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Exploring Industry 5.0: Innovations Focused on Humans, Societal Effects, and Opportunities for Sustainable Research

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Abstract

In Industry 5.0, humans work closely with advanced technology to create innovations focusing on collaboration between people and machines. Research shows that they play a vital role in this advanced era of industry, with important implications for society. Industry 5.0 is seen to build industrial systems that are sustainable, ethical, and inclusive. This article also discusses how Industry 5.0 affects the workforce and emphasizes the need for an ongoing human-centered system. The paper ends by suggesting areas for further research and how Industry 5.0 can create sustainable, human-centered systems in industry. The study utilized the mixed methods method to explore Industry 5.0, combining quantitative information and personal views to reveal its multi-faceted impacts. As we incorporate advanced technologies into our enterprises, we must rethink the skills and training needed for employees. The transformation will allow employees to coexist with machines and systems. However, it creates critical moral questions, especially around data privacy, decision-making power, and the capacity to replace some job roles. On the contrary, Industry 5.0's focus on sustainability brings new prospects for innovation in finding solutions to environmental issues and improving industry productivity and efficiency.

Keywords: Industry 5.0, Human-Centric, Industrial development, Mixed-method approach, Technological Sustainability.

Introduction

The world experienced multiple industrial revolutions that transformed society's experience of work, technology, and productivity. From the First Industrial Revolution, which started with the invention of the steam engine to Industry 4.0 automation technology to the rapid innovation of Industry 5.0, each period had new paradigms and machines that re-engineered industries and societies. The new shift from Industry 4.0 to Industry 5.0 unveils a paradigm on how human beings engage in processes. It is distinct from its predecessor, which focused on automation and optimization. Industry 5.0, however, focuses on bringing human intelligence, imagination, and morality back to industrial processes. In Industry 5.0, facilitating greater cooperation between humans and intelligent machines is all about. Investment in enhancing and retraining the capabilities of our human resources to prepare for the changes and opportunities for the new industrial revolution must be made. This paper discusses the impact of Industry 5.0 on society and individuals in various manners. It discusses how working with machines can help build a more equal and diverse working environment by assisting individuals in learning new skills. It also describes what we do not know and what should be researched next. The central research questions addressed in this paper include:

- What are the critical human-centric innovations emerging from Industry 5.0?
- How does Industry 5.0 impact human-centric system?

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• What are the societal implications of Industry 5.0 regarding inclusivity, ethics, and sustainability?

• What are future research opportunities in this area?

Industry 5.0

Industry 5.0 Industry 5.0 introduces a new way for humans to work with advanced technologies like artificial intelligence (AI), robotics, big data analytics, and cognitive computing. This collaboration combines human judgment, ethics, and innovation with machine learning to yield an ethical, sustainable, and equitable business model. It is people-focused on how to utilize them with technology and not displace them. Industry 5.0 is being promoted by the European Commission and world leaders as progress, emphasizing social, environmental, and ethics-oriented advancement over the technologically oriented advancement of Industry 4.0 and more holistic development.

Human-Centric Innovations for Industry 5.0

Industry 5.0 is people focused. It is a different way of employing technology to make life better. Instead of worrying about machines taking over, Industry 5.0 is a technology that makes us more efficient at work and does more interesting tasks. For example, new kinds of robots can help humans work in factories, and intelligent glasses can offer us helpful information during work. The vision is to leverage technology to help us innovate and make better decisions. Automating repetitive, hazardous, or physically demanding tasks, such as cobots, allows employees to do tasks that require problem-solving, innovation, and communication skills.

The Role of Human Centric System in Industry 5.0

As technology becomes more sophisticated, firms must enable their workers to learn and develop. In today's age, possessing the correct technical skills alone is insufficient. A worker should also be skilled in handling machines, making sound decisions, and responding to changes quickly. Industry 5.0 is about helping workers learn new skills and improve their use of the latest technology. It is about getting them ready to generate new ideas and be strategic in a workplace where everything is digital. Employee training must be more than just the usual methods. It should include learning constantly and getting better at what we do. Also, in Industry 5.0, workers must work well with others. This means being understanding, good at understanding feelings and solving problems together. As people work more closely with intelligent machines, getting along with others is essential, as making good choices and thinking carefully. Industry 5.0 is all about moving away from having technical skills to having a mix of skills that make employees competent to work alongside machines and perform outstandingly in areas where human beings and technology intersect.

Societal Impacts: Inclusivity, Ethics, and Sustainability

Before, new technology made it harder for people and led to unfair situations. Industry 5.0 must ensure that all people, even those left behind before, can benefit from new technology. An important part of Industry 5.0 is creating work environments where technology supports people in their jobs instead of taking them out of it. Industry 5.0 also wants to ensure everyone can work with and benefit from new technology. Another main field of Industry 5.0 is its desire to observe the just and respectful utilization of emerging technology. With our increased usage of technologies such as artificial intelligence and machine learning, we must reflect on how such technologies can foster injustice, invasions of privacy, and obfuscated decision-making.

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Challenges and Future Research Opportunities

Industry 5.0 can bring significant changes, but there are specific, very critical issues that we need to consider. One critical issue is ensuring that humans can keep up with all the new technology, such as AI, robots, and computer programs. We must also consider the ethics of using AI and machine learning in factories and other industrial settings. With AI systems becoming more prevalent to inform decisions in recruitment, product innovation, and consumer interactions, having transparent and unprejudiced AI systems is vital. The future lies in research into how humans and machines can collaborate better in the next era of business.

Literature Review

This shift from Industry 5.0 to Industry 4.0 is a milestone shift, where the focus moves away from machine-driven innovation and automation towards human-centred industrial systems. Industry 5.0 is about investing human ingenuity, intelligence, and values back into future-proof technology to boost people and machine collaboration to deliver responses to issues related to sustainability, inclusiveness, and ethics (Nahavandi, 2019). This innovation balances technological advancements and human aspirations, particularly addressing the desire for human oversight within autonomous systems (Xu et al., 2021). Transhumanism is influencing modern society and the working environment by reshaping human nature and altering the purpose of life Transhumanism is developing alongside the current Industry 4.0, but implementing some transhumanist solutions and projects can give impetus to the existing disproportionate distribution of wealth. (Nevena et al., 2025).

Industry 5.0's human-centred innovations aim at applying technology to support human intelligence and creativity rather than replace them. One of the core focus areas is collaborative robots, or "cobots," which are designed to operate in cooperation with human handlers, assisting with advanced tasks without replacing human choice-making (Demir et al., 2020; Bressanelli et al., 2022). The combination of AI and machine learning within industrial systems has been a game-changer, enabling the personalization of goods and services and incorporating a human element (Maddikunta et al., 2022). Industry 5.0 is founded on the collaboration of humans and machines; the digital skills gap represents a significant barrier, particularly in industries where classic, manual occupations dominate (Soto-Acosta & Palacios-Marqués, 2023).

Navarro et al. (2024) refer to the crucial role of industry-academia collaboration in fostering innovation and technological advancement by employing the Triple Helix model, focusing on the PLANET4 initiative. The scheme aims to bridge the gap between education-based theoretical learning in institutions and practical application within industries. The scheme tries to align academic studies with industry needs and provide training for career jobs in digital-influenced environments. It also promotes establishing education systems aligned with Industry 4.0 goals and requires strong institutional dedication and an inclination towards strengthening inter-disciplinary partnerships. In one of the recent studies (Esangbedo et al., 2024), they explained how working with companies can help students perform better in school. They considered how internships and joint projects with companies can allow students to feel the reality of working in the real world. The research showed that such synergies are equally beneficial to both the students and the companies. It also pointed out that schools and companies need to work together to ensure that students are ready for the new kinds of jobs that will emerge because of new technology.

Within health, Industry 5.0 innovations have revolutionized patient care with AI and machine

learning systems providing predictive patient outcomes analytics, allowing health practitioners to make informed decisions (Javaid et al., 2021). Within manufacturing, Industry 5.0 has enabled bespoke production where customer preferences are attained through elastic, agile systems blending human imagination with machine accuracy (Santos et al., 2022). The rapid integration of new technologies within the industry offers challenges and possibilities for a human-centred system. Upskilling and reskilling employees to facilitate their getting accustomed to emerging technological settings are crucial to ensuring employability and enabling the labour force to collaborate with emerging technologies (Javaid et al., 2021). Industry 5.0 emphasizes developing technical and soft skills, with adaptability, creativity, and ethical decision-making being key competencies in the fourth industrial revolution (Kohtamäki et al., 2020). HRD programs must prioritize training employees on interacting with AI systems, collaborative robots, and data-driven decision-making (Martin & Kroll, 2020). A shift towards lifelong learning and continuous professional development is needed to harmonize with technological progress (Papageorgiou et al., 2022).

Among the most significant social contributions of Industry 5.0 is how it ensures inclusivity through the bridging of the human beings and machine gap in a way that is equitable and inclusive to all (Xu et al., 2021; Stojanović & Bogetić, 2023). As opposed to Industry 4.0, whose effect was widening socio-economic inequalities, Industry 5.0 aims to democratize technology such that various groups are made to have access so that marginalized populations can benefit from technological advancements (Demir et al., 2020). Ethical concerns are also a top concern in Industry 5.0. Maintaining transparency, equity, and responsibility is crucial as industrial operations are increasingly combined with AI and machine learning systems (Martin & Kroll, 2020). Ethical application of data, particularly in AI systems, is a significant issue, as it promises that employees' privacy is maintained in increasingly digitalized work environments (Pérez-Pérez et al., 2023; Smith & Gonzalez, 2024).

Researchers (Ivankova et al., 2024) discuss how important it is for people to use their creativity in combination with new technology in the workplace. They think that using human creativity and technology makes better decisions and produces more new and innovative concepts. The authors discuss the difficulties of doing this, like not having enough digital skills to use AI well and worrying about using AI ethically. They suggest improving training programs focusing on creativity for workers and researchers so people and machines can work together better in Industry 5.0. Additionally, the evolving workforce development landscape in Industry 5.0 focuses on collaboration over automation, demanding a new approach to a human-centric system that emphasizes reskilling and upskilling the workforce. The authors greatly favour a permanent learning culture and lifelong education, particularly in light of quick technological advancements since workers are compelled to acquire new digital competencies. The authors state that several primary competencies are required in Industry 5.0, such as flexibility, innovativeness, and complementarity at work with AI systems. Soft competencies such as emotional intelligence and ethical judgment are just as crucial since workers interact more with AI systems that cannot be replicated with these solely human attributes. Authors also discuss the role of HRD programs in creating avenues for reskilling workers who may lose their jobs in automation. One must keep acquiring and refining one's skills. This article contributes to mixed methods research by reporting a practical application and integrating mixed methods across the full spectrum of intervention adaptation (Javaid et al., 2021).

Sustainability is also a priority, with Industry 5.0 promoting the development of green industrial systems. This involves reducing the use of energy, minimization of waste, and adaptation to

circular economy principles to ensure that industrial systems contribute positively to the environment (Bressanelli et al., 2022; Li et al., 2023). While Industry 5.0 has numerous benefits, there are still some challenges. Traditional industries' reluctance to adopt new technology due to its expense and disruption of operations is still a hindrance (Stojanović & Bogetić, 2023). Additionally, regulatory frameworks must be implemented to manage the ethical use of AI, machine learning, and data-driven technologies to ensure they are used fairly and transparently (Nahavandi, 2019). This study developed a domain ontology to represent various stages of maturity toward Industry 4.0 implementation, providing SMEs with a self-assessment tool to plan informed decisions about advancing their manufacturing processes (Mora-Alvarez et al., 2023).

Future research must cover the ethical issues of AI, study how human intelligence and imagination can be utilized best in industrial systems and understand the effects of these technologies in society. Future research should also be conducted on upskilling and reskilling workers so that this may be undertaken with equity and inclusivity (Kohtamäki et al., 2020).

Methodology

The research employed a mixed-method approach to comprehensively find the impact of Industry 5.0 on human-centric innovations, talent formation, and social effects. The approach uses qualitative research techniques, including an in-depth literature review, survey, and focus group discussions. The study found that Industry 5.0 is driving major innovations, prioritizing the role of human workers. Still, it highlighted the growing need for continuous human-centric systems to bridge the gap between technology and human capabilities. Industry 5.0 could make work fairer for everyone, but some worry about privacy and fairness. They're also concerned that not everyone will have access to the new technology.



Figure 1. Exploration of Industry 5.0

One big problem is that some old-fashioned industries don't want to change, and there aren't many rules about using new technology fairly and ethically. Figure 1 depicts the exploration of Industry 5.0, highlighting human-centric innovations, human-centric systems, societal impact, and research opportunities.

Challenges of Industry 5.0

This study employed a research approach to gather information related to Industry 5.0. Figure 2 is a pie chart illustrating the distribution of research focus areas in our paper on Industry 5.0. It highlights the relative emphasis on human-centric innovations, their impact on human resource

development, societal implications, and future research opportunities. Human resource development is vital in Industry 5.0, accounting for 30% of its focus. Ensuring workers receive proper training and skill upgrades is essential to work well alongside advanced technologies. These comprise developing tools and technologies that supplement human intelligence and creativity instead of trying to replace them. Industry 5.0 also introduces essential societal matters, which share 20% of the focus. These progress and, ensuring everyone is included in the progress, and aiming for sustainability. Also, a summary table provides an overview of the current applications of technology in Industry 5.0, outlines areas that need further research, and shows what it takes for a successful transition into this new age of industry. The table breaks down the study's principal findings and explains the principal challenges that must be addressed.



Figure 2. Research focus distribution in Industry 5.0

Category	Details				
Industry 5.0	Collaborative robotics (Cobots)				
Applications	Human-machine collaboration in Production processes				
	Smart factories with personalized production				
	Customizable product design				
Adopted	• Artificial Intelligence (AI)				
Technologies	• Internet of Things (IoT)				
	• Augmented Reality (AR) and Virtual Reality(VR)				
	• 3D printing				
	Advanced data analytics and sensors				
Future Research	Ethical implications of AI in industry				
Opportunities	Impact of Industry 5.0 on worker well-being and				
	productivity				
	Addressing inequality in technology adoption				
	• Frameworks for sustainable and inclusive				
	industrial ecosystems				
Pre-requisites for	Continuous Human Centric System				
Industry 5.0	• Upskilling and reskilling of workforce				
	• Ethical regulations for technological use				

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		•	Collaboration between government, academia, and industry
Research Areas	Focus	•	Human-centric innovations in industrial systems Enhancing workforce adaptability to advanced technologies Societal implications: inclusivity, sustainability, and ethics

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Table 1. Category and Details

Discussion

The relationship matrix between Industry 5.0 applications, adopted technologies, future research, prerequisites, and research focus is provided in Figure 3. This matrix indicates how these elements interact with one another. Industry 5.0 applications depend on adopted technologies to function (e.g., cobots, AI) and are driven by future research on trends and ethical concerns. Technologies like AI and IoT are necessary for enabling applications and require continuous exploration through research. Future research shapes how these apps evolve and addresses challenges such as prerequisites like workforce training and ethical considerations. Prerequisites like Human Centric Systems and collaboration are essential for successfully implementing applications and technologies. The research focuses on all these elements, investigating how they impact society, the workforce, and industrial innovations.

The given matrix (Figure 4) outlines the impact of Industry 5.0 on human-centred innovations, workforce development, societal effects, and the relationship levels between the various factors. This matrix illustrates the strength of relationships among categories, highlighting their interactions. The matrix highlights the interconnectedness of these elements within the Industry 5.0 ecosystem. A matrix with the relationship levels between the different categories of Industry 5.0, such as high, medium, and low.



Figure 3. Relationship Level Matrix



Factors	Human- Centric Innovations	Workforce Development	Societal Effects
Human-Machine Collaboration			
Creativity and Innovation			
Ethical Considerations			
Inclusion and Diversity			
Skills Development			
Employee Well-being			
Automation and AI Integration			
Reskilling and Upskilling			
Job Creation			
Sustainability Initiatives			
Productivity Enhancements			
Workplace Inclusivity			
Decision-Making and Transparency			
Data Privacy and Security			

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Figure 4. Impact of Industry 5.0

High Relationship indicates a strong and direct dependence or influence (e.g., Industry 5.0 applications are highly dependent on technologies like AI and IoT). Medium Relationships indicate moderate but essential interactions (e.g., prerequisites like the human-centric system are moderately connected to future research because they inform skills needed). A Low Relationship would apply if the connection between categories were minimal; however, there are no such low relationships in this context due to the strong integration of these factors in Industry 5.0. This matrix shows the relative strength of the relationships between the categories. It helps demonstrate how each factor interacts across key domains in Industry 5.0.

Industry 5.0 strongly emphasizes creativity and human-machine collaboration, resulting in high

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impacts on innovation. Ethical considerations and inclusivity efforts create moderate effects in this area. Reskilling, upskilling, and well-being are major focus areas in Industry 5.0. It drives significant efforts to ensure workers adapt and thrive in this new industrial era. 5.0's societal impacts include fostering sustainability, promoting inclusivity, and tackling ethical concerns. While automation affects job creation, overall, the focus is on human-centred improvements across sectors. Mixed research methods combine different study styles, explicitly looking at numbers and personal stories. This approach is constructive for understanding complicated ideas like Industry 5.0. By blending personal experiences, like how people feel, the effects on society, and ethical issues with complex data on things like productivity and technology use, mixed methods give us a complete picture of how Industry 5.0 impacts individuals and businesses. This integration ensures that researchers understand the technological and human factors involved in technological advances and provides a comprehensive view of how these innovations affect individuals, organizations and society. It also allows for triangulating and comparing results from different methods to confirm findings and ensure the robustness of research using the findings.

Conclusion

Industry 5.0 marks a major change towards systems focusing on people where humans and intelligent machines work together. This brings many opportunities for new ideas and benefits for society, but it also comes with challenges related to training, ethics, and ensuring everyone is included. Companies must continue helping employees learn new things and adapt to a more technology-focused world. Leaders must also consider how these changes will affect society and ensure everyone benefits from new technology.

- Developing frameworks for effective human-machine collaboration.
- Exploring ethical AI governance models for Industry 5.0.
- Investigating the role of a human-centric system in bridging the skills gap created by new technologies.
- Assessing the societal impact of Industry 5.0 on underserved populations.

These places have the potential to help us learn more about how Industry 5.0 can be used to create sustainable systems that focus on people, benefiting both industry and society. This research could revolutionize workforce development strategies and promote inclusive technological advancement. By addressing the skill gap and focusing on underserved populations, the findings could guide policies that promote equitable participation in the benefits of Industry 5.0. Ultimately, this work aims to create more sustainable and human-centred industrial systems that align technological advancements with societal well-being.

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References

Nevena Krasulja1, Milica Vasiljević-Blagojević2, Nenad Perić3, Gordana Đuretic. (2025). Transhumanism: Influence on the modern society and the working environment. Journal of Posthumanism, 5(1), 41–53. https://doi.org/10.33182/joph.v5i1.3501

- Bressanelli, G., Adrodegari, F., Saccani, N., & Perona, M. (2022). The role of digital technologies to overcome circular economy challenges in PSS business models: An Industry 5.0 perspective. Sustainability, 14(8), Article 4273. https://doi.org/10.3390/su14084273
- Demir, K. A., Döven, G., & Sezen, B. (2020). Industry 5.0 and human-robot co-working. Procedia Computer Science, 158, 688–695. https://doi.org/10.1016/j.procs.2020.08.109
- Esangbedo, C. O., Zhang, J., Esangbedo, M. O., Kone, S. D., & Xu, L. (2024). The role of industry-academia collaboration in enhancing educational opportunities and outcomes under the digital-driven Industry 4.0. International Journal of Engineering Education, 60(2), 220–233. https://doi.org/10.1080/ijee.2024.102020
- Ivankova, N. V., et al. (2024). Using mixed methods research to optimize healthy lifestyle intervention adaptation for web-based delivery: A pragmatic approach. Journal of Mixed Methods Research, 18(3), 247–257. https://doi.org/10.1177/15586898241255714
- Javaid, M., Haleem, A., Singh, R. P., & Khan, S. (2021). The role of Industry 5.0 in shaping the future of healthcare and manufacturing industries. Materials Today: Proceedings, 47(3), 2682–2688. https://doi.org/10.1016/j.matpr.2021.03.156
- Kohtamäki, M., Parida, V., Patel, P. C., & Gebauer, H. (2020). The relationship between digital servitization and competitive advantage: The role of industrial ecosystems. Technovation, 98, Article 102121. https://doi.org/10.1016/j.technovation.2020.102121
- Li, L., Chen, C. H., & Zhang, H. (2023). Sustainable production planning in Industry 5.0: A human-machine collaboration approach. Journal of Cleaner Production, 388, Article 135582. https://doi.org/10.1016/j.jclepro.2023.135582
- Maddikunta, P. K. R., Pham, Q. V., Deepa, N., Gadekallu, T. R., & Mohanty, S. N. (2022). Advances in human-centered artificial intelligence for Industry 5.0 applications. Journal of Industrial Information Integration, 27, Article 100258. https://doi.org/10.1016/j.jii.2022.100258
- Martin, C., & Kroll, H. (2020). Rethinking the socio-economic consequences of Industry 5.0. Journal of Industrial and Business Economics, 47(2), 265–282. https://doi.org/10.1007/s40812-020-00153-1
- Mora-Alvarez, Z. A., Hernandez-Uribe, O., Luque-Morales, R. A., & Cardenas-Robledo, L. A. (2023). Modular ontology to support manufacturing SMEs toward Industry 4.0. Engineering, Technology & Applied Science Research, 13(6), Article 6454. https://doi.org/10.48084/etasr.6454
- Nahavandi, S. (2019). Industry 5.0—A human-centric solution. Sustainability, 11(16), Article 4371. https://doi.org/10.3390/su11164371
- Navarro, J., et al. (2024). Bridging academia and industry in the era of Industry 4.0 by means of the triple helix: The PLANET4 initiative. Journal of Industrial Innovation Research, Article 03.005. https://doi.org/10.1016/j.jindinnres.2024.03.005
- Papageorgiou, G., Voulgaridou, I., & Spyrou, E. (2022). Industry 5.0: The fusion of human and artificial intelligence in future workplaces. Futures, 135, Article 102848. https://doi.org/10.1016/j.futures.2021.102848
- Pérez-Pérez, M., Díaz-Pérez, M., & Vega, J. (2023). Ethical implications of AI in Industry 5.0: A study on governance frameworks. Technological Forecasting and Social Change, 183, Article 121863. https://doi.org/10.1016/j.techfore.2022.121863
- Rodič, B. (2020). Industry 5.0 as a new collaborative paradigm: A discussion of potential socio-technical issues. Journal of Engineering and Technology Management, 59, Article 101619. https://doi.org/10.1016/j.jengtecman.2020.101619
- Santos, M. Y., Martinho, R., & Gomes, C. (2022). Enhancing Industry 5.0 through human-centered artificial intelligence and digital twins. Procedia CIRP, 105, 234–239. https://doi.org/10.1016/j.procir.2022.06.062

- Smith, J., & Gonzalez, R. (2024). Integrating human creativity in AI systems: A new frontier for Industry 5.0. Journal of Industrial Engineering Research, 58(2), 134–145. https://doi.org/10.1016/j.jier.2024.01.0059
- Soto-Acosta, P., & Palacios-Marqués, D. (2023). Towards a human-centric Industry 5.0: Ethics, AI, and future challenges. Journal of Business Ethics, 183, 523–537. https://doi.org/10.1007/s10551-023-05153-7
- Stojanović, I., & Bogetić, Z. (2023). Inclusive innovation for Industry 5.0: Human-centric technologies in manufacturing. Technological Forecasting and Social Change, 191, Article 122553. https://doi.org/10.1016/j.techfore.2023.122553
- Tortorella, G. L., Fogliatto, F. S., Mac Cawley Vergara, A., & Barrera, P. (2021). Contributions of Industry 5.0 towards supporting lean manufacturing: A systematic review. Journal of Manufacturing Systems, 60, 199–223. https://doi.org/10.1016/j.jmsy.2021.04.002
- Xu, G., Sun, X., Xia, L., Zheng, Y., Zhang, Y., & Shen, F. (2021). Industry 5.0: A new trend towards smart industrial value chain systems. IEEE Transactions on Industrial Informatics, 17(11), 7663–7672. https://doi.org/10.1109/TII.2021.3099182