

Superhuman-centered Design for Manufacturing Metaverse

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Abstract

This critical analysis explores the transformative potential of the metaverse for Industry 6.0 (I6.0) and explicitly shows the imperative to steer this integration toward enhancing human-centric manufacturing. This approach involves marking VR/AR, AI, and IoT (virtual reality, augmented reality, artificial intelligence, and the Internet of things) in ways that augment cognitive human capabilities into a cognitive-supercomputing domain that is not naturally emerging capability in cognition without corresponding education. Applications like intuitive interfaces for training, AI-driven predictive maintenance, and virtual twins for asset monitoring are central to this vision of what is best for the environment. Addressing the reliability of the human-centric metaverse integration at the individual level satisfies less manufacturing education. To raise risks, it is necessary to ensure that future technologies are designed for responsible use to create a legendary superhuman-centered design (SCD) for manufacturing industry horizontal integrations at lower levels of Society 5.0.

Keywords

Metaverse, manufacturing, ethics, industry, AI, integration

1. Introduction

As for an overview of technologies, as of recent advancements, the metaverse concept and the rise of I6.0 signify a groundbreaking fusion of AI with immersive digital realities poised to reshape multiple sectors, notably manufacturing. The metaverse, a collective virtual shared space created by the convergence of virtually enhanced physical and digital reality, offers a new dimension of interaction and technological experience. Concurrently, AI's role in emulating tasks that require human intellect is a cornerstone of this evolution.

I6.0 imagines a future where sophisticated technologies like VR/AR, AI, and IoT and the metaverse synergize to foster intelligent, customized manufacturing processes informed by real-time data and advanced analytics. In the manufacturing domain, this could manifest as:

- Enhanced VR/AR applications for intuitive interaction between humans and machines, streamlined training, and design simulations.
- AI integration for predictive maintenance, automated quality control, and optimizing supply chain processes.
- Synchronization of physical industrial assets with their virtual counterparts within the metaverse for improved monitoring and control.
- Facilitating of collaborative design and problem-solving via digital twins, offering expert insights and troubleshooting support.

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However, this technological vertical merger also raises significant ethical dilemmas, particularly concerning safety, privacy, individual autonomy, and transparency, necessitating thorough scrutiny and ethical assessment.

Specific ethical issues include potential job displacement due to AI/metaverse integration, biases within AI algorithms, diminishing human control and autonomy in manufacturing, challenges in comprehending AI/metaverse system functionalities, privacy concerns linked to intensified data collection, and safety hazards associated with over-reliance on imperfect AI/metaverse systems.

2. Research gap

In recent years, the emergence of the metaverse and I6.0 has brought about unprecedented opportunities for the integration of AI in various industries, including manufacturing. The metaverse concept has gained widespread attention in various industries, potentially revolutionizing entertainment, shopping, tourism, healthcare, gaming, and education [1]. The implementation of metaverse in industries is still in its infancy, with most research adopted in education and health industries, and there is unequal geographical distribution of research on metaverse in industries, calling for more international collaboration [2]. The metaverse is expected to significantly impact global markets over the next decade, transforming basic tools and methods from content creators' assets to fully immersive content experienced in the first person. However, this shift also poses real dangers that can be misused on consumers in highly manipulative ways [3]. The integration of AI and the metaverse is expected to improve people's lives in various ways, as well as many industries and working processes, such as operations in fashion, management, marketing, and education [4], specifically technology education [5]. However, the third web-empowered metaverse ecosystem has witnessed various financial crimes, and it is critical to summarize and classify the financial security threats on the Web3-empowered metaverse to maintain the long-term healthy development of its ecology [6]. As such, more research is needed to address the challenges and opportunities presented by the metaverse in different industries and contexts on ethics because there are a lot of talks among scientists about how the metaverse is changing the world, but there are no scientists, entrepreneurs or government doing it in I6.0 level that is downright galactical thunder race between cultures to achieve, and how it is so? Even social media stars failed and buried the dog [7; 8]. Even a book was written about metaverse predictively that it is hype, hope, and hell [8]. What is the truth? We do not know, but we can at least explore its ethics as technology develops from a scientific aspect. The integration of these technologies presents several ethical considerations that need to be addressed to ensure their responsible and ethical use. Developing an ethical framework that considers the implications of metaverse and AI integration in I6.0 can help minimize potential risks and negative consequences while maximizing their potential benefits. This paper explores the ethical considerations of integrating the metaverse and AI within Industries 6.0 and examines the importance of developing an ethical framework to guide their responsible use. The paper applies [10] ethics framework to the systematic articles example qualitative sample of [1, 2, 3, 4] on integrating the metaverse in the manufacturing industry to identify and analyze the ethical implications of this integration. By doing so, this paper contributes to the ongoing ethical discourse surrounding the integration of the metaverse and AI in I6.0. It emphasizes the importance of ethical considerations in the development and integration of emerging technologies.

3. Ethical considerations for AI and metaverse integration in manufacturing

The sample studies by [1], [2], [3], and [4] provide examples of current research exploring the metaverse's applications in industries like entertainment, education, marketing, and finance. While highlighting the transformative potential of metaverse integration in these domains, they also raise important ethical questions that need addressing.

When the ethics framework developed by [10] is applied to the articles by [1], [2], [3], and [4] on the integration of the metaverse in the manufacturing industry, several ethical considerations emerge.

One key consideration is ensuring that integrating the metaverse and AI in manufacturing does not lead to displacing the human workforce. The [10] framework emphasizes respecting human dignity and autonomy. It is essential to ensure that technology does not undermine these values, as the sample of [1], [2], [3], and [4] notes, the integration of AI and the metaverse should augment the capabilities of the workforce, making jobs easier and enhancing productivity.

Another ethical consideration highlighted by [10] is the need to consider the potential impact of technology on safety. Integrating the metaverse and AI in the manufacturing process can improve workplace safety by providing real-time monitoring of the manufacturing process and identifying potential hazards. However, ensuring that these systems are designed and implemented in a way that does not compromise human safety is crucial.

In addition, the [10] framework emphasizes the importance of ensuring that technology design incorporates human-centered principles. This is particularly relevant to integrating the metaverse and AI in the manufacturing industry, where ensuring that these systems are intuitive, user-friendly, and easy to use is essential. Incorporating SCD principles can help ensure that these systems are accessible to all workforce, regardless of their technological expertise.

3.1. The ethics for boosting manufacturing efficiency by technologies

On behalf of the example qualitative sample of [1, 2, 3, 4], the discussion of I6.0 metaverse integration on the [11] raises several ethical considerations that can be analyzed using the [10] ethics framework. One of the main ethical concerns is considering human factors (HF) in manufacturing. According to the [10] framework, this falls under the "agent-centered ethics" category, which emphasizes the importance of treating individuals with dignity and respect. This involves developing AI systems that work in harmony with the human workforce rather than replacing them and ensuring that the design of AI systems and the metaverse is based on SCD principles.

Another ethical concern raised by the the qualitative sample of [1, 2, 3, 4] is workplace safety. This can be analyzed using [10] "consequentialist ethics," which emphasizes the importance of promoting society's overall well-being. By integrating AI and the metaverse to provide real-time manufacturing process monitoring, manufacturers can identify potential hazards before they turn into accidents, enhancing workplace safety for employees.

An example qualitative sample of [1, 2, 3, 4] also inspires the potential benefits of I6.0 metaverse integration, such as the ability to deliver customized products and services, enhance productivity, and reduce costs. These benefits can be analyzed using the [10]

perspective of virtue ethics, which emphasizes the importance of developing good character traits, such as wisdom, courage, and justice. By collecting and analyzing data [12] adapted to [11] from various sources, including the manufacturing process, supply chain, and customer feedback, manufacturers can gain insights into their operations, enabling them to make data-driven decisions and improve the quality of their products.

Integrating the use of metaverse in the manufacturing industry, among other industries, might raise several differences. At the same time, ethical considerations still apply that must be addressed to ensure the technology is used responsibly and ethically. By considering the perspectives of agent-centered ethics, consequentialist ethics, and virtue ethics, manufacturers can develop sustainable AI systems and the metaverse to benefit both individuals and society.

3.2. Discussion

3.2.1. Developing manufacturing by utilizing technological advantages

The integration of the metaverse on the [11] raises ethical concerns that need to be addressed, according to the [10] ethics framework. One of the most significant concerns is the need to consider HF in manufacturing. The integration of AI and the metaverse should not replace the human workforce but should instead augment and support their capabilities. This can be achieved by developing AI systems that work harmoniously with the human workforce, enhancing their capabilities and making their jobs reliable. Integrating AI and the metaverse should also be based on SCD principles. SCD is a design philosophy that puts the needs of humans at the forefront of the design process. By incorporating SCD principles into the design of AI systems and the metaverse, manufacturers can ensure that their systems are intuitive, user-friendly, and easy to use.

Furthermore, integrating the metaverse in the manufacturing industry can lead to significant improvements in safety. Safety has always been a critical issue in the industry, with numerous accidents occurring yearly without preventive safety AI nets. Integrating AI and the metaverse can help mitigate these risks by providing real-time manufacturing process monitoring. This will enable manufacturers to identify potential hazards before they turn into accidents, enhancing workplace safety for employees.

To achieve the full potential of I6.0 metaverse integration, addressing safety issues in the manufacturing process is essential. Integrating AI and the metaverse should not compromise the safety and security of the human workforce. Moreover, the development of AI systems and the metaverse should follow ethical guidelines to ensure that integrating these technologies does not violate the principles of human autonomy, privacy, and dignity strictly regulated within EU and state laws.

Integrating the metaverse in the manufacturing industry can revolutionize and take it to new heights, keeping AI behind the line before humans. However, the ethical implications of this integration should be considered. The development and integration of AI systems and the metaverse should follow ethical guidelines prioritizing human factors, safety, and respect for human autonomy, privacy, and dignity. [10.].

3.2.2. Critical perspective on the AI in manufacturing

The article by [10] discusses philosophical issues surrounding the concept of omniscience, including objections raised to classical theism. The article, on behalf of the sample of [1, 2, 3, 4], introduces the metaverse concept. It discusses its potential applications leading toward I6.0 metaverse integration, taken from the perspective of the [11] manufacturing industry. These two articles can be connected by discussing the need to consider HF in integrating AI and the metaverse in the manufacturing process in line with SCD principles. While the integration of AI and the metaverse has the potential to enhance workplace safety and productivity and reduce costs, it is essential to ensure that these technologies do not replace the human workforce but instead augment their capabilities. Incorporating SCD principles into the design of AI systems and the metaverse can ensure they are user-friendly and intuitive. This connection highlights the importance of ethical considerations in developing and integrating emerging technologies such as the metaverse in various industries.

4. Conclusion

Integrating the metaverse and AI in I6.0 acts as a backbone for a range of ethical considerations that must be addressed to ensure these technologies' responsible and ethical use. These considerations include respecting human dignity and autonomy, ensuring workplace safety, and incorporating SCD principles. By considering the perspectives of different ethical frameworks, such as agent-centered ethics, consequentialist ethics, and virtue ethics, manufacturers can develop AI systems and the metaverse to benefit society's well-being. It is important to recognize that developing and integrating emerging AI-based technologies and applications to and within the metaverse must follow ethical guidelines prioritizing HF, safety, and security, respecting human autonomy, privacy, and dignity. The critical analysis of ethical and prior philosophical evaluability, as with the practical application of emerging technologies, highlights the importance of ethical considerations in developing and integrating technologies in various industries.

5. Limitations and future research

While it is true that there may be limitations in the research gap of I6.0, it is important to recognize that these limitations do not necessarily mean that it is not reachable from a qualitative viewpoint. Qualitative studies share a few limitations. The very nature of qualitative research is to explore narrow and specific topics in-depth rather than attempting to generalize findings to a larger population.

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