

The Need for Explainable AI in Industry 5.0

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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.

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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.

Table 1. Narratives of industrial revolutions

Industrial Revolution (IR)	Timeframe	Principal Traits	Manifestations
1.0	1760-1840	The shift from manual labor to mechanized production powered by water and steam marked a significant change in industrial development, giving rise to the textile, iron, and chemical industries. Additionally, urbanization, population growth, and expanded trade and transportation networks increased the demand for mechanized production.	Spinning jenny, power loom, steam engine, cotton gin, canal, railway.
2.0	1870-1914	Following the mechanized production era, mass production using electricity and internal combustion engines emerged. This was accompanied by the development of steel, petroleum, and electrical industries and the emergence of new forms of business organization and management.	Bessemer process, automobile, airplane, telephone, radio, assembly line, corporation, department store.
3.0	1945-1990	The transition from mass production to automated production saw the development of industries such as aerospace, nuclear, and biotechnology, which relied heavily on computers and electronics. The period also witnessed the emergence of globalization and an information society.	Computer, robot, satellite, internet, mobile phone, nuclear power plant, green revolution.
4.0	1990-present	The era of automated production gave way to smart production facilitated by cyber-physical systems and artificial intelligence. This marked the development of industries such as nanotechnology, renewable energy, and the Internet of Things. The period also saw the emergence of digital platforms and a network economy. However, it also presented challenges such as cybersecurity and data privacy.	Artificial intelligence, 3D printing, blockchain, cloud computing, smart grid, smart city, social media, e-commerce.
		Transition from smart production to human-centric production using collaboration and co-creation between humans and machines. Development of biomimicry, circular economy, and	Cobotics, quantum computing, wireless power transmission, fusion power plant craft

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