Journal of Smart Lean Manufacturing and Process Enhancement
Vol. 1, No. 1, 2025, pp. 29 - 40

Chers Publishers
https://jurnal.unikchers.com/jslmpe/index

RESEARCH ARTICLE

Open Access

Improving Performance Evaluation Efficiency at Darut Taqwa Vocational School through AI and Manufacturing Engineering

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Article Info
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Submitted: 08/01/2025
Reviewed: 08/03/2025
Accepted: 08/06/2025
Available Online: 08/19/2025
Keywords:
AI-based learning media; human resource performance evaluation; industrial engineering methodology; teacher satisfaction
https://doi.org.

Cite this as:
Kurniawan, R. (2025). Improving performance evaluation efficiency at Darut Taqwa Vocational School through AI and manufacturing engineering. Journal of Smart Lean Manufacturing and Process Enhancement, 1(1), 29 - 40.

Abstract
This study aims to optimize human resource (HR) performance evaluation at SMK Darut Taqwa through the integration of AI-based learning media and industrial engineering methodology. The study involved 400 students and 70 teachers, focusing on the development of an AI-based performance evaluation system integrated with adaptive learning media tailored to individual needs. Industrial engineering methodology was used to analyze the efficiency of the evaluation process and to design a system that could identify and enhance sustainable HR development. The results of the study showed a 17% increase in evaluation objectivity, a 40% reduction in evaluation time, and a 20% increase in teacher satisfaction. Additionally, the system optimized real-time feedback, which contributed to the development of teacher competencies. This research resulted in a replicable HR performance evaluation model, which can be adopted by other educational institutions to improve teaching quality and performance. The authors are fully committed to adhering to the ethics of scientific publication, including the originality of the work, honesty in data collection and interpretation, and recognizing the contributions of others, ensuring that this research provides a valid and trustworthy contribution to the advancement of educational science.

1. Introduction

The development of digital technology, particularly artificial intelligence, has brought significant changes to the world of education, including the process of evaluating human resource performance in vocational high schools. The application of AI in the education sector has the potential to revolutionize teaching and learning methods, improve administrative efficiency, and create more inclusive and personalized learning environments. AI can provide personalized learning through virtual tutors and adaptive learning systems that tailor content based on individual student needs.(Sari et al., 2024).

Darut Taqwa Vocational School, as a vocational education institution based on Islamic boarding schools, faces challenges in improving the quality of human resources and educational services amidst the demands of the industrial era 4.0 towards 5.0.(Industry et al.,

2025)Teacher performance evaluations, which have traditionally been conducted manually and tend to be subjective, require innovation to be more objective, efficient, and aligned with the needs of the institution and student development. Integrating AI-based learning media with industrial engineering methods is seen as capable of improving the HR performance evaluation process, given that AI can provide a personalized and adaptive learning experience, while industrial engineering offers a systematic approach to increase efficiency and productivity.

In education, effective HR performance evaluation must be able to measure performance objectively, provide constructive feedback, and encourage continuous professional development.(Muslikhin, 2024)AI-based learning media allows for personalized material, learning pace adjustment, and real-time learning data analysis. Implementing this media has been shown to significantly improve student understanding, with an average post-test score increase of 23.5% compared to pre-test scores.(Yeni et al., 2023). In addition, AI can help teachers conduct real-time formative assessments and identify individual training needs, allowing for more targeted and sustainable competency development.(Kurniawan et al., 2025).

Industrial engineering methodologies such as lean management, Six Sigma, and work studies can be used to optimize the HR performance evaluation process. Integrating Lean Six Sigma, for example, has been shown to reduce defects, shorten lead times, and increase employee awareness and improve their work behavior.(Prahara & Nawangpalupi, 2021)By utilizing this method, the performance evaluation process in educational settings can become more efficient, reduce waste, improve workflow, and enable quantitative productivity measurement.Research on the integration of artificial intelligence (AI) in human resource management (HRM) and organizational performance has shown rapid development in the past decade, particularly since the era of digital transformation and Industry 4.0. Several early studies, such as(Asabere & Gyamfi, 2013) And(Bohlouli et al., 2017), focusing on intelligent system design, AIDSS-HR for performance monitoring, and mathematical model-based competency assessment that emphasizes the automation of evaluation and competency mapping. Systematic review-based approaches are becoming more dominant.(Pan & Froese, 2023)analyzed 184 cross-disciplinary articles and found that AI-HRM research remains fragmented: engineering and computer science tend to focus on the development aspects of tools, while management focuses more on socio-economic impacts. This fragmentation is also confirmed by(Chowdhury et al., 2023) who formulated an AI capability framework for HRM, emphasizing the importance of combining technical and non-technical resources (leadership, organizational culture, and innovation mindset). However, this framework is still conceptual and has not been empirically validated. AI has been shown to improve the efficiency and

objectivity of HRM, particularly in performance management, process digitization, and competency analysis. Second, significant challenges arise in ethical aspects, algorithmic bias, and limited employee understanding, which can hinder technology adoption. Third, most studies are still conceptual or literature-based, with limitations in quantitative data, sample size, and long-term empirical validation.

This gap opens up further research to integrate manufacturing engineering approaches, such as system optimization, simulation-based evaluation, and decision support systems, into the context of AI-based HRM. Thus, the literature contributes not only to improving conceptual understanding but also to developing implementable models that have been tested in real-world contexts, particularly in vocational education institutions or manufacturing organizations that require a balance between technology and human performance.

This study aims to optimize human resource performance evaluation at SMK Darut Taqwa by integrating artificial intelligence (AI)-based learning media and industrial engineering methodology. In the era of digital transformation and Industry 4.0, the integration of AI in human resource management (HRM) shows great potential in improving the efficiency, objectivity, and quality of performance evaluation, as well as digitizing HR processes. On the other hand, an industrial engineering methodology-based approach allows the application of system optimization techniques, simulation-based evaluation, and decision support systems, which offer solutions to minimize these weaknesses. Therefore, this study proposes an implementation model that not only contributes to an improved conceptual understanding of AI in HRM but also provides practical solutions that can be directly applied at SMK Darut Taqwa and similar institutions. With this approach, it is hoped that the performance evaluation process can be more efficient and in line with industry needs, as well as produce human resources who are ready to face the challenges of the world of work in the digital era.

2. Research methodology

2.1. Design

This research employed quantitative methods, focusing on the collection and analysis of numerical data to test hypotheses and generalize findings to a broader population. This approach utilizes data in the form of calculations to objectively answer research questions. In its implementation, an evaluation system was developed by integrating AI-based adaptive learning media capable of recording learning activities, assessment results, and teacher-student interactions. This data is used to objectively and in real-time assess teacher performance. The system is also equipped with an analytical dashboard accessible to school management to continuously monitor the development of human resource performance.

2.2. Population and Sample

This research used a quantitative approach with a case study design at Darut Taqwa Vocational High School. The subjects included all 70 teachers and 400 students. Data were collected through surveys, interviews, observations, and data analysis using an AI-based evaluation system. AI can provide personalized feedback and help students identify and improve weaknesses in their written work.(Hindra Kurniawan et al., 2024).

2.3. Observations and Interviews

Darut Taqwa Vocational School is a pesantren-based vocational high school with 400 students and 70 teachers. The curriculum integrates vocational education and Islamic values, focusing on developing students' character and competencies.

2.4. Research Tools

Data were analyzed using descriptive and inferential statistics to measure changes in efficiency, objectivity, and user (teacher and student) satisfaction with the new evaluation system.

2.5. Research Procedure

This research procedure follows structured stages to achieve the desired objectives. The first stage is data collection, where information needed for the research is gathered through various methods such as interviews, surveys, or observations. Next, the second stage is data analysis, where the collected data is analyzed to identify patterns, relationships, or important findings using statistical techniques or other analytical methods. The third stage is the presentation of the results using a sequence diagram, where the results of the data analysis are presented in an easily understood format. Finally, the fourth stage is the conclusion, based on the results obtained and providing recommendations or implications of the research (Figure 1).

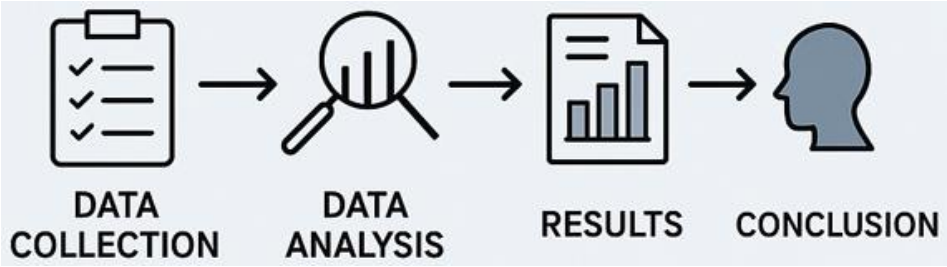

Figure1. Research Flow

3. Results and Discussion

3.1. Result

3.1.1. Implementation of AI-Based Evaluation System

The AI-based evaluation system was successfully implemented for all teachers. The use of AI technology is very helpful in the education sector and educators feel the need to know and deepen it through real practices in the field so as to increase teacher competence in facing the digitalization era in 2030.(Sari et al., 2024)This system is modeled in a sequence diagram

that can record learning activities, assessment results, and teacher-student interactions, and automatically generate performance reports. Teachers receive real-time feedback on strengths and areas for improvement. An analytical dashboard makes it easy for school management to periodically monitor teacher performance progress (Figure 2).

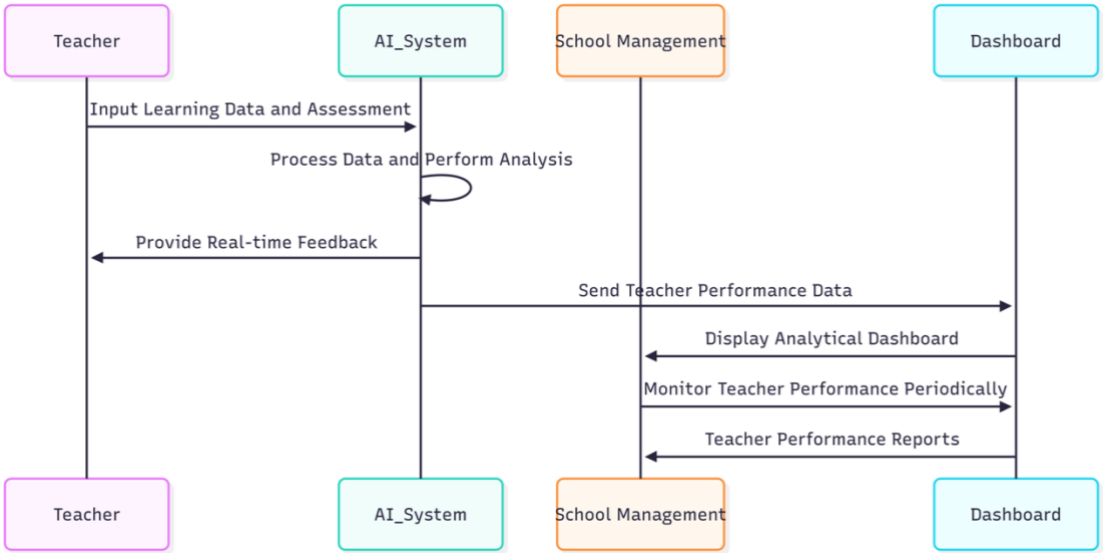

Figure2. Sequence Diagram for Teacher Performance Monitoring and Feedback System

3.1.2. Evaluation Process Efficiency Analysis

The application of industrial engineering methodology showed a 40% reduction in teacher performance evaluation processing time compared to manual methods (Table 1). The application of Lean Six Sigma methods can significantly improve the efficiency of Islamic education offices. The impact is seen in increased productivity, reduced waiting times, improved service quality, and cost savings.(Yusuf, 2023). AI systems reduce the potential for assessment bias and increase the accuracy of evaluation data.(Putra et al., 2025)The use of Lean Six Sigma in the teacher performance evaluation process results in a decrease in defects, process time, and increases employee awareness to improve working conditions. The Lean Six Sigma method with the DMAIC (Define, Measure, Analyze, Improve, Control) stages has proven effective in identifying and overcoming waste and increasing process efficiency.(Prahara & Nawangpalupi, 2021)(Figure 3).

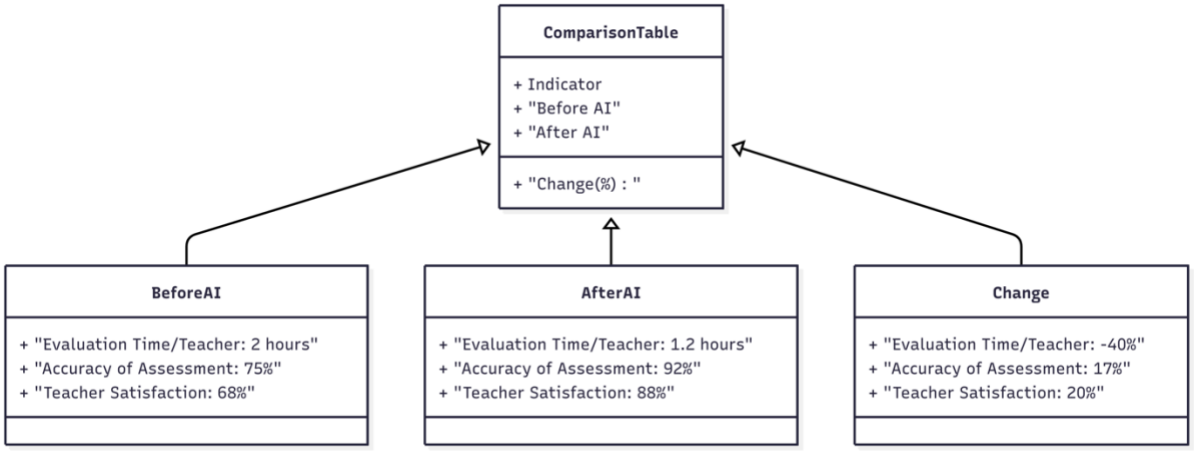

Figure3.Comparison of Teacher Performance Indicators Before and After AI Implementation

Table1. Comparison of Time and Accuracy

Indicator	Before AI	After AI	Change (%)
Evaluation time/teacher	2 hours	1.2 hours	-40%
Assessment accuracy*	75%	92%	17%
Teacher satisfaction (%)	68%	88%	20%

Note: *Accuracy is measured based on the conformity of evaluation results with actual performance data and student feedback.

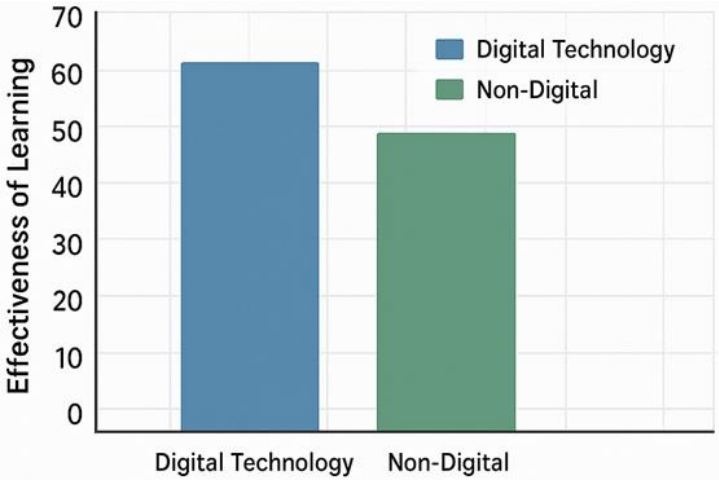

Figure4. Effectiveness of Learning

The implementation of this approach is clearly visible through performance indicators such as a reduction in evaluation time per teacher from 2 hours to 1.2 hours (a 40% decrease), an increase in assessment accuracy from 75% to 92% (a 17% increase), and an increase in teacher satisfaction from 68% to 88% (a 20% increase) (Figure 4). By integrating Lean Six Sigma principles into internal systems and AI-based digitalization processes, the Islamic education office has successfully created a system that is faster, more accurate, and oriented towards sustainable service quality. Lean Six Sigma has successfully reduced wasted waiting time, improved service quality, and saved costs at the Islamic education office. Improvements in internal control also serve to support the company's operational activities to run more effectively and efficiently.(Yusuf, 2023)(Mayangsari, 2013).

3.1.3. Impact on the Quality of Educational Services

Teachers reported increased motivation and job satisfaction due to a more transparent and fair evaluation process. Students also experienced improved learning quality through adaptive and interactive AI media. Teacher professionalism and digital literacy skills simultaneously impacted learning quality by 43.4%. Digital literacy training, such as the Journalism and Digital Literacy School at SMKN 3 Bojonegoro, has successfully improved teachers' skills in utilizing information technology for learning.(Sri Dwijayanti & Sari, 2021)(Dzulfian Syafrian, 2025)Analytical data from the AI system is used by school management to design more targeted training and human resource development.

3.1.4. Implementation Challenges and Solutions

Key challenges include resistance to change from some teachers, the need for training on how to use AI systems, and data privacy issues. Solutions implemented include intensive training, publicizing the system's benefits, and implementing data protection policies.

Some teachers at SMK Darut Taqwa may experience resistance or disapproval of the use of AI systems. This often stems from concerns about changing work practices, fears that technology will diminish their roles, or a lack of understanding of how AI systems work and their benefits. This resistance to change is often driven by psychological factors and a lack of understanding of how AI systems can support their work in improving the quality of teaching and evaluation. The use of AI in teacher performance evaluations at SMK Darut Taqwa requires intensive training to ensure teachers are proficient in this technology. This training is crucial to ensure they understand how the system works, how data is collected and analyzed, and how interpreting evaluation results can help improve their teaching competencies. Without adequate training, there is a risk that teachers will not be able to harness the full potential of AI, which could hinder system acceptance.

When implementing an AI system, personal data related to assessment results, learning activities, and interactions between teachers and students will be collected and processed. This can raise concerns about data privacy and security among teachers and students. SMK Darut Taqwa needs to ensure this data is well protected from potential misuse or leakage. Privacy issues are crucial, especially considering that educational data is sensitive information that must be managed carefully.

3.2. Discussion

To address the challenges faced by SMK Darut Taqwa in implementing an AI-based evaluation system, several integrated solutions were implemented. Intensive training was provided to all teachers to ensure they understood how the AI system worked and could use it effectively, thereby reducing resistance to change and increasing confidence in adopting new technology. Furthermore, socialization of the system's benefits was conducted to

introduce the advantages of using AI, such as increased evaluation time efficiency, assessment accuracy, and the provision of real-time feedback, which can improve teacher performance. Equally important, the implementation of a strict data protection policy was implemented to maintain the privacy and security of data collected through the AI system, ensuring that teacher and student personal data were well protected. With these steps, it is hoped that the implementation of the AI system at SMK Darut Taqwa will run smoothly and provide optimal benefits in improving the quality of education and teacher performance. The results of this study are in line with previous findings that the integration of AI in HR performance evaluation can increase the objectivity and efficiency of the assessment process. The use of industrial engineering methodology has also been shown to be effective in identifying and reducing time wastage and increasing productivity. However, the success of the implementation is greatly influenced by the readiness of HR and the support of school management.In the performance management dimension,(Varma et al., 2024)And(Gupta et al., 2024)shows that AI can improve objectivity, efficiency, and influence performance factors in the digital age, although the limitations of a small sample size and the lack of quantitative data are significant weaknesses. Other studies such as(Gupta et al., 2024) And(Tusriyanto et al., 2023)strengthens the findings, but both face limitations in empirical evidence. Meanwhile,(Cahyatih Kumandang et al., 2022)And(Wibowo et al., 2024)highlights comparative aspects and exploratory interviews. Variations in AI adoption across industries as well as potential efficiencies in HR practices, although generalizations are still limited (Kurniawan et al., 2025; Melina Sari & Titin Hargyatni, 2025; Ruengdech et al., 2024).

From a quantitative methodology perspective, the research(Murugesan et al., 2023)A study involving 271 HR respondents showed that AI strengthens organizational adaptability, workplace safety, and network analysis. Similar results were shown by(Melina Sari & Titin Hargyatni, 2025)A study combining mixed methods found an increase in HR efficiency of up to 45%. However, 80% of employees did not understand AI mechanisms and 60% were concerned about algorithmic bias. This suggests a trade-off between organizational efficiency and human resource readiness. A bibliometric-based study by(Baskara et al., 2025)shows an increasing trend in annual publications from 2020 to 2023, with increasingly strong international collaborations, indicating that the AI-HRM topic has entered a phase of global exploration (Nosratabadi et al., 2022) and (Fragiadakis et al., 2025) broadens the perspective by highlighting the employee lifecycle and human-AI collaboration, through a systematic review approach and a methodological evaluation framework. While comprehensive, both are still conceptual in nature and thus require broader empirical testing.(Mollaei et al., 2023; Plakantara et al., 2024).This research also emphasizes the importance of training and mentoring teachers in dealing with technological change. Furthermore, ethical and data

privacy aspects must be a primary concern in the development and implementation of AI-based systems in education.(Fatimatuzzahra & Hidayat, 2024). A teacher performance assessment model that is developed sustainably can improve educational accountability and support teacher professional development.(Muslikhin, 2024)Training, work motivation, and professional competence collectively have a significant influence on teacher performance, with the influence of these three variables accounting for 70%. The implementation of educational technology in Islamic educational institutions demonstrates that a holistic transformation strategy can bring significant benefits in improving the quality of learning.(Gutara et al., 2021).

4. Conclusions and Recommendations

This study shows that the integration of artificial intelligence (AI) in human resource performance evaluation at SMK Darut Taqwa has significantly impacted the efficiency, accuracy, and satisfaction of teachers. Before the implementation of AI, the time required for teacher performance evaluation was 2 hours, but after the implementation of AI, the evaluation time was reduced to 1.2 hours, representing a 40% decrease. Assessment accuracy increased from 75% to 92%, representing a 17% improvement, while teacher satisfaction increased from 68% to 88%, representing a 20% improvement. Despite challenges such as resistance to change, the need for intensive training, and data privacy concerns, the implemented solutions, including intensive training, socialization of the system's benefits, and the implementation of a data protection policy, successfully overcome these obstacles. With the appropriate implementation of AI technology, SMK Darut Taqwa was able to optimize teacher performance evaluation more efficiently and provide more accurate and rapid feedback, which in turn improved the quality of teaching and teacher performance in the digital era.

Declaration of Competing Interest

None.

Acknowledgment

The research output activity in the form of this article has been completed.

CRediT authorship contribution statement

Rudi Kurniawan contributed to the conceptualization, methodology design, data analysis, original draft writing, and manuscript review and editing.

Data Availability Statement

None.

Funding

There is no funding to report for this paper.

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