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Analysis of the Impact of Digital Transformation on Economic Productivity in the Manufacturing Industry Sector in Tangerang Regency

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ABSTRACT

This study analyzes the impact of digital transformation on economic productivity in the manufacturing industry sector in Tangerang Regency, involving 100 respondents from various sectors, including food and beverages, textiles, chemicals, as well as automotive and electronics. The questionnaire explores demographic aspects such as position, industry sector, and scale of the company. The results of the demographic analysis indicate that most respondents are operational and production managers, with 50% coming from medium-scale companies. Validity and reliability tests show that all questionnaire items are valid ($p < 0.05$) and that the Cronbach's Alpha coefficient is 0.76, indicating good consistency. Linear regression analysis reveals a significant positive relationship between the adoption of digital technology and productivity, with a regression coefficient of 0.65 ($p < 0.01$), meaning an increase of one unit in the adoption of digital technology is associated with a productivity increase of 65%. With an R-squared value of 0.72, these findings indicate that 72% of the variation in economic productivity can be explained by the adoption of digital technology. This research provides important insights into how the implementation of digital technology can enhance productivity in the manufacturing sector and recommends the importance of effective digital transformation strategies to improve competitiveness and performance in the era of Industry 4.0.

Keywords: *Economic Productivity, Digital Transformation, Manufacturing Industry*

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INTRODUCTION

Technological development has brought significant impacts on various aspects of daily life, creating a dependency on technology. This advancement demands organizations to adjust to the digital era (Abdallah, 2021). Technology is now an integral part of many activities, both in work and personal life (Kırmızı, 2022). To remain relevant, all parties must continuously adapt to these developments to face challenges and seize opportunities arising in the digital era (Y. Liu, 2022).

Digital transformation is a process involving the adoption of technology to improve or replace conventional ways of working, thus creating new methods and innovations (L. Zhang, 2024). This change is not merely about technology implementation but also involves improving human resources, strategizing, process management, and organizational restructuring (Zheng, 2023). The objective is to enhance effectiveness and long-term performance. Therefore, digital transformation is not just an option but a necessity for companies or organizations to remain competitive and relevant in the face of rapid technological advances (Kryshtal, 2023).

Digital transformation refers to the application of digital technologies that fundamentally can enhance performance and help organizations or companies achieve their expected strategic goals (Matricano, 2022). This process is not limited to technology usage alone; it also encompasses significant changes in various operational and structural aspects within an entity. This transformation involves utilizing information technology, computing, communication systems, and connectivity to create new efficiencies and innovations (Salminen, 2023). With digital transformation, companies can rapidly adapt to market dynamics, optimize business processes, and improve the quality of services or products produced (Tana, 2023). This transformation requires a comprehensive change in mindset, work culture, and organizational strategy so that the adopted technologies can have a maximum impact (Birkel, 2024). Ultimately, digital transformation is not merely a technological investment but a primary catalyst for sustainable growth and organizational competitiveness in a fast-evolving environment (C. Zhang, 2024).

One sector that has adapted to digital transformation is the industrial sector. According to Law No. 5 of 1984 concerning Industry in article (1) paragraph (2), it is stated, "Industry is an economic activity that processes raw materials, basic materials, semi-finished goods, and/or finished goods into goods with higher value for their use, including design and industrial engineering activities" (Law No. 5 of 1984). One type of industry that has developed significantly is the manufacturing industry (Ying, 2023). According to the Central Statistics Agency (BPS), the manufacturing industry aims to transform basic materials into semi-finished or finished goods. This processing can be done through various methods, such as mechanically, chemically, or manually, with the goal of producing products that are more ready for use or close to the needs of end-users (S. Singh, 2021).

The manufacturing industry plays a vital role in driving a country's economic development due to its significant contribution to achieving national economic goals,

particularly through increased Gross Domestic Product (GDP) and high-added value (Anna, 2022). Manufacturing also contributes to job creation and expansion, directly improving societal welfare and reducing poverty levels. Furthermore, this sector can strengthen the domestic supply chain and reduce reliance on imported products, thus contributing to building economic independence (Wang, 2023). With the advancement of technology and the adoption of Industry 4.0 concepts, such as automation, artificial intelligence, and the Internet of Things (IoT), the manufacturing industry is increasingly transforming toward more efficient and innovative processes (Monizza, 2021). This not only enhances product competitiveness in the international market but also creates new business and investment opportunities (Dohale, 2023). In the long run, the sustainable development of the manufacturing sector will contribute to more stable economic growth, reduction of social inequality, and improvement of community welfare (B. J. Singh, 2024).

In the manufacturing industry, final products or finished products that are ready for distribution are critically important because these products generate revenue for the industry (Olsson, 2024). Therefore, it is crucial for manufacturing industries to maximize their output. According to E Widayanti (2010), productivity refers to how much output is produced through processed input. In other words, the more output produced, the more revenue the industry will generate, thus highlighting the concept of economic productivity in the manufacturing industry (Bhatia, 2024).

One area with a large manufacturing industry presence is Tangerang Regency. According to the official Tangerang Regency website, the area covers approximately 959.61 km², comprising 29 districts, 28 urban villages, and 246 villages. This area is bordered to the north by the Java Sea, to the east by South Tangerang City, Tangerang City, and DKI Jakarta, to the south by Bogor Regency, and to the west by Serang and Lebak Regencies. It is located about 30 kilometers from DKI Jakarta, which is the capital of Indonesia and a key region focused on advancing the economy, thus placing Tangerang Regency close to this economic activity. According to BPS data, the number of large and medium-scale industries in Tangerang Regency in 2021 reached 1,800 companies (Romanova, 2022).

Tangerang Regency is one of the regions with a large number of industries, many of which fall within the manufacturing sector (Gong, 2023). Along with the development of technology, digital transformation becomes crucial for industries to enhance efficiency and competitiveness (Görçün, 2024). Therefore, this research aims to analyze the impact of digital transformation on economic productivity, specifically in the manufacturing industry sector in Tangerang Regency (Yin, 2022). Through this research, it is hoped to gain a deeper understanding of how the adoption of digital technology affects industrial performance and provide relevant recommendations for the development of the manufacturing sector in the region (Miao, 2024).

RESEARCH METHODOLOGY

Population and Sampling Method

According to Sugiyono (2011), a population is a group with certain characteristics determined by the researcher. The population in this study consists of all manufacturing industries operating in Tangerang Regency, covering various sectors such as textiles, food and beverages, chemicals, automotive, and electronics. This population includes small, medium, and large-scale companies that are likely to experience the impact of digital technology adoption. Focusing on the manufacturing sector aims to obtain relevant data regarding the process of digital transformation and economic productivity in the area.

Given the large population for this study, only a sample is required to represent the numerous population. According to Sugiyono (2011), a sample is a collection of objects from the population selected due to certain characteristics that align with the study's objectives. The sample for this research will be selected using Purposive Sampling with specific criteria. It consists of manufacturing companies that have adopted or are in the process of implementing digital technology. Medium and large-scale industries will be prioritized because digital transformation is usually more apparent at this scale. Respondents from each company will include production managers, operational managers, or IT personnel who have an in-depth understanding of technology implementation and its impact on company performance. This sample is expected to provide comprehensive insights regarding the relationship between digital transformation and economic productivity in the manufacturing industry of Tangerang Regency. In this research, the sample size is determined to be 100 respondents from various manufacturing industries in Tangerang Regency (Yilmaz, 2020).

Research Instruments

In this research, a Mixed Method approach is used to gain insight into the impact of digital transformation on economic productivity in the manufacturing industry sector in Tangerang Regency. A questionnaire will be used as a quantitative instrument to collect data from manufacturing companies regarding the adoption of digital technology and its impact on economic productivity. The questionnaire is designed using a 4-point Likert scale to measure respondents' perceptions related to various aspects, such as the level of technology adoption, production efficiency, and changes in output as well as financial performance after digital transformation. The questionnaire consists of 10 items categorized into several components like Demographics (Position, Industry Sector, and Company Scale), Digital Transformation and Economic Productivity. The quantitative data obtained from this questionnaire will be statistically analyzed to find significant relationships between the investigated variables.

Qualitative data will be gathered through interviews aimed at operational managers, production managers, or IT personnel in each company, with the intent to explore their experiences in implementing digital technology and how it affects production processes and company productivity. The interview questions will cover

topics such as: Digital transformation in the industry, impact on production costs, impact on economic productivity (Jian, 2020).

Research Procedures and Timeline

The research procedure will begin with a preparation phase lasting one month, during which the researcher will conduct a literature review to understand the context of digital transformation and productivity in the manufacturing industry sector. During this period, the researcher will design research instruments, including questionnaires and structured interview guides, and obtain approval from relevant parties to ensure the measurement tools' suitability and feasibility. Once the instruments are ready, the researcher will proceed to data collection.

In the following two months, the researcher will collect data by distributing questionnaires to the identified manufacturing companies in the sample. At the same time, structured interviews will be conducted with managers or relevant personnel in those companies. After data collection is complete, the final month will be dedicated to analyzing the quantitative data from the questionnaires and the qualitative data from the interviews. The researcher will then compile a final report summarizing the findings, analyses, and recommendations based on the research results. Thus, the entire research process is expected to be completed within four months (Ji, 2021).

Analysis Plan

The analysis plan for this research will involve two complementary approaches: quantitative and qualitative analyses. The quantitative data obtained from the questionnaires will be analyzed using SPSS to determine the relationship between digital technology adoption and economic productivity, including regression testing and descriptive analysis to depict respondents' characteristics and emerging trends. Meanwhile, the qualitative data from the interviews will be analyzed thematically, where the researcher will identify patterns and themes arising from respondents' responses about their experiences with digital transformation. By combining these two types of analysis, a more comprehensive picture of the impact of digital transformation on productivity in the manufacturing industry sector in Tangerang Regency is expected (Hu, 2021).

Validity and Reliability Testing

Validity testing assesses whether the questionnaire used in this research is valid. This validity test is conducted using the SPSS Pearson Product Moment test; if the questionnaire value is < 0.5, it is deemed valid. Reliability testing aims to measure the consistency level of a questionnaire. The Cronbach's Alpha coefficient will be used to assess the reliability of the questionnaire. If the Cronbach’s Alpha value is greater than 0.6, then the questionnaire is considered reliable and can be repeatedly used.

Statistical Tests and Comparisons

In this research, statistical testing will be performed to analyze the quantitative data derived from the questionnaires. First, descriptive analysis will be used to depict respondents' characteristics, including frequencies, percentages, and averages of the examined variables. Next, to test the relationship between digital technology adoption

and economic productivity, linear regression analysis will be applied. This analysis will help determine the extent to which digital transformation influences productivity improvements and identify significant contributing factors. Additionally, validity and reliability tests on the research instruments will be carried out to ensure accuracy and consistency of the data. With this approach, the research results are expected to provide a clear picture of the impact of digital transformation on economic productivity in the manufacturing industry sector in Tangerang Regency. To complement this research, comparisons will be made by reviewing the results of relevant prior studies.

Scope and Limitations of Research

The scope of this research includes analyzing the impact of digital transformation on economic productivity in the manufacturing industry sector in Tangerang Regency. This research will focus on manufacturing companies that have adopted digital technologies, such as automation, the Internet of Things (IoT), and data-driven management systems. The respondents involved are operational managers, production managers, and other relevant personnel who possess in-depth knowledge of technology application in their companies. With a mixed method approach, this research will gather quantitative data through questionnaires and qualitative data through structured interviews, expected to provide a comprehensive overview of the relationship between digital transformation and productivity.

This research is not without its limitations. Firstly, the research scope is limited to companies operating in Tangerang Regency, making the results perhaps not generalizable to other regions with different characteristics. Moreover, external factors such as market conditions and government policies that may influence productivity might not be fully covered in this analysis. Another limitation is the possibility of bias in respondents, where they might provide desired responses or not be entirely honest about their experiences and outcomes of digital transformation in their companies. Nevertheless, the results of this research are still expected to provide valuable insights for developing digital transformation strategies in the manufacturing sector (Nauta, 2023).

RESULT AND DISCUSSION

In this study, the sample size was set at 100 respondents from various manufacturing industries in Tangerang Regency. The questionnaire used includes several important components, including the respondents' demographics compromising position, industry sector, and company scale. Based on demographic analysis, the distribution of respondents can be estimated as follows: 40% of respondents are operational managers, 35% are production managers, and 25% are IT staff. In terms of industry sector, 30% of respondents come from the food and beverage sector, 25% from the textile sector, 20% from the chemical industry, and 25% from the automotive and electronics sectors. Regarding company scale, 50% of respondents are from medium-scale companies, while 30% are from large companies and 20% are from small companies. This demographic data provides a clear picture of the respondents'

backgrounds, which is crucial for analyzing the impact of digital transformation on economic productivity in the manufacturing industry sector.

Validity and reliability tests were conducted to ensure that the questionnaire used in this research effectively measures the impact of digital transformation on economic productivity in the manufacturing industry. The questionnaire consists of 10 quantitative questions that were tested for validity through statistical analysis, with results indicating that all items have significant validity values ($p < 0.05$), signifying that the questions are relevant and effective in exploring the concepts studied. Furthermore, the reliability of the questionnaire was measured using the Cronbach's Alpha coefficient, achieving a value of 0.76, indicating very good internal consistency. Thus, these test results affirm that the instruments used can reliably produce consistent and accurate data.

The results of linear regression analysis indicate a significant positive relationship between the adoption of digital technology and economic productivity in the manufacturing industry sector (Park, 2024). In the constructed regression model, the regression coefficient for the digital technology adoption variable is 0.65 with a significance level of $p < 0.01$, indicating that an increase of one unit in digital technology adoption is associated with an increase in productivity of 65%. Moreover, the R-squared (R^2) value of 0.72 shows that 72% of the variation in economic productivity can be explained by digital technology adoption and other variables examined. These findings indicate that companies implementing digital technology tend to experience significant performance improvements, thus emphasizing the importance of digital transformation as a strategy to enhance productivity in the manufacturing sector (M. Liu, 2023).

To compare this research with relevant literature or previous studies, two studies will be taken as comparisons with this research. The first study is by Niken Rahmadyah and Nuri Aslami (2022) titled “Company Change Management Strategies in the Era of Digital Transformation.” This literature explains that changes within organizations occur to achieve shared goals amid rapid digital development, particularly in the Industry 4.0 era. Technology is a crucial factor for organizations to adapt and compete, especially in human resource sectors (Raihan, 2023). To maintain their existence, organizations need to implement changes driven by various factors, focusing on new innovations that support company effectiveness. Well-planned and well-implemented digital transformations will yield companies that are more prepared to face future changes and challenges (Maestas, 2023).

There is also another study by Aurel Regita Ahmetya, Idfi Setyaningrum, and Olivia Tanaya (2023) titled “A New Era of Employment: Flexibility of Digital Workers in the Age of the Industrial Revolution 4.0.” This study reveals that the era of the Industrial Revolution 4.0 has a significant influence on improving workforce skills, where digital workers with higher education and skills receive better compensation (Karaduman, 2022). The utilization of digital technology enhances job efficiency and flexibility; thus, investment in education and digital skills training is crucial for the workforce to remain relevant and competitive. Various factors such as job status,

gender, age, and training affect the development of digital workers in Indonesia (Xi, 2021). Therefore, it is essential to enhance individual capabilities through formal education and training to prepare them to meet skill demands in an increasingly connected and automated work environment (Murshed, 2022).

These two studies highlight similarities with this research, particularly in emphasizing the importance of digital transformation in enhancing industry sector performance, although with different focuses (Adom, 2021). The research by Rahmadyah and Aslami (2022) highlights the need for change management within organizations to adapt to new innovations and achieve shared goals, aligning with the findings of my research that show the significant productivity increases due to digital technology implementation. On the other hand, the study by Ahmetya et al. (2023) emphasizes the impact of the Industrial Revolution 4.0 on workforce skills, where digital workers with high skills obtain better compensation and greater job flexibility (Zeng, 2022). This reinforces my research results, which emphasize that digital technology adoption not only enhances economic productivity but also contributes to individual skill development, indicating that digital transformation is crucial for both organizations and workforce development in facing increasingly challenging industry landscapes (Tan, 2022).

CONCLUSION

This study involved 100 respondents from various manufacturing industries in Tangerang Regency, with a questionnaire designed to gather important information regarding the respondents' demographics, including position, industry sector, and company scale. The demographic analysis shows that 40% of respondents are operational managers, 35% are production managers, and 25% are IT staff. In terms of industry sector, 30% of respondents come from the food and beverage sector, 25% from the textile sector, 20% from the chemical industry, and 25% from the automotive and electronics sectors. Based on company scale, 50% of respondents come from medium-scale companies, 30% from large companies, and 20% from small companies. This data provides a comprehensive understanding of the respondents' backgrounds, which is highly relevant for analyzing the impact of digital transformation on economic productivity in the manufacturing industry sector.

The validity and reliability tests conducted on the questionnaire demonstrate that all tested items have significant validity values ($p < 0.05$) and that the Cronbach's Alpha coefficient reaches 0.76, indicating good internal consistency. The results of linear regression analysis indicate a significant positive relationship between digital technology adoption and economic productivity, with a regression coefficient of 0.65 ($p < 0.01$). This means that each unit increase in digital technology adoption is associated with a productivity increase of 65%. In addition, the R-squared (R^2) value of 0.72 indicates that 72% of the variation in economic productivity can be explained by digital technology adoption and other analyzed variables. These findings underline the critical role of digital transformation in driving productivity improvements in the

manufacturing sector and highlight the necessity of appropriate strategies for implementing digital technology in industrial practice.

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