International Journal of Cyber and IT Service Management (IJCITSM)
Vol. 4, No. 2, October 2024, pp. 133−142
E-ISSN: 2808-554X | P-ISSN: 2655-8807, DOI:10.34306

The Importance Increasing Attendance Efficiency Accuracy with Presence System in Era Industrial Revolution 4.0

Tri Hartono[1], Bintang Nandana Henry[2], Sirje Nurm[3*], Lukita Pasha[4], Dwi Julianingsih[5]
[1]Department of Accounting, Bank Negara Indonesia, Indonesia
[2]Department of Informatics Engineering, Kreatif Desain, Indonesia
[3]Department of System Information, Ilearning Incorporation, Estonia
[4]Department of Digital Business, CAI Sejahtera Indonesia, Indonesia
[5]Department of Retail Management, University of Raharja, Indonesia
[1]tri.hartono@raharja.info, [2]bintang.nandana@raharja.info, [3]sir.num@ilearning.ee, [4]lukita@raharja.info, [5]dwi.julianingsih@raharja.info
***Corresponding Author**

Article Info

Article history:

Submission August 2, 2024
Revised August 23, 2024
Accepted September 30, 2024
Published October 16, 2024

Keywords:

Industrial Revolution 4.0
IoT
Big Data
Employee
Attendance Efficiency

ABSTRACT

Employee attendance management systems have become a major focus of the Industrial Revolution 4.0 era due to their significant role in increasing organizational productivity and performance. **This study** demonstrates the importance of the SmartPLS methodology in analyzing the impact of IoT based attendance technology and big data analytics on the efficiency and accuracy of employee attendance. Both the assessments reviewed show that the use of IoT based attendance technology and the implementation of big data analytics systems have a significant positive impact on the efficiency and accuracy of employee attendance. IoT based attendance technology enables real-time attendance data collection with high accuracy, while big data analytics enables organizations to derive valuable insights from the large volume of collected attendance data. **These findings** provide a better understanding of the contribution of technology in increasing organizational productivity and performance in today digital age. This study provides valuable insights for business professionals and academics to develop adaptive and effective attendance management strategies. **Using IoT** based attendance technology and big data analytics, organizations can improve operational efficiency, increase payroll accuracy, and optimize overall human resource utilization. Furthermore, the study also highlights the importance of adapting and innovating in the face of technological developments. **By incorporating** knowledge of the latest technology and industry trends, organizations can continuously enhance their attendance management strategies to remain relevant and competitive in the ever changing business environment.

DOI: https://doi.org/10.34306/ijcitsm.v4i2.168

1. INTRODUCTION

In the era of Industrial Revolution 4.0, technological transformation has fundamentally changed the business landscape, introducing concepts such as the Internet of Things (IoT), Big Data, and Artificial Intelligence (AI) [1]. An important area in this context is employee attendance management at the workplace. The efficiency and accuracy of employee attendance are crucial for the productivity and operational efficiency of organizations in the face of increasingly dynamic and competitive market demands. Attendance systems using

the latest technologies such as IoT and big data analytics are potential solutions to increase the efficiency and accuracy of recording employee attendance [2]. Amidst this dynamism, the SmartPLS (Partial Least Squares) method offers an effective approach to analyze the relationships between complex variables in the context of systems present in the era of Industrial Revolution 4.0 [3]. SmartPLS enables researchers to understand the impact of independent variables, such as IoT based timekeeping technology and big data analytics systems, on dependent variables such as employee timekeeping efficiency and accuracy. Therefore, this study aims to explore the role and contribution of the SmartPLS method in enhancing our understanding of the factors affecting employee timekeeping efficiency and accuracy in the era of the fourth industrial revolution [4]. Through a review of two journals that use the SmartPLS method, this study will identify the applicable framework and key findings relevant to the context of this study. It is hoped that the results of this study can provide valuable insights for business practitioners, academics, and other stakeholders in their efforts to improve the efficiency and accuracy of employee timekeeping management in today digital era [5].

2. LITERATURE REVIEW

In this literature review, we will describe the latest developments in technology that are driving the transformation of employee attendance management, as well as the theoretical concepts that are the basis for understanding the role of this technology in the context of the Industrial Revolution 4.0.

2.1. Traditional vs. Modern Presence Systems Technology Based Presence System

In the era of the Industrial Revolution 4.0, technological transformation has changed the model of employee attendance management, replacing traditional manual attendance systems with more complex technological solutions [6]. Traditional attendance systems often involve time consuming and error prone manual processes, such as recording employee attendance with paper cards or time cards. Meanwhile, technology based attendance systems use innovations such as biometric sensors, facial recognition, or GPS monitoring to automatically record employee attendance. By using this technology, businesses can reduce the administrative time and effort required to manage employee attendance, as well as increase the accuracy and precision of recording attendance data [7].

Technology based attendance systems also offer additional benefits in terms of flexibility and accessibility. Unlike traditional timekeeping systems that are limited to certain physical locations, technology solutions make it possible to monitor employee attendance from anywhere and at any time [8]. This is possible for companies with employees who work remotely or have flexible work schedules. Additionally, technology timekeeping systems are often integrated with Human Resource Management (HRM) systems, allowing attendance information to be fed directly into payroll and other employee management processes. Thus, the comparison between traditional and technology timekeeping systems shows a significant shift in the way companies manage employee attendance in the era of the Fourth Industrial Revolution [9].

2.2. IoT in Attendance Management

The IoT has become one of the key technologies that is transforming the way businesses manage employee attendance [10]. In the context of attendance management, IoT enables the integration of smart sensors and other connected devices to effectively monitor and manage employee attendance. For example, businesses can use presence sensors that are directly connected to the Internet to automatically detect employee presence when they enter and exit the workplace. Additionally, IoT sensors can be used to monitor the work environment, such as temperature and humidity, which can affect employee productivity and health. With the data collected through IoT, companies can optimize attendance management processes, identify patterns and trends, and take necessary actions to increase employee efficiency and comfort [11].

The application of IoT in timekeeping management also opens up new opportunities for developing more integrated and adaptive solutions. By applying IoT technology, businesses can connect their timekeeping systems with their HRM platforms and other systems, such as payroll systems and employee performance analytics [12]. This integration allows for a smoother flow of information between different business functions, leading to faster and more informed decision making. In addition, the use of IoT in timekeeping management allows businesses to improve the employee experience by providing easier and more transparent access to their own timekeeping data. Therefore, the implementation of IoT in timekeeping management has a positive impact on operational efficiency and the overall employee experience [13].

2.3. Big Data Analytics for Attendance Management

Big Data Analytics has transformed the way businesses manage employee attendance by enabling in depth analysis of various aspects of attendance. In the context of attendance management, Big Data Analytics enables businesses to collect, store, and analyze large volumes of employee attendance data quickly and efficiently [14]. This includes data on work schedules, absences, and working hours collected from various sources, including attendance systems, mobile applications, and IoT sensors. Using big data analytics techniques such as pattern analysis, clustering, and prediction, businesses can identify trends, anomalies, and behavioral patterns that are useful for optimizing attendance management. This can help businesses create more efficient work schedules, reduce absenteeism, and increase overall employee productivity [15].

One of the key benefits of big data analytics in attendance management is its ability to provide deep and predictive insights. By using sophisticated analytics techniques, such as machine learning and data mining, companies can make more accurate predictions about future employee attendance trends [16]. This allows businesses to take preventive or corrective action faster, such as predicting staff shortages in busy schedules or identifying unusual absenteeism patterns that may indicate underlying problems within the organization. Therefore, the use of big data analytics in attendance management offers significant benefits to businesses by increasing operational efficiency, reducing costs, and improving employee work experience [17].

2.4. Challenges and Opportunities in Implementing a Presence System in the Era of Industrial Revolution 4.0

Implementing a time attendance system in the era of the Fourth Industrial Revolution poses a number of challenges that businesses must overcome [18]. One of the main challenges is integrating new technology with existing infrastructure. Companies should ensure that the time attendance system they implement can integrate with existing systems, such as HRM and payroll systems [19].

In addition, businesses should also consider stricter data security when managing sensitive employee time attendance information. This includes protecting biometric data and other personal information stored in technology based time attendance systems. In addition to technical challenges, companies also face cultural and organizational challenges in adopting technological change. Employee acceptance and adoption of new technology can be a barrier, so companies must implement effective training and communication programs to ensure successful implementation [20].

However, in the face of current challenges, implementing a timekeeping system in the era of the Fourth Industrial Revolution also brings great opportunities for businesses. One of the main opportunities is to improve operational efficiency and HRM. By using more sophisticated timekeeping technology, businesses can reduce the administrative time and effort required to manage employee timekeeping, as well as increase the accuracy and precision of recording timekeeping data [21]. Furthermore, the use of technology based time attendance systems also opens up the possibility of developing more integrated and adaptive solutions that can improve collaboration and coordination between different departments within the organization. Thus, implementing a presence system in the era of the 4.0 industrial revolution is not only a necessity but also an opportunity to improve the company operational efficiency and competitiveness in an increasingly competitive and dynamic market.

2.5. The Effect of Attendance Efficiency and Accuracy on Organizational Productivity and Performance

The importance of efficiency and accuracy of attendance in the context of organizational productivity and performance has become an increasingly important focus in the era of Industrial Revolution 4.0. The efficiency of employee attendance is closely linked to the optimal management of an organization time and resources [22]. As the employee attendance process becomes more efficient, the administrative time and effort spent on recording and managing attendance can be reduced, allowing more focus on productive activities that add value to the organization. On the other hand, the accuracy of employee attendance plays an important role in measuring the availability of human resources required for the organization operations. With accurate attendance records, businesses can identify employee attendance and absence patterns, better manage work schedules, and predict future workforce needs, which helps increase overall organizational productivity and performance [23].

Previous research has provided strong evidence of a positive relationship between the effectiveness and accuracy of attendance and organizational productivity and performance. As companies strive to improve the efficiency and accuracy of employee timekeeping, they tend to see increased productivity at various levels, from

the individual level to the overall organizational level [24]. Research has also shown that effective and accurate timekeeping can help reduce costs associated with unplanned absences, increase attendance rates, and optimize the use of human resources [25]. Therefore, a thorough understanding of the impact of timekeeping efficiency and accuracy on organizational productivity and performance can provide valuable insights for businesses in their efforts to improve operational efficiency and competitiveness in an increasingly competitive market.

2.6. Problem

The problem posed in this study is how to increase the efficiency and accuracy of employee attendance in the era of the Industrial Revolution 4.0 through the implementation of technology based attendance systems, such as the IoT and big data analytics. Faced with increasingly dynamic and competitive market demands, effective and accurate attendance management becomes crucial to organizational productivity and performance. However, the implementation of an effective attendance system faces challenges in integrating new technology with existing infrastructure, data security, and cultural and organizational appropriateness [26]. Therefore, this study aims to explore the role of SmartPLS in analyzing the relationship between factors such as IoT based attendance technology and big data analytics with the efficiency and accuracy of employee attendance, thereby providing valuable insights for business practitioners and scholars for improvement. Attendance Management in Today Digital Age.

3. RESEARCH METHODS

This research method applies a descriptive analysis method using two reference journals that have used the SmartPLS method in the context of employee attendance management in the era of the Industrial Revolution 4.0. First, the framework applied in both reviews was identified, including the independent variables used to analyze the impact of IoT based attendance technology and Big Data analytics systems on the efficiency and accuracy of employee attendance [27]. Next, adjustments were made to the identified variables with those of this study, thus allowing for a suitable comparison between the results found in the two reference reviews and the current study.

The research variables and indicators used in this study are summarized in Table 1, which presents the different categories of variables such as IoT based presence technology, Big Data analysis systems, actual use, efficiency, and accuracy, along with their corresponding indicators and codes. The findings of this research are expected to provide insights into the significance of adopting technology to enhance the quality and accuracy of attendance processes across various industrial sectors [28].

Table 1. Research Variable Table

Variable	Indicator	Code
IoT Based Presence Technology	Feature Design	MAFD
	Effort Expectancy	EE
	Social Influence	SI
	Facilitating Condition	FC
	Habit	HT
	Behavioral Intention	BI
Big Data Analysis System	Perceived Usefulness	COULD
	Performance Expectancy	PE
	Attitude Toward Using	MORE
	Hedonic Motivation	HM
Actual use	Use Behavior	UB
	Actual Use	AUOM
Efficiency (IF)	Required Recording Time	WPD
	Administrative Cost Savings	PBA
	Increased Employee Productivity	PPK
Accuracy (AND)	Logging Error Rate	TKP
	Attendance Data Consistency	KDK
	Necessary Reconciliation	RYD

This study aims to examine the importance of improving attendance efficiency and accuracy through the use of presence systems based on technology in the era of Industry 4.0. The primary focus of the research is to analyze how the implementation of IoT based attendance systems and Big Data analytics can impact time management, administrative cost savings, employee productivity, and the accuracy of attendance data within organizations. The study also explores the relationship between the technologies used and the factors influencing actual usage, as well as their impact on efficiency and accuracy [29].

Table 2. Hypothesis Table

Hypothesis	Variable	Channel	Description
H1	IoT Based Presence Technology	**Independent Variable**	The use of IoT based attendance technology increases employee attendance efficiency.
		Accuracy	The use of IoT based attendance technology increases the accuracy of employee attendance.
H2	Big Data Analysis System	**Independent Variable**	Implementing a big data analysis system increases employee attendance efficiency.
		Accuracy	Implementing a big data analysis system increases the accuracy of employee attendance.
H3	Employee Attendance Efficiency	**Dependent Variable**	The use of IoT based attendance technology has a positive impact on employee attendance efficiency.
		Big Data Analysis System	The implementation of a big data analysis system has a positive impact on employee attendance efficiency.
H4	Employee Attendance Accuracy	**Dependent Variable**	The use of IoT based attendance technology has a positive impact on employee attendance accuracy.
		Big Data Analysis System	The implementation of a big data analysis system has a positive impact on the accuracy of employee attendance.

The hypotheses related to this study are summarized in Table 2, which presents the different hypotheses, their associated variables, channels independent or dependent, and detailed descriptions. This table provides a clear overview of how each technology and system impacts employee attendance efficiency and accuracy [30].

This study aims to explore the impact of two key technologies IoT based presence systems and Big Data analysis systems on employee attendance efficiency and accuracy. It investigates how the implementation of these technologies as independent variables can influence attendance efficiency and accuracy as dependent variables. By analyzing the relationships between these variables, the research aims to provide insights into the positive effects of technology integration in improving organizational attendance management [31].

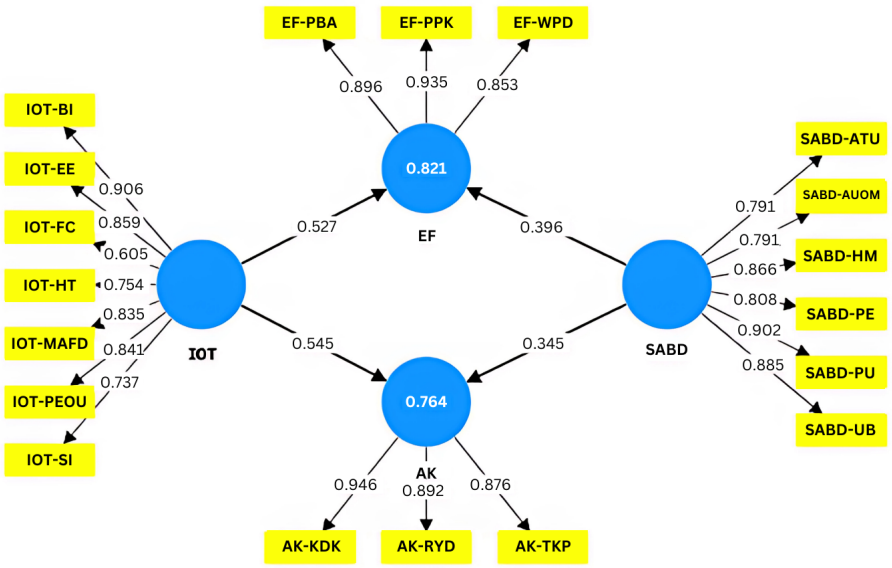

Figure 1. Flow of Research Variables

As shown in Figure 1, the influence of IoT and Big Data systems on attendance is highlighted, along with their impact on both efficiency and accuracy. This visual representation aids in grasping the conceptual framework of the research.

This figure illustrates the core components of the IoT based presence technology and Big Data analysis system as they relate to employee attendance efficiency and accuracy. It visualizes the interaction between the different variables such as the independent variables IoT based presence technology and Big Data analysis system and the dependent variables employee attendance efficiency and accuracy. The diagram helps in understanding the proposed relationships and how each element contributes to the overall performance and effectiveness of the attendance management system.

4. RESULT AND DISCUSSION

For example, the path coefficient of 0.545 for IoT indicates a strong positive relationship between IoT based technology and automated attendance accuracy. This can be interpreted as a call for organizations to invest in advanced IoT solutions to reduce errors in attendance tracking. The analysis is then conducted by comparing the key findings of the two reference reviews with the purpose of the current study, namely, to explore the impact of IoT based presence technology and Big Data analytics on employee efficiency and accuracy. This comparison is made by noting the similarities and differences in the analytical methods used as shown in Table 3, the results found, and the implications generated in the research context. In this way, a deeper understanding of the contribution of the SmartPLS approach in exploring the factors influencing employee attendance management in the era of the 4.0 industrial revolution can be obtained.

Table 3. Cronbach Alpha

Variable	Cronbach Alpha	AVE
AND	0.889	0.819
IF	0.861	0.783
IOT	0.902	0.634
SABD	0.917	0.708

Table 3 presents the Cronbach Alpha values and Average Variance Extracted (AVE) for the different variables analyzed in the study. Cronbach Alpha is used to measure the internal consistency or reliability of the variables, with higher values indicating better reliability. The AVE is a measure of the variance captured by the construct in relation to the variance due to measurement error.

Table 4. Path Coefficient

Variable	Path Coefficient
IOT → AC	0.545
IOT → EF	0.527
SABD → AC	0.345
SABD → EF	0.396

Table 4 presents the path coefficients for the variables in the study. Path coefficients represent the strength and direction of the relationships between the variables in the model. A higher path coefficient indicates a stronger influence of one variable on another.

From the results of the analysis using the SmartPLS method, it was found that the use of IoT Based Presence Technology has a significant influence on employee Attendance Accuracy, with a path coefficient of 0.545. This shows that the implementation of IoT based attendance technology can positively increase the accuracy of recording employee attendance in the context of the Industrial Revolution 4.0. Apart from that, its influence on Attendance Efficiency (EF) is also quite strong, with a path coefficient of 0.527, indicating that this technology also has the potential to increase efficiency in employee attendance management. Apart from IoT, System Analysis Big Data (SABD) also has a significant impact on the AK and EF of employees, although the coefficient is slightly lower than IoT. The path coefficient between SABD and AK is 0.345, while that between SABD and EF is 0.396. These results indicate that the implementation of Big Data analysis systems also contributes positively to the accuracy and efficiency of employee attendance in a digitally connected work environment.

These results support the hypothesis proposed previously. The First Hypothesis (H1) is proven with significant path coefficients between IoT AK and EF. Likewise with the Second Hypothesis (H2) regarding SABD and its influence on AK and EF. Both strengthen the argument that IoT based attendance technology and Big Data analysis systems have an important role in increasing the accuracy and efficiency of employee attendance in the Industrial Revolution 4.0 era. The contribution of these results is very relevant in the context of employee attendance management in the current digital era. The implication is that organizations and companies should seriously consider adopting IoT based attendance technologies and Big Data analysis systems to increase the efficiency and accuracy of employee attendance, which in turn can improve productivity and overall company performance. In addition, this research provides a strong foundation for further exploration and development in optimizing employee attendance and attendance management systems in the future.

5. MANAGERIAL IMPLICATION

This study emphasizes the significant role of IoT based attendance technology and big data analytics in enhancing the efficiency and accuracy of employee attendance management. For managers, this implies that adopting these advanced technologies can lead to substantial improvements in operational efficiency and accuracy. By integrating IoT based systems, organizations can collect real time, error free attendance data, which allows for more accurate payroll processing and better tracking of employee performance. Additionally, big data analytics enables managers to analyze large volumes of attendance data to derive valuable insights, optimize resource allocation, and improve workforce management.

From a strategic perspective, managers should prioritize the implementation of these technologies to streamline administrative processes, reduce costs, and improve overall productivity. This can lead to better decision making, as access to accurate and timely data provides a clearer understanding of employee behavior and performance patterns. Furthermore, incorporating IoT and big data into attendance systems ensures that the organization is well prepared to meet the demands of the digital age, maintaining its competitiveness in an increasingly tech driven business environment.

However, it is important for managers to remain adaptable and continuously innovate. As the technological landscape evolves, managers must stay informed about the latest trends and advancements in IoT and data analytics to keep their attendance management systems up to date. By doing so, organizations can enhance their operational strategies, stay competitive, and ensure long term success in the rapidly changing market.

6. CONCLUSION

Future research could explore the long term impacts of IoT and Big Data Analytics in diverse organizational settings, or evaluate the performance of varied IoT devices in attendance management systems. The results of this research, using the SmartPLS method in the context of employee attendance management during the Industrial Revolution 4.0 era, highlight the significant positive influence of IoT based attendance technology and Big Data analytics on both the efficiency and accuracy of employee attendance. These findings confirm the critical role of technology in improving organizational performance, demonstrating its potential to enhance operational efficiency and reduce errors in attendance management.

Moreover, the study emphasizes the effectiveness of the SmartPLS method in uncovering the underlying factors influencing employee attendance management. By showing how IoT and Big Data contribute to higher productivity and accuracy, the research underscores the importance of adopting advanced technologies to meet the demands of the modern workplace. This is particularly crucial in an era where businesses are faced with increasing competition and dynamic market conditions.

However, there are limitations in the scope of the study, such as the sample size and the generalization of the results. Further research could investigate the application of these technologies in different industries or regions to better understand their long term impact and scalability. These insights would provide valuable guidance for business practitioners and academics looking to strengthen adaptive and effective attendance management strategies, helping organizations thrive in the increasingly digital and competitive environment.

7. DECLARATIONS

7.1. About Authors

Tri Hartono (TH) -

Bintang Nandana Henry (BN) -

Sirje Nurm (SN) -

Lukita Pasha (LP) -

Dwi Julianingsih (DJ) https://orcid.org/0000-0002-6257-4881

7.2. Author Contributions

Conceptualization: TH; Methodology: BN; Software: SN Validation: LP and DJ; Formal Analysis: SN and DJ; Investigation: BN; Resources: TH; Data Curation: LP; Writing Original Draft Preparation: LP and DJ; Writing Review and Editing: TH and SN; Visualization: BN; All authors, TH, BN, SN, LP, DJ have read and agreed to the published version of the manuscript.

7.3. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

7.4. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

7.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

REFERENCES

[1] A. G. Menezes, J. M. d. C. Sá, E. Llapa, and C. A. Estombelo-Montesco, "Automatic attendance management system based on deep one-shot learning," in *2020 International Conference on Systems, Signals and Image Processing (IWSSIP)*. IEEE, 2020, pp. 137–142.

[2] A. Eiji and S. Mehta, "Simulation-based 5g femtocell network system performance analysis," *International Journal of Cyber and IT Service Management*, vol. 3, no. 1, pp. 74–78, 2023.

[3] M. Sheikholeslami, S. A. Farshad, Z. Ebrahimpour, and Z. Said, "Recent progress on flat plate solar collectors and photovoltaic systems in the presence of nanofluid: a review," *Journal of Cleaner Production*, vol. 293, p. 126119, 2021.

[4] U. Rusilowati, H. R. Ngemba, R. W. Anugrah, A. Fitriani, and E. D. Astuti, "Leveraging ai for superior efficiency in energy use and development of renewable resources such as solar energy, wind, and bioenergy," *International Transactions on Artificial Intelligence*, vol. 2, no. 2, pp. 114–120, 2024.

[5] N. S. Ali, A. H. Alhilali, H. D. Rjeib, H. Alsharqi, and B. Al-Sadawi, "Automated attendance management systems: systematic literature review," *International Journal of Technology Enhanced Learning*, vol. 14, no. 1, pp. 37–65, 2022.

[6] F. Zidan and D. E. Febriyanti, "Optimizing agricultural yields with artificial intelligence-based climate adaptation strategies," *IAIC Transactions on Sustainable Digital Innovation (ITSDI)*, vol. 5, no. 2, pp. 136–147, 2024.

[7] M. Annas and S. N. Wahab, "Data mining methods: K-means clustering algorithms," *International Journal of Cyber and IT Service Management*, vol. 3, no. 1, pp. 40–47, 2023.

[8] E. L. Crable, D. L. Biancarelli, M. Aurora, M.-L. Drainoni, and A. J. Walkey, "Interventions to increase appointment attendance in safety net health centers: A systematic review and meta-analysis," *Journal of Evaluation in Clinical Practice*, vol. 27, no. 4, pp. 965–975, 2021.

[9] M. R. Anwar and L. D. Sakti, "Integrating artificial intelligence and environmental science for sustainable urban planning," *IAIC Transactions on Sustainable Digital Innovation (ITSDI)*, vol. 5, no. 2, pp. 179–191, 2024.

[10] O. Jayanagara and S. Watini, "The role of smart automation in tourism industry management using smart pls," *International Transactions on Artificial Intelligence*, vol. 2, no. 1, pp. 7–23, 2023.

[11] A. K. Tyagi, T. F. Fernandez, S. Mishra, and S. Kumari, "Intelligent automation systems at the core of industry 4.0," in *International conference on intelligent systems design and applications*. Springer, 2020, pp. 1–18.

[12] I. H. Sarker, "Ai-based modeling: techniques, applications and research issues towards automation, intelligent and smart systems," *SN Computer Science*, vol. 3, no. 2, p. 158, 2022.

[13] H. Haryanto, Y. S. Putra, and N. Natasyah, "Web-based employee recruitment management system in pt. tropicabadi," *APTISI Transactions on Management*, vol. 4, no. 2, pp. 139–148, 2020.

[14] V. Wati, K. Kusrini, H. Al Fatta, and N. Kapoor, "Security of facial biometric authentication for attendance system," *Multimedia Tools and Applications*, vol. 80, no. 15, pp. 23 625–23 646, 2021.

[15] F. Agustin, S. Syafnidawati, N. P. L. Santoso, and O. G. Amrikhasanah, "Blockchain-based decentralized distribution management in e-journals," *Aptisi Transactions On Management*, vol. 4, no. 2, pp. 107–113, 2020.

[16] M. Qureshi, "The proposed implementation of rfid based attendance system," *International Journal of Software Engineering & Applications (IJSEA)*, vol. 11, no. 3, 2020.

[17] F. S. Putri, H. R. Ngemba, S. Hendra, and W. Wirdayanti, "Sistem layanan ujian psikotes sim menggunakan computer based test berbasis website: Sim psychological test service system using computer based test based on website," *Technomedia Journal*, vol. 9, no. 1, pp. 92–104, 2024.

[18] A. A. Khan, A. A. Laghari, and S. A. Awan, "Machine learning in computer vision: a review," *EAI Endorsed Transactions on Scalable Information Systems*, vol. 8, no. 32, pp. e4–e4, 2021.

[19] R. Bhandari and M. V. A. Sin, "Optimizing digital marketing in hospitality industries," *Startupreneur Bisnis Digital (SABDA Journal)*, vol. 2, no. 1, 2023.

[20] O. Olawale, F. A. Ajayi, C. A. Udeh, and O. A. Odejide, "Leveraging workforce analytics for supply chain efficiency: a review of hr data-driven practices," *International Journal of Applied Research in Social Sciences*, vol. 6, no. 4, pp. 664–684, 2024.

[21] L. Tran and S. Gershenson, "Experimental estimates of the student attendance production function," *Educational Evaluation and Policy Analysis*, vol. 43, no. 2, pp. 183–199, 2021.

[22] M. H. R. Chakim, A. Kho, N. P. L. Santoso, and H. Agustian, "Quality factors of intention to use in artificial intelligence-based aiku applications," *ADI Journal on Recent Innovation*, vol. 5, no. 1, pp. 72–85, 2023.

[23] N. S. M. S. Lee, S. Hussain, R. A. Rashid, M. A. Raffar, and N. Aripin, "The effect of training towards employee performance: An evidence from a public university in malaysia," *International Journal of Industrial Management*, vol. 17, no. 3, pp. 178–185, 2023.

[24] E. Dolan, S. Kosasi, and S. N. Sari, "Implementation of competence-based human resources management in the digital era," *Startupreneur Business Digital (SABDA Journal)*, vol. 1, no. 2, pp. 167–175, 2022.
[25] B. Aeon, A. Faber, and A. Panaccio, "Does time management work? a meta-analysis," *PloS one*, vol. 16, no. 1, p. e0245066, 2021.
[26] K. Painuly, Y. Bisht, H. Vaidya, A. Kapruwan, and R. Gupta, "Efficient real-time face recognition-based attendance system with deep learning algorithms," in *2024 International Conference on Intelligent and Innovative Technologies in Computing, Electrical and Electronics (IITCEE)*. IEEE, 2024, pp. 1–5.
[27] R. Setiowati, E. Y. Utami, N. Sonani, A. P. Sudrajat, and M. H. Santoso, "Development of employees attendance features of human resource information system in a national logistics company," *Jurnal Informasi dan Teknologi*, pp. 136–140, 2023.
[28] Y. Fernando, M.-L. Tseng, I. S. Wahyuni-Td, A. B. L. de Sousa Jabbour, C. J. Chiappetta Jabbour, and C. Foropon, "Cyber supply chain risk management and performance in industry 4.0 era: information system security practices in malaysia," *Journal of Industrial and Production Engineering*, vol. 40, no. 2, pp. 102–116, 2023.
[29] S. Bose, S. K. Dey, and S. Bhattacharjee, "Big data, data analytics and artificial intelligence in accounting: An overview," *Handbook of big data research methods*, pp. 32–51, 2023.
[30] W.-H. Wang and W.-S. Hsu, "Integrating artificial intelligence and wearable iot system in long-term care environments," *Sensors*, vol. 23, no. 13, p. 5913, 2023.
[31] N. Lutfiani and L. Meria, "Utilization of big data in educational technology research," *International Transactions on Education Technology*, vol. 1, no. 1, pp. 73–83, 2022.