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Theoretical Study of Factory Machine Equipment: Manual vs Artificial Intelligent

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ABSTRACT
The development of industrial technology has brought significant changes in the factory operational system, especially in the use of machine tools. This study aims to describe the theoretical factory machine tools: manual vs AI and the theoretical factory machine tools manual vs AI. The research method uses triangulation comparative analysis. The results show that The study shows that the implementation of AI-based machines offers significant advantages over manual machines, especially in terms of efficiency, productivity, and predictive maintenance. Although AI implementation faces some challenges, such as initial costs and the need for skilled human resources, the long-term benefits are enormous for the industry.

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INTRODUCTION

Operational management is one of the Important Points in running Company Operations (Gunawan, 2015). Theoretical study topics of manual Vs Al Factory Machine equipment in factories involving Equipment, human resource machines and finance are important studies in Operational management. If there is no Equipment, the Factory cannot produce the planned output (Assuari, 2017).

Some previous studies with the same topic include: (Anaam et al, 2022), Anwar, K. (2024), Fitriana & Zanah (2020), (Mubarak 2020). The researchers focused on the implementation of equipment while this study focuses on the Theory of Factory Machine Equipment: Manual vs AI which emphasizes the theory regarding the comparison of the use of manual machines and artificial intelligence-based machines in the production process in factories, and the research method is different from the current researcher. The researcher used the literature comparison and triangulation methods while they did not use methods outside of literature comparison.

The purpose of this study is This study aims to describe the theoretical aspects of manual vs AI factory machine tools and describe the theoretical aspects of manual vs AI factory machine tools.

LITERATURE REVIEW

Factory machines are one of the main resources in the production process that function to help convert raw materials or inputs into finished goods or outputs that have added value and can be used or sold (Mehrpouya et al, 2019). According to Saez et al (2018), factory machines are described as important production units that support industrial

operations, whose performance can be monitored and predicted using historical data. In this study, the focus is on how intelligent systems such as the K-Nearest Neighbor algorithm can be used to predict machine failures based on sensory parameters (temperature, vibration, sound) in order to avoid fatal damage and improve machine maintenance efficiency.

Factory machine tools are a collection of mechanical elements such as shafts, couplings, bearings, gears, and transmission systems that are technically designed to support the production process in an industrial environment. (Nur and Suyuti, 2018). Factory machine tools are mechanical or electromechanical tools used in the process of processing raw materials into finished goods, either manually or automatically (Youssef et al, 2023). Factory machine tools according to the approach in this book are a collection of mechanical elements such as bolts-nuts, cotter pins, shafts, bearings, gears, clutches, belts-pulleys, chains-sprockets, and brakes, each of which has a specific function in the construction and operation of industrial machines. These elements work synergistically to form a machine system that is capable of running the production process in the factory, as well as described by Sathyabama Institute Of Science And Technology.

According to a study by Anaam et al (2022) explains that the production process in the modern industrial era has experienced a major shift through the application of automation. Technologies such as robotics, machine learning, and automatic control systems are used to replace manual work. Meanwhile, according to Javaid et al. (2022), in a modern industrial environment, the production process is supported by an artificial intelligence-based automation system. The AI system can analyze operational patterns, automatically set machine work schedules, and provide predictions regarding operational needs.

Factory machines are mechanical devices that convert raw materials into finished products, operating with human assistance or automatically. Factory machine tools consist of mechanical elements such as shafts, couplings, and gears, which work together to support the production process (Krivosheya et al, 2015). In the modern industrial era, the application of automation technologies, including robotics and artificial intelligence (AI), has changed the way production is done by replacing manual work and increasing efficiency. AI systems can monitor machine performance, plan operational schedules, and predict failures based on sensory data, thereby supporting more effective maintenance and reducing the risk of fatal failures (Mathew et al, 2023).

Use of AI in Industry

Artificial Intelligence (AI) has brought major changes to the industry, including in optimizing production machines. AI functions to increase production efficiency by monitoring, managing machines, and predicting machine damage, thus enabling the implementation of preventive maintenance and reducing production downtime (Dewi, 2024). In the context of the manufacturing industry, AI also plays an important role in supporting production automation, maximizing speed, reducing production costs, and improving product quality (Anaam et al., 2022). The use of AI accelerates decisions in the production process based on real-time data analysis.

Implementation of AI in Automotive Manufacturing

In the automotive industry, AI is used to solve the complexity of production systems that cannot be solved by conventional techniques. Techniques such as Genetic Algorithm, Simulated Annealing, and Tabu Search have been applied to optimize production systems (Mubarak, 2020). With AI, the automotive industry is able to solve problems in design, production, quality, and raw material efficiency more effectively.

Comparison of Manual Machines and AI Based Machines

Manual machines rely on human power and tend to experience more downtime due to human error or operational limitations. Meanwhile, AI-based machines are equipped with automatic decision-making capabilities, real-time condition monitoring, and maintenance requirement predictions, thereby increasing factory productivity (Anwar et al., 2024). On the other hand, the use of AI still faces challenges such as high initial investment costs and the need for a workforce with high-tech skills.

The Importance of Manual Machine Maintenance

Although AI brings many advantages, manual machines still require routine maintenance strategies, both preventive and corrective. Preventive maintenance aims to prevent damage before it occurs, keep the machine in optimal condition, and extend the life of the machine. Companies that implement routine machine maintenance are able to maintain smooth production and minimize damage costs., as well as described by Prihastono and Prakoso (2017).

RESEARCH METHOD

This study uses qualitative descriptive analysis with comparative literature triangulation. This researcher will look for sources from journals, books, online newspapers and websites related to the theory of factory machine equipment: manual vs AI. With this, it will compare and explain in detail from these sources.

RESULT AND DISCUSSION

Artificial Intelligence (AI) has undergone rapid development since it was first introduced in the world of computing. AI is generally defined as a branch of computer science that focuses on the development of systems that can perform tasks that normally require human intelligence, such as problem solving, pattern recognition, natural language processing, and decision making.

Artificial intelligence (AI) is growing rapidly and has a major impact on various industrial sectors. According to the McKinsey Global Institute (2023), AI is expected to contribute up to $15.7 trillion to the global economy by 2030, mainly through automation and data analysis. Around 50% of global companies have implemented AI, especially in process automation, market analysis, and customer interaction. A PwC study (2022) shows that AI can increase work efficiency by up to 40%, with the greatest impact on the financial, manufacturing, and healthcare sectors.

In the manufacturing sector, AI is driving intelligent automation and predictive maintenance, reducing machine downtime by 30% and increasing production efficiency by 25% (Gartner, 2023). Companies like Tesla and BMW are using AI for real-time product quality detection, reducing manufacturing defects by 50%. In addition, AI is also

improving supply chain efficiency by reducing operational costs by 20–30% through better demand prediction and inventory management (World Economic Forum, 2023).

In the healthcare sector, AI improves diagnostic accuracy and efficiency of medical services. The Lancet Digital Health study (2023) showed that AI can detect breast cancer with 96% accuracy, higher than radiologists. AI also accelerates drug discovery, reducing research time by up to 50%. Pfizer and Moderna have used it to accelerate the development of COVID-19 vaccines.

In the financial sector, AI helps detect fraud and improve the efficiency of banking services. The use of AI reduces fraudulent transactions by up to 30% (Juniper Research, 2023) and saves operational costs. Banks such as JPMorgan and Citibank monitor suspicious transactions in real-time. In addition, AI chatbots reduce customer wait times by up to 40% and increase service satisfaction (Deloitte, 2022).

In the transportation sector, AI is driving the development of autonomous vehicles, with over 60% of automotive research focused on this technology (Stanford AI Index Report, 2023). AI systems from Waymo, Tesla, and Cruise are able to reduce the risk of accidents by up to 90%. AI is also used to optimize traffic, such as in Singapore and London, which have managed to reduce congestion by up to 25% through real-time data-based traffic light settings.

In addition to the economic impact and industrial efficiency, AI also has a major impact on the labor market. According to the World Economic Forum (2023), AI is predicted to replace around 85 million jobs worldwide by 2025, but on the other hand it will also create around 97 million new jobs focused on data analysis, software development, and AI system management (Forum, 2023). A study by (McKinsey Global Institute, 2023) (2023) found that around 70% of large companies are now investing in reskilling their workforce to ensure a smoother transition to the era of AI-based automation

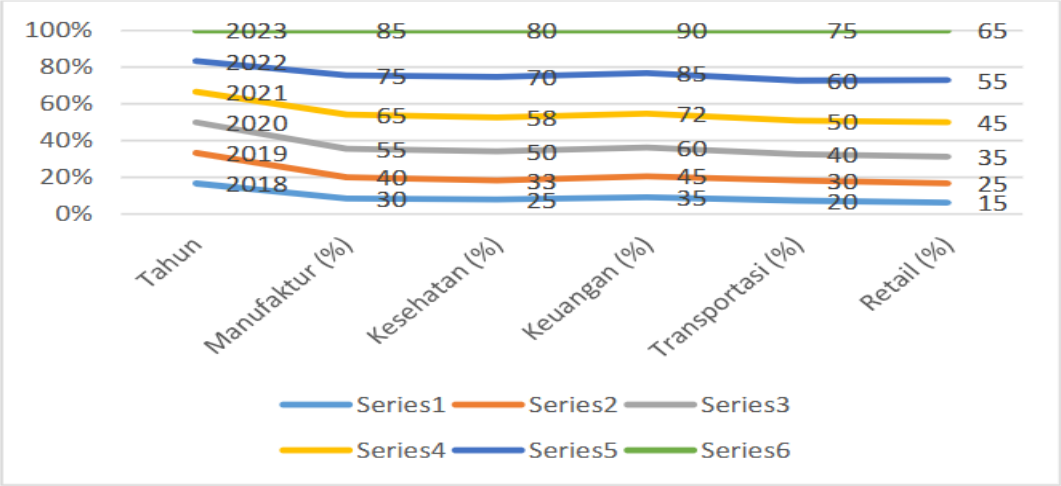

Figure. 1 . AI Adoption Trends in Various Industries (2018-2023)

Source: *Modified from McKinsey Global Institute (2023), Gartner (2023)*

Note : Manufaktur (Manufacture), Kesehatan (Health), Keuangan (Finance), Transportasi (Transportation), and Retail

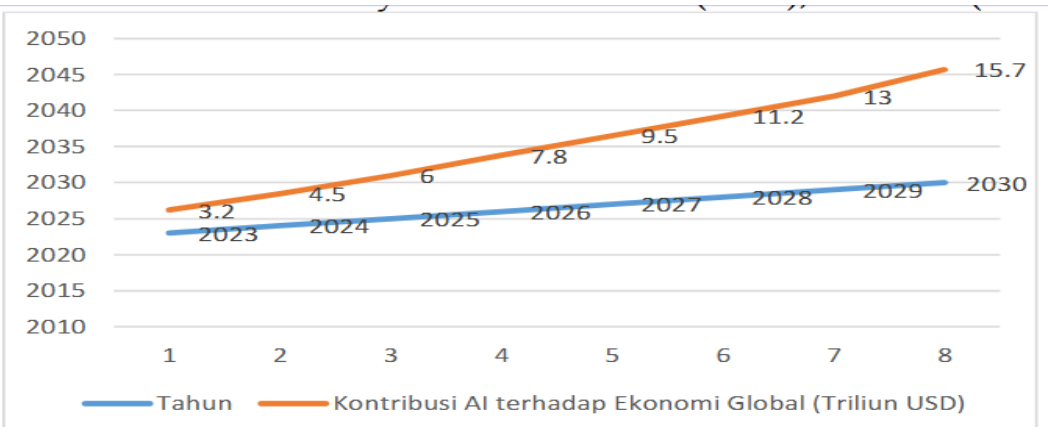

Figure. 2 . Contribution of AI to the Global Economy (2023-2030)
***Source**: Modified from PwC (2022), World Economic Forum (2023)*. Note : Tahun (Year)

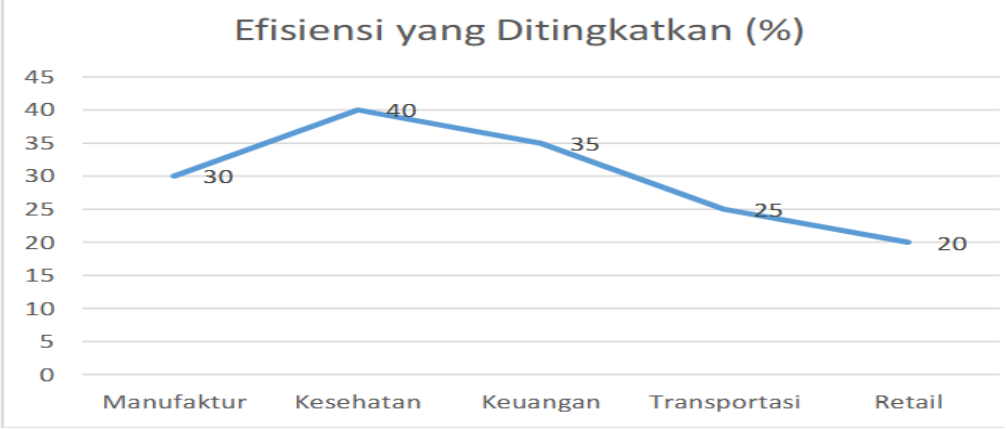

Figure. 3. Impact of AI on Industrial Efficiency (2023)
***Source**: Modified from Gartner (2023), Deloitte (2023)*
Note : Manufaktur (Manufacture), Kesehatan (Health), Keuangan (Finance), Transportasi (Transportation), and Retail

Based on the empirical and statistical data that has been presented, it is clear that AI has an increasingly large role in shaping the world of technology and the global economy. With the increasing adoption of AI in various sectors, the main challenges that must be faced include proper regulation, mitigating the risk of job losses, and implementing ethics in the development of AI technology. However, with good management, AI can continue to develop sustainably and provide optimal benefits for the industry and society as a whole. With such rapid development and its broad impact in various sectors, this study focuses on an in-depth analysis of the evolution of AI, its impact on the world of technology, and the challenges faced in its development. Although AI brings many benefits, there are still various issues that need to be considered, such as the ethics of using AI, data privacy, and the social implications of the widespread adoption of this technology.

The results of this study show that the use of AI-based machines can increase efficiency and productivity compared to manual machines. Comparison of Manual Machines and AI-Based Machines in Industry

1. Manual Machine vs AI Based Machine

   Manual machines are still widely found in traditional industries due to their low initial cost and ease of operation. However, these machines have various drawbacks, such as heavy reliance on human power, high risk of operational errors, and longer production times. In addition, the potential for downtime is greater because there is no automatic monitoring system.

   In contrast, AI-based machines are able to automate production processes in real-time, continuously monitor machine conditions through temperature, vibration, and sound sensors, and predict maintenance needs. This contributes to higher operational efficiency, reduced downtime, and lower production costs.

2. Effectiveness of AI-Based Machines

   Based on the study:

   AI can increase work efficiency by up to 40% (PwC, 2022). Machine downtime decreased by 30%, and production efficiency increased by 25% (Gartner, 2023). Companies like Tesla and BMW have managed to reduce production defect rates by up to 50% with AI-based quality control systems. AI also helps supply chain management by predicting market demand and managing inventory automatically.

3. Application of AI in Other Industries

   AI is not only impacting the manufacturing sector, but is also revolutionizing various sectors:

   a. Health: AI can detect breast cancer with up to 96% accuracy (Abdollahi et al, 2020).
   b. : Reduce transaction fraud cases by up to 30% and increase customer service efficiency through chatbots (Deloitte, 2022).
   c. Transportation: AI supports the development of autonomous vehicles and traffic optimization, reducing congestion levels by up to 25% (Stanford AI Index, 2023).

4. Economic and Social Impacts of AI Adoption

   According to McKinsey (2023), AI is projected to contribute up to $15.7 trillion to the global economy by 2030. Currently, around 50% of global companies have implemented AI in automation and data analysis. While AI is expected to displace around 85 million jobs, it will also create 97 million new jobs in technology and data management (WEF, 2023). However, major challenges remain, especially in the need for reskilling the workforce and the need for regulation and ethics in the use of AI.

5. Relevance of Manual Machines and Maintenance Strategies

   Although less efficient than AI-based machines, manual machines still have an important place in small and medium industries. Maintenance strategies such as preventive maintenance and corrective maintenance are very important to maintain performance and extend the life of the machine.

CONCLUSION

The study shows that the implementation of AI-based machines offers significant advantages over manual machines, especially in terms of efficiency, productivity, and predictive maintenance. Although AI implementation faces some challenges, such as initial costs and the need for skilled human resources, the long-term benefits are enormous for the industry. Manual machines are still relevant, especially in sectors that have not been able to invest in AI, but global trends clearly show a shift towards automation and artificial intelligence for higher industrial competitiveness.

REFERENCES

Authored Book

Gunawan, C.I (2015). *Ekonomi Makro*. Malang : CV. IRDH.

Krivosheya, A., Danilchenko, J. U., Storchak, M., & Pasternak, S. (2015). Design of shaping machine and tooling systems for gear manufacturing. In *Theory and Practice of Gearing and Transmissions: In Honor of Professor Faydor L. Litvin* (pp. 425-450). Cham: Springer International Publishing.

Mathew, D., Brintha, N. C., & Jappes, J. W. (2023). Artificial intelligence powered automation for industry 4.0. In *New horizons for Industry 4.0 in modern business* (pp. 1-28). Cham: Springer International Publishing.

Nur, R., and Suyuti, M. A. (2018). *Perancangan mesin-mesin industri*. Yogyakarta : Deepublish.

Youssef, H. A., El-Hofy, H. A., & Ahmed, M. H. (2023). *Manufacturing technology: materials, processes, and equipment*. Florida, USA : Crc Press.

Journal Article

Abdollahi, J., Keshandehghan, A., Gardaneh, M., Panahi, Y., & Gardaneh, M. (2020). Accurate detection of breast cancer metastasis using a hybrid model of artificial intelligence algorithm. *Archives of Breast Cancer*, 22-28.

Anaam, I. K., Hidayat, T., Pranata, R. Y., Abdillah, H., & Putra, A. Y. W. (2022, June). Pengaruh trend otomasi dalam dunia manufaktur dan industri. In *Vocational Education National Seminar (VENS)* (Vol. 1, No. 1).

Dewi, L. S. (2024). Peranan Artificial Intelligence dalam Meningkatkan Produktivitas Industri. *Circle Archive*, *1*(5).

Javaid, M., Haleem, A., Singh, R. P., & Suman, R. (2022). Artificial intelligence applications for industry 4.0: A literature-based study. *Journal of Industrial Integration and Management*, *7*(01), 83-111.

Mehrpouya, M., Dehghanghadikolaei, A., Fotovvati, B., Vosooghnia, A., Emamian, S. S., & Gisario, A. (2019). The potential of additive manufacturing in the smart factory industrial 4.0: A review. *Applied Sciences*, *9*(18), 3865.

Mubarak, R. (2020). Implementasi Artificial Intelligence Dalam Proses Industri Manufaktur Otomotif. *Jurnal Ilmu Komputer*, *3*(2).

Prihastono, E., & Prakoso, B. (2017). Perawatan preventif untuk mempertahankan utilitas performance pada mesin cooling tower di cv. arhu tapselindo bandung. *Dinamika Teknik Industri*.

Saez, M., Maturana, F. P., Barton, K., & Tilbury, D. M. (2018). Real-time manufacturing machine and system performance monitoring using internet of things. *IEEE Transactions on Automation Science and Engineering*, *15*(4), 1735-1748.

Website

Deloitte. (2022). The state of AI in business transformation. Deloitte Insights. https://www.deloitte.com/id/en.html

Gartner. (2023). AI-driven transformation: Opportunities and risks for enterprises. Gartner Research. www.gartner.com

PwC. (2022). Sizing the prize: The economic impact of AI on the world economy. PricewaterhouseCoopers. www.pwc.com

Sathyabama Institute Of Science And Technology. Manufacturing Technology. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SPR1301.pdf