**Original Research Paper**

# Transition to industry 5.0 with ai and digilitalization of production systems

# Tranzicija ka industriji 5.0 sa ai i digitalizacijom proizvodnih sistema

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*Abstract: This paper presents a comprehensive framework for integrating advanced artificial intelligence (AI) and digitalization into manufacturing processes, and contributing to the transition towards Industry 5.0. By focusing on a human-centric approach, advanced AI integration, sustainability, and flexibility, the study outlines strategies for enhancing production systems and competitiveness in enterprises. The main goal was to develop a model that outlines the transition process towards Industry 5.0. Additionally, suggestions and guidelines for improving enterprise production systems and competitiveness are discussed. The findings suggest that embracing digital transformation, collaborative robotics, and continuous innovation are vital for achieving operational efficiency, environmental sustainability, and personalized customer experiences. The paper highlights the importance of ethical practices and continuous learning in fostering a resilient and innovative industrial ecosystem.*

*Keywords: Industry 5.0, Digitalization, Production systems, Artificial intelligence*

*Apstrakt: Ovaj rad predstavlja sveobuhvatan okvir za integraciju napredne veštačke inteligencije (AI) i digitalizacije u proizvodne procese i doprinos tranziciji ka Industriji 5.0. Fokusirajući se na pristup usredsređen na čoveka, naprednu integraciju veštačke inteligencije, održivost i fleksibilnost, studija ocrtava strategije za unapređenje proizvodnih sistema i konkurentnosti u preduzećima. Glavni cilj je bio da se razvije model koji ocrtava proces tranzicije ka Industriji 5.0. Pored toga, razmatraju se predlozi i smernice za unapređenje sistema proizvodnje i konkurentnosti preduzeća. Nalazi sugerišu da su prihvatanje digitalne transformacije, kolaborativne robotike i stalne inovacije od vitalnog značaja za postizanje operativne efikasnosti, ekološke održivosti i personalizovanog korisničkog iskustva. Rad naglašava važnost etičke prakse i kontinuiranog učenja u negovanju otpornog i inovativnog industrijskog ekosistema.*

*Ključne riječi: Industrija 5.0, Digitalizacija, Proizvodni sistemi, Veštačka inteligenicija*

## 1 INTRODUCTION

Industry 5.0 represents the next phase in the evolution of the industrial sector, emphasizing the integration of advanced technologies and human ingenuity. This new era seeks to balance automation and robotics with the creativity, critical thinking, and emotional intelligence unique to humans [1-3]. The goal is to create more personalized, efficient, and sustainable production processes that not only optimize output but also enhance worker satisfaction and

product customization. Industry 5.0 builds upon the digital transformation ushered in by Industry 4.0, aiming for a collaborative coexistence between humans and machines, where technology enhances human capabilities rather than replacing them [4].

Advanced Artificial Intelligence (AI) plays a pivotal role in realizing the vision of Industry 5.0. By leveraging machine learning, natural language processing, and robotics, AI can analyze vast amounts of data, predict trends, and automate complex tasks

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with precision. This not only boosts efficiency and productivity but also allows for the creation of smarter, adaptive systems that can learn and evolve over time [5].

Alongside AI, the digitalization of business is a fundamental component of this new industrial paradigm. It involves transforming traditional operations with digital technologies to streamline processes, enhance decision-making, and foster innovation., innovative, and customer-centric solutions [6].

In this paper, the main goal was to develop a theoretical model that presents the transition process to Industry 5.0. In addition, suggestions and guidelines for improving production and business are discussed.

## 2 THEORETICAL FRAMEWORK

### 2.1 Industry 5.0 and human-centric business development

Industry 5.0 represents a significant shift towards a more human-centric approach in the industrial sector, emphasizing the harmonious integration of human intelligence and creativity with advanced technological systems. The concept of human-centric production within Industry 5.0 underlines the importance of leveraging technology not just to replace human labor but to augment and complement it, fostering environments where humans and machines collaborate to achieve more innovative, flexible, and sustainable outcomes [7].

The human-centric production model prioritizes the unique attributes humans bring to the industrial process, including creativity, empathy, and complex problem-solving abilities. Industry 5.0 aims to create more inclusive and adaptable manufacturing environments. This approach improves the quality of work life for employees and drives the development of products and solutions that are more closely aligned with human needs and values. Through collaborative robots (cobots) and AI-driven tools that take over repetitive or dangerous tasks, workers can engage in more meaningful and creative aspects of production. Human-centric production in Industry 5.0 emphasizes

the importance of worker safety, ergonomics, and the development of new skills. Businesses adopting this model invest in training and education to prepare their workforce for the future, ensuring that employees are not only equipped to work alongside new technologies but also to thrive in an increasingly digital world.

### 2.2 Advanced AI, digitalization, and production systems

AI and digitalization in production systems can siginicantly improve business through:

Increased efficiency and productivity: AI technologies enable production systems to achieve higher levels of efficiency and productivity by automating complex and repetitive tasks [8].

Predictive maintenance: One of the most significant advantages of AI in production systems is its ability to predict equipment failures before they occur [9].

Real-time monitoring and control: AI technologies play a crucial role in enabling real-time monitoring and control of production processes. Through the integration of sensors, IoT devices, and AI algorithms, production systems can continuously collect and analyze data on various parameters such as temperature, pressure, speed, and quality. This allows for the immediate detection of deviations from standard operating conditions and the automatic adjustment of processes to maintain quality and efficiency [10, 11].

Incorporating AI into production systems in these ways not only enhances operational capabilities but also drives innovation, resilience, and competitiveness in the manufacturing sector.

Digitalization enables businesses implement and apply data analytics, cloud computing, and the Internet of Things (IoT), leading to improved operational efficiency, reduced costs, and the ability to quickly adapt to market changes [12-14]. Digitalization facilitates a more agile and flexible business model, where companies respond to customer demands with greater speed and precision.

## 3 DEVELOPED MODEL

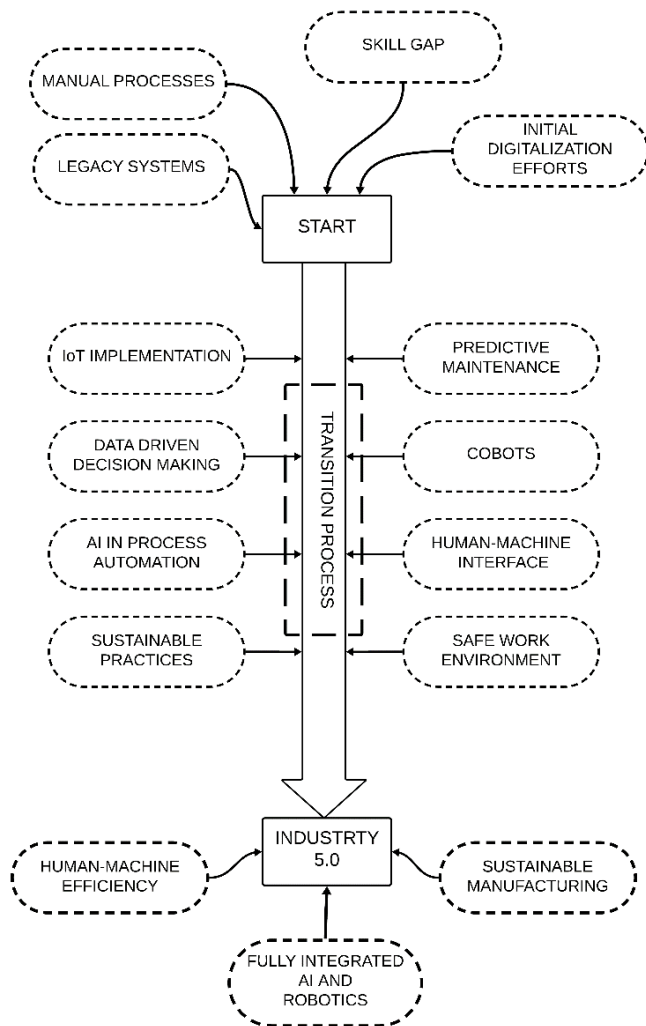The developed model is presented on Figure 1.

*Figure 1. Modeling the transition to Industry 5.0*

The transition to Industry 5.0 necessitates a shift from these traditional paradigms to more advanced, integrated, and human-centric approaches. The Transition Process involves a series of strategic actions and adaptations, including the integration of AI and digital technologies, the adoption of sustainable manufacturing practices, and the development of a more skilled and adaptable workforce. The result of the transition process is the realization of Industry 5.0, chracterized by integration of human-machine efficiency, sustainable manufacturing, and fully integrated AI and robotics in enterprises.

## 4 SUGGEESTIONS AND GUIDELINES

Based on the analyzed literature in the domain of AI, digitalization, Industry 5.0 and production systems, suggestions and guidelines for enhancing production systems and competitiveness in enterprises are noted:

- Human-centric approach: Adopting a human-centric approach means valuing the role of human creativity and expertise within the industrial environment. Enterprises should design workplaces that enhance human skills and creativity, fostering an environment where technology supports human decision-making and innovation. This includes ergonomic workstations, safety measures, and opportunities for workers to engage in more meaningful, creative tasks while robots can handle repetitive or dangerous jobs.

- Advanced AI integration: Integrating advanced AI involves implementing algorithms and machine learning models to automate processes, predict maintenance needs, and optimize production lines. This requires a robust data infrastructure, where real-time data from IoT devices are analyzed to make informed decisions, improve efficiency, and reduce downtime. AI can also personalize customer experiences and supply chain management.

- Digitalization and data analytics: Digital transformation is crucial for enhancing operational efficiency and agility. Through digitizing processes and utilizing data analytics, companies can gain insights into production trends, customer behavior, and market dynamics. This allows for faster adaptation to new opportunities or challenges. Implementing digital tools for collaboration and project management can also improve workflow and productivity.

- Collaborative robots (Cobots): Cobots are designed to work alongside human workers, enhancing productivity without replacing the human workforce. These robots can be used for tasks that are repetitive, physically demanding, or require precision, freeing human workers to focus on higher-level problem-solving, planning, and control. Implementing cobots should be accompanied by training programs to ensure workers are equipped to work effectively with this technology.

- Sustainability and ethical practices: Emphasizing sustainability involves adopting manufacturing processes that minimize waste, reduce energy consumption, and utilize eco-friendly materials. Ethical practices in AI use ensure that technologies are developed and used in ways that are fair, transparent, and beneficial to all stakeholders, including employees, customers, and the broader community. This approach not only addresses environmental concerns but also builds trust and enhances brand reputation.

- Customization and flexibility: The ability to offer customized products and services through AI-driven insights provides a significant competitive advantage. Enterprises should leverage AI and digital manufacturing technologies like 3D printing to offer personalized options to customers without compromising on efficiency or cost. This requires a flexible production system that can easily adapt to changing customer preferences and market trends.

- Continuous improvement and innovation: A culture of continuous improvement and innovation involves encouraging experimentation and learning from failures. AI and digital tools can provide valuable insights for optimizing processes and identifying new opportunities for innovation. Companies should invest in research and development, encourage cross-functional collaboration, and remain open to adopting emerging technologies that can drive future growth.

- Adaptable and flexible production systems: Developing production systems that are both adaptable and flexible ensures that enterprises can respond fast to market changes, technological advancements, or shifts in consumer demand. This involves modular system designs, scalable technologies, and processes that can be easily reconfigured or upgraded. Flexibility in production allows for the efficient allocation of resources, reducing lead times and enhancing the ability to meet customer needs promptly.

Enterprises can implement some or all of these guidelines, and this way they can significantly improve their production systems and competitiveness, aligning with Industry 5.0 principles to create more sustainable, efficient, and human-centric manufacturing environments.

## 5 CONCLUSIONS

The transition to Industry 5.0 represents an important movement towards more sustainable, efficient, and human-centric manufacturing ecosystems. Through the integration of AI, digital technologies, and ethical practices, enterprises can significantly enhance their competitiveness and production systems. This study notes the necessity of adopting a holistic approach that balances technological advancement with environmental sustainability and workforce development.

Future research should explore the long-term impacts of these strategies on global supply chains and the broader socio-economic landscape. Embracing the principles of Industry 5.0 will enable enterprises to thrive in an increasingly complex and dynamic global market.

## Acknowledgment

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