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Impact of Technology Transformation on Service Quality: Service Speed as a Mediating Variable in Vehicle Inspection Sector

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ABSTRACT

Objective: *This study explores the impact of technological transformation on service quality in vehicle KIR testing services at the Jember Regional Office of the Transportation Agency, emphasizing the mediating role of service speed.* ***Method:*** *Using a quantitative research approach with Structural Equation Modeling (SEM) via SmartPLS 4, the study analyzes data collected from 190 respondents who utilized KIR services.* ***Results:*** *The findings demonstrate that technological transformation significantly enhances service speed and service quality, with service speed serving as a critical intermediary in translating technological advancements into improved user satisfaction. The adjusted R^2 values indicate that 41.2% of the variance in service speed and 74.8% of the variance in service quality are explained by technological transformation and service speed.* ***Novelty:*** *These results highlight the importance of integrating digital infrastructure with operational efficiency to optimize public service delivery. The study provides theoretical contributions to the understanding of service speed as a mediating factor while offering practical recommendations for policymakers to prioritize digital transformation initiatives in enhancing public service quality. Limitations of the study and avenues for future research are also discussed to expand the generalizability of the findings.*

INTRODUCTION

Vehicle inspection especially motor testing (KIR/KEUR) is a crucial aspect in ensuring public transportation safety and highway safety. Digital transformation in vehicle testing has changed the paradigm of conventional services to be more efficient and accurate through the implementation of modern technology [1]. Digital inspection systems allow thorough inspections to be completed in minutes with the help of *AI* technology and 360° scanning, which significantly improves accuracy and reduces the potential for human error [2]. The integration of Industry 4.0 technologies in automotive logistics and vehicle testing has also improved process transparency and overall operational efficiency [3]. The implementation of digital testing systems not only improves service quality but also helps to identify vehicles with high pollutant emissions more effectively, which contributes to environmental protection efforts [4].

The purpose of implementing motor vehicle testing based on the Regulation of the Minister of Transportation Number PM 133 of 2015 is to ensure the technical feasibility of motor vehicles operating on the road in order to ensure safety, comfort, security, and transportation efficiency. This test also aims to support environmental protection efforts through the control of exhaust gas emissions, in accordance with applicable standards. So, motor vehicle testing is an important part of sustainable and public service-oriented land transportation management [5].

Jember Transportation Department has a strategic role in carrying out motor vehicle testing (KIR test) as part of efforts to improve transportation safety and comfort in the

region. As a responsible agency, Jember Transportation Department has implemented various policies to ensure that vehicles operating on the highway meet the technical and environmental standards that have been set. In an effort to improve service quality, the Jember Transportation Department also continues to adapt to technological developments, such as the use of digital systems in vehicle testing, which speeds up the inspection process and improves the accuracy of test results. Through this digital transformation, the Jember Transportation Department not only improves service efficiency, but also plays an active role in controlling air pollution by ensuring that vehicle emissions remain within safe limits, in accordance with applicable regulations.

Table 1. Service quality phenomenon based on satisfaction survey in 2024.

Year	Indicator									Sum
	Speed			Hospitality			Satisfaction			
	Highly satisfied	Satisfied	Dissatisfied	Highly satisfied	Satisfied	Dissatisfied	Highly satisfied	Satisfied	Dissatisfied	
2020	531	21	11	511	37	15	539	22	2	1689
2021	791	25	13	781	27	21	792	33	4	2487
2022	811	22	14	788	43	16	802	40	5	2541
2023	903	41	7	905	38	8	912	34	5	2853
2024	1012	40	19	1021	40	10	1015	52	4	3213
Total	4048	149	64	4006	185	70	4060	181	20	12783

Source : Vehicle Inpection Unit, Jember Transportation Department (2024)

The phenomenon of the quality of motor vehicle testing services in Jember Regency shows a discrepancy between the increase in community satisfaction scores and the decrease in the number of vehicles taking the KIR test. Although the results of the public satisfaction survey from 2020 to 2024 show very positive figures, with significant improvements in the indicators of speed, friendliness, and satisfaction (especially in 2024, where more than 1,000 respondents stated that they were very satisfied with the service), there was a fairly sharp decline in the level of vehicle participation in the KIR test as recorded in Table 1, Although satisfaction with the speed of service reached 1,012 respondents who were very satisfied in 2024, the percentage of vehicles participating in the KIR test actually showed a downward trend, especially in the types of passenger cars and freight cars. Based on this, an in-depth analysis is needed related to the factors that can affect this, one of which is the quality of service.

Service quality is a crucial factor in determining the success of an organization in meeting the needs and expectations of service users [5]. Good service quality is important for the survival of the company [6]. The evaluation of the quality of transportation services must consider various aspects such as reliability, responsiveness, assurance, empathy, and physical evidence that can be measured through quantitative and qualitative approaches [7]. Digital transformation in transportation services has changed the way organizations interact with customers, with technology being a key enabler in

improving operational efficiency and user experience [8]. The implementation of modern technology in public services not only improves the speed of services but also contributes to the improvement of process accuracy and transparency [9]. The use of information and communication technology in transportation services allows for the collection of real-time data that can be used for service optimization and better decision- making. Good service quality will result in higher customer satisfaction, which in turn can increase loyalty and sustainable use of services [7].

Service speed is a critical factor in determining the level of customer satisfaction and overall service quality in the service sector [10]. Service speed is defined as a service time target that can be completed within a predetermined time by the service provider unit to achieve community satisfaction. The effective implementation of service speed can directly affect the perception of service quality and customer satisfaction [11]. Service completion time in fulfilling promised services also has a significant impact on customer satisfaction. Speed and the ability to respond to customer needs are the main focus in the quality service dimension. Empirical studies show that speed of service has a positive and significant influence on customer satisfaction, which in turn contributes to customer loyalty [12].

This study proposes service speed as a mediating variable on the grounds that service speed has a crucial role in connecting technological transformation and facility utilization with service quality. The implementation of technological transformation, such as integrated information systems and modern test equipment, is expected to shorten service time and improve the efficiency of the KIR test process. Similarly, the use of adequate facilities and infrastructure, including service facilities and comfortable waiting rooms, can contribute to the speed and smoothness of the service process. With the increase in service speed, the service user community will experience an improvement in service quality which is characterized by time efficiency and ease of access. Therefore, service speed is positioned as an intervening variable that mediates the influence of technological transformation and the use of facilities on the quality of KIR test services.

Technological transformation in the digital era has become the main driver of fundamental changes in business practices, models, and operational processes, including in terms of improving service quality [13]. The implementation of Industry 4.0 technologies such as the Internet of Things (IoT), blockchain, cloud computing, and artificial intelligence has enabled better integration across vertical and horizontal value chains [13]. Digital transformation is not only changing the way organizations interact with customers but also improving operational efficiency through process automation, real-time data analysis, and artificial intelligence systems that aid in decision-making [8]. The use of AI technology in service transformation has been proven to improve reliability, operational efficiency, and user satisfaction through more accurate schedule and route optimization [14]. The success of digital transformation is highly dependent on the readiness of the organization to change, which includes aspects of technology, culture, and adaptability to change [15].

Several previous studies have examined the relationship between variables in the context of public services. Technological transformation has a positive and significant influence on service quality through improved operational efficiency and user experience [17]. The implementation of technological transformation has been proven to increase service speed through process automation and artificial intelligence systems that help make decisions faster [18]. Service speed has a positive and significant influence on service quality, where the faster the service is provided, the higher the perception of service quality perceived by users [11], [19]. This study detected several gaps in previous studies related to the relationship between the variables studied. Research finds that digital transformation and information technology infrastructure do not directly affect service quality, but must be through service quality commitments first, and this influence will only be significant if added by environmental complexity as an intermediary [20]. The gap in the results of this study shows that there are still inconsistencies in the relationships between the variables studied, so further research is needed to clarify these relationships in the context of vehicle KIR test services.

Based on the phenomenon of inconsistency between the increase in service satisfaction score and the decrease in KIR test participation at the Jember Transportation Department, as well as the gap in the results of previous research related to the relationship between variables, this study is important to analyze the influence of the implementation of service technology transformation on service quality through service speed as a mediating variable in vehicle KIR test services at the Jember Transportation Department. Practically, the results of this study can be the basis for evaluating and improving the KIR test service policy at the Jember Transportation Department to increase public participation in motor vehicle testing, which ultimately contributes to improving public transportation safety and environmental protection. The originality or novelty of this research lies in testing the role of service speed mediation in the relationship between service technology transformation, and service quality in the specific context of vehicle inspection services at Jember Transportation Department. This study uses the latest empirical data to comprehensively analyze how service speed affects the relationship between these variables, so that it is expected to provide a deeper understanding and a real contribution to improving the quality of KIR testing services.

RESEARCH METHOD

This study uses a quantitative research design with the explanatory research method to test the influence between research variables. The population in this study includes all people of Jember Regency who have the obligation to carry out vehicle KIR tests, both through online and offline services at the Jember Transportation Department. Because the number of population is not known for sure, this study uses a purposive sampling technique with the criteria for inclusion of people who have used vehicle inspection services. The determination of the number of samples refers to the formula, which is at least 10 times the number of indicators [21] With 19 indicators in this study, the minimum number of samples is 190 respondents. This research covers three main

variables, namely technological transformation (X1), service speed (Z), and service quality (Y). Each variable is defined through specific indicators to ensure accurate measurements. Primary data was obtained through a questionnaire based on the Likert scale which was designed to measure respondents' perception of each variable. In addition, secondary data is collected from a variety of reliable sources, such as government reports, scientific publications, and academic journals, to complement the primary data and provide context for research analysis.

For data analysis, this study employs SmartPLS 4, a state of the art tool for conducting Partial Least Squares Structural Equation Modeling (PLS-SEM). This method is particularly suitable for analyzing complex models involving multiple latent variables and numerous indicators, making it ideal for research contexts that require nuanced exploration of relationships between variables. PLS-SEM is widely recognized for its flexibility in handling data that may not conform to a normal distribution, making it especially advantageous for studies with small sample sizes or non-parametric characteristics. The analytical process in this study is conducted in two main stages to ensure the rigor and reliability of the findings. The first stage, known as the outer model assessment, focuses on evaluating the validity and reliability of the constructs.

The second stage is the inner model assessment, which examines the structural relationships between latent variables. SmartPLS 4 was specifically chosen for its advanced features and capabilities, which align well with the research parameters. The software effectively manages complex relationships in models with multiple indicators, allowing for simultaneous analysis of direct and indirect effects. Its non-parametric bootstrapping method enhances the reliability of significance testing, particularly in datasets with limited sample sizes. Additionally, the software's ability to handle reflective and formative measurement models ensures flexibility in construct specification.

The insights derived from these analyses are expected to provide practical recommendations for improving vehicle KIR services in Jember Regency. By leveraging technology, the study aims to identify strategies to enhance service speed and quality, addressing key challenges faced by the Transportation Department. For example, findings related to service efficiency and user satisfaction can guide the development of technology-driven solutions, such as digital platforms for service delivery and automated processes to reduce administrative delays. Furthermore, the results can inform policymaking and resource allocation, ensuring that improvements are sustainable and aligned with the needs of service users. In the end, SmartPLS 4 enables this study to comprehensively explore the relationships between variables, offering robust and actionable insights. The application of PLS-SEM ensures that both theoretical and practical contributions are derived, paving the way for significant advancements in vehicle KIR services and broader public service innovations.

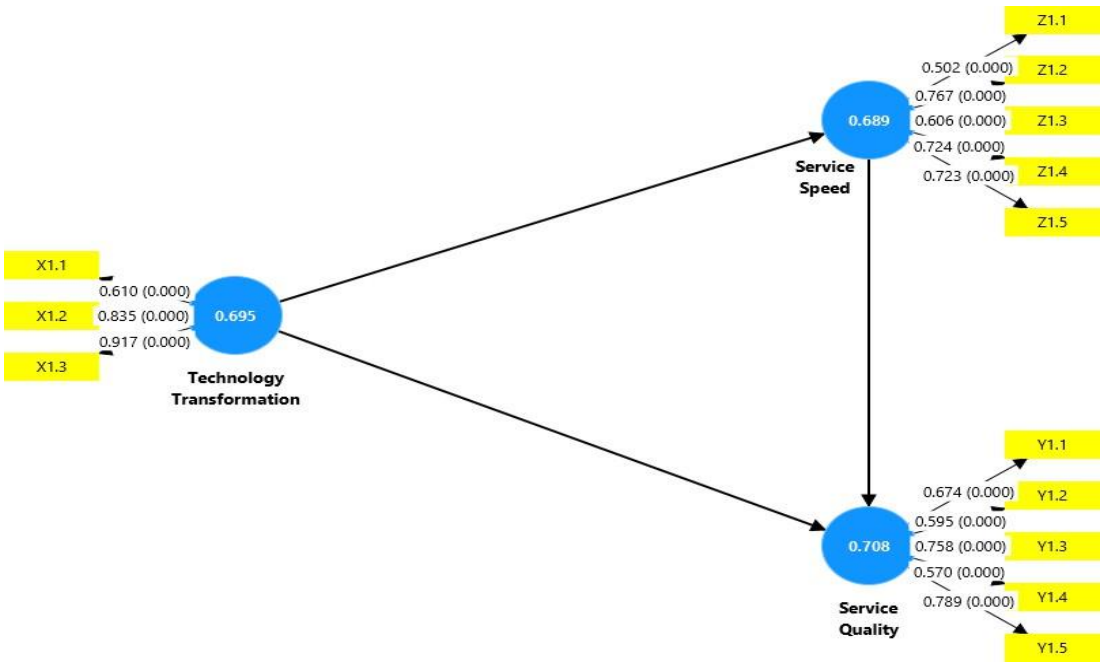

Figure 1. Outer model result.

Based on the results of the outer model analysis, Cronbach's Alpha (CA) values for each latent variable showed good results, with values of 0.695 for Technology Transformation, 0.689 for Service Speed, and 0.708 for Service Quality. These values indicate that the indicators used have sufficient internal consistency to represent each of the latent constructs. The indicators in the Technology Transformation variable showed a significant contribution, with the highest loading factor in the X1.3 indicator (0.917). In the Service Speed variable, the Z1.4 indicator (0.724) makes the largest contribution in reflecting the latent variable. Meanwhile, for Service Quality, the Y1.5 indicator (0.789) has the most dominant contribution. With its tested validity and reliability, the constructs in this model can be declared feasible for use in further analysis. This reflects that each indicator consistently and significantly represents the variable being measured.

RESULTS AND DISCUSSION

Results

The results of this study provide an in-depth analysis of the relationship between technology transformation, service speed, and service quality within the context of vehicle inspection services at Jember Transportation Department. Using SmartPLS 4 for data analysis, this study focuses on evaluating both the measurement model (outer model) and the structural model (inner model) to explore how these variables interact and influence each other. The findings not only highlight the importance of technology transformation in improving service delivery but also emphasize the mediating role of service speed in enhancing service quality. These insights offer a comprehensive understanding of the key factors that drive public service efficiency and effectiveness.

The outer model results demonstrate strong validity and reliability for all constructs, as indicated by Cronbach's Alpha values above the minimum threshold. Each variable's indicators show significant contributions, reflecting their relevance in

capturing the latent constructs. Similarly, the inner model results highlight the significant impact of technology transformation on both service speed and service quality. The mediating effect of service speed further strengthens the overall relationship, underscoring its role as a critical factor in translating technological advancements into enhanced public service outcomes. These findings provide actionable recommendations for policymakers and practitioners aiming to optimize service quality through strategic technological integration and operational efficiency.

Table 2. Inner Model Result

Path	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Service_Speed -> Service_Quality	0.681	0.682	0.062	10.901	0.000
Technology_Transformation -> Service_Quality	0.254	0.255	0.070	3.634	0.000
Technology_Transformation -> Service_Speed	0.644	0.648	0.039	16.339	0.000
Technology_Transformation -> Service_Speed -> Service_Quality	0.439	0.442	0.048	9.085	0.000

Source: Data Processed by Researchers (2024)

The results of the inner model analysis highlight significant relationships between technology transformation, service speed, and service quality, demonstrating their interdependence in the context of public service delivery. Technology transformation shows a strong direct influence on service speed, as indicated by a path coefficient of 0.644, with a T-statistic of 16.339 and a p-value of 0.000. This finding underscores the critical role of technological advancements in improving the speed and efficiency of service delivery, supporting previous studies that emphasize the value of digital infrastructure in streamlining operations. Furthermore, the direct relationship between technology transformation and service quality is also significant, with a path coefficient of 0.254, a T-statistic of 3.634, and a p-value of 0.000. This demonstrates that technological innovation contributes to improved service quality, albeit to a lesser extent compared to its impact on service speed.

The mediating role of service speed in the relationship between technology transformation and service quality is particularly noteworthy, with a significant indirect effect (path coefficient = 0.439, T-statistic = 9.085, p-value = 0.000). This mediation effect illustrates how advancements in technology indirectly enhance service quality by first improving the efficiency and responsiveness of service speed. Additionally, the direct relationship between service speed and service quality, with a path coefficient of 0.681, a T-statistic of 10.901, and a p-value of 0.000, emphasizes the pivotal role of speed in shaping user perceptions of service excellence. Collectively, these findings highlight the importance of integrating technological solutions and operational efficiency to achieve

higher service quality, providing valuable insights for decision-makers in public service sectors aiming to optimize performance and customer satisfaction.

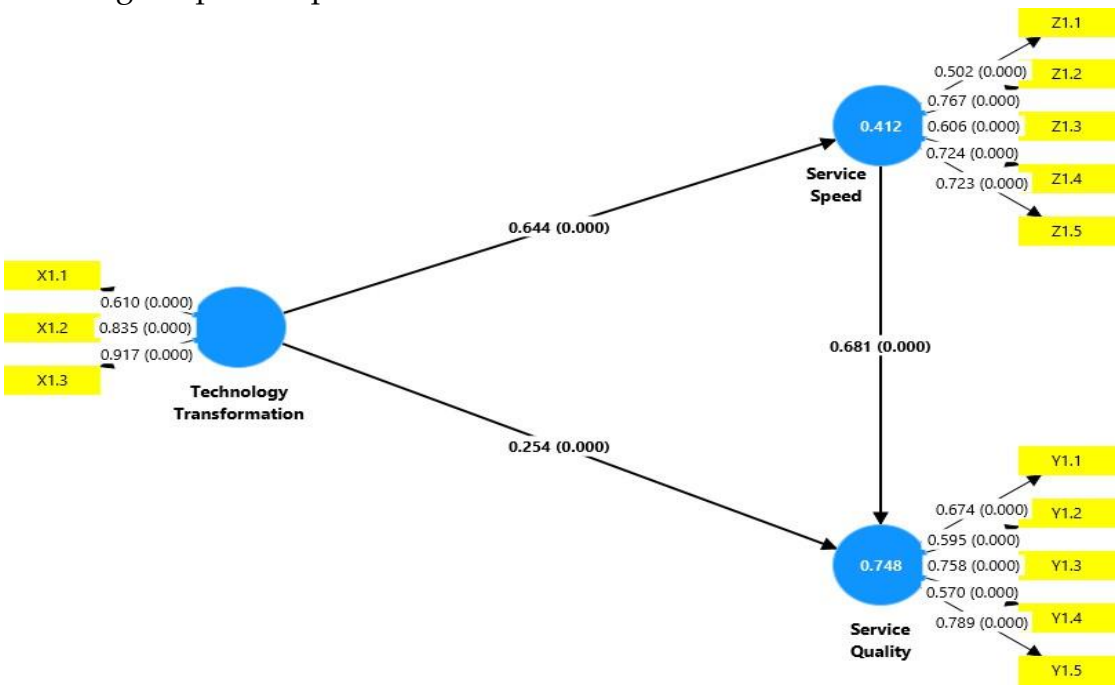

Figure 2. Path analysis results.

The results of the analysis reveal the predictive strength of the model, as reflected by the adjusted R^2 values for the latent variables. The adjusted R^2 for Service Speed is 0.412, indicating that 41.2% of the variation in service speed can be explained by the influence of technology transformation. This demonstrates the critical role of technology transformation in improving service speed, as it allows for streamlined processes, automation, and enhanced communication between service providers and users. The relatively high explanatory power of this variable underlines its importance as a driving factor in achieving operational efficiency in service delivery.

Meanwhile, the adjusted R^2 for Service Quality is 0.748, which shows that 74.8% of the variation in service quality can be explained by both technology transformation and service speed. This substantial value highlights the combined impact of these factors in shaping user perceptions of service excellence. Notably, the indirect contribution of technology transformation through service speed emphasizes the mediating role of speed in translating technological improvements into better service outcomes. These findings underscore the necessity of integrating technological advancements with efforts to improve operational responsiveness to achieve superior service quality, providing actionable insights for policymakers and organizational leaders aiming to enhance public service performance.

Discussion

The findings of this study emphasize the critical role of technological transformation in enhancing service speed and quality, particularly in the context of vehicle KIR testing services at the Jember Transportation Department. Technological transformation has a significant direct effect on service speed, with a path coefficient of 0.644, T-statistic of 16.339, and p-value < 0.000. This finding is consistent with prior

research, highlighting that the implementation of modern technology, such as integrated digital systems and process automation, substantially accelerates service completion and improves operational efficiency [14]. The integration of Industry 4.0 technologies, such as the Internet of Things (IoT) and artificial intelligence (AI), has proven instrumental in supporting faster and more accurate decision-making, enabling public service providers to better meet societal needs [3].

Furthermore, technological transformation directly impacts service quality with a path coefficient of 0.254, T-statistic of 3.634, and p-value < 0.000. This underscores the role of innovation in improving service transparency and reducing human error, as noted in previous studies [10]. However, the magnitude of its direct effect on service quality is relatively smaller compared to its impact on service speed, indicating that technological advancements are more impactful when mediated by service speed. These findings align with prior research asserting that digital transformation in public services enhances service quality through operational efficiency and improved user experience.

Service speed serves as a significant mediating variable in the relationship between technological transformation and service quality. The indirect effect of technological transformation on service quality through service speed, with a path coefficient of 0.439, T-statistic of 9.085, and p-value < 0.000, highlights how technological advancements indirectly improve service quality by enhancing speed and efficiency. Service speed allows users to experience the direct benefits of technology, such as faster response times, better accessibility, and smoother processes. Moreover, the direct effect of service speed on service quality, with a path coefficient of 0.681, T-statistic of 10.901, and p-value < 0.000, underscores its critical role in shaping user perceptions of service excellence. This finding aligns with studies suggesting that speed is a pivotal dimension of service quality, reflecting the organization's capability to meet customer needs efficiently and effectively [12].

The inner model analysis demonstrates the predictive strength of the research framework. The adjusted R^2 value for Service Speed is 0.412, indicating that 41.2% of the variance in service speed is explained by technological transformation. This highlights the importance of digital transformation in enhancing service speed by automating processes, integrating systems, and utilizing digital infrastructure (Trilaksono et al., 2023). Meanwhile, the adjusted R^2 value for Service Quality is 0.748, showing that 74.8% of the variance in service quality is explained by both technological transformation and service speed. The substantial predictive power of this model underscores the combined impact of these factors on service quality and the critical role of speed as a mediating factor in translating technological improvements into enhanced service outcomes [7].

These findings have several practical implications for policymakers and public service managers. First, the implementation of technological transformation, including digital KIR testing systems and process automation, should be prioritized to improve service speed. Second, staff training and competency development in utilizing digital technologies are essential to ensure effective implementation [16]. Third, integrating technological solutions with efforts to enhance operational responsiveness is necessary to achieve superior service quality, ultimately leading to increased public satisfaction and participation in KIR testing services [8].

This study also contributes theoretically by elucidating the mediating role of service speed in the relationship between technological transformation and service quality, a relationship that has been underexplored in prior research [20]. However, the study is limited to the context of KIR testing services in Jember Regency. Future research should explore the generalizability of these findings to other public service sectors or regions to strengthen their relevance and validity. Consequently, this study not only provides empirical insights but also offers actionable recommendations for enhancing public service delivery in the digital era.

CONCLUSION

Fundamental Findings : This study underscores the pivotal role of technological transformation in enhancing service quality within vehicle KIR testing services, particularly through the mediating effect of service speed. The findings reveal that technological advancements significantly improve both service speed and quality, with service speed serving as a critical bridge that translates digital innovations into user satisfaction. **Implication :** These results highlight the importance of integrating digital infrastructure with operational responsiveness to optimize public service delivery. These insights not only contribute theoretically to the understanding of service quality dynamics but also offer practical implications for enhancing public service policies and operational strategies. **Limitation :** However, the study is limited to the specific context of KIR testing in Jember Regency, necessitating caution when generalizing the findings to other sectors or regions. **Future Research :** Future research should explore additional variables, such as organizational culture, user behavior, and external environmental factors, to provide a more comprehensive framework for improving public service quality in the era of digital transformation.

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