of set on saw teeth Effect of saw tensioning Tipped saws
Mounting saw blade	Sequence and method of mounting Function of machine guards
Dexterity in feeding and backing	Machine operation Matching speed to material Correct location of face sides Correct stacking of parts Work-place layout
Recognizing correctly cut material	Appearance of sawn surfaces Application of measuring gauges Disposal of substandard product

Faults

The operator should be able to recognise the following faults outlined below and take the appropriate remedial action.

Fault	Possible causes	Symptoms	Remedy
Product out of true	Original face side/ edge not true	Material does not sit square on table or against fence when feeding	Trim material square before cutting
Burning	Blunt saw	Smell of burning Marking on material Feed requires more pressure	Change saw blade (blade aside for sharpening)
	Incorrect machine adjustment causing binding	Uneven feeding Marking on material and saw blade	Adjust and reset machine
Varying thickness	Poor set on teeth	Uneven feeding with tendency to bind Cut surface has fibrous appearance	Change saw blade (blade aside for resetting)

Fault	Possible causes	Symptoms	Remedy
	Riving knife	Material binds Sound of back edge cutting Saw marks on product	Adjust riving knife
	Blade out of true	Width of cut excessive Saw cuts on product	Check saw plates and blade
Material not to size	Wrong setting		Reset machine
Broken edge on material	Feed is too fast for material	Uneven or ragged cutting Splintering	Feed at correct speed

C. Syllabus for training dimension saw bench operators

Purpose

This syllabus may be used to compile training programmes for apprentice wood machinists and adult trainee dimension saw bench operators.

Supervision

The responsibilities of supervisory personnel are indicated below.

Company training officer

Training programme content

Advising mill supervisor on instructor and equipment requirements

Advising instructor on instructional techniques

Setting training standards and supervising tests

Mill supervisor

Providing instructors and equipment

Correct technical content of instruction

Adjustments of earnings for instructors

Recommending pay awards to trainees for productive work

Supervision of training records, including instructor/trainee hours

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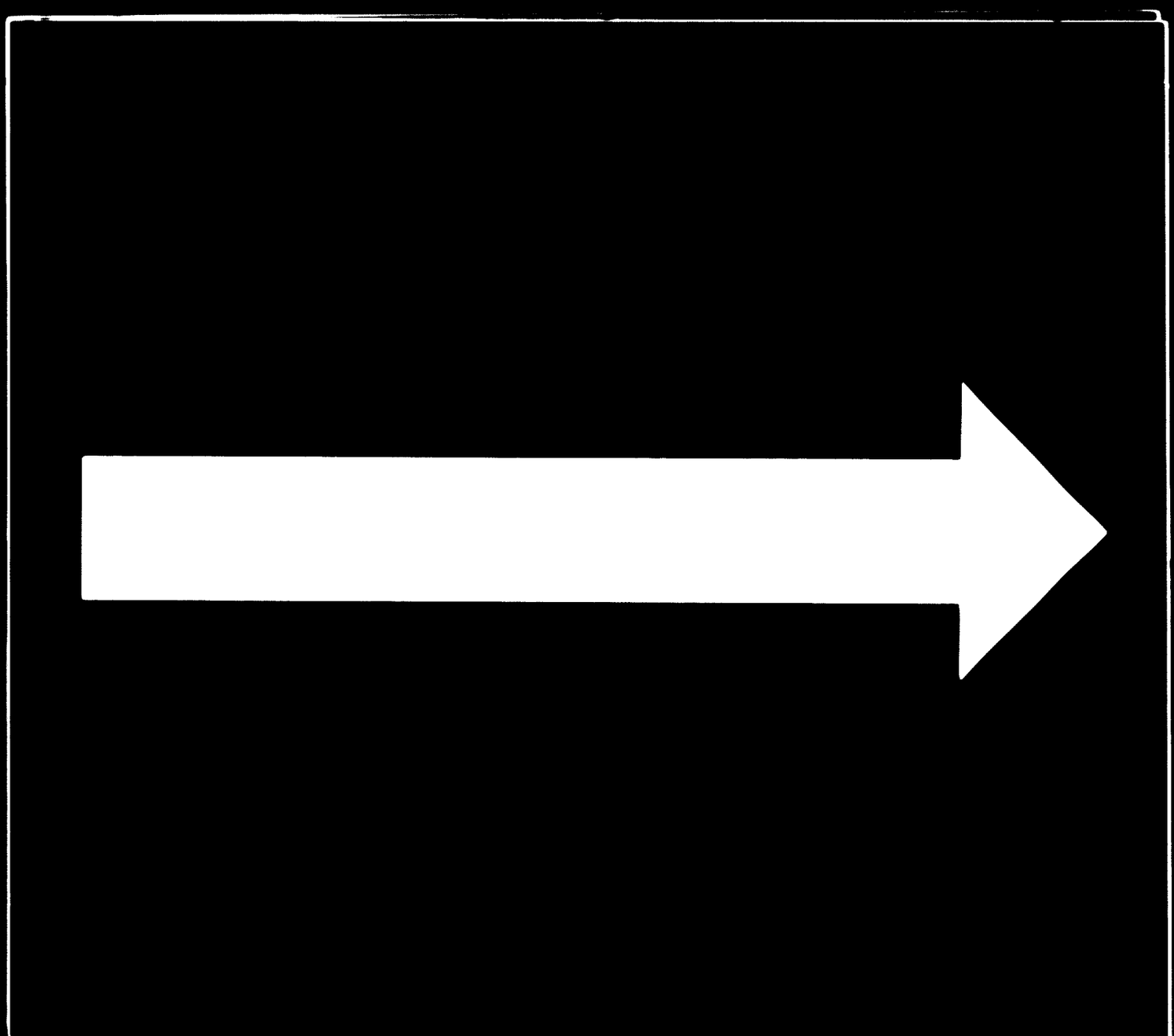

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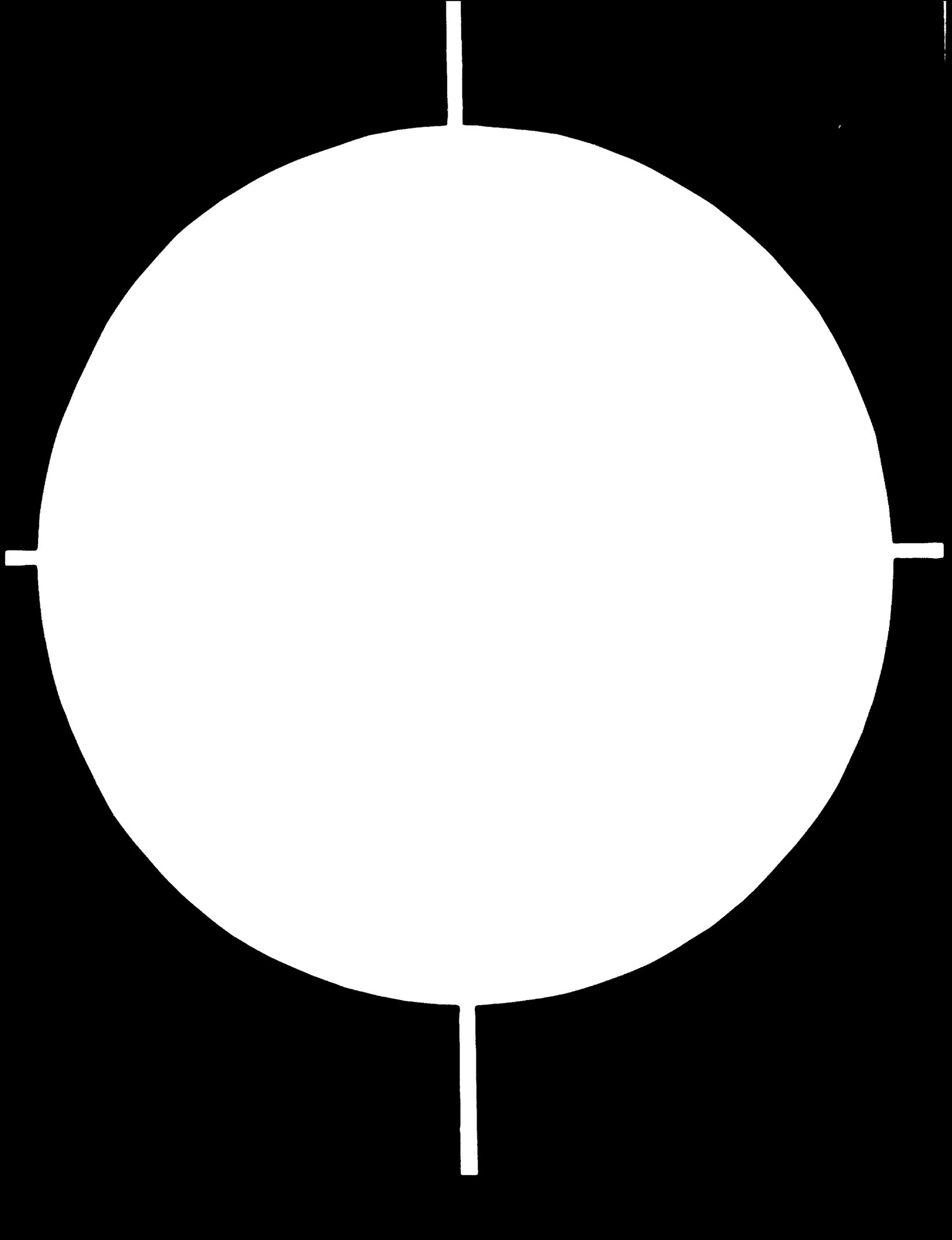

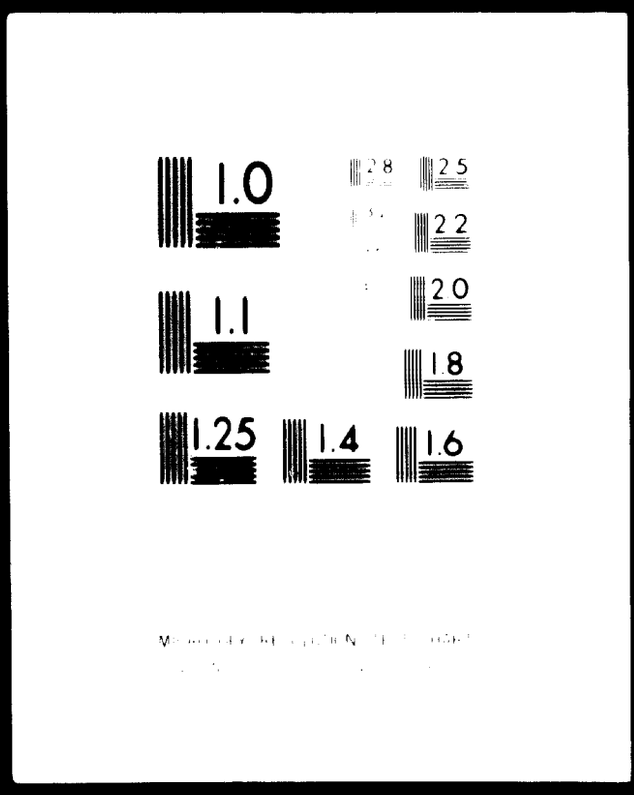

Instructor

Preparing lesson plans

Checking tools, materials and instructional aids

Detailed instruction to the standard specified

Behaviour (including discipline and safety obser ance of trainees)

Maintaining training records

Programme

Serial	Subject	Instructor	Time (in hours)	Remarks
1	Safety regulations for woodworking machinery	Company safety officer Mill supervisor	½	See woodworking machinery regulations
2	Machine safety features	Mill supervisor	¼	Practical use of push sticks and holding blocks
3	Working drawings and patterns	Drawing office supervisor	1½	Conventions, scales, including practical interpretation
4	Linear and angular measurement	Instructor	1½	Use of rules, vernier gauges and machine scales
5	Characteristics of materials	Instructor	3	Nature of timber, plastics; recognition of defects
6	Operation of machine	Instructor	8	Emphasis on safe working practice
7	Saw blades	Mill supervisor Saw doctor Instructor	¼ 3/4 10	Including care and maintenance
8	Jointing by machine	Instructor	3	
9	Jigs	Instructor	5	
10	Revision and practice	Instructor	88	Including training for stamina
11	Tests		12	Theory and practice
		Total	133 3/4	

The dimension saw bench detailed syllabus would be included in serial 9 and part of serial 1.

Example of a block syllabus of in-company training for a first-year apprentice wood machinist.

Serial	Subject	Time in weeks
1	Induction and probation	2
2	Materials planning	1
3	Tool maintenance	2
4	Cabinet making/assembly operations	1½
5	Polishing and finishing operations	1½
6	Drilling machine	3
7	Circular saws	6
8	Bench saw	2
9	Dimension saw bench	3½
10	Planers and thicknessers	7
11	Mortisers	3
12	Wood turning lathe	3
13	Tool room practice	4
14	Practical and production work	8
15	Revision and tests	2
	Total	49½

D. In-company training programme

Job title: Dimension saw bench

Standard:

1. On entry: second-stage woodworking machinist apprentice/adult trainee operator
2. On completion: setting and operating the machine under supervision, working from a given cutting list

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Note: The complete programme will be carried out by a second-stage apprentice. It may be modified to suit an adult trainee operator.

Training programme

Stage	Item	Training time (in hours): Under direct instruction	Training time (in hours): Gaining planned experience	Level of competence to be reached
1	Preparing cutting lists from working drawings: Taking off dimensions Selection of material	8	16	Able to read a simple three-view working drawing and extract specifications applicable to dimension sawing Selecting material for a three-stage cutting operation
2	Limits of safe handling Push sticks Holding blocks	8	16	Indicating the limits of safe handling and understanding the use of push sticks and holding blocks
3	Workplace layout			Understanding the advantages of a tidy workplace
4	Machine construction including: Controls Guards and safety equipment Riving knife	8	8	Naming the controls and parts of the machine and explaining their function Able to adjust guards and riving knife to regulation requirements and explain their significance and use
5	Allied operations	2	-	Able to describe preceding and following processes Appreciating the sequence of wood milling operations and their relation to the finished product
6	Setting machine for: Square cutting Angle cutting Compound angle cutting			Under supervision making and fitting extension table, back and side fences. Explaining and demonstrating setting for square and angle cutting
7	Use of: Fences Extension tables	8	16	Gauging product to 1/32 inch (1 mm) and $\frac{1}{2}$ degree

Training programme (continued)

Stage	Item	Training time (in hours) Under direct instruction	Training time (in hours) Gaining planned experience	Level of competence to be reached
8	Types of saw blade teeth			Explaining the characteristics and purpose of different saw blades
	Tungsten-carbide-tipped saw blades			Understanding and obeying safety rules
9	Care of saws:			Cleaning, setting and sharpening a disused saw blade under supervision
	Cleaning, setting and sharpening			Making a carrying case for a saw blade
	Defects and remedial action			
	Simple saw hammering	11	37	
10	Use of machine table, guides and rollers			Adjusting and explaining the use of guides and rollers
11	Sequence of production and setting the machine for jointing:			Able to set the machine for a grooving operation
	Grooving			Explaining and demonstrating under supervision the production of simple joints
	Simple joints			
12	Making and use of jigs			Making a simple two-position jig to produce a square and angle cut
				Cutting test pieces of square and angle work using jig
		8	18	
	Total (under direct instruction)	45	-	
	Total (gaining planned experience)		95	

Further training

In the case of the adult worker, training will continue until full production speed and stamina have been reached.

The apprentice will attain production speed during further atages of training.

E. Job descriptions

Production director

Job title:	Production Director
Responsible to:	Enterprise Director
Directly supervising:	Panel sizing, veneering, machining, sanding, surface coating, assembling and dispatch departments
Main purpose of job:	To plan and control all production activities to agreed standards

Duties and responsibilities

1. Purchasing and raw material stock control:	Prepare purchasing budget Order materials Check contracts and improve sources of supply Arrange for storage of materials, including issues and receipts Establish stock control system Dispose of scrap (waste) and surplus materials and plant
2. Production planning:	Construct a production programme including designs and appropriate documentation Prepare production budgets Revise production schedules where necessary Balance production staff to meet schedules and materials requirements Provide technical estimates Investigate and advise on new production techniques Establish and maintain appropriate work study techniques Keep abreast of the latest developments in production technology

3.	**Production:**	Produce according to specification and agreed production levels Establish and maintain work and performance standards Determine and maintain the machines, equipment and handling system required Design special production machines Keep methods and layout under review and simplify operations where possible Ensure that the factory's capacity is fully used Record production and the issue of production materials Establish liaison with design and sales departments on the introduction of new designs and models Establish and maintain quality standards and control Inspect products Advise on machinery and equipment needing overhauling Devise ways to improve quality and reduce waste within cost and performance standards Control costs by effective use of manpower and materials Maintain personnel training programmes
4	**Maintenance:**	Organize and maintain plant register Prepare preventive maintenance check-sheets for all machinery, equipment and buildings Maintain obligatory register of checks on dust extraction systems, storage, transport and materials-handling equipment Carry out repairs to plant and machinery

Furniture technician

Job title:	**Furniture technician**
Responsible to:	**Production Director**
Purpose:	**To plan the physical aspects of furniture production**
Scope:	**To design and produce all aids for efficient series production to agreed standards**

Duties and responsibilities

1	**Design and product development:**	**To interpret all working drawings, extract all relevant production information and produce prototypes**
2	**Production planning:**	**Assist in the construction of a production programme, including the preparation of appropriate production, planning and control documentation**

	Provide all production aids for accurate series production, including jigs, fixtures, forms, measuring gauges, master parts, and adaptation of standard machines for specific production purposes Design, produce, and arrange efficient work stations for a variety of machining, assembling and upholstery processes Understand and apply the principles and practice of work study as it applies to furniture production in terms of method study and work measurement Keep abreast of the latest developments in production technology
3 Production:	Supervise production according to specifications and agreed production levels Train the work-force in the use of production aids and equipment listed above Maintain quality standards Maintain good working conditions and facilities Maintain all production equipment and special production aids Establish and maintain all safety precautions Maintain all production documentation Establish and maintain an inspection system Reduce waste Assist in operating training programmes
4 Timber-yard organization:	Plan timber-yard layout Determine and implement yard procedures Arrange for personnel and recommend any equipment required Establish and implement a system for reporting faulty material

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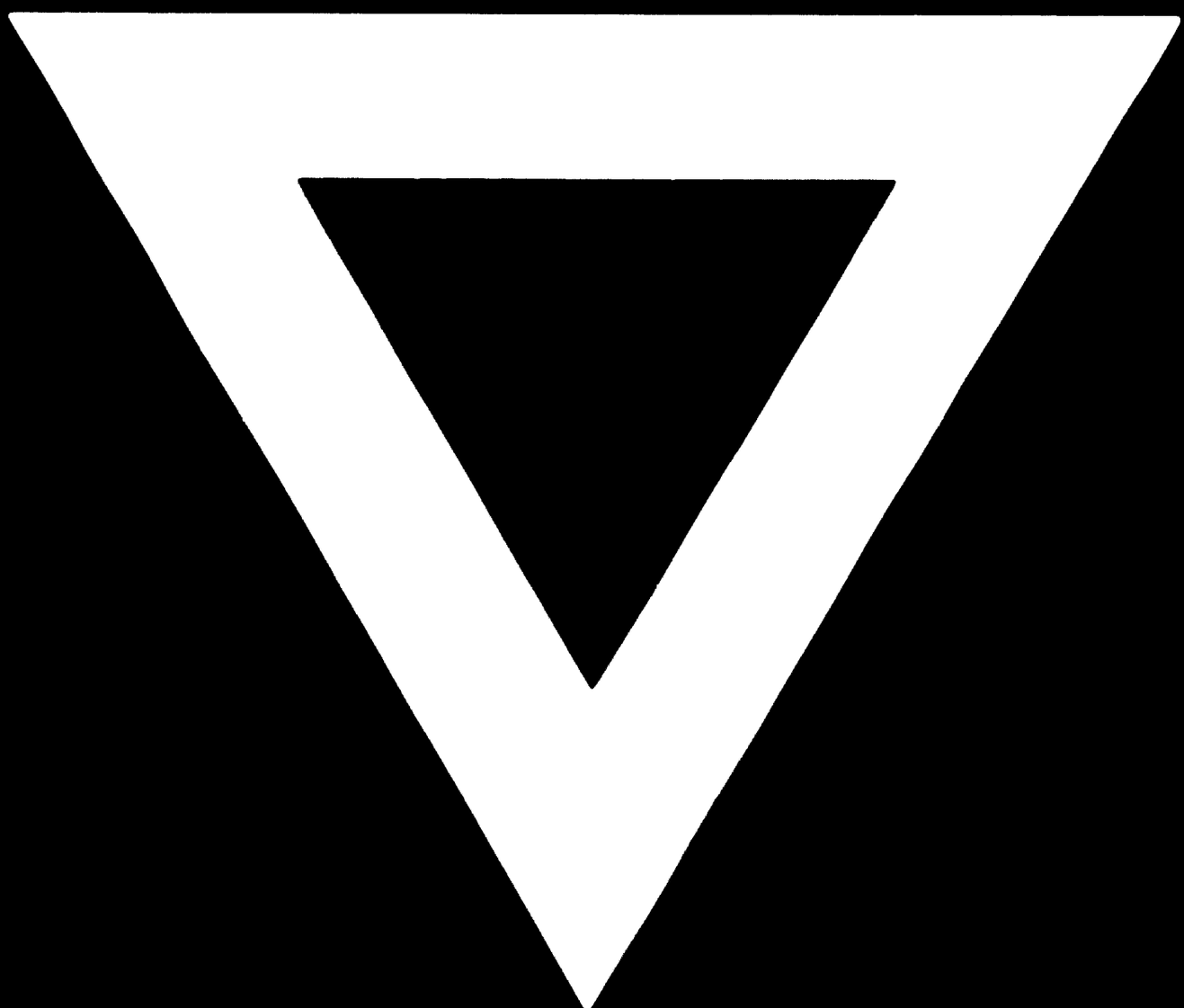

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