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DIGITALISATION OF THE WOOD PROCESSING AND FURNITURE MANUFACTURING INDUSTRY

Mira Stankevikj Shumanska[1], Angela Nikolovska[2], Ivana Antovska[1]

[1]Ss Cyril and Methodius University in Skopje, North Macedonia
Faculty of Design and Technologies of Furniture and Interior – Skopje
[2]KAPA5 ENTERTEJMENT DOOEL Skopje
e-mail:stankevik@fdtme.ukim.edu.mk, angelanikolovska10@gmail.com,
antovska@fdtme.ukim.edu.mk

ABSTRACT

The potential for digital transformation in industries such as wood processing and furniture manufacturing highlights the vital role of innovation in driving entrepreneurial growth and the evolution of these sectors. Analyses show that while the adoption of innovative practices is essential for all enterprises, a structured and strategic approach is needed to overcome the challenges associated with digitalisation. The scientific paper indicates that innovation, particularly digital innovation, forms the foundation for businesses aiming to maintain their competitive advantage, adapt to market dynamics, and ensure long-term success in a digitalised economy.

Keywords: innovation, digitalisation, digital transformation, wood processing industry, furniture manufacturing, operational efficiency.

1. INTRODUCTION

The wood processing and furniture manufacturing industries have long been rooted in tradition, with production largely based on manual craftsmanship, artisanal skills, and labour-intensive processes. However, the global market and customer demands are evolving rapidly, pushing these industries towards modernisation and the adoption of digital tools. While traditional practices still hold significant value, digitalisation offers an opportunity for progress and has become the only viable path to maintaining competitiveness among manufacturers.

Digitalisation has rapidly emerged as a transformative force across industries, and the wood sector is no exception. As industrial sectors worldwide implement digital innovations to enhance efficiency, optimise production, and boost competitiveness, the wood processing and furniture manufacturing industries face similar pressures. The need to adapt to digital technologies is driven by several factors, including shifts in market dynamics, heightened competition, the rise of Industry 4.0, and the demand for improved resource management and sustainability.

In the wood and furniture industries, digitalisation refers to the integration of digital technologies into business operations and manufacturing processes. These technologies include automation, data analytics, the Internet of Things (IoT), and other advanced tools that enable companies to improve efficiency, monitor operations in real time, and reduce waste. By adopting these technologies, businesses can streamline operations, minimise human error, and make informed decisions based on real-time data.

Nevertheless, despite its benefits, the wood processing and furniture sectors have been slower to embrace digitalisation compared to other industries. The traditional nature of the sector, reliance on manual labour, and insufficient workforce education contribute to this lag. In regions such as the Balkans, companies are still in the early stages of digital implementation. Research shows that while

many wood processing companies recognise the potential advantages of digital technologies, the majority lack a systematic or strategic approach to implementing these innovations. (Digitalisation in wood processing companies – Managers' Perspective — Dražena Gašpar, Mirela Mabić, Ivica Ćorić).

2. POTENTIAL FOR DIGITALISATION

Digitalisation represents a transformative opportunity for the wood processing and furniture manufacturing industries. By integrating digital tools into various aspects of production, supply chain management, and customer communication, businesses can achieve greater efficiency, scalability, and innovation.

2.1 Production Processes

The production process within wood processing and furniture manufacturing is the area where digitalisation can have the most significant impact. Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM) form the foundation of this transformation, offering new ways to design, prototype, and manufacture products.

Computer-Aided Design (CAD): The CAD software enables designers to create precise, three-dimensional furniture models that can be easily modified, shared, and optimised before production begins. This software eliminates the need for manual drafting and speeds up the design process while also allowing designers to visualise complex furniture pieces with greater accuracy. The global CAD market is expected to grow from USD 10.11 billion in 2024 to USD 15.77 billion by 2032, showing an annual growth rate of 5.7%. With the introduction of new software packages, the efficiency of production processes and modelling has significantly improved. This has also led to increased creativity in designs across different engineering disciplines. (Computer-Aided Design Market Share, Size, Trends, Industry Analysis Report – Polaris)

Computer-Aided Manufacturing (CAM): The CAM software takes CAD designs and translates them into instructions for automated machines such as CNC (Computer Numerical Control) systems. CNC machines can cut, shape, and assemble components with extreme precision, ensuring consistent quality across production batches. These machines can handle complex designs that would be either impossible or financially unfeasible to produce using manual methods. The market for computer-aided manufacturing in Europe is projected to reach USD 1,659.1 million by 2030. It is expected to grow at an annual rate of 8.3% over the period from 2024 to 2030. (Europe Computer Aided Manufacturing Market Size & Outlook – Horizon)

Automation and robotics: In automated production facilities, machines carry out tasks that were previously done by workers. These machines range from basic systems, such as Computer Numerical Control (CNC) machines, to more complex robots that can be programmed for various functions. Robots are typically assigned tasks that are monotonous, dirty, dangerous, or physically demanding. These types of tasks are often referred to as the "4Ds of robotics" and are generally better suited for machines than for people. However, not all workers readily accept the increased use of robots in the workplace. Many are understandably concerned about being replaced. While some low-skilled jobs may be lost as a result, the introduction of robotics can also lead to the creation of new employment opportunities. Despite increasing capabilities, robots still cannot perform every task that humans can. The most effective approach is to combine the strengths of robots and human workers and create environments that support collaboration. The global industrial automation market is valued at 190 billion USD, with process automation being the largest segment. (Unlocking the industrial potential of robotics and automation – McKinsey)

Additive manufacturing (3D printing): 3D printing was previously mentioned in the chapter on digital technologies, but it holds particular significance for manufacturing processes in furniture production. This emerging technology is especially valuable for prototyping and small-scale production. It allows manufacturers to experiment with complex shapes, textures, and materials, enabling innovative furniture designs that go beyond the limitations of traditional woodworking. Additive manufacturing can also shorten production timelines by supporting rapid prototyping and faster product launches.

The digitalisation of manufacturing processes brings notable advantages in terms of flexibility, allowing producers to offer customised designs. The integration of smart technologies, such as IoT

sensors in machinery, enables real-time monitoring of equipment performance, predictive maintenance, and greater control over production parameters.

2.2 Supply Chain and Logistics

In the furniture industry, efficient supply chain management is critical due to the high volume of raw materials required, complex logistics, and the global nature of the market. Digitalisation can significantly improve supply chain and logistics operations.

Greater transparency in the supply chain: Enterprise Resource Planning (ERP) systems provide complete visibility across the entire supply chain. From procurement to production and delivery, ERP systems consolidate data into a single platform, offering real-time insights into inventory levels, supplier performance, and shipment status. This visibility supports better and more streamlined decision-making, helping manufacturers manage inventory more effectively and avoid disruptions.

Automated warehousing: Warehouse automation involves optimising repetitive and time-consuming operations traditionally performed manually by workers. In digitised supply chains, automated storage systems use robots and IoT devices to manage the storage and distribution of products. Smart sensors and RFID (Radio-Frequency Identification) can track inventory in real time, reducing the risk of overstocking or stockouts. Warehouse automation also lowers labour costs and improves order accuracy.

According to Statista, the global warehouse automation market was valued at over USD 23 billion in 2023 and is expected to grow at an annual growth rate of around 15%, reaching approximately USD 41 billion by 2027. (Size of the warehouse automation market worldwide from 2023 to 2027 – Statista)

Logistics optimisation: Logistics automation encompasses both hardware and software solutions designed to optimise logistics processes, including transportation, warehousing, and data management. Automating these operations increases efficiency, reduces errors, and shortens execution times. Digital tools can streamline logistics by using data to optimise delivery routes, reduce fuel consumption, and minimise delivery times. For example, GPS tracking and delivery route optimisation algorithms ensure that products are delivered to customers efficiently, lowering delivery costs and increasing customer satisfaction. The global logistics automation market was valued at USD 38.76 billion in 2023 and is expected to grow at an annual rate of 15.90% through 2032. (Logistics Automation Market Share, Size, Trends, Industry Analysis Report – Polaris) Automation plays a key role in enabling business expansion by allowing efficient management of larger workloads through the use of autonomous robots, transport systems, and automated warehouse solutions.

Sustainability: The integration of digital tools can also contribute to sustainability in supply chain management. By optimising resource usage, manufacturers can reduce waste, minimise their carbon footprint, and ensure a more sustainable supply of raw materials.

2.3 Sales, Marketing, and Customer Communication

Digitalisation is transforming how furniture manufacturers and entrepreneurs interact with their customers. E-commerce, digital marketing, and customer data analytics open new opportunities for growth.

E-commerce and Online Sales: The rise of e-commerce platforms enables furniture manufacturers to present their products to a global audience without the need for physical stores. Selling directly to consumers helps reduce overhead costs and increase profit margins. A key advantage is the way these platforms function. For example, online configurators let customers personalise products by selecting materials, colours or dimensions before placing an order, improving the overall shopping experience.

Augmented Reality (AR): Augmented Reality (AR), which refers to the integration of digital information with the user's environment in real time, plays a key role in the digitalisation of the furniture industry and enhances the sales process. AR is reshaping the way people buy furniture. With AR applications, customers can preview how a piece of furniture will look in their home before purchasing. The IKEA Place app, for instance, allows users to see 3D models of IKEA products in their own rooms, helping to reduce uncertainty and improve satisfaction.

Digital Marketing and Analytics: Modern CRM systems and data analytics tools help manufacturers and retailers segment customer bases, track buying patterns and improve the targeting of marketing campaigns. By understanding customer preferences, companies can offer tailored recommendations, launch focused promotions and build long-term customer loyalty.

3. IMPLEMENTATION OF DIGITAL TECHNOLOGIES

Digital transformation is a complex process that requires careful planning, strategic investment, and adequate technological infrastructure. While the potential benefits of digitalisation are significant, the path to full implementation involves several critical steps.

To successfully implement digital technologies in the wood processing and furniture manufacturing industries, companies should follow a structured approach:

Assessment of existing capacities: The first step in digital transformation is analysing the current state of the business. This involves conducting a digital audit of existing processes, identifying bottlenecks, and determining where digital tools can create the greatest value. This may include evaluating manual tasks, outdated machinery, or inefficient supply chain practices.

Developing a digital strategy: After the assessment, companies need to create a long-term digital strategy aligned with their business objectives. This strategy should define which technologies will be implemented, the desired outcomes (such as cost reduction or improved customer communication), and an implementation roadmap. The strategy should also allow for scalability so that today's digital solutions can grow alongside the business.

Investing in technology: Once the strategy is in place, the next step is investing in the appropriate technologies. This includes selecting a suitable ERP system, CNC machinery, or implementing IoT devices. Companies should prioritise technologies that offer flexibility, integration capabilities, and real-time data analytics.

Change management and workforce training: A crucial aspect of digital transformation is managing the organisational changes that come with implementing new technologies. This includes preparing employees for the changes, providing thorough training, and fostering a company culture that embraces innovation. Upskilling the workforce is essential, as employees must be able to operate new machinery, interpret data, and manage digital platforms.

Monitoring and continuous improvement: Digital transformation is an ongoing process that requires regular evaluation of the technologies in use. Companies should establish key performance indicators (KPIs) to measure the success of their digital initiatives and identify areas for improvement. As new technologies and innovations emerge, manufacturers must be prepared to adapt and optimise their operations accordingly.

4. CHALLENGES IN IMPLEMENTING DIGITALISATION

Despite the numerous opportunities that digitalisation offers to the wood processing and furniture manufacturing industry, the process of full digital transformation presents numerous challenges. Research highlights several key obstacles that companies in this sector face when attempting to implement digital technologies.

One of the most significant challenges is the financial barrier related to digitalisation. Moving from traditional methods to digital tools requires substantial investment in new equipment, software, and infrastructure. Many wood processing companies, particularly small and medium-sized enterprises, operate with limited budgets. This makes it difficult to justify the costs of these technologies without immediate returns. The lack of financial resources is aggravated by the absence of strategic planning, since most companies do not have an annual digitalisation plan or a dedicated budget for such initiatives.

Another key barrier is the lack of digital skills among the workforce. Many employees in the wood processing industry do not possess the digital literacy or technical knowledge needed to work with advanced technologies such as IoT, automation, and data analytics. This gap in skills presents a serious challenge to the effective implementation of digital solutions. In addition, companies face high staff turnover, which further complicates efforts to develop a digitally capable workforce. Training and upskilling employees require both time and resources. Without a systematic approach to

workforce development, companies struggle to keep pace with technological progress.

Resistance to change at various organisational levels is also a major barrier. Middle management and employees, particularly those who have long relied on traditional methods, often resist adopting new technologies. This cultural resistance can slow the pace of digital transformation, as employees may see digitalisation as a threat to their jobs or as an unnecessary disruption to established practices.

On the technological side, the lack of integration between different digital systems creates further challenges. Many companies do not use a unified data system, which means data from various devices and software programmes is inconsistent. This lack of standardisation makes it difficult to obtain a complete overview of operations. The fragmentation of data prevents companies from fully taking advantage of digital technologies for decision-making and process optimisation. (Digitalisation in the Construction and Woodwork Sectors - Nicole Oertwig, Konstantin Neumann and Holger Kohl)

Although many wood processing and furniture manufacturing companies recognise the need for digitalisation, they must overcome serious barriers related to finance, employee skills, organisational culture, and technology integration in order to fully implement digital transformation.

4.1 Practices and Strategies

Research highlights several practices that can support the successful implementation of digital technologies in the wood processing and furniture industries:

- **Phased Implementation:** Introducing digitalisation in phases is often the most effective approach. Rather than overhauling all business operations at once, companies should begin by implementing digital tools in specific areas, such as automating a single production line or integrating an ERP system for inventory management. This allows them to assess the impact of digitalisation and make adjustments before scaling the initiative across the entire organisation.
- **Engaging a Technology Consultant:** In many cases, furniture manufacturing companies lack the in-house expertise needed to implement complex digital solutions. Engaging external firms or consultants can help address this issue. These consultants can provide technical support, deliver training, and guide companies through the complexities of digital transformation.
- **Customer-Orientated Digitalisation:** Successful digital transformations often prioritise the customer experience. This includes using digital tools to improve services, personalise marketing efforts, and enhance the online sales experience.
- **Data-Driven Focus:** Digitalisation generates large volumes of data. Businesses must focus on data management and analytics in order to turn this data into actionable insights. Leveraging data to improve decision-making, optimise operations, and predict trends is essential for maximising the benefits of digital transformation.

5. ANALYSIS OF IKEA'S INNOVATION AND DIGITALISATION STRATEGY

Founded in 1943 in Älmhult, Sweden, IKEA has evolved from a small mail-order business into the world's largest furniture retail company. Known for its flat-pack furniture and Scandinavian style, IKEA operates 486 stores worldwide, with a revenue of nearly 45.1 billion euros in 2024. (FY24 Year in Review – IKEA) The company closely follows customer demands and continuously develops its business model to meet their changing needs.

5.1 IKEA's Approach to Innovation

- **Stylish and Affordable Products with Scandinavian Design:** IKEA's business model focuses on producing stylish, functional, and affordable furniture. The products are designed for easy assembly and transport, which optimises logistics and reduces costs. Through in-house production and the establishment of regional manufacturing centres, IKEA maintains strong control over quality and expenses.
- **Omnichannel Experience:** IKEA integrates physical and digital channels to enhance the customer experience and simplify the purchasing process. This approach allows customers to shop online, use 3D visualisation tools to plan their homes, and access fast and secure home delivery. Approximately 899 million customers visited IKEA stores in 2024, while digital sales accounted for 26% of total revenue. (Inter IKEA Group Financial Summary FY24).

- **Sustainability and the Circular Economy:** IKEA is committed to sustainable practices. This includes a focus on renewable energy in its stores, sustainable sourcing of materials, and initiatives such as furniture recycling and buy-back programmes for used products. The company aims to become climate-positive by 2030.

5.2 Digital Transformation Strategy

- **Expansion of E-Commerce:** IKEA has increased its online sales by creating in-store collection points for online orders. This transformation has helped the company adapt to the shift towards online shopping. According to company reports, IKEA's online platform received as many as 4.6 billion visits in 2024. (Inter IKEA Group Financial Summary FY24)
- **Integration of AR and VR:** IKEA's augmented reality (AR) app, IKEA Place, allows customers to visualise furniture in their homes before making a purchase. Virtual reality (VR) is also used in stores to simulate product placement, enhancing the customer experience.
- **Generative AI Shopping Assistant:** In 2023, IKEA introduced a generative AI shopping assistant that enables customers to receive real-time product recommendations and inventory information. This technology has improved the user experience, simplified the purchasing process and increased online conversion rates.

IKEA's ongoing innovations are driven by the need to remain competitive in a rapidly evolving market. The company focuses on understanding customer needs, improving accessibility, and staying true to its core values of sustainability and design. Every innovation is aligned with IKEA's vision to create a better everyday life for its customers and make a positive contribution to society.

6. CONCLUSION

Digitalisation represents a significant form of innovation. By adopting digital technologies and automation, companies in the wood processing and furniture manufacturing industries can improve productivity, increase operational efficiency, and develop new business models. Digital technologies also enable better resource management, reduced waste, and more efficient customer service. The example of IKEA demonstrates how digitalisation can redefine traditional practices and lead to sustainable growth.

The implementation of digital technologies is of great importance for the wood and furniture industries to maintain their competitiveness and meet growing demands for personalised products, faster production times, and sustainability. Digital transformation will require significant investment not only in technology but also in workforce training, as companies must equip their employees with the necessary skills to operate advanced digital tools. The pressure to digitalise is not only about improving efficiency but also about building more resilient and flexible operations that can adapt to future market changes and innovation.

REFERENCES

1. Digitalization in wood processing companies - Managers Perspective — Dražena Gašpar, Mirela Mabić, Ivica Ćorić, https://sm.ef.uns.ac.rs/index.php/proceedings/article/view/292/413
2. Computer Aided Design Market Share, Size, Trends, Industry Analysis Report – Polaris, https://www.polarismarketresearch.com/press-releases/computer-aided-design-cad-market
3. Europe Computer Aided Manufacturing Market Size & Outlook – Horizon, https://www.grandviewresearch.com/horizon/outlook/computer-aided-manufacturing-market/europe
4. Unlocking the industrial potential of robotics and automation – McKinsey, https://www.mckinsey.com/~/media/mckinsey/industries/advanced%20electronics/our%20insights/unlocking%20the%20industrial%20potential%20of%20robotics%20and%20automation/unlocking-the-industrial-potential-of-robotics-and-automation-final.pdf
5. Size of the warehouse automation market worldwide from 2023 to 2027 – Statista, https://www.statista.com/statistics/1094202/global-warehouse-automation-market-size/#:~:text=The%20global%20warehouse%20automation%20market,billion%20U.S.%20dollars%20in%202027

6. Logistics Automation Market Share, Size, Trends, Industry Analysis Report – Polaris, https://www.polarismarketresearch.com/industry-analysis/logistics-automation-market
7. Digitalisation in the Construction and Woodwork sectors – Nicole Oertwig, Konstantin Neumann and Holger Kohl, https://library.fes.de/pdf-files/bueros/bruessel/20331-20230530.pdf
8. FY24 Year in Review - IKEA, https://www.ikea.com/global/en/our-business/how-we-work/year-in-review-fy24/
9. Inter IKEA Group Financial Summary FY24 - https://www.inter.ikea.com/-/media/interikea/igi/financial-reports/fy24-financial-reports/inter_ikea_group_financial_summary_fy24.pdf?rev=76f8481fd2e14a63a8359eeda8eefdbd&sc_lang=en
10. IKEA - Statistics & Facts - Statista, https://www.statista.com/topics/1961/ikea/