LOREM Computational Engineering and Computer Informations System

Volume 2 Nomor 3 Tahun 2025
p-ISSN: 3032-3894
e-ISSN: 3032-3924

Leveraging Digital Transformation for Sustainable Manufacturing Production

Nur Andita Prastyo[1], Agung Muliawan[2], Iqbal Sabilirrasyad[3]

Universitas Jember, Indonesia [1]
Politeknik Negeri Jember[2]
Insitut Teknologi dan Sains Mandala[3]

ABSTRACT

Digital transformation in the manufacturing industry has significantly enhanced efficiency, productivity, and sustainability. This article synthesizes findings from 18 scholarly journals on the application of digital technologies, including management information systems, process automation, and quality digitalization. The implementation of the Software Development Life Cycle (SDLC) in designing a material fulfillment system for minibus production has been shown to reduce delays and improve coordination. Technologies such as the Internet of Things (IoT) and robotics accelerate production, increase capacity, and lower workplace accident rates. Android-based occupational health and safety (OHS) systems have improved workers' awareness and compliance with safety protocols. The adoption of renewable energy sources, such as solar and wind power, reduces conventional energy use and carbon emissions, supporting environmentally sustainable manufacturing. However, challenges remain, including limited technological infrastructure, poor system integration, and low digital literacy among workers. Successful digital transformation requires not only technical readiness but also organizational preparedness, targeted human resource training, and sustained managerial support. A collaborative, gradual approach—aligned with each unit's readiness—ensures effective technology integration without disrupting productivity. Regular evaluations of digital systems are essential to verify measurable positive impacts. Ultimately, digital transformation in manufacturing is not merely a technical upgrade but a strategic shift toward cultural change and data-driven decision-making.

Keywords: *Manufacturing, Digitalization, Information Systems, Automation, Appropriate Technology*

Corresponding Author:
Nur Andita P
nurandita@unej.ac.id

Received: Oktober 2025
Revised: November 2025
Accepted: November 2025
Published: November 2025

1. INTRODUCTION

In the era of digital transformation, the manufacturing sector faces significant challenges in adapting to the rapid pace of technological change. Digital technology has become a key element in enhancing the efficiency, productivity, and sustainability of production processes. The integration of technologies such as management information systems, industrial automation, the Internet of Things (IoT), and quality management digitalization has been shown to have a substantial impact on improving operational

performance in many manufacturing companies worldwide [2], [8], [11]. These technologies not only enhance production effectiveness but also enable companies to respond to increasingly dynamic market conditions [1], [3].

However, despite the considerable potential of digital technologies to improve efficiency, their implementation is not without challenges. Key obstacles faced by many companies include uneven access to digital infrastructure, a shortage of skilled human resources capable of managing such technologies, and insufficient strategic planning for adopting new systems [17], [15]. Furthermore, not all organizations possess the same level of readiness to embrace these changes, both in terms of work culture and information technology governance [10], [14]. Therefore, these challenges must be identified and managed effectively to ensure that the digital transformation process can be successfully implemented and deliver optimal results.

This study aims to identify the key factors influencing the successful adoption of digital technologies in the manufacturing sector, as well as to provide insights into the challenges that may arise during implementation [5], [7]. In addition, it explores how companies can mitigate risks associated with digital technology adoption and ensure that such technologies are leveraged to enhance operational efficiency [6], [9].

The research focuses on the application of digital technologies in manufacturing, particularly in the context of management information systems, IoT, and quality management digitalization. These three aspects are considered the main pillars of digital transformation in many modern manufacturing companies [8], [11], [4]. Other sectors or technologies outside the scope of this topic are excluded from the discussion.

The findings of this study are expected to provide practical references for industry practitioners, academics, and policymakers in formulating more effective and efficient digitalization strategies [17], [10]. Furthermore, the study aims to offer insights into how companies can design and implement policies that support digital transformation to improve operational efficiency and sustainability [2], [14]. The results may also serve as a basis for developing solutions to address the challenges faced by the manufacturing sector in adopting appropriate digital technologies [1], [5].

This research has a clear scope, focusing solely on the manufacturing sector and on digital technologies directly related to management information systems, IoT, and quality management digitalization. Broader sectors or unrelated technologies are excluded to allow for a more in-depth and focused analysis of relevant digital technology applications in manufacturing [8], [4].

2. METHODS

This study employed a Systematic Literature Review (SLR) method with a qualitative descriptive approach to evaluate and synthesize previous research relevant to digital transformation in the manufacturing sector. This method was selected because it enables the development of a systematic, structured, and data-driven understanding of the research topic [10], [17].

The implementation of this method consisted of three stages:

1. **Literature Search :** Literature was collected from reputable sources, including Google Scholar, Neliti, and official journal websites with a Digital Object Identifier (DOI). The search keywords included: “digital transformation in the manufacturing industry”, “management information systems”, “Internet of Things (IoT)”, and “production quality digitalization”. The publication period was limited to 2021–2025 to ensure relevance to current conditions [1], [8].
2. **Literature Selection :** The collected articles were screened based on inclusion criteria, such as a focus on the manufacturing sector, relevance to the application of digital technologies, and availability of full-text access. Articles that did not meet these criteria were excluded from further analysis [7], [3].

3. **Data Analysis and Synthesis :** A total of 18 articles that met the criteria were thematically analyzed. The analysis included identifying the types of digital technologies used (e.g., management information systems, IoT, quality digitalization), implementation strategies [11], [17], their impact on production efficiency [2], [5], and the challenges encountered [14], [15]. The synthesis results were compiled narratively to provide a comprehensive overview of trends and best practices in implementing digital transformation in the manufacturing sector [4], [14].

Table 1. Synthesis of the 18 journals reviewed in this study

No.	Journal Title	Main Approach Used	Key Findings
1	Implementation of SDLC for Designing a Material Fulfillment System	SDLC Method	Improved production efficiency and workflow
2	Performance Analysis of Sustainable Manufacturing Systems	Integration of Renewable Energy	Increased energy efficiency, reduced operational costs and emissions
3	Appropriate Technology Innovation in Optimizing Production Systems	IoT and Robotics	Increased production, reduced working time, improved workplace safety
4	Application of Automatic Particle Counter for Hydraulic Oil Condition Monitoring	APC & Microcontroller	More accurate and preventive particle detection
5	Glass Bottle Physical Quantity Inspection System Based on Image Processing	YOLOv4 (Machine Vision)	Highly accurate detection and counting of glass bottles
6	Break-Even Point Calculation in a Wood Manufacturing Company	BEP Analysis	Unit and monetary break-even points calculated as production benchmarks
7	Stability Analysis of the Manufacturing Process for Car Body Parts	Statistical Process Control (SPC)	Welding process requires improvement for production stability
8	Conceptual Design of Quality Management Digitalization in the FMCG Industry	Literature Review and Digitalization Concept	Thematic categorization in digital quality management based on publications
9	Bankruptcy Prediction Application Using Altman Z-Score	Altman Z-Score + Web Application (R Shiny)	75% accuracy in predicting bankruptcy potential
10	Decision Support System Analysis for Supply Chain Management	Multi-Agent System & Web-Based Services	Faster supply chain collaboration and communication
11	Software Requirements Specification for Manufacturing Information Systems	ISO/IEC/IEEE 29148:2018 Standard	Development of information system modules based on company requirements
12	Application of Lean Concepts in Warehouse Operations	Value Stream Mapping (VSM) – Lean Manufacturing	Reduced lead time and improved warehouse efficiency
13	Occupational Health and Safety (OHS) Learning Application Using Android	Android-Based OHS Education Application	Increased worker understanding and awareness of safety protocols
14	The Impact of Automation Trends in Manufacturing	Industrial Automation Literature Review	Automation accelerates processes and equipment control in manufacturing
15	Asset Management Information System for the Bangka Belitung State Manufacturing Polytechnic	Asset Management System + QR Code	Faster and more efficient asset information access
16	Design of an Employee Attendance Information System	Desktop-Based Attendance System	Simplified attendance recording and reporting
17	Strategic IS/IT Planning Using the Ward and Peppard Method	Ward & Peppard Strategic Analysis	More targeted IS/IT planning aligned with business objectives
18	Application of the Waterfall Method in the Manufacturing Information System of Fitria Konveksi	Waterfall Model + Field Observation	Reduced losses, improved monitoring of raw material and production data

3. RESULTS AND DISCUSSION (Book Antiqua, 11pt, Bold)

Digital transformation in the manufacturing industry is the process of adapting digital technologies to enhance efficiency, productivity, and corporate competitiveness [2], [8]. This process not only impacts organizational systems and structures but also demands changes in individual competencies and roles within the organization [17], [14]. Various studies indicate that digital transformation offers significant benefits, including process automation, improved product quality, operational efficiency, and data-driven decision-making [3], [5], [4].

Nevertheless, this transformation also presents challenges, particularly in terms of human resource readiness and the integration of complex technological systems [15], [14]. Individuals within organizations must be equipped with new capabilities, such as operating information systems [11], utilizing big data [10], and understanding software development models such as waterfall and prototype [1]. At the organizational level, strategic planning and comprehensive, continuous technology implementation are required to ensure the success of digital transformation [17], [18].

Table 2. Analysis of Digital Transformation Literacy and Implementation, 2021–2025

Ref.	Organizational Transformation	Individual Transformation	Field of Application
[1]	Design of a material fulfillment system based on SDLC, implementation of material kitting, and digitalization of component fulfillment workflows	Improved staff understanding in implementing new SOPs and operating the system	Manufacturing Industry, Logistics Systems
[2]	Integration of renewable energy technologies (solar and wind) for energy efficiency and carbon emission reduction	Awareness and adaptation of individuals to renewable energy technologies in operations	Renewable Energy, Environment
[3]	Implementation of appropriate technology: automation, digitalization, and big data for production process efficiency	Enhanced worker skills and adaptation to the use of new technologies	Production Technology, Data Management
[4]	Implementation of an automatic hydraulic oil monitoring system using Automatic Particle Counter (APC) sensors and microcontrollers	Reduced reliance on manual monitoring and increased user awareness	Automation Technology, Equipment Maintenance
[5]	Application of machine vision for automated inspection in packaging processes using the YOLOv4 algorithm	Development of individual skills in using image-based automated monitoring systems	Imaging Technology, Monitoring Systems
[6]	Break-Even Point (BEP) calculation to determine the return-on-investment threshold in a wood manufacturing company	Improved individual understanding of cost management and BEP calculation	Finance, Business Management
[7]	Use of Statistical Process Control (SPC) to improve manufacturing process stability and reduce production defects	Enhanced technical skills in machine and die maintenance during production	Process Technology, Manufacturing
[8]	Conceptual design of integrated quality management digitalization for industries and organizations	Improved individual understanding of digital quality management and decision-making	Quality Management, Systems Management
[9]	Development of a bankruptcy prediction application using the Altman Z-score for manufacturing companies	Improved individual understanding of using bankruptcy prediction applications	Finance, Manufacturing

[10]	Development of a big data–based demand prediction system to optimize the supply chain	Enhanced individual capability in using big data technology for demand analysis	Manufacturing, Information Technology
[11]	Software requirements analysis for a management information system in a manufacturing company (CV Mandiri Service Engineering)	Improved individual understanding of using integrated information systems to support business	Information Systems, Manufacturing
[12]	Application of lean techniques in warehouse operations to reduce waste and improve delivery efficiency	Improved individual understanding of identifying and reducing waste in warehouse operations	Manufacturing, Logistics
[13]	Implementation of an Android-based occupational health and safety (OHS) system to increase worker awareness and protection	Workers' understanding of using Android-based OHS applications to comply with safety regulations	Occupational Health and Safety, Information Technology
[14]	Impact of automation in manufacturing to improve quality, efficiency, and effectiveness	Improved individual understanding of using automation technology for production process efficiency	Industrial Automation, Manufacturing Technology
[15]	Design of a prototype-based asset management information system with QR Code integration to accelerate asset management	Improved individual understanding of using QR Code–based information systems for efficiency	Information Systems, Manufacturing
[16]	Design of an employee attendance information system for a manufacturing company using Java Spring Framework and MySQL	Improved individual understanding of using automated attendance systems for efficient attendance data management	Manufacturing, Information Systems
[17]	Strategic IS/IT planning at PT. ABC to support corporate objectives using the Ward and Peppard method	Improved individual understanding of effective IS/IT implementation aligned with business goals and processes	Manufacturing, Information Systems, Information Technology
[18]	Management of manufacturing bookkeeping, including product stock, raw material stock, production, and orders integrated with an information system	Improved individual understanding of using systems for efficient management of products, raw materials, and orders	Manufacturing, Information Systems

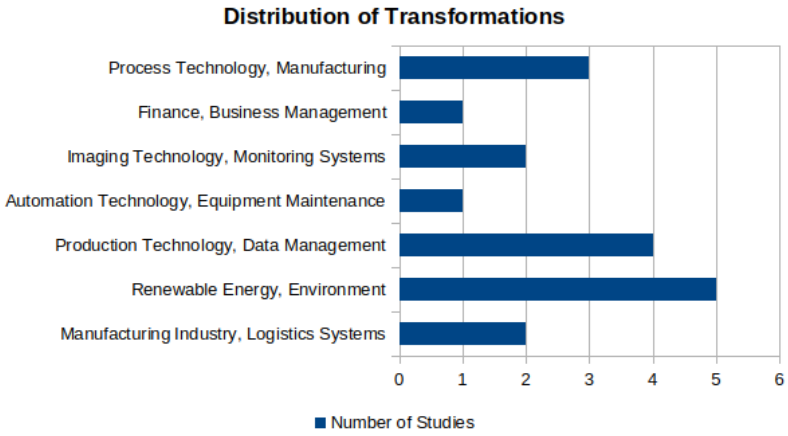

Image 1. Plot Most Frequent Transformations

Based on the review of 18 journals, the application of digital transformation in the manufacturing industry can be categorized into several major groups that reflect the direction and focus of digitalization in business processes. The most dominant group is the development and understanding of the System Development Life Cycle (SDLC), which discusses systematic approaches to software development, including the waterfall and prototype models used as the foundation for production information systems [1].

In addition, the group focusing on production digitalization and automation is among the most frequently discussed, as it involves sensor technologies, machine vision, and big data, which have been proven to enhance process efficiency, reduce manual errors, and support data-driven decision-making [3], [4], [5], [10], [14].

Another group, such as information system management and IT strategy, highlights the importance of technology integration in asset management, system planning, and manufacturing bookkeeping efficiency [11], [15], [16], [17], [18]. Improvements in production efficiency and workforce skills are also widely examined through approaches such as lean manufacturing, statistical process control (SPC), and quality digitalization [7], [8], [12].

Meanwhile, sustainability innovation appears in studies addressing the use of renewable energy sources, such as solar and wind power, in manufacturing processes [2]. The financial aspect is also a point of focus, with the use of break-even point (BEP) indicators and the Altman Z-score method in evaluating financial health [6], [9].

Furthermore, occupational safety is discussed through Android-based systems designed to facilitate reporting and increase OHS awareness [13]. Overall, this classification shows that digital transformation is not only related to technology but also encompasses organizational aspects such as policy and operations, as well as individual aspects such as behavior and readiness for digital innovation [1]–[13].

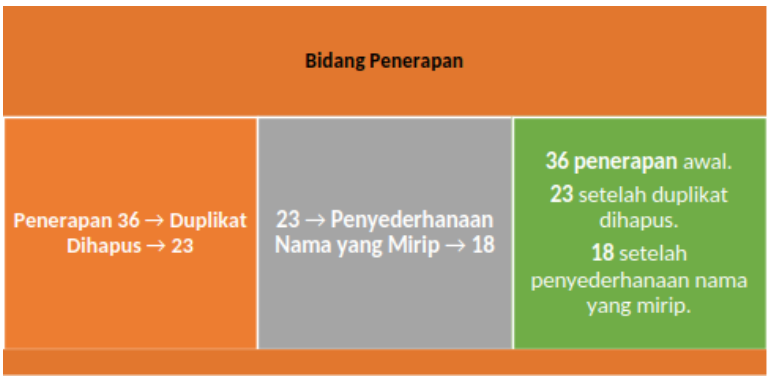

Image 2. Implementation Stages

From the analysis of application fields in the 18 reviewed journals, a total of 37 initial implementation terms were identified, which appeared in raw and varied forms. However, after a normalization and grouping process was conducted to merge terms with similar meanings, the number was streamlined to 18 unique application fields.

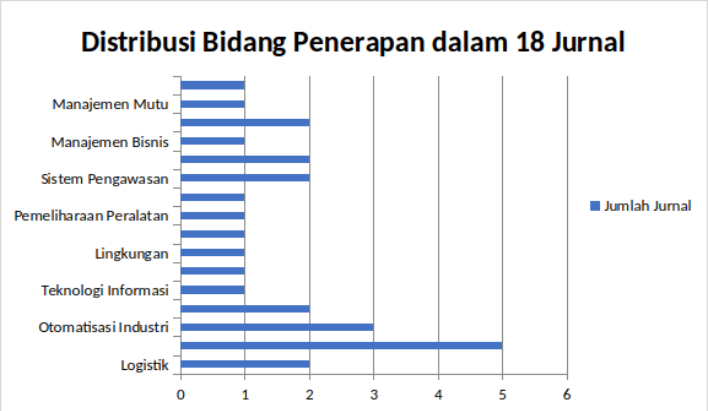

Image 2. Implementation Distributions

Several groupings were made based on contextual similarities, such as the terms Manufacturing Industry, Manufacturing, and Manufacturing Technology, all of which were classified under the Manufacturing category. Similarly, the terms Industrial Automation and Automation Technology were merged into Industrial Automation, while Information Systems and Systems Management were grouped under Information Systems.

From the table, it can be observed that digitalization approaches have been applied in various ways, ranging from system design and efficiency measurement to the development of prediction-based applications. These diverse approaches indicate a positive trend in improving the operational quality of the manufacturing industry in Indonesia.

4. CONCLUSION

Digital transformation has a significant impact on enhancing efficiency, productivity, and sustainability in manufacturing processes. Based on the analysis of 18 journals, digital technologies have been implemented at both organizational and individual levels. This transformation forms part of companies' adaptive strategies in responding to an increasingly competitive and dynamic industrial landscape, while also demanding speed in data-driven decision-making.

The most frequently applied technologies include management information systems, software development methods such as the System Development Life Cycle (SDLC), the utilization of the Internet of Things (IoT), production line automation, and the integration of renewable energy into industrial processes. These innovations span 18 application areas, ranging from material and attendance management, quality management, and demand prediction to occupational safety systems. The implementation of these technologies has demonstrated improvements in efficiency, process transparency, and manufacturing competitiveness.

Nevertheless, digital transformation still faces challenges, such as uneven infrastructure, low technological literacy among the workforce, and suboptimal integration of information systems across units. These challenges indicate that the success of digitalization must be accompanied by strong internal readiness, particularly in human resources and change management.

Therefore, collaboration between organizations, individuals, and technology providers is essential. Continuous training, consistent policy support, and the strengthening

of the digital ecosystem are required to ensure that digital transformation can be implemented optimally and deliver long-term benefits for the manufacturing industry.

REFERENCES

[1] J. N. C. Gunawan, Y. Hadi, and N. K. Putrianto, "Penerapan System Development Life Cycle untuk Perancangan Sistem Pemenuhan Material pada Proses Produksi Minibus (Studi Kasus pada Departemen Perlengkapan Karoseri PT X)," Jurnal Tekstil: Jurnal Keilmuan dan Aplikasi Bidang Tekstil dan Manajemen Industri, vol. 7, no. 1, pp. 69–80, Jun. 2024, doi: https://doi.org/10.59432/jute.v7i1.96.

[2] A. Saputra, "Analisis Kinerja Sistem Manufaktur Berkelanjutan: Integrasi Teknologi Energi Terbarukan Dalam Proses Produksi," Jurnal Teknik dan Teknologi Tepat Guna, vol. 3, no. 1, pp. 13–18, Feb. 2024, doi: https://doi.org/10.62357/j-t3g.v3i1.393.

[3] B. Rinaldi and I. Ikhwan, "Inovasi Teknologi Tepat Guna Dalam Optimalisasi Sistem Manufaktur Dan Proses Produksi," Jurnal Teknik dan Teknologi Tepat Guna, vol. 1, no. 3, pp. 106–113, Oct. 2022, doi: https://doi.org/10.62357/j-t3g.v1i3.391.

[4] Y. Erdani and R. A. Gumadi, "Implementation of Automatic Particle Counter for Hydraulic Oil Condition Monitoring", JOKI, vol. 16, no. 2, pp. 95-103, Sep. 2024. doi: https://doi.org/10.5614/joki

[5] S. B. Bhaskoro, H. Supriyanto, and S. Falah, "Sistem Identifikasi Jumlah Produk Berbasis Pengolahan Citra dengan Algoritma YOLO pada Proses Pengepakan Industri Manufaktur," JTRM (Jurnal Teknologi dan Rekayasa Manufaktur), vol. 6, no. 1, pp. 13–28, Jun. 2024, doi: https://doi.org/10.48182/jtrm.v6i1.114.

[6] P. Mutiara, "PERHITUNGAN BREAK EVEN POINT PADA PERUSAHAAN MANUFAKTUR KAYU", jsti, vol. 20, no. 02, pp. 161–165, Jan. 2024. doi: https://doi.org/10.59637/jsti.v20i02.368

[7] Muhammad Miftahul Abid, "Analisis Kestabilan Proses Manufaktur Part Body Mobil," G-Tech, vol. 7, no. 2, pp. 464–473, Mar. 2023, doi: https://doi.org/10.33379/gtech.v7i2.2034.

[8] Septian Sugestyo Putro and S. Santoso, "DESAIN KONSEPTUAL DIGITALISASI MANAJEMEN MUTU PADA INDUSTRI FMCG," MIX JURNAL ILMIAH MANAJEMEN, vol. 11, no. 2, pp. 147–162, Oct. 2021, doi: https://doi.org/10.22441/mix.2021.v11i2.001.

[9] Nur Jihan Salsabiila, Ayu Rizky Nurlaili, H. D. Septianti, A. T. Okweningtyas, and Dwi Oktavianto Wahyu Nugroho, "Aplikasi Prediksi Kebangkrutan Menggunakan Metode Altman Z-Score pada Perusahaan Manufaktur Sektor Barang Konsumsi," Jurnal Sains dan Seni ITS, vol. 11, no. 1, pp. D1–D7, Feb. 2022, doi: https://doi.org/10.12962/j23373520.v11i1.62541.

[10] A. A. Setiyawan, N. R. Hidayat, and N. Syamsi, "Analisa Sistem Pendukung Keputusan untuk Manajemen Operasi Rantai Pasokan," ADI Bisnis Digital Interdisiplin Jurnal, vol. 2, no. 2, pp. 7–12, Sep. 2021, doi: https://doi.org/10.34306/abdi.v2i2.488.

[11] M. W. Rezkita and Y. Kurniawan, "SOFTWARE REQUIREMENTS SPECIFICATION SISTEM INFORMASI MANAJEMEN PERUSAHAAN MANUFAKTUR DENGAN STANDARD ISO/IEC/IEEE 29148:2018," Kurawal - Jurnal Teknologi, Informasi dan Industri, vol. 5, no. 1, pp. 1–15, Mar. 2022, doi: https://doi.org/10.33479/kurawal.v5i1.547.

[12] M. S. N. Afif and S. Sudarto, "Penerapan Konsep Lean untuk Meningkatkan Operasi Warehouse di Industri Manufaktur," Operations Excellence: Journal of Applied Industrial Engineering, vol. 14, no. 1, p. 57, May 2022, doi: https://doi.org/10.22441/oe.2022.v14.i1.043.

[13] Febriand Yesaya, Dhian Nur Rahayu, and Asep Samsul Bakhri, "Aplikasi Pembelajaran Keselamatan dan Kesehatan Kerja (K3) Menggunakan Metode Berbasis Android Pada

PT.Yangtze Optics Indonesia," Dirgamaya: Jurnal Manajemen dan Sistem Informasi, vol. 2, no. 1, pp. 40–51, 2022, doi: https://doi.org/10.35969/dirgamaya.v2i1.244.
[14] Ibnu Khoirul Anaam, T. Hidayat, Ridwan Yuga Pranata, Hamid Abdillah, and W. Putra, "Pengaruh trend otomasi dalam dunia manufaktur dan industri," Vocational Education National Seminar (VENS), vol. 1, no. 1, 2022, Accessed: Dec. 26, 2022, url: https://jurnal.untirta.ac.id/index.php/VENS/article/view/15784
[15] Riki Afriansyah, "Sistem Informasi Manajemen Aset Politeknik Manufaktur Negeri Bangka Belitung," TeIKa Jurnal Teknologi Informasi dan Komunikasi, vol. 12, no. 02, pp. 135–146, Oct. 2022, doi: https://doi.org/10.36342/teika.v12i02.2918.
[16] N. Purwandari, "PERANCANGAN SISTEM INFORMASI ABSENSI PEGAWAI PADA PERUSAHAAN MANUFAKTUR PRE-SERVER BERBASIS DESKTOP," Jurnal Sistem Informasi Bisnis (JUNSIBI), vol. 2, no. 1, pp. 1–10, Apr. 2021, doi: https://doi.org/10.55122/junsibi.v2i1.208.
[17] A. Firdaus, I. W. Chrisstyadi, V. A. Oktaviyanti, S. D. Lastiyono, H. M. Fikriyaddien, and A. Pakarbudi, "Perencanaan Strategi Sistem Informasi dan Teknologi Informasi Pada Perusahaan Manufaktur Menggunakan metode Ward dan Peppard (Studi Kasus : PT. ABC)," Prosiding Seminar Nasional Teknik Elektro, Sistem Informasi, dan Teknik Informatika (SNESTIK), vol. 1, no. 1, pp. 241–248, Jun. 2021, doi: https://doi.org/10.31284/p.snestik.2021.1815.
[18] Awang Andhyka, Rizky Aditya Nugroho, and I. Nur, "Penerepan Metode Waterfall Dalam Sistem Informasi Manufaktur Pada Usaha Fitria Konveksi," Prosiding Seminar Nasional Sains dan Teknologi Terapan, vol. 0, no. 0, 2022, Accessed: May 03, 2025, url: https://ejournal.itats.ac.id/sntekpan/article/view/3650