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Analysis of the Influence of Transformational Leadership Style and Employee Competence on Work Productivity: A Random Forest Machine Learning Approach

(*Analisis Pengaruh Gaya Kepemimpinan Transformasional dan Kompetensi Karyawan terhadap Produktivitas Kerja: Pendekatan Pembelajaran Mesin Random Forest*)

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Abstract:

Objective : This study investigates the influence of organizational culture and leadership style on employee performance, with work motivation as a mediating variable at PT Indonesia Chemi-Con. A quantitative survey was conducted using structured questionnaires distributed to employees

Methodology : Data were analyzed through path analysis to examine direct and indirect relationships among variables.

Research results : The results show that organizational culture and leadership style have a significant positive effect on employee performance, both directly and indirectly through work motivation. A strong organizational culture enhances motivation and aligns employee behavior with company objectives, while participative leadership strengthens commitment and role clarity. Work motivation significantly mediates the relationship between culture, leadership, and performance. The study highlights the strategic importance of motivation in improving organizational effectiveness within the manufacturing sector. Future research should broaden variables and sample coverage to increase generalizability.

Keyword: Organizational Culture, Leadership Style, Work Motivation, Employee Performance

1. Introduction

Employee Employee productivity is a fundamental indicator of organizational success, particularly in the manufacturing and automotive machining parts industries where efficiency and product quality are critical. Productivity is shaped not only by technical aspects but also by organizational behavior, including leadership style and employee competence. Transformational leadership has been shown to enhance motivation, commitment, and engagement by inspiring employees, developing individual potential, and fostering innovation (Banks et al. 2021; Ibrahim et al. 2022). At the same time, employee competence encompassing knowledge, technical skills, and professional attitudes plays a vital role in ensuring work effectiveness and production quality (Hamouche, 2021; Sutarman et al. 2024). Previous studies have largely relied on conventional statistical approaches such as regression or Structural Equation Modeling (SEM) to examine the relationship between leadership, competence, and productivity (Purwanto et al. 2021; Indriani et al. 2024). While valuable, these methods are limited in capturing non-linear patterns and complex interactions among human resource indicators

(Koopmans et al. 2021). With the advancement of data analytics, machine learning has emerged as a powerful tool in human resource management, offering higher accuracy and more comprehensive performance predictions (Margherita, 2021; Minbaeva, 2021). Among these, the Random Forest algorithm stands out for its ability to combine multiple decision trees, generate stable predictions, and identify dominant variables through feature importance analysis (Biau and Scornet, 2020; Probst et al. 2019). Recent studies confirm its effectiveness in processing complex HR data and producing robust predictive models compared to traditional methods

(Sharma and Singh, 2023; Saprudin et al. 2025). Although many studies have examined the relationship between leadership, competence, and productivity, significant gaps remain. Methodologically, traditional models struggle to capture non-linear and high-dimensional HR dynamics. Analytically, they rarely provide a clear hierarchy of which indicators most strongly drive productivity. Contextually, research applying advanced machine learning to HR metrics in the automotive machining industry is still scarce, as most studies focus on technology or banking

sectors. Addressing these gaps, this study applies the Random Forest algorithm to analyze the influence of transformational leadership and employee competence on productivity at PT. Adi Tehnik Mandiri, Bekasi. The novelty lies in integrating machine learning into HR analytics, offering superior predictive accuracy and feature importance analysis that highlights the most influential variables. By situating this approach within a localized SME manufacturing context, the study provides both theoretical enrichment and practical recommendations, demonstrating the scalability of Industry 4.0 technologies in human resource management.

2. Literature Review

2.1. Transformational Leadership

Transformational leadership has been increasingly emphasized in recent studies as a leadership style that motivates employees to go beyond standard expectations by fostering innovation, commitment, and adaptability. Research in the past five years shows that this leadership approach significantly enhances organizational performance and employee engagement, particularly in manufacturing and digital-era contexts (Banks et al. 2021; Ibrahim et al. 2022). More recent findings highlight its role in guiding employees through technological change and Industry 4.0 challenges, strengthening creativity and resilience in the workplace.

2.2. Employee Competence

Employee competence is defined as the integration of technical knowledge, operational skills, and professional attitudes that enable individuals to perform effectively. In the manufacturing sector, competence is directly associated with precision in machining processes and adherence to strict quality standards. Studies conducted in the last five years confirm that competence strongly influences productivity and reduces error rates, while digital competence has become increasingly vital in adapting to technological advancements and automation (Sutarman et al. 2024).

2.3. Work Productivity

Work productivity is a multidimensional construct that combines effectiveness in achieving production targets with efficiency in resource utilization. In the automotive machining industry, productivity is measured not only by output volume but also by compliance with quality specifications and minimization of defective products. Recent literature emphasizes that productivity should be assessed through both quantitative and qualitative indicators, incorporating psychosocial and technical factors that influence performance outcomes (Koopmans et al. 2021; Ratnasahara et al. 2025).

2.4. Random Forest in HR Analytics

Random Forest has emerged as a robust machine learning algorithm in HR analytics, capable of handling complex non-linear data patterns and identifying dominant variables through feature importance analysis. Compared to traditional regression models, Random Forest provides superior predictive accuracy and stability (Biau and Scornet, 2020; Probst et al. 2019). Recent applications in HR research demonstrate its effectiveness in predicting employee performance, attrition, and productivity, making it particularly relevant for analyzing leadership and competence factors in industrial contexts (Sharma and Singh, 2023; Saprudin et al. 2025).

3. Research Methodology

This study adopts a quantitative approach aimed at testing hypotheses and measuring research variables through numerical data supported by statistical analysis. The purpose of this approach is to obtain objective and measurable evidence regarding the influence of transformational leadership style and employee competence on work productivity. In line with the research objectives, the design combines descriptive and verificative elements through a survey method. The descriptive aspect is used to portray the actual conditions of leadership, competence, and productivity at PT. Adi Tehnik Mandiri Bekasi based on employee perceptions, while the verificative aspect seeks to identify causal relationships and the magnitude

of influence between the independent and dependent variables. The study is causal-associative in nature, focusing on how one variable affects another, and data were collected cross-sectionally at a single point in time. The research was conducted at PT. Adi Tehnik Mandiri (PT. ATM), a manufacturing company located in Bekasi, West Java, specializing in automotive component machining services. This location was selected due to observed fluctuations in productivity and high defect rates (No Good/NG) during the 2022–2024 period. The subjects of the study were employees in the production department, specifically machine operators, as they are directly involved in operational processes, precision demands, and production targets.

Data collection was carried out systematically to ensure validity and reliability. The primary instrument was a structured questionnaire consisting of closed-ended statements representing indicators of transformational leadership, employee competence, and work productivity, measured using a five-point Likert scale ranging from strongly disagree to strongly agree. In addition to the survey, field observations were conducted in the production workshop to capture real-time interactions between supervisors and operators and to assess the application of technical competencies in operating machinery. Documentation studies were also employed to gather secondary data, including company profiles, organizational structures, production reports comparing targets and realizations, and defect rate records from 2022 to 2024, which served to validate issues of quality and efficiency.

4. Results and Discussion

This study involved 115 respondents, all of whom were employees in the production division of PT. Adi Tehnik Mandiri Bekasi. The majority of participants were male and within the productive age range, a demographic particularly relevant to the technical demands of the automotive machining industry. Such work requires sustained concentration, physical stamina, and precision in operating machinery to meet production targets. Prior to conducting the machine learning analysis, the research instrument was tested for validity and reliability. The validity test confirmed that all indicators for transformational leadership, employee competence, and work productivity exceeded the minimum correlation threshold of 0.60, indicating that

each item accurately represented its respective construct. The summary of the validity test is presented in Table 1.

Table 1. Summary of Instrument Validity Test

Variable	Number of Items	Correlation Range	Status
Transformational Leadership	10	0.61 – 0.79	Valid
Employee Competence	7	0.70 – 0.88	Valid
Work Productivity	13	0.68 – 0.92	Valid

Source: Primer Data, 2026

All indicators met the validity requirements, confirming that the instrument was suitable for data collection. Reliability testing was then conducted using Cronbach's Alpha, with all variables producing values above 0.90. This demonstrates a very high level of internal consistency, as shown in Table 2.

Table 2. Instrument Reliability Test Results

Variable	Cronbach Alpha	Criteria
Transformational Leadership	0.978	Highly Reliable
Employee Competence	0.947	Highly Reliable
Work Productivity	0.973	Highly Reliable

Source: Primer Data, 2026

These results confirm that the instrument was both valid and reliable, making it a trustworthy measurement tool for the study. The Random Forest algorithm was subsequently applied to analyze the data. Model evaluation produced a Mean Squared Error (MSE) of 0.158, a Root Mean Squared Error (RMSE) of 0.398, and a classification accuracy of 85.7%. The classification performance metrics are summarized in Table 3.

Table 3. Random Forest Model Evaluation Results

Parameter	Value
Accuracy	0.857
Precision	0.778
Recall	0.933
F1-Score	0.848

Source: Primer Data, 2026

The results indicate that the Random Forest model achieved strong predictive accuracy and demonstrated consistent performance in classifying work productivity categories. The coefficient of determination (R^2) was 0.473, meaning that transformational leadership and employee competence together explained 47.3% of the variance in work productivity. The remaining 52.7% was attributed to other factors outside the scope of this study, such as machinery conditions, workplace environment, or compensation systems. Feature importance analysis revealed that employee competence was the most dominant factor influencing productivity, particularly through technical proficiency and operational precision. Transformational leadership also contributed significantly by motivating employees to achieve production targets and reduce defective products.

The findings highlight that transformational leadership has a positive and significant impact on productivity. Leaders who provide inspirational motivation and intellectual stimulation encourage employees to perform beyond standard expectations, which is crucial for PT. Adi Tehnik Mandiri in addressing the surge of defective products that reached 17,537 units in 2024. Strong leadership fosters greater diligence and accountability in maintaining work quality. Similarly, employee competence was confirmed as a key driver of productivity. In the automotive machining industry, technical knowledge and operational skills are indispensable. Competent employees are able to minimize procedural errors, which are often the primary cause of rejected products. This supports the theoretical perspective that mastery of expertise is directly proportional to efficiency and output quality. Taken together, leadership and competence contributed significantly to productivity,

explaining nearly half of its variance. The model's accuracy of 85.7% demonstrates that combining inspiring leadership with competent employees is an effective strategy to restore production stability and close the gap between actual output and production targets. These findings suggest that PT. Adi Tehnik Mandiri should integrate leadership development with technical training programs to strengthen human resource capacity and achieve sustainable operational efficiency.

5. Conclusion and Suggestions

This study demonstrates that both transformational leadership and employee competence significantly influence work productivity at PT. Adi Tehnik Mandiri Bekasi. Transformational leadership was found to positively affect employee performance by providing inspirational motivation, role modeling, and individualized support, which encouraged operators to work more diligently and reduced human error under production pressures. Employee competence emerged as the dominant factor, with technical knowledge, operational skills, and professional attitudes proving essential in achieving precision and minimizing defective products. When analyzed simultaneously, these two variables explained 47.3% of productivity variation, while the Random Forest model achieved an accuracy of 85.7%. These findings confirm that the combination of inspiring leadership and competent employees is a reliable predictor of productivity outcomes and highlight the importance of integrating leadership development with technical training to enhance organizational performance.

Based on these conclusions, several recommendations can be made. For the management of PT. Adi Tehnik Mandiri Bekasi, it is advisable to strengthen employee competence through regular training programs focused on advanced machining technologies and adherence to Standard Operating Procedures, thereby reducing reject rates. Leadership development initiatives should also be prioritized, equipping supervisors and production managers with skills in persuasive communication and coaching to foster motivation and accountability. In addition, establishing structured knowledge-sharing programs between experienced employees and new hires can accelerate adaptation and ensure consistent skill levels across production lines. For

future researchers, the unexplained variance of 52.7% suggests that other factors such as workplace environment, compensation systems, or machinery technology may also play a significant role in productivity. Subsequent studies could explore these variables and employ qualitative or mixed-method approaches to gain deeper insights into the psychological and social dynamics between leaders and subordinates, thereby enriching the understanding of productivity drivers in industrial contexts.

6. Daftar Pustaka

Banks, George C., Kyle D. McCauley, William L. Gardner, and Cenk E. Guler. "The Effects of Transformational Leadership on Organizational Performance: Testing the Mediating Effects of Knowledge Management." *Sustainability* 13, (14) (2021): 1-10.

Biau, Gérard and Erwan Scornet. "A Random Forest Guided Tour." *Sorbonne Université* 25 (2016): 197–227.

Hamouche, Salima. "Human Resource Management and the COVID-19 Crisis: Implications, Challenges, Opportunities, and Future Organizational Directions." *Journal of Management and Organization* 29, (5) (2021): 799–814.

Ibrahim, Muhammad, Muhammad Al-Amin, and Dwi Puspita Sari. "The Effect of Transformational Leadership, Work Motivation and Culture on Millennial Generation Employees Performance of the Manufacturing Industry in the Digital Era." *Frontiers in Psychology* 13 (2022): 1–5.

Indriani, Luh W., and Netty Herachwati. "Transformational Leadership, Job Competence, and Job Satisfaction as a Critical Predictor of Employee Performance: A Quantitative Study." 19, (1) (2024): 10–21.

Koopmans, Linda, Claire M. Bernaards, Vincent H. Hildebrandt, Stef van Buuren, Allard J. van der Beek, and Henrica C. W. de Vet. "Measuring Individual Work Performance: Identifying and Selecting Indicators." *Work* 48, (2) (2014): 229–238.

Margherita, Alessandro. "Algorithmic Human Resource Management: Synthesizing Developments and Cross-Disciplinary Insights on Digital HRM." *International*

Journal of Human Resource Management 32, (12) (2021): 2545–2562.

Minbaeva, Dana. "Disrupted HR?" *Human Resource Management Review* 31, (4) (2021): 1–10.

Probst, Philipp, Marvin N. Wright, and Anne-Laure Boulesteix. "Hyperparameters and Tuning Strategies for Random Forest." *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery* 9, (3) (2019): 1-12.

Purwanto, Agus, Innocentius Bernarto, Masduki Asbari, Lilis M. Wijayanti, Chang Hyun, and Rudy Pramo "Effect of Management Innovation, Transformational Leadership, and Knowledge Sharing on Market Performance of Indonesian Consumer Goods Company." *Journal of Applied Management* 19, (2) (2021): 424–434.

Saprudin, S., Y. Nugroho, and D. Rahmawati. "IBM HR Analytics on Employee Attrition and Performance Using Random Forest Classifier." *GeeksforGeeks* (2025).

Sharma, Shikha, and Rajesh Singh. "An Extensive Analytical Approach on Human Resources Using Random Forest Algorithm." *International Journal of Engineering Trends and Technology* 69, (5) (2023): 119–127.

Sutarman, Agus, Abdul Kadim, and Ali Garad. "The Effect of Competence and Organizational Commitment on Work Productivity of Indonesian Manufacturing Industries." *International Journal of Technology* 15, (5) (2024): 1449–1461.