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Technical Course on Criteria for the Selection of Woodworking Machines

Milan, Italy, 17 - 26 May 1976

BASIC CONCEPTS FOR THE PLANNING OF A FACTORY FOR THE PRODUCTION OF VENEERED AND PAINTED FURNITURE 1/

by

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CONTENTS

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

The purpose of this study is to draw attention to the use of modern techniques in the construction of a new complex for the production of furniture, at the same time also giving indications on the problems arising from those techniques.

In explaining the various subjects dealt with, an analysis is made of the theoretical aspects, while bearing in mind the practical aspects of the problem. Lastly, an attempt is made to trace, as completely as possible, the long and complicated path to be followed in setting up a new production unit that will be both efficient and functional.

1.00 CONSIDERATIONS ON THE CHOICE AND LOCATION OF THE PRODUCTION UNIT

The key factors to be considered in choosing the site of the new factory are as follows:

- A position that will meet the requirements of local, national and possibly foreign markets.
- Minimum ecological disturbance (pollution, noise, etc.) of the surrounding areas.
- Possibility of obtaining raw materials.
- Ease and limited cost of transport, both for raw materials and finished products.
- Limited cost of plant and operation connected with the type of land (unstable, therefore heavy expenditure to lay foundations, or restricted by easements, which present an obstacle to future expansion).
- Grants and concessions of various kinds on the part of public bodies (tax exemption, free gift of land etc.).
- Availability of skilled labour at favourable conditions and in sufficient quantity.
- Availability and limited cost of primary energy sources, such as electricity, or chemical energy provided by fuels.

2.00 DEFINITION OF PRODUCTION BUDGETING

Once the product to be manufactured has been chosen, it is necessary to establish the annual volume of production and of sales. This choice, made with the aid of marketing techniques, must be the result of careful consideration and evaluation of the areas for which the new product is destined. The volume of annual production will have to be developed in "type environments" in accordance with a percentage distribution arrived at through market research. The individual environment will subsequently be developed in "articles". Thus, it will be possible to obtain the annual quantities to be produced for the various articles forming the lines planned. The articles will then be broken down into pieces, thus obtaining the annual quantity of pieces to be produced. This quantity represents the basic figure for calculating the productive potential of the plant, and subsequently for determining the amount of raw material used and the budget involved.

3.00 DECISION ON MACHINERY NEEDED AND ITS PRODUCTION CAPACITY

In order to identify the technical characteristics of the machines and the types of plant to install, it is necessary to determine the quantity to be produced in each individual phase.

Through the process of production budgeting, which we saw in the previous section, the quantity of pieces to be produced is obtained. Consequently, the quantities of materials required will have to be calculated.

It must be borne in mind that a considerable number of variables figure in the normal production of various kinds of plant. Nevertheless, it is necessary to identify certain parameters, so that these may give very reliable indications for determining the production capacity of the machines being chosen.

These parameters may vary both as a function of the type and of the quantity of furniture to be manufactured, and in relation to the various types of machine and plant considered.

The figures to be used must be realistic values, obtained from careful studies of production lines in various factories. It is therefore necessary for the planner to have considerable experience through direct contact with those engaged in the field.

3.01 CALCULATION OF SATURATION OF MACHINE AND PLANT

As a function of the quantities of panels to be produced and the practical productivity values previously established, a calculation can be made of the saturation points of the machines and plant, as is shown by the following example. This example refers to calculation of the saturation of a squaring-up and edging line.

CALCULATION OF SATURATION OF SQUARING-UP AND EDGING LINE	
Items	**Figures**
Pannelling squared up per year	800,000 m
Additional 30% for equipment	240,000 m
Total pannelling squared up per year	1,040,000 m
Actual speed per minute	6 m
Line working time per year	173,333 min.
Time available per year	105,600 min.
Line saturation	164%

The time available was calculated taking 220 working days a year by 8 hours a day. With regard to the result obtained from the previous count, the following two points may be made:

1. The plant will consist of two squaring-off lines, one of which is saturated at 10% and the other at 64%.

2. The plant will consist of one line, which will operate with two working shifts, for a total of 13 hours a day.

The same working method will also be used for all the machines and lines, thus obtaining the decisive figures for the final choice.

3.02 Description of Machinery and Technologies

3.02.1 Preparation of Hollow Panels

The hollow panel is normally constructed with a frame obtained with lengths of inexpensive, soft wood. These lengths have to be dried out, so as to avoid subsequent deformation of the strips forming the frame. The drying treatment is therefore of great financial importance, because it makes it possible to reduce to a minimum the waste involved in squaring-off and the discards in gauging. The dried and seasoned lengths are then selected by measurement: this is done with manual or automatic, single-blade butt-gauges, with electronic programming of the cuts, or else with multi-blade butt-gauges in the case of large-scale production. The systems for obtaining the strips forming the frame are mainly two:

1. The width of the strip is obtained from the thickness of the original planks, while the thickness of the strip is obtained by cutting the planks across their width.

2. The thickness of the planks determines the thickness of the strip after the plank has been planed, while the width of the strip is obtained by cutting the plank along its length.

Thus, two different types of machine may be used: either the simple multiblade type, or a machine that simultaneously straightens and planes to the thickness of the plank, and cuts the strips with a group of variable blades.

The materials used for filling the inside of the frame may be wood or paper.

The facing panels may be plywood, chipboard, or various wood compounds.

The joining of the strips to form the frame may be carried out either with metal pins or with heat-melted glue; this is done manually for small-scale production, and with special machines for large-scale production.

The pressing for the formation of the panel may be done hot, usually with temperatures below 90°C, using presses with tables and uric glues, or else cold, arranging the panels in stacks, employing vinyl glues, and pressing the pile with suitable presses. If the pressing is done hot, it will be

essential to provide an adequate warehouse where the panels can be left to cool off and settle down before further processing.

To sum up, the machines to be used for preparing hollow panels are the following:

- Wood driers.
- Plank cutters (single-blade or automatic).
- Multiblade (with or without planing).
- Frame assembly (by hand or with automatic machine).
- Gluing machine.
- Press (hot or cold).

3.02.2 Veneering

The preparation of veneers start with the sheets of scaleboard, which are bought in packs; they are cut into leaves which are multiples of the desired width and joined, to obtain the required dimensions.

These operations depend very much on the ability of the operative. Indeed, in joining the leaves, quality and technique are all-important. Once joined, the leaves have to be numbered.

The machines used for preparing veneer are as follows:

- Marking gauge.
- Cutter and trimmer.
- Joining machine using paper or thread.

3.02.3 Sectioning of panels

The panels of plywood, chipboard, and various agglomerates that are purchased from the factories that produce them in standard dimensions must be sectioned in the measurements desired, bearing in mind one most important point: it is essential to have the panels sectioned as rapidly, having strict regard for the time taken to perform the various cuts.

It is therefore necessary to make a careful study, in advance, of the "sectioning plan", which in many cases will have to obey the concept of differentiated cuts (see Attachment No. 1).

It is therefore considered that a very good system for avoiding waste and making the best use of time is to section a pack of panels longitudinally, after which it is automatically transferred and sectioned transversely by another sectioning machine, combined with the previous one in one unit. In this way, it is possible to obtain sectioning with differentiated cuts.

The machines to be used are of various kinds and represent various constructional principles; the choice will be based on the daily quantity of material to be sectioned. The machine chosen may be of the vertical type for small-scale production (maximum value of material sectioned: about $10m^3$ in eight hours), or of the horizontal type for growing production, as a function of the automation planned.

A complete sectioning plant consists of the following:

- Automatic loader of packs of panels for sectioning.
- Machines for longitudinal cut.
- Automatic transfer of packs of strips.
- Machine for transverse cutting.
- Automatic unloader of whole cut pack.
- Equipment for sorting piles of panels.

3.02.4 Pressing Line

The application of veneer to previously prepared panels (hollow or chipboard) is done with hot presses, which may have tables, or else be of the continuous-cycle type - this choice is based on the quantity of panels to be pressed.

The panels before being pressed, have to be gauged on their two surfaces, so as to obtain, for equal thicknesses, perfectly identical panels. The gauging machine will preferably be installed in line with the gluing machine and the press, so as to avoid feeding-in and unloading panels merely for a gauging operation.

The glues used with double gluing machines are of the uric type, and may be either in liquid or powder form.

A complete pressing unit for large-scale production is therefore made up of the following:

- Double gluing machine.
- Double gluing machine.
- Single-chamber press with a continuous cycle, or with tables.

3.02.5 Squaring up, Edging and Drilling

The choice of this type of plant must be carefully thought over, evaluating the quantity and type of production to be turned out. To this end, a number of important considerations on the following subjects should be borne in mind:

a) The productivity of a line complete with squaring-up and edging -- by complete line, we mean a line formed by longitudinal squaring-up and edging, piece-turning devices, transfers, squaring-up and edging, and a drilling machine -- strictly depends on the quantity of similar pieces fed into it.

Indeed, as shown by the curve in Attachment No. 2, obtained from figures recorded under actual working conditions (the abscissa indicates the quantity of identical panels, while the ordinate gives production per unit of time), the productivity of the line is optimal only from 1,000 identical panels on. It is therefore obvious that if the quantity of pieces to produce is much below the above value, the whole line loses efficiency until it becomes uneconomical due to the very small quantities of pieces (100-200). It will then be advisable to split the line up in two parts, thus getting "monolines", with an independent drilling group.

The advantages of monolines are mainly two:

1. By removing the drilling machine from the line, the time required for tooling (most of which is accounted for by the drilling machine) is greatly reduced. Indeed, an increase of up to 50% in productivity can be achieved (actual results may vary).

2. If a mechanical fault occurs, or a defect in the operation of individual machines, the whole sequence of machines does not have to stop.

If the line is made automatic, with automatic loading and unloading, and the squaring-up and edging operation is performed by a machine whose measurements are changed by means of an electronic programmer, the final result will be a considerable increase in productivity in absolute value.

b) It is interesting to note the behaviour of the curve shown in Attachment No. 3, which indicates the production that can actually be achieved (metres per minute) as a function of the length of the pieces being worked.

On examining the curve, we find that, only for pieces longer than 150 cm, does productivity not vary greatly; below that value, there is a marked drop in productivity.

Obviously this consideration is fundamental, because, as a function of the type of furniture produced, productive capacity changes considerably, and consequently the choice of the machines and their characteristics must be carefully evaluated in

the right of the above.

3.02.06 machines or units, pre-assembling, outside the line

After the automatic operations of squaring-up, edging and drilling, it will probably be necessary to perform certain jobs outside the line, using individual machines, such as: the pantograph, the router, edging of curved parts, and special sanding. In addition, certain important details have to be checked visually, and even manual repairs may be necessary.

3.02.7 Dyeing, Painting, Sanding

Painting and sanding represent, for the furniture manufacturer, about 20% of the whole working cycle. Moreover, this cycle is extremely variable, depending on the type of finish desired. In this section, an attempt will therefore to be made to establish certain basic concepts of the problem so as to give some hints on how to determine the typology of the plant.

A. Sanding, Dying and Painting of Edges

The wooden edges of panels are sanded in the edging line, if they are straight, or with a separate machine, after squaring up, if they have special shapes.

After sanding, the piles of panels pass on to a painting shed, and after that to an oven, for application and drying of the dye, which is sprayed on, and a few coats of paint. Any frames, or any other loose pieces, to be applied to the furniture during assembly, are dyed and painted by spraying, and dried on trolleys, which pass on into a hot-air oven.

B. Sanding of Wood

The most advisable system is that of sanding in line, followed by [illegible] and unloading operations are carried out.

To make satisfactorily, the machine has to be a combination of several [illegible] abrasive papers, whether crossed or not, with surfaces or rollers, depending on the type of veneer to be sanded. It is preferable to use a combination of three abrasive papers with different grain, in order to obtain the roughing and finishing of the panels in a single pass.

The productivity of the machine is such that it can easily stand up to any demand from the line.

C. Dyeing Wood

The dyeing operation, which is performed in the line, may be carried out with machines operating with rubber rollers. With such machines it is possible to use spirit dyes, aniline dyes, and ink dyes. Machines with sponge rollers are used for water dyes (advisable, for example, for walnut). Drying takes place in an oven which is a mixture of infra-red rays and hot air, drying time varies, depending on the dye used. The degree of surface humidity of the panel should not under any circumstances exceed 10-12%, so as not to prevent the undercoat from sticking, or cause patches to appear on the veneer.

D. Application of the process

In planning new plant, the problems of indoor and outdoor pollution must be borne in mind.

Indeed, in some countries, there are laws on the subject that severely restrict the use of paints with solvents. On the other hand, the paint-producing firms have now almost found the ideal solutions, so that this is the best path to follow.

In any case, plant has to be such that it can use various types of paint and produce different finishing effects; lastly, they must be flexible. The speed of production of plant has to be carefully calculated, depending on the type of finish required, and consequently the number of passes required on the line to obtain the production aimed at.

The plant must be able to apply paint with rollers — one or two coats — and drying can be done with infra-red lamps, with ultra-violet lamps of varying power, which enable a coat of paint to be dried in 10 minutes, or else with ovens in which hot air circulates under pressure.

At this juncture, the type of finish desired has to be chosen, and the following combinations may be had:

a. The surface may be left as it stands (with open pores).
b. First, the undercoat, which has been applied with a roller, is sanded in the line, then a very thin coat is sprayed on to finish (semi-closed pores).

e. Application of a further very thin coat of polyester or polyurethane [illegible]. This will have to be dried and then sanded, after which a thin coat of finishing paint is applied, either with an additional [illegible], or else on another unit (closed cycle).

E. Drying of Undercoat or Finishing Paint

To dry polyurethane or polyester products applied as a very thin coat, the commonest system of drying is by hot air in ovens that may be of the following types:

- Vertical tables.
- Horizontal tables.
- Roundabout type.

The choice of one of these systems may be decided by the following:

- Space available.
- Cost of plant.
- Characteristics of the paint to be dried.

F. Sanding of Undercoat

The sanding of paint is in itself a delicate operation, not only because of the nature of the product, but also because, since very thin layers of material has to be removed and the operations are carried out by machine, it is easy to run into trouble with the finish.

In addition, not only the flat surfaces, but also the straight or shaped edges have to be sanded. It is therefore advisable for the plant for sanding paints not to be combined or coincide with that used for sanding raw wood, and that, in any case, it should be separate from the line used for applying the undercoat.

When production requirements indicate the need for a separate plant for the application of finishing paint, the sanding plant can be placed in the line with the latter, thus eliminating one loading and unloading operation.

For constructional reasons, it may happen that the finishing paint is applied by a spray after the piece of furniture has been assembled, instead of being put on as a skimming coat. Thus, after being assembled, the piece of furniture will be sprayed with finishing paint and dried in a hot-air oven.

6. Dyeing and Painting of Assembled Furniture

For certain types of period furniture, with an "antique" finish, it is necessary to perform all dyeing and painting operations after assembly.

In such a case, the furniture is assembled in the raw state and put into a plant consisting of a succession of spraying sheds and drying ovens, connected to each other by conveyor-belts. In this way, the piece of furniture moves forward at a speed that depends on the number of pieces of furniture

that have to be produced.

The following is the order of operations:

- Spray-dyeing - several coats.
- Drying of dye in hot-air ovens.
- Spraying with a substance having a tar base.
- Removal of the latter with a cloth.
- Drying in a hot-air oven.
- Spraying of several coats of undercoat.
- Drying in hot-air oven of undercoat.
- Sanding by hand.
- Spraying of finishing paint.
- Drying, in hot-air oven, of finishing paint.

3.02.8 Automation of Work Line

The high cost of labour and the desire to obtain the greatest possible productivity from the line make it advisable to install automatic feeds and stackers for the panels.

In fact, the performance of workmen attending the feeds of lines varies greatly, due to both physical and phsychological fatigue.

The constant rythm of the feeds and the stackers makes it possible to get round this disadvantage, and also enables production to be programmed with certainty and precision. There are suitable machines for all working lines; the most widespread system consists in raising the panels by means of a

suction device, so that there is no question of the surfaces being damaged.

The more modern machines also make it possible to work with panels stacked 1.6 m high, without having to have pits or sunken areas in the floor, and also enable down time due to the loading and unloading of the [illegible] to be completely eliminated.

3.02.9 Pre-Assembly and Assembly of Furniture

The various operations involving the pre-assembly of metal fixtures, frames, and the assembly of the structure with subsequent fitting of doors and drawers should be performed with equipment and machines that will ensure a continous supply of the goods from the warehouse, located after the pre-assembly bay, into the finished-products warehouse.

In choosing equipment, account must be taken of a series of rules that have to be respected as far as possible. In particular:

- Eliminate all useless movement of materials.
- Store all semi-finished goods upstream of the assembly line, so as to occupy the minimum space and enable them to be removed easily.
- Avoid placing parts on the ground and removing semi-finished products once they have been put on the assembly line.
- Perform all the pre-assembly, assembly and packing operations, whether manual or mechanical, while the piece of

furniture moves along the assembly line.

- During pre-assembly, perform any drilling operations left undone, and operations that identify similar parts until they are assembled as a function of the established assembly programme.

To determine the quantity of semi-finished panels in the warehouse before assembly, and consequently the area required, it is necessary to determine the plan to be followed in programming assembly, as follows:

- For assembly to order, the finished-product warehouse provides reserved space, striking the balance between requests for sales and the needs of production, inasmuch as all the parts produced are assembled. In such a case, the space reserved for semi-finished goods is relatively small.

- For assembly according to the delivery programme, the semi-finished goods are removed from the warehouse only to meet requests for goods already sold. In this case, the finished-goods warehouse becomes smaller, while the space for the semi-finished goods increases considerably.

The assembly plant may consist of the following equipment and machines:

- A machine for the automatic insertion of pins.
- A machine for auxiliary drilling operations, or possibly the automatic application of certain types of metal fixture.

- Conveyor belts or slatted conveyors, controlled by variable-speed motors, for pre-assembly, with containers for equipment and pneumatic tools, as well as containers for metal fixtures, so that the operative can reach out and take any parts or tools he requires.
- Presses for the assembly and squaring up of furniture.
- Automatic tipping devices.
- Slatted conveyors, carrying parts to be fixed on the structure of the piece of furniture as it moves along at a set speed: doors, drawers, or other parts.

3.02.10 Packing of Furniture

At the end of the assembly line, the furniture has to be suitably protected from damage during all the handling to which it is subjected, whether in store, during transportation to warehouses, right up to its delivery to the customers. Since the furniture is veneered and painted, its protection must be such as to ensure that exposure to the light will not spoil the colour of the wood.

For this type of production, it is normally made of packing consisting of cardboard boxes, corner pieces made of polystyrene, and padded paper for delicate surfaces.

There is special equipment to help close the underside of the boxes.

The closure of the boxes, depending on the amount of production, may be performed with taping or binding machines, which may be manual or automatic.

3.03 Internal Transport and Movement of Materials

The unloading of all materials on arrival is performed by forklifts, preferably of the electrical type. Their capacity varies, depending on the type of material to be unloaded. However, it is preferable to have at least one truck that will take about 40 quintals, for the unloading of heavy planks, chipboard or veneer.

For the transportation of materials from the general arrival warehouse to the places where it will be used, use can be made of small hand or electrical trucks with a loading surface and a driver's seat. The movement of the finished product when it leaves the assembly line, on its way to the warehouse, and from the latter to some means of transportation, may be by means of trucks with frontal, pneumatically-controlled grippers, or by overhead conveyors, which automatically pick up the packaged furniture and put it down in pre-established areas.

The movement or storage of all products in the course of manufacture takes place along lanes consisting of loose or controlled rollers, properly protected, or, in the case of transfer from one area to another, in trucks running on special rails.

Feeding the assembly lines with semi-finished goods from the arrival warehouse or from the pre-assembly area (drawers, doors etc.) may be effected by means of overhead conveyors,

fitted with special sawing equipment.

3.04 Internal Maintenance Workshop

The more sophisticated and complex the machinery and equipment of the furniture manufacturer is, the more necessary it is to have a proper maintenance department. For productivity may well depend largely on its efficiency, and so may the whole factory, too.

It is therefore necessary to equip a department with a series of machines that will make this service self-sufficient, and able to deal with any needs that may arise. The machinery and equipment may be the following:

- Electric-welders.
- Electric drills.
- Lathes.
- Milling machines.
- Electrical tool benches.
- Tool sharpeners.
- Measuring instruments.
- Miscellaneous equipment and tools.

3.05 Summary of Machinery and Equipment

Having determined the work to be done by the machines, the working cycles, as we have seen in previous sections, a complete list may be drawn up, by production centre or machining line, giving the following technical characteristics, needed

for the definition of technical plant:

- External measurements	in mm
- Weight	in kg
- Installed power	in kW
- Compressed air absorbed	in l/min.
- Suction air (quantity)	m^3/min.
- Suction air (velocity)	in m/sec.
- Cooling water	in K ca/h

4.00 Determination of Service Plant

Assuming that the energy available can be broken down as follows:

- Primary: Electric energy and chemical energy supplied by fuels.

- Derivates: That is, supplied by the primaries, such as pneumatic energy (compressed air), and emergency energy (own generator).

The sources that supply these types of energy are described hereunder.

4.00.1 Electric Sub-Station

Centre for transforming electric energy from high to low voltage. This will consist of transformer, protection and control equipment.

The services supplied by the electrical sub-station are:

- Lighting.
- Power for:
  - Production
  - Heating plant.
  - Compressed air plant
  - Hot-air plant
  - Plant for extraction of dust
  - Safety installations.

4.00.2 Heating Plant

Centre for conversion of chemical energy into thermal energy.

The users are the technological departments and the hot-air plant.

The first includes presses, drying-ovens, and painting-sheds.

The second includes hot-air plant, which has to meet the following requirements:

- Balance of air leaving and entering the factory.
- Balance of temperature and ambient humidity, with reference to local and seasonal situations that may arise.

a) Temperate climatic zone; in the winter, heating is called for, and in the summer, ventilation.

b) Hot climatic zone; continuous ventilation, with the possibility of air-conditioning.

- Absence of dust from the air within the working area. This

is achieved by channelling the air through a water atomizer, which causes the dust and impurities to drop to the ground.

4.00.3 Compressed-Air Plant

Centre for transforming electric energy into mechanical energy.

This consists of units for compressing and drying air, in order to avoid phenomena associated with condensation.

The users of this facility are mainly the technological departments, and its purpose is to provide energy to drive the tools and the automatic devices providing protection, regulation and control of the production cycles.

4.00.4 Extraction of Dust and Shavings

Centre for removing all materials (dust and shavings) produced by individual machines.

It consists of:

- Sub-stations for the extraction, filtering and removal of dust.
- Groups of ventilators and extractors.
- Silos.
- Automatic equipment for extracting dust.

4.005 Protection and Safety Installation

The factory may be the victim of incidents that compromise

its efficiency, or even its existence, such as:

- Fire
- Lightening
- Accidental electrical contact
- Conflagrations

To provide protection for and prevent such occurrences, a system of devices will be provided.

5.00 Layout

The layout is the phase in which the productive process of the whole factory takes on form and dimensions. Layout incorporates certain basic principles such as:

- Minimum distance covered by material between one operation and another.
- The areas assigned for each individual operation should follow each other in the same order as the working cycle.
- The plant should allow for future changes and expansion.
- Service departments should be situated as near as possible to their users.

The flow of work may follow three different patterns, as follows:

- In line
- Zig-zag
- "U" formation

The choice depends on the characteristics of the ground and,

consequently, on the type of construction that it is possible to build, as well as the greater or lesser complexities of the work cycles.

The chief flow diagram to follow in setting up the furniture factory is the one that we have devised and is shown in Attachment No. 4.

The practical implementation of the layout of a furniture factory for the production of interchangeable module furniture is that shown in Drawing UNIDO No. 1.1024, which we should like to illustrate briefly (explanation of work cycle and machinery in the layout presented).

6.00 Remarks on Planning of Work Environment

The last act in the planning of the manufacturing unit belongs to the architect, who, however, will not confine himself to the simple designing of buildings. Architecture is not only an architectural problem, but is subordinate to a series of urgent requirements that precede it in logical order.

Attention is therefore drawn to the following points:

1. Organization of working space, taking into account the psychological aspects as well as the purely functional ones.

2. Space chosen in such a way as to make an ideal place for work and provide an effective link with the outside (open space with trees, room to relax and sit down etc.).

3. Choice of construction materials such as to provide maximum comfort with the minimum waste (sound-proof materials, pleasant colours, indirect lighting, height of buildings in proportion to machinery installed).

4. Choice of an architectural style of expression that makes no concession to formal or monumental works.

7.00 Hints on Cost Analysis

The final phase in the planning of a new factory is the analysis of investments, costs and profit margins.

The planner will have to go into this subject with great care and have complete mastery of the figures involved.

Here are some of the subjects dealt with:

a. Cost of technical investments
b. General cost of plant
c. Cost of production plant
d. Organizational costs (planning, training, starting-up).

For these costs, it will be necessary to determine the amount of depreciation, corrected with a coefficient that takes into account the rate of the interest payable on the capital invested.

In addition, the following will have to be estimated:

e. Direct and indirect labour requirements

f. Managerial and clerical staff requirements

g. General administrative expenditure

h. Sales expenditure

i. Auxiliary material and energy requirements

l. Cost of storage of material (raw materials, semi-finished and finished products).

In addition, it will be necessary to determine the direct need for materials, estimating the quantity of furniture to be produced, established in the production budget (see Section 3.00), after which the financial study will be concluded with a forecast for the coming year and a statement of investment requirements.

8.00 CONCLUSION

The construction of a new wooden-furniture factory, however big it may be, poses considerable problems.

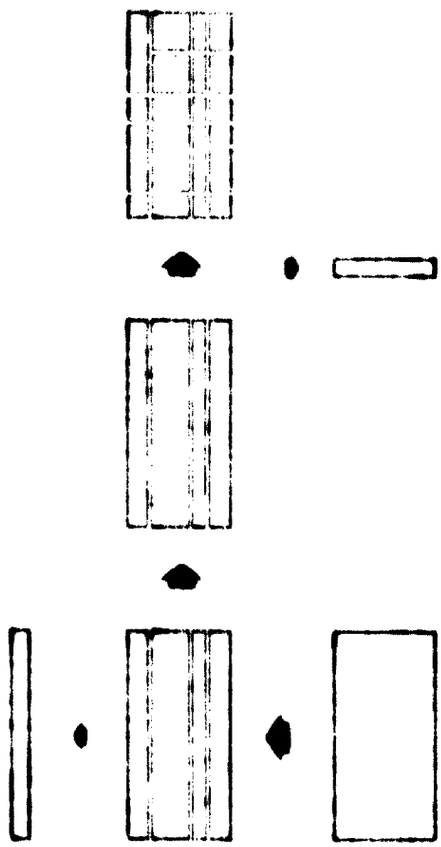
We have tried to explain these problems with equal clarity, so as to show that advanced technological standards can be reached, not only for cars, refrigerators, but also for furniture.

I should like to conclude by stressing that, in setting up a new industrial plant, a decisive factor must be a preliminary study of the sociological influences that condition man,

which is [illegible] for it is with the [illegible] and a meeting point, [illegible] study element.

ATTACHMENT No. 1

FLOW DIAGRAM OF PAPER SHORTENING (BCO)



ATTACHMENT No. 2

DIAGRAM SHOWING PRODUCTIVITY OF A SQUARING-UP LINE

AS A FUNCTION OF QUANTITY OF PANELS (UC01)

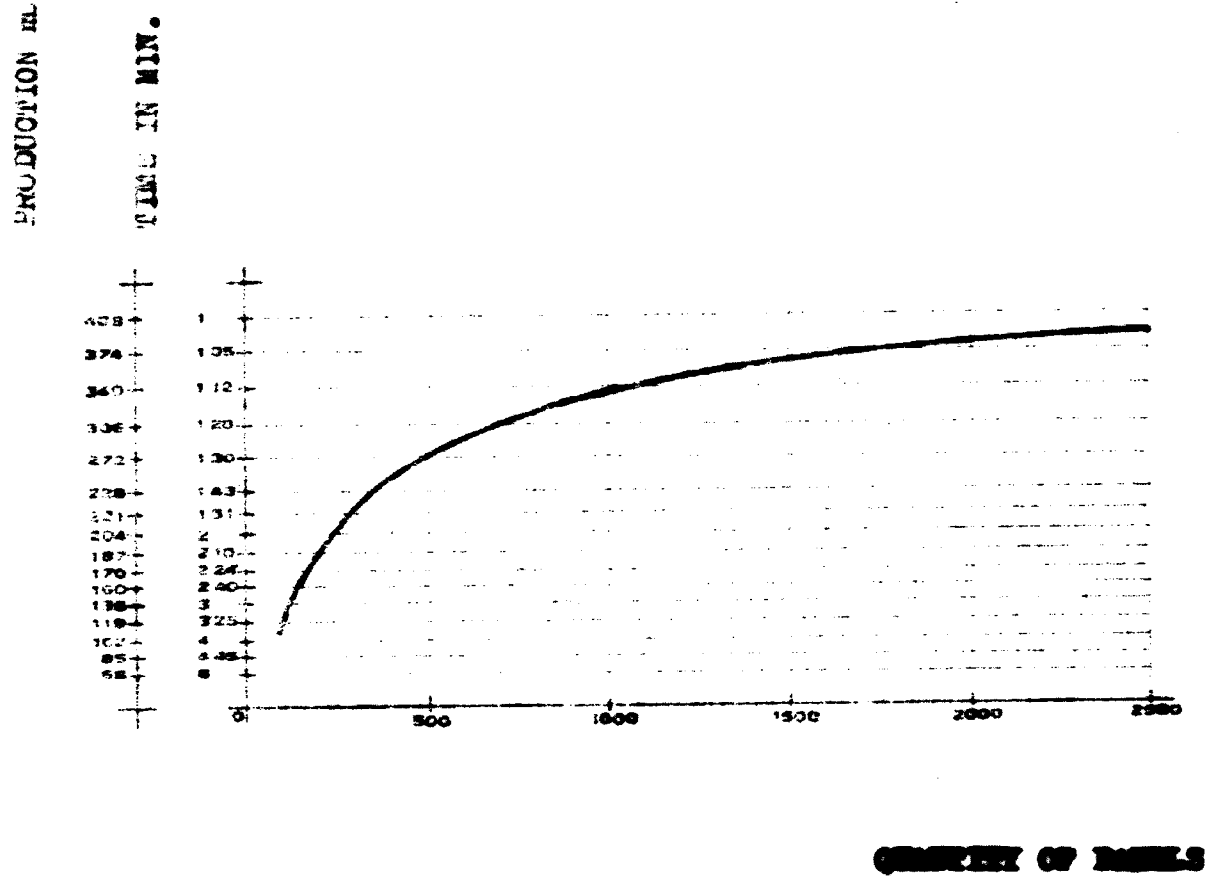
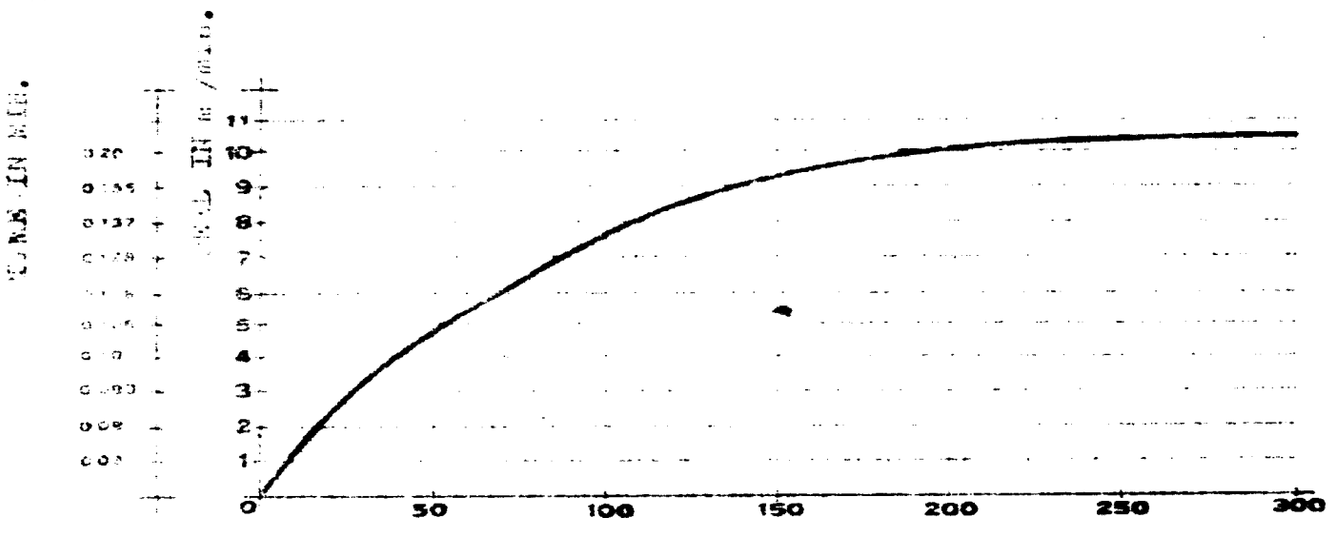


DIAGRAM SHOWING PRODUCTIVITY OF SQUARING-UP LINE AS A FUNCTION OF LENGTH OF PANELS (UC01)

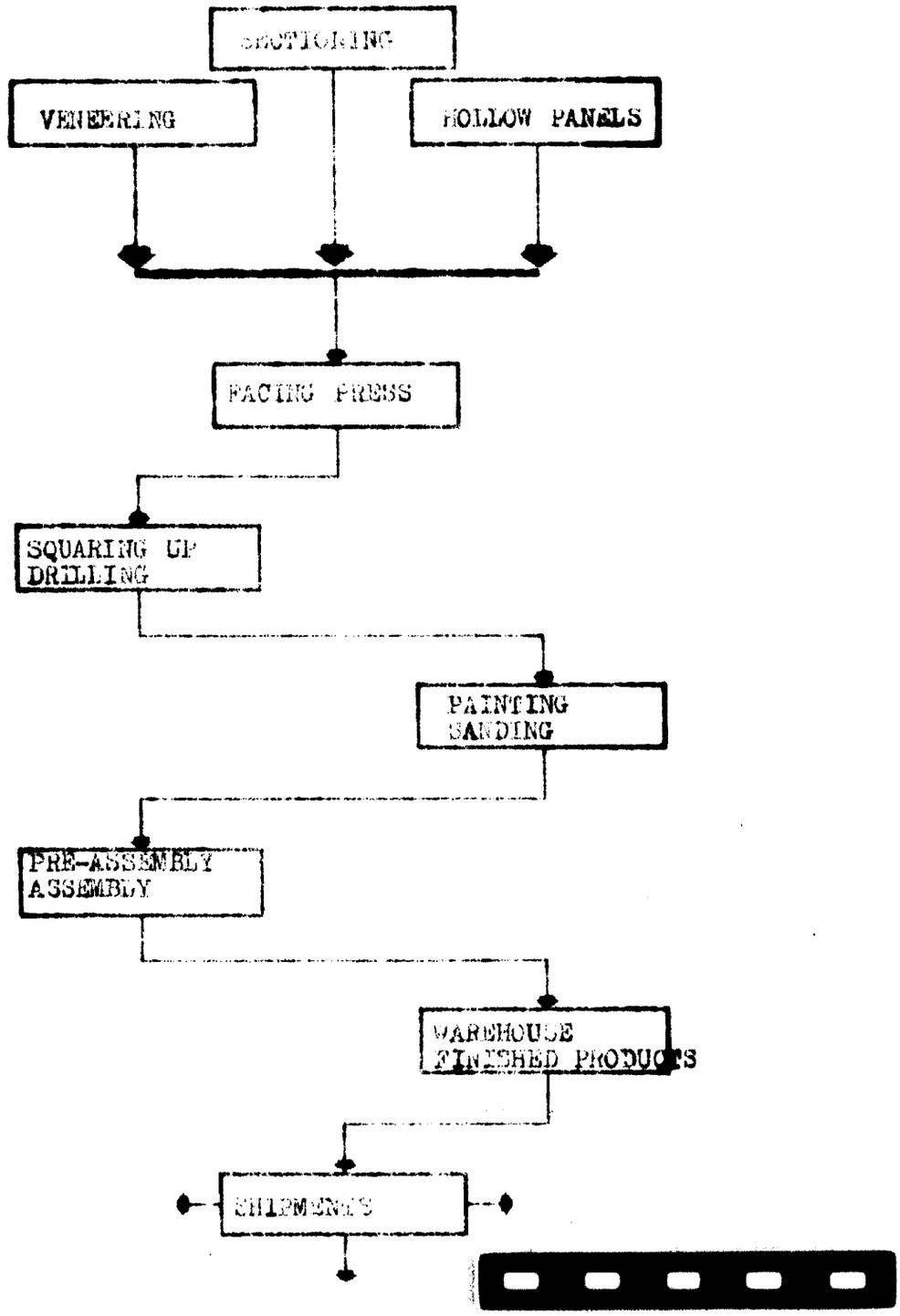


LENGTH OF PANELS IN CM

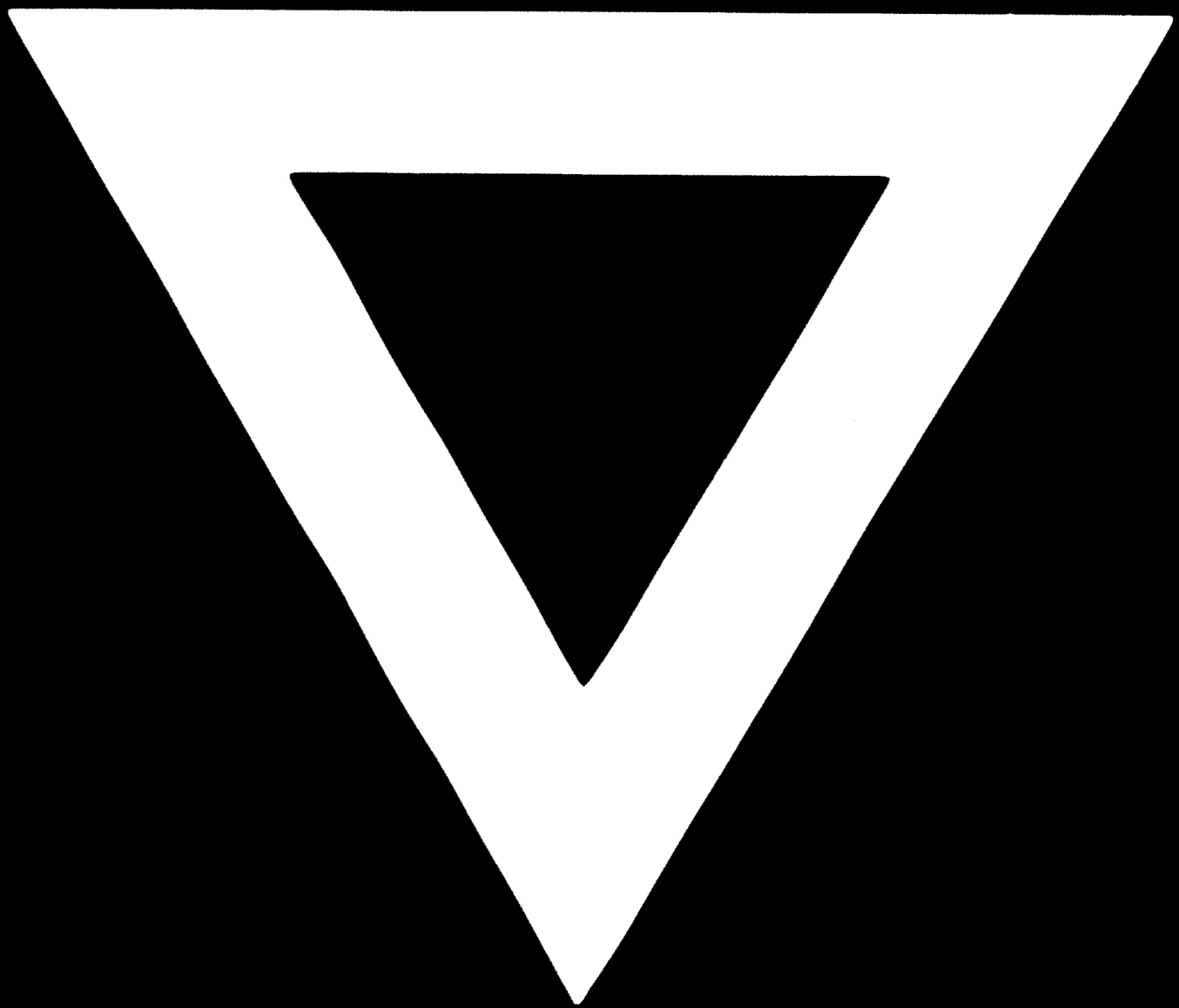
ANNEXURE NO. 5

ATTACHMENT No. 4

MAIN FLOW DIAGRAM OF COMPANY MANUFACTURING VENEERED AND PAINTED FURNITURE (U001)



C-267



77.06.28