

DESIGN OF THE TECHNOLOGICAL FLOW FOR THE MANUFACTURING OF VENEERED CHIPBOARD TABLES

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RESEARCH ARTICLE

Abstract

The paper presents the method for producing veneered particleboard panels, for a very high volume of rectangular tables, within an existing industrial hall. Consideration is given to creating a one-piece flow system, with the minimal possible use of forklifts in the production hall. One-piece flow is a lean manufacturing method focused on continuous, single-unit movement through production to minimize waste and maximize efficiency. Producing veneered particleboard panels typically involves specific machinery across several stages to process raw materials into finished, laminated panels

Keywords: technological flow, particleboard tables, specific machinery, one-piece flow

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INTRODUCTION

The technological flow for the production of tables made from veneered Particleboard (or veneered MDF) is a modern process that involves specific stages for processing composite materials. We can read specific papers as (Budău, Ispas, 2014; Alexandru, 2002; Cismaru, 2005; Dogaru, 1989).

The goal is to produce veneered particleboard panels in an existing industrial hall for a very high volume of rectangular tables (over 60,000) and round tables (over 80,000 per year). The existing hall is already equipped with basic facilities: electricity, sewage, and an exhaust cyclone. The objective is also to create a one-piece flow system while minimizing the use of forklifts in the production hall. To determine the necessary machinery and their correct positioning in the production hall, the flows will be divided into three separate categories to meet the requirement of the one-piece flow system. Therefore, for the projected production, we will have a flow for rectangular table tops, a flow for round table tops, and a separate flow for legs.

The technological flow focuses on transforming the raw material into product components and the final assembly of both rectangular and round top tables. It can be seen

more details in (Fragassa et al., 2019; Teggin et al., 2015). To correctly assess the necessary space and meet the client's requirements, as well as guarantee the required volumes of finished product, we must evaluate the production flow to fit the requirement of the one-piece flow system.

The main stages of the technological flow are:

- 1. Material Supply and Preparation:** This involves the reception and storage of materials under optimal humidity and temperature conditions.
- 2. Sizing and Cutting: Cutting optimization** involves using specialized software to plan the cutting of standard panels (e.g., 2800x2070 mm) into table components (top, legs, aprons) with minimal waste. The actual cutting uses very precise panel sizing saws, often with Computer Numerical Control (CNC), to obtain the rough or net dimensions of each element.
- 3. Edge Banding: Edge preparation** involves the cut edges of the particleboard being exposed and requiring covering for protection and aesthetics. Edge banding is performed using an automatic edge banding machine that applies adhesive (hot

melt), presses the edge band strip (ABS, PVC, melamine, or even natural veneer), and trims the excess. The edges are then milled and cleaned for a smooth finish. If the table top is round, small-radius or manual/semi-automatic edge banding machines are used.

4. **Additional Machining (Drilling and Milling):** Creating the necessary holes for the table joints (e.g., for tabletop screws, dowels, or for attaching the legs). Multiple drilling machines or **CNC machining centers** are used. Milling (if necessary) involves creating special shapes or profiles on the edges or surfaces, depending on the table design.
5. **Surface Finishing (Lacquering/Painting):** If the panels are natural veneered, they usually require subsequent finishing. If melamine or HPL is used, this step is omitted as the material is already finished. A fine sanding of the veneered surfaces is also performed to prepare them for finishing. Application of lacquer (matte, semi-matte, glossy) or paint. 1-3 coats can be applied, with drying and light sanding between them.
6. **Assembly:** Components are brought to the assembly area. Legs are attached to the aprons or directly to the top using specified hardware. Quality control during assembly involves checking the alignment and stability of the table.
7. **Final Inspection and Packaging: Final quality control** involves a thorough inspection of the finished product (dimensions, finish, functionality). Packaging: tables are packaged (disassembled or assembled, depending on logistics) using protective film, cardboard, and corner protectors to prevent damage during transport.
8. **Storage and Delivery:** Packaged products are temporarily stored in the finished goods warehouse, ready for shipment to customers.

MATERIAL AND METHOD

To determine the type of machinery and their correct positioning in the production hall, we

will divide the flows into three separate categories to meet the requirement of the **one-piece flow system**.

1. Rectangular Table Top Flow:

For this flow, we will need:

- **Sizing Machine:** Due to the large volumes, we will use an **automatic sizing machine from Holzma**.
- **Edge Banding Machine:** For the same reason, we will use **double-sided machines from Homag**.
- **Hot Press:** To glue the veneer sheets (we will use an **ODW press with water-heated platens and automatic polyurethane applicators**).
- **Edge Profiling and Finishing Machine:** To trim the excess veneer, profile the edges, and finish the edges, we will use **dedicated machines from Homag** for this purpose.
- **CNC Machining** for the leg joint method: We will use a **Biesse Rover A-type processing machine**.
- **Surface Finishing:** We will use an **automatic water-based finishing line with a drying tunnel and UV lamps from Burckle, with calibrating machines from Costa**.

2. Round Table Top Flow:

For this technological flow, we need:

- **Raw Material Sizing/Cutting:** We will use a **CNC, Biesse ROVER B**, due to the shape of the tops.
- **Edge Banding CNC:** For the same reason, we will use a **CNC Rover A-type** for edge banding the panels.
- **Veneer Gluing:** This will be done on an **ODW hot press**.
- **Veneer Trimming and Profiling:** This will be done on the **Biesse Rover A-type CNC**.
- **Edge Finishing:** Since it is a round edge, we cannot use a standard edge finishing machine, so we will use a **spray booth**.

- **Surface Finishing:** This will be done with a **dedicated finishing line, with a tunnel and UV lamps from Burckle.**

- **End Finishing:** This will be done **manually.**

Integrated Schemes of Technological Flows, Referenced to the Existing Production Hall:

3. Table Leg Flow:

To achieve this, we will need:

Existing Hall Drawing:

- **Sizing/Cutting:** We will use a machine from **Holzma.**
- **Leg Core Gluing:** We will use **Itallpress hot presses.**
- **Core Formatting to the Desired Profile:** This will be done with a **BACCI CNC machine** (depends on the leg design; we will use round legs as an example).
- **Leg Veneering:** We will use **dedicated Barberan machines** for wrapping them with 0.5mm natural veneer.
- **Leg Finishing:** We will do this via **vacuum with dedicated Makor machines.**
- **Formatting and Drilling or Milling:** Depending on the leg-to-top attachment system, we will use a **Bacci 5-axis CNC.**

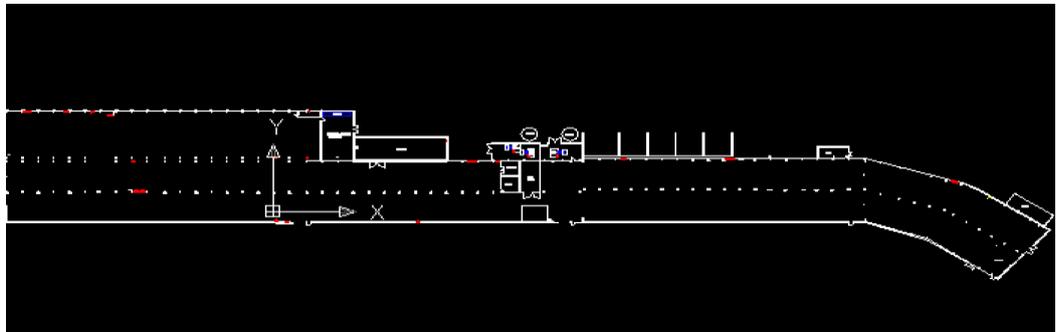


Figure 1. Location of the first production flow

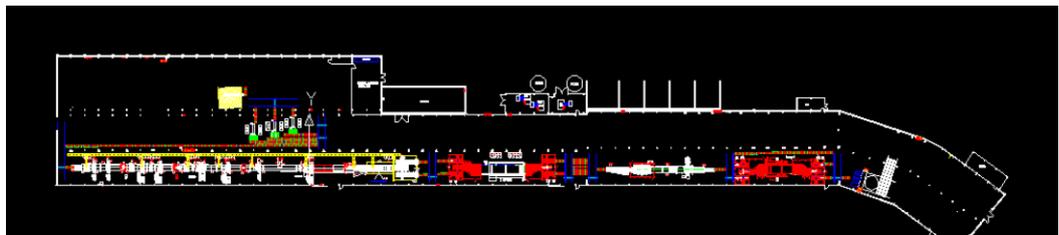


Figure 2. Both countertop lines



Figure 3. Complete hall with all three production lines

RESULTS AND DISCUSSIONS

As we can see the core principle of one-piece flow is to align production with customer demand by processing one item at a time through each step without unnecessary waiting or inventory accumulation, as opposed to traditional batch production (Lucisano et al., 2016; Warcholinski, Gilewicz, 2022)

- **Immediate Quality Feedback:** Defects are detected and corrected immediately at the station where they occur, preventing an entire batch from being affected and improving overall product quality
- **Continuous Flow of Units:** Units move directly from one process to the next without delay, resulting in shorter lead times and faster delivery to customers.
- **Minimize Work-in-Process (WIP) Inventory:** Eliminates large queues of unfinished goods between workstations, freeing up space and capital.
- **Cellular Manufacturing Layout:** Equipment and workstations are arranged in a sequential, often U-shaped, layout to minimize transportation and motion waste.

Regarding the existing industrial hall, concerning the production of veneered particleboard panels for a very high volume of rectangular tables (over 60,000) and round tables (over 80,000 per year) we can conclude:

The goal is to create a **complex one-piece flow system**, with the minimal possible use of forklifts in the production hall.

In this equipment layout format, everything will be done according to the **one-piece flow principles**, and the machines are interconnected with automatic rollers and

transfer systems. Each flow has its dedicated lane.

CONCLUSIONS

One Piece Flow offers a practical solution. By moving products one unit at a time through each step of the process, manufacturers can reduce delays, eliminate overproduction, and respond faster to changes.

Advantages of the System:

- Guarantees **fluent production** with maximum control.
- **Zero downtime** between machines.
- A **lower number of employees** is required.
- The **5S system** can be implemented very easily in the factory.

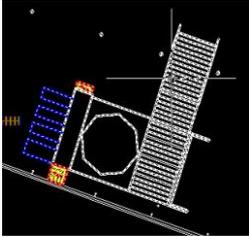
Disadvantages of the System:

- Like any flow that operates **just-in-time** and piece-by-piece, any deviation or defect caused at any point in the production **stops the entire chain**.
- **Flexibility in production is nonexistent**.

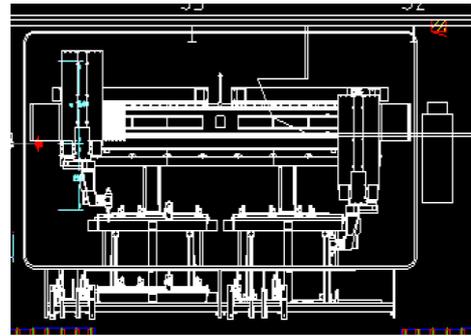
As a conclusion the Real-World Application:

- In real production conditions, it can only be **partially applied**.
- It would be advisable to use the **Kaizen system** as a material **buffer** between certain key points to ensure the process continues to function even if a malfunction occurs at one point in the production.

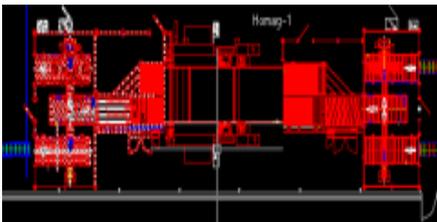
Project legend:



Holzma pallet formatting machine



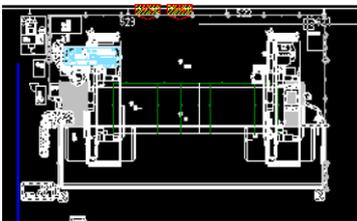
CNC BACCI double jet



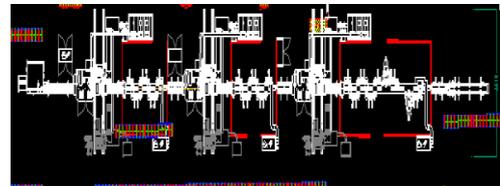
Homag edge banding machine



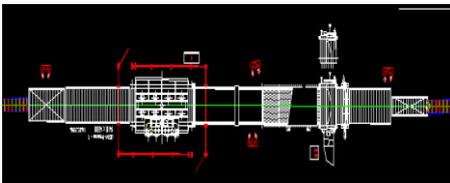
Barberan wrapping machine



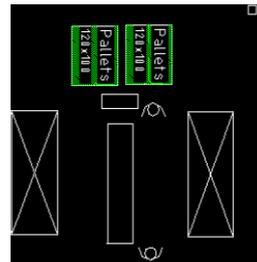
CNC Nesting



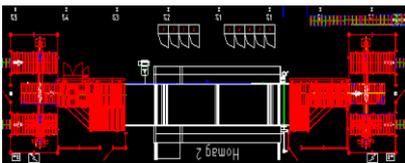
Vacuum finished machine



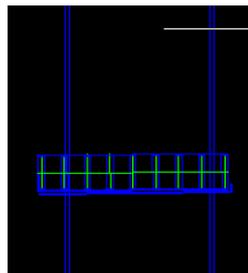
ODW sandwich press



Packing table



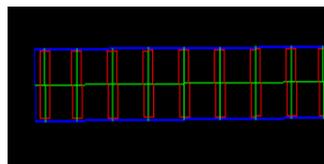
Homag edge finishing machine



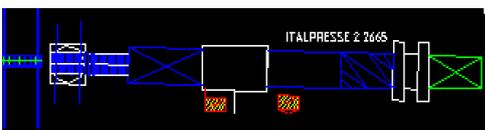
Transfer roller



Coima spray booth



Conveyor roller



Sandwich press ITALLPRESS

REFERENCES

- Budău, G., Ispas, M. (2014). *Mașini unelte pentru prelucrarea lemnului*, Editura Luxlibris, Brașov.
- Alexandru, Șt. (2002). *Agregate și linii automate în industria lemnului*, Editura Tehnică, București.
- Cismaru, I., Cismaru, M. (2005). *Proiectarea tehnologică în industria lemnului. Proiectare la formă și dimensiuni*, Editura Universității Transilvania, Brașov.
- Dogaru, V. (1989) *Așchiera lemnului și scule*, Litografia Universității Brașov.
- Fragassa, C., Campana, G., Lucisano, G., Marinkovic, D., (2019), *A Practical Guideline in the Design and use of Woodworking Tools*, FME Transaction 47(3):487-495.
- Lucisano, G., Stefanovic, M., Fragassa, C., (2016), *Advanced Design Solutions For High-Precision Woodworking Machines*, International Journal for Quality Research 10(1) 143–158 ISSN 1800-6450.
- Ravi Teggim, Shivanand Kavadiatti and Shashank Hebbal, (2015), *Design And Fabrication Of Machine Performing Multiple Wood Working Operations*, Proceeding of NCRIET-2015 & Indian J.Sci.Res. 12(1):162-167, 2015.
- Warcholinski, B., Gilewicz, A., (2022), *Surface Engineering of Woodworking Tools*, a Review, MDPI, Applied Sciences, October 2022, 12(20):10389.
- *Ministerul Educației și Cercetării, (2023-2024), *Fabricarea produselor din lemn Repere metodologice* (materiale pentru învățământul profesional și tehnic).