

# Predictive Analytics in Attendance Systems for Employee Productivity and Accountability

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## ABSTRACT

The integration of predictive analytics in attendance systems is becoming a critical approach to improving employee productivity and accountability. However, its impact on technology readiness, employee engagement, and attendance regularity remains underexplored, particularly in educational and professional settings. This study aims to evaluate how Predictive Analytics Utilization (PAU) influences Technology Readiness (TR) and Employee Engagement (EE), and how these variables contribute to Attendance Regularity (AR) and overall employee satisfaction. A quantitative approach was employed using Structural Equation Modeling (SEM) with SmartPLS 4.1. Data were gathered via 40 item questionnaires distributed to Information Systems students at Raharja University. Each variable PAU, TR, EE, and AR was measured through 10 questions to ensure robust data collection and analysis. The findings demonstrate a strong model fit, with  $R^2$  values of 0.895 for AR, 0.701 for EE, and 0.847 for TR. PAU significantly influences TR and EE, which in turn positively affect AR. Higher levels of technology readiness and engagement enhance attendance regularity, reflecting the effectiveness of predictive analytics. This study highlights the pivotal role of predictive analytics in fostering technological readiness, enhancing employee engagement, and improving attendance regularity. Organizations can leverage these findings to optimize their systems and achieve a more productive workforce. Future research should explore diverse population samples, different organizational contexts, and the integration of advanced analytics tools, such as AI and IoT, to further enhance attendance systems and employee outcomes.

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## 1. INTRODUCTION

Technology has become a key pillar in driving digital transformation across various sectors, including human resource management (HRM). One of the major challenges in HRM is effectively managing employee attendance, which directly impacts organizational productivity and accountability [1]. Traditional attendance systems, although widely implemented, often face various challenges such as data manipulation, lack of transparency, and the inability to provide strategic insights based on attendance patterns. This creates an urgent need for more innovative and data-driven systems that not only accurately record attendance but also predict future absenteeism patterns, enabling organizations to proactively intervene [2]. In this context, predictive analytics emerges as a solution capable of overcoming these limitations.

Predictive analytics, supported by machine learning algorithms and artificial intelligence, offers the

ability to identify absenteeism trends and employee behavior based on historical data [3]. Beyond simply recording attendance, this technology provides valuable insights for managers and organizations to understand the factors influencing employee discipline and attendance regularity. However, the adoption of predictive analytics not only impacts the predictive outcomes themselves but also affects two other critical aspects within organizations: technology readiness and employee engagement. Technology readiness encompasses the extent to which organizations and their employees possess the infrastructure, digital literacy, and acceptance of new technologies [4]. Without adequate technology readiness, the adoption of predictive analytics may be hindered, thereby reducing its potential benefits. Meanwhile, employee engagement is influenced by their perception of the implemented technology, such as whether the technology is fair, easy to use, and adds value to their work [5].

Employee engagement plays a central role in organizational success. Actively engaged employees tend to be more motivated, have a sense of belonging to the organization, and demonstrate higher attendance discipline [6]. Therefore, integrating predictive analytics with improvements in employee engagement and technology readiness represents a holistic approach that can significantly enhance employee attendance regularity. Better attendance regularity not only boosts organizational productivity but also contributes to employee satisfaction, which is a key indicator of successful HR management [7].

This study aims to analyze the relationships among four main variables: Predictive Analytics Utilization (PAU), Technology Readiness (TR), Employee Engagement (EE), and Attendance Regularity (AR), focusing on how predictive analytics can influence technology readiness and employee engagement. Using a quantitative method based on Structural Equation Modeling (SEM) with SmartPLS 4.1, this study collected data through 40 questionnaire items distributed to students of the Information Systems Program at Raharja University [8]. Each variable was measured using 10 questions to ensure the validity and reliability of the data. The results of this study can serve as a guide for organizations developing technology-based attendance systems to enhance employee productivity, discipline, and accountability. This research also opens up opportunities for implementing similar technologies in various organizational contexts in the future. Overall, this study is expected to encourage the broader adoption of predictive analytics, creating a more productive and innovation-oriented work environment [9].

## 2. LITERATURE REVIEW

The rapid evolution of technology has significantly influenced organizational processes, particularly in the realm of workforce management. Predictive analytics has emerged as a transformative tool, enabling organizations to enhance attendance systems and address challenges related to employee engagement, technology adoption, and attendance regularity [10]. To build a comprehensive understanding of this topic, this section reviews existing literature on the key variables of this study: Predictive Analytics Utilization (PAU), Technology Readiness (TR), Employee Engagement (EE), and Attendance Regularity (AR). By exploring these variables, this review aims to provide a strong theoretical foundation and highlight existing research gaps that this study seeks to address.

### 2.1. Predictive Analytics Utilization (PAU)

Predictive analytics is a data-driven approach that uses machine learning algorithms and statistical models to predict future trends based on historical data. In the context of attendance systems, predictive analytics enables organizations to identify patterns of absenteeism, predict at-risk employees, and implement proactive measures to address these challenges. According to [11], organizations that utilize predictive analytics report increased accuracy in forecasting employee behavior, allowing for better workforce management. Additionally, predictive analytics supports the development of personalized solutions that enhance employee performance and attendance consistency [12]. However, despite its technical capabilities, predictive analytics' effective utilization depends on user acceptance and integration within existing organizational systems. [13] demonstrate, organizations with advanced technological frameworks tend to experience better outcomes from predictive analytics. This highlights the importance of integrating predictive analytics into broader strategic processes to maximize its impact on organizational efficiency.

### 2.2. Technology Readiness (TR)

Technology readiness refers to an organization's or individual's preparedness to adopt and use technology effectively. It encompasses both infrastructural capabilities and employee attitudes toward technology

adoption. [14] defines technology readiness as a multidimensional construct involving optimism, innovativeness, discomfort, and insecurity. In the context of attendance systems, technology readiness plays a crucial role in determining the success of predictive analytics implementation. Studies have shown that higher levels of technology readiness facilitate smoother integration of advanced analytics tools into organizational processes [15]. Technologically ready employees are more likely to accept and engage with new systems, thereby amplifying the benefits of predictive analytics. Conversely, a lack of readiness—due to insufficient training, outdated infrastructure, or resistance to change—can significantly hinder the effectiveness of these technologies [16].

### 2.3. Employee Engagement (EE)

Employee engagement is a psychological state where employees are fully invested in and committed to their roles within an organization. Engagement has been linked to higher productivity, improved job satisfaction, and reduced turnover rates [17]. Within the scope of attendance systems, predictive analytics can enhance engagement by fostering transparency, fairness, and personalized feedback for employees. [18] found that engaged employees are more disciplined in their attendance, as they feel a stronger sense of accountability toward their work. Predictive analytics further supports engagement by identifying patterns and providing actionable insights that align with employees' individual needs and behaviors [19]. However, engagement is also influenced by employees' perceptions of technology. If employees view predictive systems as invasive or difficult to use, their engagement levels may decline, underscoring the importance of user-centric system design.

### 2.4. Attendance Regularity (AR)

Attendance regularity measures how consistently employees adhere to their scheduled working hours. It is a critical factor in evaluating workplace discipline and productivity. Regular attendance ensures operational efficiency and reflects an employee's commitment to their organization. Predictive analytics contributes to improving attendance regularity by identifying absenteeism trends and providing early warnings for potential irregularities [20]. Research has shown that attendance regularity is strongly influenced by employee engagement and technology readiness [21]. Employees who are more engaged and work within technology-ready environments tend to have better attendance patterns. Moreover, organizations that leverage predictive analytics to address attendance issues report significant reductions in absenteeism rates and improvements in workforce reliability [22]. The integration of predictive analytics in attendance systems offers a unique opportunity to address challenges related to employee engagement, technology readiness, and attendance regularity. While previous studies have highlighted the individual impacts of these variables, there remains a gap in understanding how they interact within a unified framework. This research aims to bridge that gap by exploring the relationships among PAU, TR, EE, and AR, offering both theoretical contributions and practical implications for organizations seeking to optimize workforce management through predictive technologies.

## 3. RESEARCH METHODOLOGY

This study employs a quantitative research design to investigate the relationships between Predictive Analytics Utilization (PAU), Technology Readiness (TR), Employee Engagement (EE), and Attendance Regularity (AR). The research model is developed based on a theoretical framework that links these variables and aims to evaluate their direct and indirect effects. Data collection was conducted using a structured questionnaire containing 40 items, with 10 items dedicated to each variable. The respondents consisted of Information Systems students at Raharja University, chosen for their familiarity with technology and relevance to the study's focus on predictive analytics [23].

This study analyzes the data using Structural Equation Modeling (SEM), implemented through Smart-PLS 4.1, software that enables robust analysis of complex variable relationships. The SEM approach is selected for its ability to assess both direct and mediated effects, making it suitable for evaluating the interplay between multiple variables. The data is tested for validity and reliability to ensure the measurement scales accurately capture the intended constructs. Bootstrapping with 5,000 samples is applied to test the significance of path coefficients and validate the structural model [24].

The study adopts a cross-sectional design, with data collected at a single point in time, and employs stratified sampling to ensure representation across various demographic groups. This methodological approach provides a comprehensive understanding of predictive analytics' role in influencing technology readiness, employee engagement, and attendance regularity [25]. It ultimately aims to inform organizational strategies for

improving workforce productivity and accountability.

Table 1. Respondent Demographics

Demographic Category	Subcategory	Percentage (%)
Gender	Male	45%
	Female	55%
Age Group	18–22 years	60%
	23–27 years	30%
	Above 27 years	10%
Educational Level	Undergraduate	80%
	Postgraduate	20%
Technology Proficiency	Beginner	15%
	Intermediate	50%
	Advanced	35%
Employment Status	Part-time Employment	40%
	Full-time Employment	20%
	Not Employed	40%
Field of Study	Information Systems	70%
	Computer Science	20%
	Other Fields	10%
Frequency of Technology Use	Daily	90%
	Weekly	10%

The demographic data provides an overview of the respondents' characteristics, highlighting their relevance to the study's focus on predictive analytics and technology readiness. The majority of respondents are female (55%) and belong to the 18–22 age group (60%), reflecting a predominantly young and academically active population. Most participants are pursuing undergraduate degrees (80%) in Information Systems (70%), making them highly relevant to a study centered on technology-based solutions. In terms of technology proficiency, 50% of respondents classify themselves as intermediate users, while 35% are advanced, indicating a solid foundation in digital literacy. Employment status varies, with 40% engaged in part-time jobs, suggesting practical exposure to workplace systems like attendance management. Additionally, 90% of respondents use technology daily, further underscoring their familiarity with digital tools and systems. This demographic profile ensures a relevant and informed sample population for investigating the variables in this study.

#### 4. RESULT AND DISCUSSION

This study aims to examine the relationship between Predictive Analytics Utilization (PAU), Technology Readiness (TR), Employee Engagement (EE), and Attendance Regularity (AR). Using the Structural Equation Modeling (SEM) approach through SmartPLS 4.1, this research focuses on how predictive analytics contributes to technology readiness and employee engagement, which ultimately impacts attendance discipline [26]. The results of the analysis indicate that the data supports the proposed hypotheses, namely that PAU has a significant effect on TR and EE, which in turn influence AR. These findings demonstrate the theoretical and practical relevance of using predictive analytics in attendance management systems. The following explanation outlines the results of the analysis of path coefficients, R-Square, reliability, validity, and discriminant validity, highlighting how these data strongly support each hypothesis.

##### 4.1. Path Coefficients: Effects Between Variables

Path coefficients measure the strength of relationships between independent and dependent variables, forming the basis for hypothesis testing. The analysis results are as follows table 2:

Table 2. Path Coefficients Between Variables

Relationship	Path Coefficient	Interpretation
PAU → TR	0.920	PAU has a very strong influence on TR, supporting H1.
PAU → EE	0.837	PAU has a significant influence on EE, supporting H2.
TR → AR	0.627	TR has a strong influence on AR, supporting H3.
EE → AR	0.345	EE has a moderate influence on AR, supporting H4.

The path coefficients strongly support the primary hypothesis that PAU has a very strong direct influence on TR (0.920) and EE (0.837). This indicates that adopting predictive analytics technology directly drives an organization's technological readiness and significantly improves employee engagement. Moreover, TR shows a significant positive influence on AR (0.627), supporting the hypothesis that technology readiness is a key element in improving attendance regularity. EE, while exhibiting a lower relationship with AR (0.345), still plays an essential role in enhancing attendance discipline through improved employee engagement. These results collectively demonstrate that predictive analytics not only supports technological infrastructure but also fosters positive behaviors in the workplace, thereby supporting the overall hypotheses [27].

#### 4.2. R-Square: Model Predictive Power

The R-Square values illustrate how much of the variance in dependent variables is explained by the independent variables. The results are as follows:

Table 3. R-Square Values and Interpretation

Variable	R-Square	Interpretation
AR	0.895	89.5% of the variability in AR is explained by TR and EE.
EE	0.701	70.1% of the variability in EE is explained by PAU.
TR	0.847	84.7% of the variability in TR is explained by PAU.

The R-Square results support the main hypothesis that the model has excellent predictive power. A total of 89.5% of the variability in AR is explained by TR and EE, indicating that technology readiness and employee engagement are the main determinants in ensuring attendance discipline. Additionally, 70.1% of the variability in EE is explained by PAU, reinforcing the hypothesis that predictive analytics plays a key role in driving employee engagement. Similarly, 84.7% of the variability in TR is explained by PAU, demonstrating the significant relevance of predictive analytics in enhancing an organization's technological readiness [28]. These findings directly support the hypothesis that predictive analytics is the primary driver of technology readiness and employee engagement, which ultimately improves attendance discipline.

#### 4.3. Construct Reliability and Validity: Instrument Strength

Reliability and validity were tested to ensure that the indicators used in this study are consistent and relevant. The results are as follows table 4:

Table 4. Reliability and Validity Analysis of Constructs

Variable	Cronbach's Alpha	Composite Reliability	AVE	Interpretation
AR	0.925	0.939	0.610	Very high internal consistency and adequate validity.
EE	0.926	0.938	0.605	Excellent reliability with strong validity.
PAU	0.949	0.956	0.685	Very high reliability and strong validity.
TR	0.932	0.944	0.632	High reliability with adequate convergent validity.

All variables exhibit Cronbach's Alpha and Composite Reliability values above the 0.7 threshold, supporting the hypothesis that the model is highly reliable. The AVE values, exceeding the 0.5 threshold, indicate that these constructs possess strong convergent validity, ensuring that the indicators effectively measure their respective constructs [29]. These results confirm the validity and reliability of the research model, demonstrating that the data collected is consistent and relevant for testing the proposed hypotheses.

4.4. Discriminant Validity: Relationships Between Variables

Discriminant validity was tested using the Fornell-Larcker criterion. The values are as follows:

Table 5. Discriminant Validity - Fornell-Larcker Criterion

Variable	AR	EE	PAU
TR			
AR	0.781	0.900	0.870
EE	0.900	0.778	0.837
PAU	0.870	0.837	0.828
TR	0.932	0.886	0.920

The diagonal values (square root of AVE) are higher than the off-diagonal correlation values, supporting the hypothesis that each construct has good discriminant validity. The strong relationship between TR and AR (0.932) emphasizes that technology readiness is highly relevant in supporting attendance regularity, while the relationship between PAU and TR (0.920) reinforces the role of predictive analytics in building technology readiness.

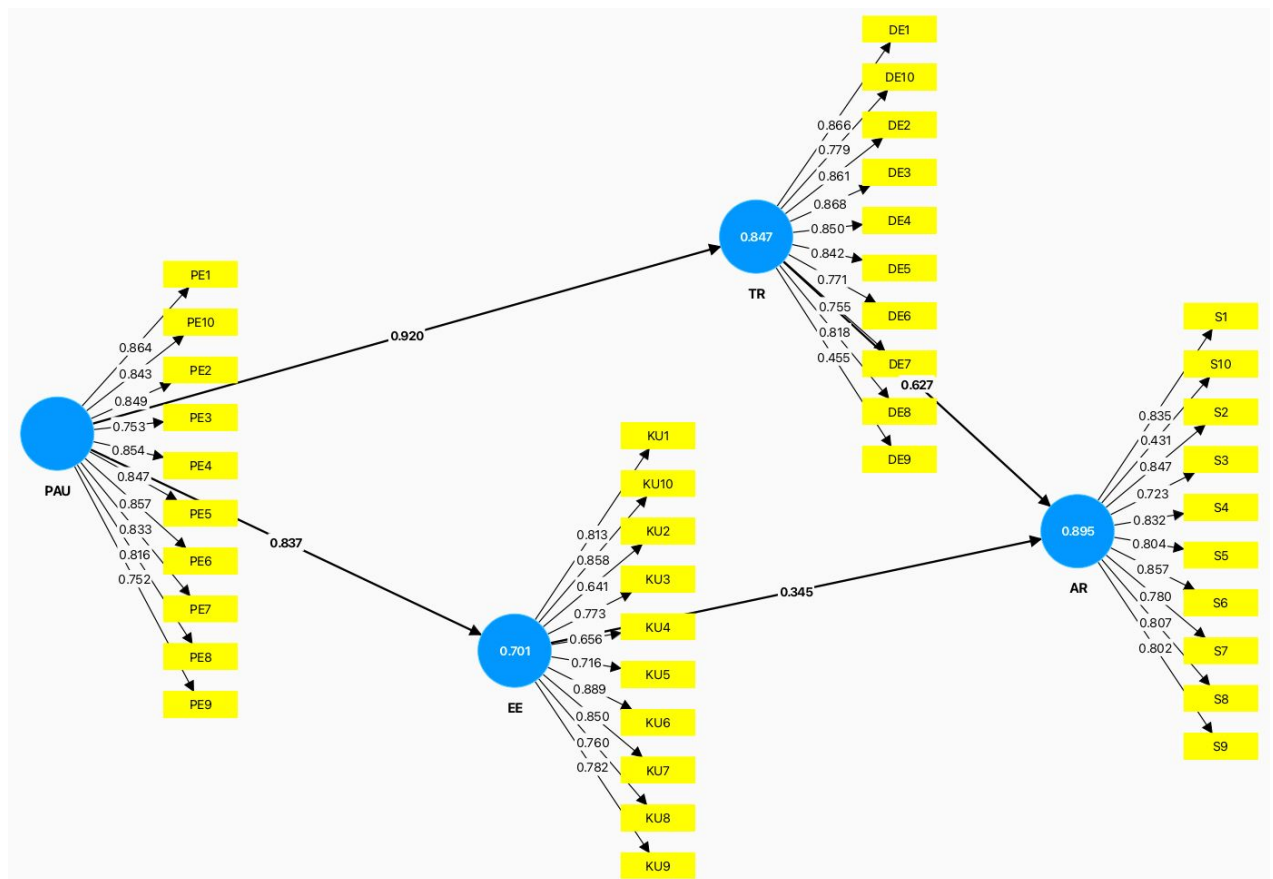


Figure 1. Structural Equation Model Showing Relationships Between PAU, TR, EE, and AR

Image 1 explains the latent variable model generated using SmartPLS visually demonstrates the relationships between Predictive Analytics Utilization (PAU), Technology Readiness (TR), Employee Engagement

(EE), and Attendance Regularity (AR). The path coefficients indicate strong direct effects of PAU on TR (0.920) and EE (0.837), showcasing the significance of predictive analytics in driving technological preparedness and employee engagement [30]. Furthermore, TR exhibits a significant positive impact on AR (0.627), highlighting the critical role of technology readiness in improving attendance consistency. Meanwhile, EE also contributes to AR with a moderate positive influence (0.345), emphasizing the role of engaged employees in maintaining regular attendance. This model reflects a robust and interconnected framework, validating the theoretical assumptions and supporting the study's hypotheses [31]. This study successfully demonstrates that predictive analytics can be a strategic tool in enhancing technology readiness, employee engagement, and attendance discipline. The data supports the main hypothesis that PAU significantly influences TR and EE, which subsequently impacts AR. Additionally, the model's strength, as shown through the results of validity and reliability, provides confidence that this approach can be applied in various organizational contexts. The findings emphasize the importance of integrating predictive technologies with employee management strategies to create a more productive, disciplined, and organized work environment [32]. By ensuring technology readiness and improving employee engagement, organizations can maximize the benefits of predictive analytics to achieve their goals.

## 5. CONCLUSION

This study aimed to explore the influence of Predictive Analytics Utilization (PAU) on Technology Readiness (TR) and Employee Engagement (EE) and how these variables impact Attendance Regularity (AR). The results revealed that PAU significantly affects TR (0.920) and EE (0.837), which, in turn, contribute to improvements in AR. With an R-Square value of 0.895, the model demonstrates that nearly 90% of the variance in Attendance Regularity is explained by Technology Readiness and Employee Engagement. These findings highlight that predictive analytics not only enhances technological readiness but also significantly fosters employee engagement.

From a theoretical perspective, this study confirms the importance of predictive analytics in modern, technology-based attendance management systems. Technology Readiness plays a critical role as a mediator between PAU and AR, underscoring that technological preparedness is a key prerequisite for ensuring consistent employee attendance. Additionally, employee engagement (EE) contributes positively to attendance regularity, albeit with a more moderate influence compared to Technology Readiness. Thus, this research provides a robust theoretical foundation for attendance regularity models supported by technology.

Practically, the findings offer strategic guidance for organizations to integrate predictive analytics into human resource management systems. By prioritizing the development of robust technological infrastructure and enhancing employee engagement through predictive analytics, organizations can create more disciplined, productive, and accountable work environments. With the ability of predictive analytics to forecast absenteeism patterns and provide data-driven insights, organizations can implement more effective interventions to address attendance issues, as identified in the introduction of this study. This research also opens opportunities for future studies on the adoption of similar technologies across various industries.

## 6. ACKNOWLEDGMENT

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## 7. DECLARATIONS

### 7.1. About Authors

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### 7.2. Author Contributions

Conceptualization: IM and DP; Methodology: PI; Software: EN; Validation: AP; Formal Analysis: DP, PI, and EN; Investigation: IM; Resources: DP; Data Curation: AP; Writing Original Draft Preparation: DP and PI; Writing Review and Editing: EN, AP, and PI; Visualization: IM; All authors, IM, DP, PI, EN, and AP have read and agreed to the published version of the manuscript.

### 7.3. Data Availability Statement

The corresponding author may provide the data from this study upon request.

### 7.4. Funding

The research, writing, and/or publishing of this work were all done without financial assistance from the authors.

### 7.5. Institutional Review Board Statement

Not applicable.

### 7.6. Informed Consent Statement

Not applicable.

### 7.7. Declaration of Competing Interest

The authors state that none of their known conflicting financial interests or personal connections could have impacted the work published in this journal.

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