Automation in Manufacturing Industry

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The paper presents data on advantages and disadvantages of automation, based on one pilot study and one Delphi study in two rounds.The purpose of automated systems is to perform functions more efficiently, more reliably, and more accurately than human operators.Also, expectations are that automated systems can perform functions and tasks at a lower cost than human operators. The purpose of the survey was to partly capture the perception of terms like levels of automation and automation strategies among production mangers and production technicians working with automation in industryThis paper explores task allocation in semi-automated systems and proposes a systematic approach to change automation levels. It reviews definitions and taxonomies, suggests a LoA definition and taxonomy for manufacturing, and suggests dividing automation into physical/mechanical and cognitive information-related variables.This paper aims to enhance understanding of task allocation in semi-automated systems and propose a systematic approach for adjusting automation levels, based on a literature review.

Keyword: Automation,Manufacturing

1.INTRODUCTION

Businesses are searching more and more for a fundamental digital transformation, wherein systems can develop intelligence to adjust to dynamic business dynamics and picky customer preferences . Additionally, clients consistently request systems be flexible and responsive enough to handle not just their regular tasks but additionally to give them more information so they can make informed and more Industry was first brought up as a major strategic initiative of the German federal government's High-Tech Strategy 2020 action plan in 2011 [1]. Since then, businesses, academic institutions, and research centers have discussed it frequently [2, 3].

The term "Industry " [2] refers to the fourth industrial revolution, which is presently occurring [3], and which offers enormous economic potential in addition to promising social and ecological opportunities [4]. Additionally, Industry 4.0 and its contemporary concepts—such as the Smart Factory, Cyber-Physical System (CPS), Internet of Things (IoT), and Internet of Services (IoS)— cause a paradigm shift in business models [1], production technology [7], work organization [6], and the Internet of Things (IoT) [5]. The smart, linked, integrated, and real-time oriented factories of the future are what define them.

I. .Level of Automation

A modern manufacturing system consists of many different activities, such as hiring labor and investing in automation, as well as the procedures required to produce goods that are ready for consumers. The manufacturing system itself consists of facilities, protocols, software, and technological as well as human resources. All interdependent in a convoluted mixture Thus, successful manufacturing requires both highly skilled human labor and sophisticated technical systems. Finding the right degrees of automation in the manufacturing sector thus seems to have a lot of potential. Therefore, in order to increase the robustness of the system, the appropriate level of automation can be reached for the appropriate manufacturing situation. We have decided to define the Level of Automation in this paper.

II. . RESEARCH METHODS

The history, experience, and expertise of the participants were the main topics of the first section.

The interviewees were specifically questioned regarding the kind of manufacturing techniques they

employed the most ability with. Following the interviewee's selection of the practices in which he or she was most proficient, he or she was instructed to focus on these procedures for the duration of the conversation. The latter half of The interview was predicated on a questionnaire that their opinions on automation and the distribution of tasks involving both humans and technology.

What is the benefit of using automation?

What is the benefit of using automation? o When is automation or manual work inappropriate?

SURVEY RESULT

When asked in the pilot research which tasks they thought weren't good candidates for automation,Need to mention which jobs are inappropriate for you to perform By hand. Here, it was also verified that automation of new product introduction and ramp-up product, manufacturing of sporadic goods, or Producing goods with a brief lifespan is not appropriate for mechanization.
Additionally, a number of businesses admit that there are too many items or variations in When automating, production may become problematic. Upon yet, duties with poor ergonomic high production quantities and favorable conditions are not appropriate for manual execution

III. AUTOMATION EFFECTS THE MANUFACTURING INDUSTRY

a. Automation is an effective solution to growing labor shortage problems.

Automation can complement human labor by handling repetitive, mundane, or physically demanding tasks, allowing human workers to focus on more complex and creative aspects of their jobs.In industries facing labor shortages, particularly in physically demanding or hazardous environments, automation can reduce the dependency on a large manual workforce.Automation can complement human labor by handling repetitive, mundane, or physically demanding tasks, giving human workers the opportunity to concentrate on more intricate and imaginative aspects of their work.

b. Increased worker's safety

Automation can be deployed to handle tasks that are inherently hazardous to human health, such as exposure to toxic chemicals, extreme temperatures, or environments with high levels of noise or vibrations. Robots or automated systems can take on these tasks, reducing the risk of workplace injuries.Tasks involving heavy lifting or physically demanding work can be automated using machinery designed to handle such loads.
Automated material handling systems, including robotic exoskeletons or autonomous vehicles, can efficiently manage these tasks.

c. Resource Optimization and Environmental Sustainability:

Automation can contribute to the optimization of resource usage, reducing waste and energy consumption. This focus on sustainability aligns with efforts to address environmental challenges and create a more eco-friendly world

d. Innovation and Technological Advancements:

Automation drives technological innovation, fostering the development of new technologies and solutions. This innovation can lead to the creation of new industries, job opportunities, and improved living standards.

e. Automation Increased production capacity

Automated systems can operate 24/7 without the need for breaks, holidays, or shifts. This continuous operation ensures that production lines remain active, leading to a substantial increase in overall output.

f. automation Increased worker's safety

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g. Accomplish impossible tasks

Automation has the potential to accomplish tasks that may be considered challenging, complex, or even impossible for humans to perform efficiently or safely. Here are some ways in which automation can tackle tasks that might be deemed difficult for humans Automation excels in tasks that require a high level of precision and repetition. Machines, such as robotic arms in manufacturing, can consistently perform intricate and repetitive actions without fatigue or errors.

h. Higher Customer Satisfaction

Automation, when integrated with advanced technologies like robotics and computer numerical control (CNC) machining, allows for efficient customization and personalization of products.
This flexibility to meet individual customer needs enhances satisfaction by providing tailored solutions.

IV. CHALLENGES IN AUTOMATION MANUFACTURING INDUSTRY

a. High Initial Costs

Implementation of automation systems requires a significant upfront investment in technology, equipment, and employee training. Small and medium-sized enterprises (SMEs) may find it challenging to justify these initial costs.

b. Integration Issues:

Integrating new automation systems with existing manufacturing processes and legacy equipment can be complex. Compatibility issues may arise, leading to downtime and disruptions in production.

c. Workforce Resistance:

Employees may resist the adoption of automation due to fear of job loss or concerns about their roles changing. Managing this resistance and providing adequate training to the workforce is crucial for successful automation implementation.

d. Skilled Labor Shortage:

As manufacturing processes become more automated, there is an increasing demand for skilled workers who can operate, maintain, and troubleshoot complex automated systems. There is often a shortage of such skilled labor in the workforce.

e. Technology Obsolescence:

Rapid advancements in technology mean that automation systems can quickly become outdated. Manufacturers need to stay updated with the latest technologies to avoid the risk of investing in obsolete systems.

f. Cybersecurity Concerns:

With increased connectivity and the use of the Internet of Things (IoT) in automation, there is a higher risk of cybersecurity threats. Ensuring the

security of automated systems and protecting sensitive data is a significant challenge.

g. *Flexibility and Adaptability:* Some automated systems may lack the flexibility to adapt to changes in product design or manufacturing processes. Manufacturers need systems that can easily adapt to variations in production requirements.

h. *Maintenance Downtime:* Automated systems require regular maintenance, and unexpected breakdowns can lead to significant downtime. Planning for maintenance schedules and ensuring quick and efficient repairs are crucial for minimizing disruptions.

i. *Regulatory Compliance:*

Compliance with industry regulations and standards is essential. Keeping up with evolving regulations and ensuring that automated systems adhere to safety and quality standards can be challenging.

j. *Global Supply Chain Disruptions:*

Automation systems often rely on a global supply chain for components and parts. Disruptions, such as geopolitical events, natural disasters, or the impact of a global pandemic, can lead to delays and shortages.

k. *Human-Machine Collaboration:*

Achieving seamless collaboration between humans and machines is a challenge. Some tasks may still require a human touch, and finding the right balance between automation and human intervention can be complex.

CONCLUSION

The purpose of automated systems is to performfunctions more efficiently, more reliably, and more accurately than human operator.Also,expectations are that automated systems canperform functions and tasks at a lower cost thanhuman operators. Thereby there are few arguments that can be put against the efficiency, reliability, and accuracy of automated systems.
With higherreliability, it could be argued that a system would be a safer system as wellThe research undertaken sheds light on the multifaceted landscape of automation in the manufacturing industry. The findings highlight both the remarkable advantages and the formidable challenges associated with the integration of automated systems.

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REFERENCE

[1]J. Frohm, V. Lindström, M Winroth, J. Stahre,THE INDUSTRY'S VIEW ON AUTOMATION IN MANUFACTURING,IFAC Proceedings Volumes,Volume 39, Issue 4,2006,

[2] J. Frohm, V. Lindström, J. Stahre, and M. Winroth, 'Levels of automation in manufacturing', Ergonomia - an International journal of ergonomics and human factors, vol. 30, no. 3, 2008.

[3]M. Chui, K. George, J. Manyika, and M. Miremadi, "Human+ machine: A new era of automation in manufacturing," McKinsey & Company, 13, 2017.

[4] M. Rüßmann, M. Lorenz, P. Gerbert, M. Waldner, J. Justus, P. Engel, and M. Harnisch, "Industry 4.0: The future of productivity and growth in manufacturing industries," Boston Consulting Group, vol. 9, no. 1, pp. 54-89, 2015

[5] G. L. Tortorella, G. Narayanamurthy, and M. Thurer, "Identifying pathways to a high-performing lean automation implementation: An empirical study in the manufacturing industry," International Journal of Production Economics, vol. 231, p. 107918, 2021.

[6]X. Li, E. C. M. Hui, W. Lang, S. Zheng, and X. Qin, "Transition from factor-driven to innovation-driven urbanization in China: A study of manufacturing industry automation in Dongguan City," China Economic Review, vol. 59, p. 101382, 2020.

[7] F. A. Lievano-Martínez, J. D. Fernández-Ledesma, D. Burgos, J. W. Branch-Bedoya, and J. A. Jimenez-Builes, "Intelligent process automation: An application in manufacturing industry," Sustainability, vol. 14, no. 14, pp. 8804, 2022.

[8] M. Saturno, V. M. Pertel, F. Deschamps, and E. D. F. R. Loures, "Proposal of an automation solutions architecture for Industry 4.0," in 24th International Conference on Production Research, vol. 1, no. 14, p. 2021, March 2017.

[9] D. Horvat, H. Kroll, and A. Jäger, "Researching the effects of automation and digitalization on manufacturing companies' productivity in the early stage of industry 4.0," Procedia Manufacturing, vol. 39, pp. 886-893, 2019.

[10] D. G. Hansen, A. A. Malik, and A. Bilberg, "Generic challenges and automation solutions in manufacturing SMEs," in Proceedings of the 28th DAAAM International Symposium, pp. 1161-1169, DAAAM International, November 2017

[11] J. Atack, R. A. Margo, and P. W. Rhode, "Automation of Manufacturing in the Late Nineteenth Century: The Hand and Machine Labor Study," *Journal of Economic Perspectives*, vol. 33, no. 2, pp. 51-70, 2019.

[12] M. Garetti, L. Fumagalli, A. Lobov, and J. L. Martinez Lastra, "Open automation of manufacturing systems through integration of ontology and web services," *IFAC Proceedings Volumes*, vol. 46, no. 9, pp. 198-203, 2013. ISSN: 1474-6670, ISBN: 9783902823359.

[13] S. Meister, M. Wermes, J. Stüve, and R. M. Groves, "Investigations on Explainable Artificial Intelligence methods for the deep learning classification of fibre layup defect in the automated composite manufacturing," *Composites Part B: Engineering*, vol. 224, pp. 109160, 2021.

[14] N. Gat, S. Subramanian, J. Barhen, and N. Toomarian, "Spectral imaging applications: remote sensing, environmental monitoring, medicine, military operations, factory automation, and manufacturing," in *25th AIPR Workshop:

[15] A. Ambrus, P. Pournazari, P. Ashok, R. Shor, and E. van Oort, "Overcoming barriers to adoption of drilling automation: Moving towards automated well manufacturing," in *SPE/IADC Drilling Conference and Exhibition*, March 2015, OnePetro.

[16] J. G. Everett and A. H. Slocum, "Automation and robotics opportunities: construction versus manufacturing," *Journal of Construction Engineering and Management*, vol. 120, no. 2, pp. 443-452, 1994.

[17 W. Wu, B. Jiang, L. Xie, F. Klunker, S. Aranda, and G. Ziegmann, "Effect of compaction and preforming parameters on the compaction behavior of bindered textile preforms for automated composite manufacturing," *Applied Composite Materials*, vol. 20, pp. 907-926, 2013.

[18] G. E. Monahan and T. L. Smunt, "A multilevel decision support system for the financial justification of automated flexible

[19] V. Granell, "Levels of automation in manufacturing systems: aligning strategic and tactical decisions by means of operational measurement," Ph.D. dissertation, Chalmers University of Technology, 2007.

[20] A. K. Chakravarty, "Dimensions of manufacturing automation," *International Journal of Production Research*, vol. 25, no. 9, pp. 1339-1354, 1987.