



Chapter 1

The Need for Explainable AI in Industry 5.0

Azeem Khan

 <https://orcid.org/0000-0003-2742-8034>
University Islam Sultan Sharif Ali, Brunei

Noor Zaman Jhanjhi

 <https://orcid.org/0000-0001-8116-4733>
Taylor's University, Malaysia

Dayang Hajah Tiawa Binti Awang Haji Hamid

University Islam Sultan Sharif Ali, Brunei

Haji Abdul Hafidz bin Haji Omar

University Islam Sultan Sharif Ali, Brunei

ABSTRACT

As we enter the era of Industrial Revolution 5.0 (IR 5.0), the role of artificial intelligence (AI) in various domains such as manufacturing, military, healthcare, education, and entertainment is becoming increasingly vital. However, the growing complexity and opacity of AI systems have led to a problem known as the “black box,” which hinders trust and accountability. This is where explainable AI (XAI) comes in, providing a set of processes and methods that enable human users to understand and trust the results and output produced by machine learning algorithms. By describing AI models, their expected impact, and potential biases, XAI helps ensure accuracy, fairness, transparency, and accountability in AI-powered decision making. In this chapter, the authors argue that XAI is indispensable for IR 5.0, as it enables humans to collaborate with AI systems effectively and responsibly. The authors reviewed the current state of XAI research and practice and highlighted the challenges and opportunities for XAI in IR 5.0.

DOI: 10.4018/978-1-6684-6361-1.ch001

I. INTRODUCTION

As narrated in Table 1.0, The fourth industrial revolution(A. Khan, Jhanjhi, & Sujatha, 2022; Shah, Jhanjhi, Amsaad, & Razaque) has brought about automation(Khandelwal et al., 2023), robotization, big data analytics, smart systems(A. Khan, Jhanjhi, & Humayun, 2020; A. Khan, Jhanjhi, & Humayun, 2022), virtualization, AI, machine learning and Internet of Things, enabling new levels of efficiency, productivity, and innovation across various domains. However, these technologies have also created new challenges and risks, such as the complexity and opacity of AI systems, the ethical and legal implications of AI-powered decision making, and the impact on trust and accountability in human-machine collaboration. Therefore, there is a need to prepare for the fifth industrial revolution (IR 5.0), which aims to balance the economic benefits of technology with the social and environmental goals of humanity, reinforcing the role and contribution of industry to society by addressing global challenges.

A key enabler for IR 5.0 is explainable AI (XAI)(Mankodiya, Obaidat, Gupta, & Tanwar, 2021; Woźnica & Biecek, 2021), which allows human users to comprehend and trust the results and output created by machine learning algorithms. XAI characterizes model accuracy, fairness, transparency, and outcomes in AI-powered decision making, and can help humans collaborate with AI systems effectively and responsibly by enhancing their understanding, confidence, and control over the technology(M. M. Khan & Vice, 2022; Vice & Khan, 2022). This chapter explores the concept of Industry 5.0 and its implications for industry and society, reviews the current state of XAI research and practice, highlights the challenges(Humayun, Niazi, et al., 2022) and opportunities for XAI in IR 5.0, provides an overview of techniques for developing explainable AI systems, suggests best practices for implementing XAI in industry, and discusses the future of explainable AI in IR 5.0 and the importance of balancing innovation with accountability.

A. Overview of Industry 5.0 and the role of AI

Industry 5.0 is the latest stage of industrial revolution, characterized by the integration of advanced technologies such as artificial intelligence (AI), robotics, and the Internet of Things (IoT)(Ettazi & Nassar, 2023; Freire, Melo, Do Nascimento, Nascimento, & de Sá, 2022; Jagatheesaperumal et al., 2022; Pal et al.) into manufacturing processes as depicted in Fig 1.0 . AI in particular is expected to play a critical role in driving productivity, efficiency, and innovation in Industry 5.0. The dawn of the fifth industrial revolution represents an unprecedented stage of industrialization that champions a harmonious synergy between humans and AI-powered robots in optimizing workplace processes. This novel wave of technological advancement shifts the focus from mere efficiency and productivity to a more human-centric perspective, with a strong emphasis on sustainability, resilience, and keen focus on the well-being of the worker as the centerpiece of the production process.

The driving force behind this industrial transformation stems from breakthroughs in Information Technology (IT), ranging from artificial intelligence, machine learning, and smart systems (Humayun, Afsar, Almufareh, Jhanjhi, & AlSuwailem, 2022), to big data analytics (Pal et al., 2023), cloud computing, and the internet of things. With these technological tools at their disposal, Industry 5.0 envisions a future that embraces collaboration and co-creation between humans and machines as depicted in Fig 2.0, leading to the personalization and customization of products and services.

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