Mirko Kariž, Manja Kitek Kuzman, Jože Kropivšek*[1]

Possibilities of Using Artificial Intelligence in Furniture/Woodworking Industry

Mogućnosti primjene umjetne inteligencije u drvoprerađivačkoj industriji i proizvodnji namještaja

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ABSTRACT • *The use of artificial intelligence (AI) in various fields has attracted a lot of attention in the past year, especially after the release of ChatGPT, a freely available intelligent online system. Several advanced software solutions that incorporate AI are becoming available on a larger scale and could help improve every aspect of our lives. The use of AI also has great potential in various areas of the woodworking industry. In the design phase, AI-supported design software can facilitate the development of new ideas and shorten 3D modelling processes. In the construction phase, AI plays a crucial role in optimising construction details using techniques such as topology optimisation, numerical simulations and generative design. The use of AI can also be applied in the production process, where it automates the creation of CNC machining programs and optimises machining methods. Quality control is improved through AI monitoring of machines and surface quality using advanced image analysis and machine vision systems. In addition, AI contributes to predicting production needs and facilitates the maintenance of production machines. AI can be used in market analysis and enables companies to make informed decisions. It helps in the strategic planning of marketing activities and the sales process by providing insights derived from comprehensive market analyses. AI could help in creating marketing materials, communicating with customers, managing social networks and websites, analysing competitors, predicting demand, etc. The use of AI could enable major technological improvements with efficiency gains and innovation in various operational areas, but also causes some concerns about trust in these new systems and fear of being replaced by machines. AI should be seen as a tool to improve our productivity and performance, automate certain tasks and transform existing jobs. There is a need for ethical oversight, policy decisions and regulations to ensure fair treatment of all humans. An overview of currently available solutions was given to discover new opportunities for the use of AI in the wood industry, as a pivotal aspect of the ongoing digital transformation.*

KEYWORDS: *artificial intelligence; digital transformation; furniture design; woodworking industry*

* Corresponding author
[1] Authors are researchers at University of Ljubljana, Biotechnical Faculty, Department of Wood Science and Technology, Ljubljana, Slovenia. https://orcid.org/0000-0002-8088-2570; https://orcid.org/0000-0002-3764-4681; https://orcid.org/0000-0003-0839-0202

SAŽETAK • Primjena umjetne inteligencije (AI) u raznim područjima privuklo je veliku pozornost u protekloj godini, posebice nakon izlaska ChatGPT-a, besplatno dostupnoga inteligentnog online sustava. Nekoliko naprednih softverskih rješenja koja uključuju AI postaju sve dostupnija i mogu pomoći u poboljšanju svake sastavnice naših života. Korištenje AI-a također ima veliki potencijal u raznim područjima drvoprerađivačke industrije. Dizajnerski softver podržan AI-em u fazi projektiranja može olakšati razvoj novih ideja i skratiti procese 3D modeliranja. U fazi konstruiranja AI ima ključnu ulogu pri optimizaciji konstrukcijskih detalja zahvaljujući primjeni tehnika kao što su optimizacija topologije, numeričke simulacije i generativni dizajn. Korištenje AI-a također se proširuje na proizvodni proces putem automatizacije stvaranja CNC programa za obradu i optimizaciju metoda obrade. Kontrola kvalitete poboljšana je primjenom AI-a za praćenje rada strojeva i kvalitete površine uz pomoć napredne analize slike i sustava strojnog vida. Osim toga, AI pridonosi predviđanju proizvodnih potreba i olakšava održavanje proizvodnih strojeva. AI se može upotrijebiti i u analizi tržišta te tvrtkama omogućiti donošenje informiranih poslovnih odluka. Pomaže u strateškom planiranju marketinških aktivnosti i procesa prodaje dajući uvide proizašle iz sveobuhvatnih analiza tržišta. AI bi mogao pomoći i u kreiranju marketinških materijala, komunikaciji s kupcima, upravljanju društvenim mrežama i web stranicama, u analizi konkurenata, predviđanju potražnje itd. Primjena AI-a mogla bi omogućiti velika tehnološka poboljšanja, uz povećanje učinkovitosti i postizanje inovacija u raznim operativnim područjima, ali ipak donosi i dozu zabrinutosti glede povjerenja u te nove sustave, kao i strah da će sve ljude zamijeniti strojevi. No AI treba promatrati kao alat za poboljšanje naše produktivnosti i performansi, za automatizaciju određenih zadataka i transformaciju postojećih poslova. Definitivno postoji potreba za etičkim nadzorom, političkim odlukama i propisima kako bi se osiguralo pošteno postupanje prema svim ljudima. Dan je pregled trenutačno dostupnih rješenja da bi se otkrile nove prilike za primjenu umjetne inteligencije u drvnoj industriji kao ključnom aspektu digitalne transformacije koja je u tijeku.

KLJUČNE RIJEČI: *umjetna inteligencija; digitalna transformacija; dizajn namještaja; drvna industrija*

1 INTRODUCTION
1. UVOD

Artificial intelligence (AI) refers to the simulation of human intelligence in machines, especially computer systems, that are programmed to think, learn and solve problems like humans (National Science and Technology Council, 2016; Russell and Norvig, 2010). There are various definitions of AI that emphasise the behaviour that requires intelligence or the rational management of complex problems or the taking of appropriate actions to achieve goals under changing conditions.

AI, which includes technologies such as machine learning and deep learning algorithms, enables computers to analyse large amounts of data, recognise patterns and make decisions. These systems mimic human intelligence by performing tasks such as understanding natural language, recognising speech or images and making predictions. The aim of artificial intelligence is to develop machines that can adapt and continuously improve on their own, so that over time they can better deal with complicated problems and tasks (National Science and Technology Council, 2016). As a transformative technology, AI is revolutionising various industries, from healthcare and finance to manufacturing and entertainment, fundamentally changing the way we live, work and interact with the world.

The fundamental ideas of artificial intelligence were formulated by Alan Turing in his famous 1950 paper, "Computing Machinery and Intelligence", with the question: "Can machines think?". Milestones in the development of AI were the victory of IBM's chess computer Deep Blue over the world champion Garry Kasparov in 1997, DARPA's Cognitive Agent that Learns and Organises (CALO), from which Siri from Apple Inc. emerged, the victory of IBM's question-and-answer computer Watson in the TV game show "Jeopardy!" and the success of self-driving cars in the DARPA Grand Challenge competitions in the 2000s (National Science and Technology Council, 2016; Stone *et al.*, 2022).

With the availability of big data from multiple sources, improved machine learning approaches and algorithms, more powerful computers and increasing investment, AI has really evolved over the last decade. In current AI practises, machines predominantly plan, manage, control and optimise work without adequately considering human input and preferences (Rafsanjani and Hossein Nabizadeh, 2023). While AI tools are advanced, they are not omnipotent and require intelligent input from users. Users must carefully consider their input to optimise idea, prototype and solution generation. The syntax of the questions is of great importance.

The use of AI in the economy is closely linked to digitalisation and can be intertwined with it in various ways. Digitalisation is changing the way companies do business and is closely linked to investing in, developing and using modern (digital) technologies. It involves the use of digital technologies to change a technology-based business model to generate new revenue and value by creating new opportunities; it is the process of transitioning to a digital enterprise (Rachinger *et al.*, 2019).

Despite the great importance of the digital transformation of companies and despite the economic growth in Slovenia in recent years, as many as 82 % of Slovenian companies have a low digital index in 2019, and the situation is even worse among manufacturing companies (Kmet Zupančič, 2019; Zupan, 2017). In 2022, the proportion of larger companies with a low digitalisation index was still 73 %, while the situation is even worse for small companies (81 % with a low index) ("Digital entrepreneurship, detailed data, 2022," n.d.).

Companies must decide how and where to invest in new technologies and which ones best meet their needs. Within the technological pillars and trends of the concept of digital transformation within the fourth industrial revolution, blockchain, digital twins, quantum computing, augmented analytics and artificial intelligence are expected to drive disruption and new business models (Panetta, 2018). We are approaching the concept of the 'smart factory', also referred to as the U-factory, factory of things and smart factory of the future (Hozdić, 2015; Movrin, 2017), arguing that a smart factory combines the human, the product, the process and the organisation into a holistic system and includes the following components: smart products, smart equipment, smart people, smart conceptual processes and smart management.

Smart factories are a key feature of Industry 4.0 and they focus on the creation of intelligent products, processes and procedures with an emphasis on sustainable development (Červený *et al.*, 2022). Globalisation and networking will be crucial for the future nature of production – in the post-Internet of Things or so-called Industry 4.0 era (Matt and Rauch, 2020). The new direction, Industry 5.0, is already emerging, aimimg to highlight the role of humans in Cyber–Physical Systems (CPS) and promote the symbiosis of humans with new technologies. This new model for creating the factories of the future is known as the Human–Cyber–Physical System (HCPS) (Saniuk *et al.*, 2022). It is about the penetration of artificial intelligence into people's everyday lives, their "collaboration" to strengthen human capabilities and the return of humans to the "centre of the universe". In this context, the term Industry 5.0 Society 5.0 is more appropriate (Červený *et al.*, 2022; Saniuk *et al.*, 2022).

Industry 4.0 is a great opportunity for woodworking processes. Wood is a material of biological origin that is subject to fluctuations during the manufacturing process. Today, robust sensors, computing capacity, communication and intelligent algorithms make it possible to control the variability of wood. By learning from data, actions can be taken in real time (Ramos-Maldonado *et al.*, 2021). Based on the results of the study of the level of digitalisation in the Slovenian wood industry (Kropivšek and Grošelj, 2020), which found that digitalisation is still at a relatively low level, awareness of the importance of digitalisation and previous experience with digitalisation appear to be the main reasons for the further development of such technologies and approaches in companies. In the context of investment in ICT, companies rate investment in cloud computing and conversational platforms, the development of smart apps and smart things, and the implementation of some elements of the smart factory (i.e. advanced materials, sensor technologies, smart guidance systems and smart mechatronic tools) as most important.

The aim of this review article was to provide an overview of the currently available solutions that are based on the use of AI to support processes in the wood industry as an important aspect of the digital transformation of wood processing companies. We wanted to show how AI can support various processes and be an important part of the digitalisation of wood processing companies in line with New European Bauhaus values. The aim was also to help woodworking companies understand the practical ways in which AI can shape their operations and make them more efficient and competitive.

2 AI IN MANUFACTURING – POSSIBLE USES OF AI IN WOODWORKING INDUSTRY

2. AI U PROIZVODNJI – MOGUĆNOSTI KORIŠTENJA AI-a U DRVNOJ INDUSTRIJI

The woodworking industry today faces various challenges and opportunities that emphasise the need for innovation and dominance in the furniture market during the transition from the traditional furniture industry to smart upgrading (Xiong *et al.*, 2017). Sustainable furniture design has emerged as an important area of research that focuses on the interactions between people, furniture and the environment (Ashraf and Johar Town, 2023; Zhu *et al.*, 2023). In the past, furniture factories relied on manual labour and craftsmanship to produce furniture. With technological advancements, furniture factories are now integrating AI into their production processes to improve efficiency, quality and customer satisfaction (Ahmadli, 2023).

AI can be used in various ways in the wood processing industry to increase productivity, quality and efficiency. Here are some selected promising (in our opinion) applications of AI technologies in the wood industry:

- Generative design and customisation
- Optimisation of the supply chain
- Quality control and inspection
- Predictive maintenance
- Virtual shopping and augmented reality (AR)

These technologies offer numerous opportunities to increase efficiency, personalise products and improve the customer experience. Their application is constantly evolving as technology advances and companies find new ways to utilise them. Each of these technologies is briefly described. In addition, the tenets of the New European Bauhaus, focusing on sustainability, aesthetics, and cross-disciplinary collaboration, also exhibit potential synergy with the integration of Artificial Intelligence (AI) in the woodworking industry.

2.1 Generative design and customisation
2.1. Generativni dizajn i prilagodba

AI-powered generative design algorithms can create a variety of unique furniture designs based on specific parameters and constraints. This allows designers and customers to quickly explore a variety of creative options (Kocaman and Toğay, 2023). AI can also facilitate real-time personalisation, allowing customers to personalise furniture pieces according to their preferences, resulting in bespoke designs. Various platforms have been developed in recent years, some of which are already available to the public. Various versions are used, such as the creation of 3D models from existing images, text-to-image and 3D model generators, applications that modify or optimise existing models.

Spline AI, Masterpiece Studio, MirageML or 3DFY, for example, are AI-supported text-to-3D generators that can create photorealistic 3D models in response to text instructions ("Spline AI – 3D Design faster with AI.," n.d.). Only a few lines of text are required from users to generate fully functional 3D models and animations (Figure 1) (Caires *et al*., 2024). The AI text-to-3D generator turns a user's descriptive speech into a 3D model using sophisticated natural language processing (NLP) technology ("Generate – Masterpiece X," n.d.). In these cases, the exact product description is needed, and a correct prompt is important (usually at least 3-7 words long, including subject and descriptors, avoid abstract description, with added aesthetic and stylistic keywords). The text can also be created using AI-assisted generators, or even brainstorming using various platforms such as www. NUclino.com.

Sometimes it is easier to start modelling from an existing sketch or photo of a product. Make3D and Kaedim3D are web applications that allow you to convert a 2D image into a high-resolution, production-ready 3D model without the need for prior modelling experience. This process is fully automated and simply requires you to upload your image to the website and wait for the model to be generated (Figure 1, right). Even images for 3D model generators can be created based on some initial sketches using the Midjourney platform.

AI also offers great support in the creation of realistic photos of existing 3D models. The NeROIC (Neural Rendering of Objects from Online Image Collections) app, for example, suggests different lighting and style settings and generates several different rendered views of the model so that the users only have to select the photo they like best (Figure 2).

AI in design can create new shapes and forms and optimise product structures. Traditional furniture design is based on experience, calculations or finite element analyses. Generative design software improves this process by optimising the design based on constraints such as load, material properties and product lifespan, considering the environmental impact in terms of sustainability (Papallo *et al*., 2023).

Generative design, a subfield of artificial intelligence, addresses technical issues with defined constraints and offers a range of solutions. It can be used in various industries such as consumer goods, automotive, aerospace, industrial machinery and building products. The main application is the automatic generation of pre-tested design options that fulfil specific requirements (Miles, 2022). The fundamental goals of

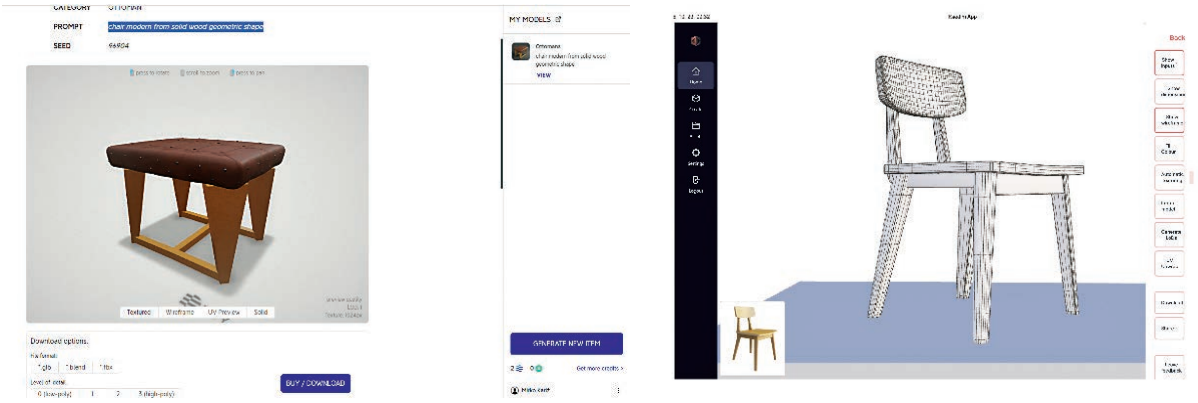

Figure 1 Left: Suggested model of chair from text prompt: "*chair modern from solid wood geometric shape"*("3DFY Prompt – Download Model," n.d.); right: 3D model from image generator – Kaedim3d (https://www.app.kaedim3d.com/dashboard)
Slika 1. Lijevo: predloženi model stolice iz tekstualnog upitnika opisan kao: "moderna stolica od punog drva geometrijskog oblika" ("3DFY Prompt – Download Model", n.d.); desno: 3D model iz generatora slika – Kaedim3d (https://www.app.kaedim3d.com/dashboard)

Figure 2 Example of AI supported rendering app NeROIC (Kuang *et al.*, 2022)
Slika 2. Primjer aplikacije za renderiranje NeROIC podržane umjetnom inteligencijom (Kuang *et al.*, 2022.)

Figure 3 Left: Generative design of construction joint concept (Han *et al*., 2022); right: AI Chair made with support of generative design tools ("A.I. chair Starck Kartel," 2020)
Slika 3. Lijevo: generativni dizajn koncepta konstrukcijskog spoja (Han *et al*., 2022); desno: AI stolica izrađena uz podršku alata za generativni dizajn ("AI chair Starck Kartel", 2020.)

generative design are to improve product performance (e.g. lightweight construction for logistics and sustainability), reduce costs and promote innovation. In contrast to traditional design methods or optimisation methods such as topology optimisation, generative design starts earlier and presents ideas based on functional constraints rather than incrementally improving an existing solution.

Topology optimisation refines an engineer's original solution, while generative design explores the entire design space to propose solutions without relying on an existing design (Miles, 2022). With the rapid development of AI, generative design introduces more automatic and efficient methods for collaborative designs (Figure 3) and provides a modern approach to comprehensive design plans (Han *et al*., 2022; Tyflopoulos *et al*., 2018).

One of the first famous commercial furniture products to be produced using AI was the "AI chair", designed by "Philippe Starck" in collaboration with the Italian furniture manufacturer Kartell using Autodesk's generative design tools ("A.I. chair Starck Kartel," 2020; Buonamici *et al*., 2021) (Figure 3).

AI, especially machine learning algorithms, has the potential to revolutionise the modern furniture industry. By analysing consumer data from sources such as social media, online searches and purchase history, AI can predict design trends and preferences (Haleem *et al*., 2022). This information enables designers to create furniture that is customised to consumer needs and desires (Ai in the Furniture Industry: Business Better with or without Ai?, n.d.). Furthermore, the influence of AI extends to both the creative and scientific aspects of furniture design by providing innovative ideas and assisting with stress calculations, design constraints and statistical analyses (Zahra, 2023), thereby reducing material waste and manufacturing costs (Ahmadli, 2023). In the manufacturing of complex products, AI can be used as a decision support system by analysing big data and product lifecycles to identify industry differences and select optimal production methods (Luo *et al*., 2021).

Traditionally, designers invest a lot of time in tasks such as data research, sketching, material selection and structural testing to achieve a few design results. However, AI can quickly generate thousands of results and help designers analyse complex data, simulate thought processes and solve problems intelligently. AI results can even present unique shapes not conceived by humans, with the final selection left to the designer's discretion (Zahra, 2023).

While many open-source AI tools such as TensorFlow and PyTorch are available for free, some platforms offer limited free access with possible usage restrictions. For example, Kaedim3d.com, a photo-to-3D model creation service, offers various pricing plans (for 50 models, the price is $300 per month), which emphasises the importance of checking costs on official websites or documentation, being aware of product development costs.

2.2 Supply chain optimisation
2.2. Optimizacija lanca opskrbe

AI algorithms can analyse historical data, market trends (Bharadiya, 2023) and customer preferences using machine learning algorithms to optimise the furniture supply chain. This includes demand forecasting, inventory management and efficient logistics, resulting in lower costs and less waste. By analysing data from social media, online searches and purchase history, the AI can identify the most popular styles, colours and materials. This information can then be used by designers to create furniture that meets the needs and desires of consumers.

Inventory management is another area where AI can improve efficiency and reduce costs. By analysing demand patterns, AI algorithms can optimise stock levels, reducing the risk of over or under stocking. This can help to reduce inventory costs, improve production planning and increase customer satisfaction (Ahmadli, 2023).

However, there is also great potential in using AI to manage waste or used furniture and all types of wood materials in the supply chain to promote sustainability and efficiency in forest-based supply chains (Feng and Audy, 2020; Onyeaka *et al.*, 2023). Many wood wastes remain unutilised or are used for low value-added products or even for heating purposes, which could be better utilised with better decision support systems (Garcia and Hora, 2017). Advanced planning systems can help support the decisions of the different actors in the supply chain, e.g. forest owners, harvesters, transporters, wood processing industry, traders and users. Such tools can help manage the complex interdependencies between different companies that often have conflicting goals and actions, which can increase the efficiency of forest-based supply chains (Scholz *et al.*, 2018).

In the sawmill industry, for example, many efforts have already been made to use resources effectively, plan optimally and maximise productivity, but there are still many challenges ahead. AI-based approaches are the most popular techniques for solving optimisation problems, especially in the transport and logistics sector. The combination of AI techniques such as neural networks, multi-agent simulation, genetic algorithm, ant colony algorithm, simulated annealing, discrete event simulation and mathematical programming, etc. with simulation models significantly enriches the flexibility of problem solving (Hosseini and Peer, 2022; Rahman *et al.*, 2014).

Inventory management, including inventory analysis with systems that read images in real time to count boards, identifies sizes and minimises waste. Traditionally, these operations rely on manual processes and outdated systems, leading to inefficiencies, errors and increased costs (Albayrak Ünal *et al.*, 2023, Singh and Adhikari, 2023). Sales forecasting and delivery logistics will all utilise AI and machine learning. This technology will permeate the entire timber supply chain. AI can analyse historical data and current market trends to predict demand and help sellers optimise their stock levels and reduce waste.

2.3 Quality control and inspection
2.3. Kontrola kvalitete i nadzor

AI-based computer vision systems can inspect furniture components and finished products for defects to ensure compliance with quality standards. AI algorithms can analyse images, videos and sensor data to detect defects, deviations from specifications and inconsistencies (Ren *et al.*, 2021). This can lead to early detection of defects, reduce rework and increase customer satisfaction. Advanced robotics and AI-driven machines are used to produce customised furniture with incredible precision and speed. These machines can cut, mould and assemble furniture with an accuracy that would be impossible for humans to achieve. Current problems in the furniture industry such as low production efficiency, low accuracy and lack of product innovation can be addressed by introducing AI management systems to improve product quality and production efficiency in furniture companies (Jin Long *et al.*, 2020).

AI with augmented reality (AR) equipment can help improve the quality and efficiency of wood processing and assembly. For example, AR can provide workers with advanced work instructions, real-time feedback and quality control (Deshpande *et al.*, 2021). AR can also help workers detect and repair defects and damage to wood products ("AI in Manufacturing: Solutions & Stories | Microsoft AI," n.d.).

AI can facilitate the automation of tasks by enabling machines (including robots) to take over or facilitate repetitive, routine and dangerous tasks that would otherwise be performed by humans (Deshpande *et al.*, 2021). The machines are not affected by repetitive tasks, and the quality of the products thus manufactured is more consistent and with less degradation.

AI-assisted quality control of the wood surfaces of CLT panels could be combined with autonomous material handling and thus incorporate Industry 4.0 concepts such as the Industrial Internet of Things (IoT), the smart factory, flexible automation and cyber-physical systems to create modern automated production (Ericsson *et al.*, 2021). In sawmills, AI can be used to sort logs based on

their quality, texture and other characteristics. This data could then be used to optimise the allocation of logs and wood parts to conserve resources, reduce waste and increase the value of incoming material ("AI for the wood processing industry | Bid Group," n.d.). Defect detection is another area where AI can recognise knots and other defects to cut out bad sections using connected tools and machines (Lopes *et al.*, 2020).

Artificial intelligence (AI) is revolutionising the field of computer-aided numerical control (CNC) and manufacturing by optimising various steps in the production process. AI-powered computer-aided manufacturing (CAM) software can automatically generate CNC programmes from CAD models and optimise machining parameters, workflows, toolpaths and speeds, leading to shorter cycle times, improved tool life and higher quality results (Hashmi *et al.*, 2022; Park and Kim, 1998; Soori *et al.*, 2023). During the production process, the machines and the product could be monitored by various methods such as image processing or various sensors (vibrations, acoustic emissions, power consumption, temperature, etc.) and the processes could be optimally adapted (Soori *et al.*, 2023). By combining 3D scanning, image analysis, AI-supported machine vision and other measuring instruments, the final product can be compared with the original CAD model, deviations or errors can be recognised and the production process can be adjusted to improve efficiency and quality (Rojek *et al.*, 2022).

2.4 Predictive maintenance
2.4. Prediktivno održavanje

AI-powered sensors in furniture manufacturing monitor the condition of machines and analyse data patterns to predict maintenance needs, prevent breakdowns and ensure smooth production. Together with cameras, these sensors can detect faults, alert maintenance teams and self-correct errors to minimise downtime and improve plant utilisation (Ahmadli, 2023).

Artificial intelligence is also extending its influence on CNC machine tools by predicting maintenance periods and equipment structures. By analysing production data, AI provides insights into machine performance and tool life and helps with production planning by indicating maintenance intervals. This predictive data results in fewer tool failures, longer tool life, reduced downtime and machining times, ultimately leading to cost savings in part production (Soori *et al*., 2023).

2.5 Virtual shopping and augmented reality (AR)
2.5. Virtualna kupnja i proširena stvarnost (AR)

AI could be involved in customer service on several levels. AI-driven chatbots can instantly help customers with personalised support, product recommendations and purchase assistance (Zimmermann *et al.*, 2023). This can improve customer satisfaction and reduce the workload of customer service agents, allowing them to focus on more complex issues (Ahmadli, 2023). One example is the Alibaba chatbot, which handled 95 % of customer enquiries in 2017, allowing human employees to focus on complex cases and challenging interactions with customers (Deshpande *et al.*, 2021). AI can be used as a content generator for marketing materials, such as product descriptions and social media posts (Anantrasirichai and Bull, 2021).

By analysing big data about consumer preferences, AI can create personalised furniture designs based on individual preferences and needs. The right product could be suggested and presented to customers with its advantages and disadvantages. On the other hand, the analysis of buyer behaviour, products and future trends could be suggested to the production departments.

AI-driven virtual shopping platforms can offer customers immersive experiences that allow them to visualise pieces of furniture in their living spaces through augmented reality. This improves the online shopping experience, reduces the risk of returns and gives customers the opportunity to make informed decisions. With virtual reality (VR) and AR tools, furniture selection is now even more immersive. Designers traditionally provide complex sketches that are often difficult for customers to understand. With augmented reality, customers can view and even change interior designs in real time (Carvalho *et al.*, 2011).

Augmented reality could also be used to support complex engineering tasks, including for ready-to-assemble furniture, especially for first-time users of such furniture (Deshpande & Kim, 2018), ultimately increasing user satisfaction and reducing the risk of frustration, poor usability, product damage and user injury.

An AI-powered camera and non-invasive technologies could be used to detect and analyse users' biometric reactions in order to recognise their emotions and changes in behaviour. Based on big data analysis, decisions could be made to change the interior design to simulate a change in user behaviour and increase the efficiency of the space ("AMBIT Cluster – Interiors Living Lab," 2022).

3 CONCERNS ABOUT USING AI TECHNOLOGIES
3. ZABRINUTOST U VEZI S PRIMJENOM AI TEHNOLOGIJA

The use of AI enables such technological improvement in terms of scientific advances, human welfare, economic value and the potential to solve important social and environmental problems that are certain to become more prevalent in our daily lives (Omrani *et al.*, 2022; Russo-Spena *et al.*, 2019). The success of the integration of AI in companies depends crucially on employees' trust in AI technology. Trust is a central component of the interaction between humans and AI, as the

wrong level of trust can lead to incorrect use, misuse or non-use of the technology (Omrani *et al.*, 2022).

Current AI models can approximate the cognitive abilities of humans in many areas and are even better than humans in some of them. This opens the possibility of fully automating some tasks, including those that require sophisticated skills and decision-making. However, this has raised concerns about the risk of unemployment for skilled workers (Kwilinski *et al.*, 2020; Omrani *et al.*, 2022) and questions about trust in new systems. The fear of being replaced by artificial intelligence and automation is a widespread concern, especially as these technologies are advancing rapidly (Brower, 2023; Cox, 2023). According to a recent study that analysed 300 fictional and non-fictional works about AI, people's fears about intelligent machines can be divided into four main categories (Cave and Dihal, 2019): fear of loss of identity (also known as 'inhumanity"); fear of 'obsolescence' or obsolescence; concern that humans will no longer need each other (also known as 'alienation"); and concern that AI will rebel against humans. The most discussed concern is the first, and it is generally agreed that increasing automation will increase the AI fear factor (Khogali and Mekid, 2023).

However, AI should be seen as a tool to improve our productivity and performance, to automate certain tasks and to transform existing jobs. While certain jobs can be automated, the development, implementation and maintenance of AI systems also creates jobs in areas such as AI research, software engineering, data analytics and cybersecurity. With the increasing integration of AI into the workplace, there will be a need for ethical oversight, policy decisions and regulations to ensure fair treatment of workers. Addressing concerns related to job displacement will require careful consideration of the social and economic impact of these technologies.

The costs of AI-supported systems are also significant as the tools are not equally available to all people. This is all the more true for education systems. The concept of equality in the context of the use of paid AI raises several issues that need to be considered: availability of technology or internet connection, opportunities limited by financial constraints, ethical considerations on equal access to AI services, etc.

4 CONCLUSIONS
4. ZAKLJUČAK

AI is transforming the modern furniture industry by driving innovation, improving design processes, optimising supply chains and enhancing quality control. It also offers exciting opportunities for customer engagement and augmented reality applications that ultimately improve the overall customer experience. Accessibility and cost considerations remain key factors for the widespread adoption of these technologies in the industry. In addition, experts predict that AI will continue to evolve at a rapid pace and become even more powerful over the next few years at least, while computing power will continue to increase as companies spend more money and the underlying technology becomes cheaper (Henshall, 2023).

Companies continue to see profits in the business areas where they use AI and plan to increase their investments in the coming years (McKinsey & Company, 2023). Consequently, the integration of AI into the modern furniture industry is crucial and has great potential to transform various aspects of the sector and drive the industrial transition to digitalisation and circular economy practises.

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Corresponding address:

JOŽE KROPIVŠEK
University of Ljubljana, Biotechnical Faculty, Department of Wood Science and Technology, Rožna Dolina, c. VIII 34, 1000 Ljubljana, SLOVENIA, e-mail: joze.kropivsek@bf.uni-lj.si

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Upute

Predani radovi smiju sadržavati najviše 15 jednostrano pisanih A4 listova s dvostrukim proredom (30 redaka na stranici), uključujući i tablice, slike te popis literature, dodatke i ostale priloge. Dulje je članke preporučljivo podijeliti na dva ili više nastavaka. Tekst treba biti u *doc formatu*, u potpunosti napisan fontom *Times New Roman* (tekst, grafikoni i slike), normalnim stilom, bez dodatnog uređenja teksta.

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Latinska imena trebaju biti pisana kosim slovima (italicom), a ako je cijeli tekst pisan kosim slovima, latinska imena trebaju biti podcrtana.

U uvodu treba definirati problem i, koliko je moguće, predočiti granice postojećih spoznaja, tako da se čitateljima koji se ne bave područjem o kojemu je riječ omogući razumijevanje ciljeva rada.

Materijal i metode trebaju biti što preciznije opisane da omoguće drugim znanstvenicima ponavljanje pokusa. Glavni eksperimentalni podaci trebaju biti dvojezično navedeni.

Rezultati trebaju obuhvatiti samo materijal koji se izravno odnosi na predmet. Obvezatna je primjena metričkog sustava. Preporučuje se upotreba SI jedinica. Rjeđe rabljene fizikalne vrijednosti, simboli i jedinice trebaju biti objašnjeni pri njihovu prvom spominjanju u tekstu. Za pisanje formula valja se koristiti Equation Editorom (programom za pisanje formula u MS Wordu). Jedinice se pišu normalnim (uspravnim) slovima, a fizikalni simboli i faktori kosima (italicom). Formule se susljedno obrojčavaju arapskim brojkama u zagradama, npr. (1) na kraju retka.

Broj slika mora biti ograničen samo na one koje su prijeko potrebne za objašnjenje teksta. Isti podaci ne smiju biti navedeni i u tablici i na slici. Slike i tablice trebaju biti zasebno obrojčane, arapskim brojkama, a u tekstu se na njih upućuje jasnim naznakama ("tablica 1" ili "slika 1"). Naslovi, zaglavlja, legende i sav ostali tekst u slikama i tablicama treba biti napisan hrvatskim i engleskim jezikom.

Slike je potrebno rasporediti na odgovarajuća mjesta u tekstu, trebaju biti izrađene u rezoluciji 600 dpi, crno-bijele (objavljivanje slika u koloru moguće je na zahtjev autora), formata jpg ili tiff, potpune i jasno razumljive bez pozivanja na tekst priloga.

Svi grafikoni i tablice izrađuju se kao crno-bijeli prilozi (osim na zahtjev). Tablice i grafikoni trebaju biti na svojim mjestima u tekstu te originalnog formata u kojemu su izrađeni radi naknadnog ubacivanja hrvatskog prijevoda. Ako ne postoji mogućnost za to, potrebno je poslati originalne dokumente u formatu u kojemu su napravljeni (*excel* ili *statistica* format).

Naslovi slika i crteža ne pišu se velikim tiskanim slovima. Crteži i grafikoni trebaju odgovarati stilu časopisa (fontovima i izgledu). Slova i brojke moraju biti dovoljno veliki da budu lako čitljivi nakon smanjenja širine slike ili tablice. Fotomikrografije moraju imati naznaku uvećanja, poželjno u mikrometrima. Uvećanje može biti dodatno naznačeno na kraju naslova slike, npr. "uvećanje 7500 : l".

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Primjer

Kärki, T., 2001: Variation of wood density and shrinkage in European aspen (*Populus tremula*). Holz als Roh- und Werkstoff, 59: 79-84. http://dx.doi.org/10.1007/s001070050479.

Knjige: Prezime autora, inicijal(i) osobnog imena, godina: Naslov. (ev. izdavač/editor): izdanje (ev. svezak). Mjesto izdanja, izdavač (ev. stranice od – do).

Primjeri

Krpan, J., 1970: Tehnologija furnira i ploča. Drugo izdanje. Zagreb, Tehnička knjiga.

Wilson, J. W.; Wellwood, R. W., 1965: Intra-increment chemical properties of certain western Canadian coniferous species. U: W. A. Cote, Jr. (Ed.): Cellular Ultrastructure of Woody Plants. Syracuse, N.Y., Syracuse Univ. Press, pp. 551- 559.

Ostale publikacije (brošure, studije itd.)

Müller, D., 1977: Beitrag zür Klassifizierung asiatischer Baumarten. Mitteilung der Bundesforschungsanstalt für Forstund Holzvvirt schaft Hamburg, Nr. 98. Hamburg: M. Wiederbusch.

Web stranice

***1997: "Guide to Punctuation" (online), University of Sussex, www.informatics.sussex.ac.uk/department/docs/punctuation/node 00.html. First published 1997 (pristupljeno 27. siječnja 2010).

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***1997: "Guide to Punctuation" (online), University of Sussex, www.informatics.sussex.ac.uk/department/docs/punctuation/node00.html. First published 1997 (Accessed Jan. 27, 2010).

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