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THE EFFECT OF IMPLEMENTING TECHNOLOGY AND INNOVATION MANAGEMENT THROUGH ELECTRICITY LOSS APPLICATION INNOVATION ON CUSTOMER SERVICE AT PLN ULP BUKITTINGGI

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Abstract

Digital transformation is a strategic key for companies in improving the quality of public services, including in the electricity sector. This study aims to analyze the effect of digital technology implementation and innovation management on customer service, with the innovation of the Electricity Loss Application as an intervening variable at PT PLN (Persero) ULP Bukittinggi. The research method used is a quantitative approach with an associative causal design, involving 100 respondents who are active customers of the Electricity Loss Application. Data analysis was conducted using Structural Equation Modeling (SEM) based on Partial Least Squares (SmartPLS 4.0). The results of the study indicate that the application of digital technology does not have a significant direct effect on customer service. However, digital technology has a positive and significant effect on application innovation. Innovation management is proven to have a direct and indirect effect on customer service, through the innovation of the Electricity Loss Application as a mediating variable. This application innovation is proven to significantly mediate the effect between technology implementation and innovation management on improving customer service. These findings confirm that the success of digital transformation in public services is highly dependent on the existence of digital innovation that meets user needs. Therefore, the Electricity Loss Application can be an effective digital technology-based service innovation model in improving the quality of service in the electricity sector.

Keywords: ***Digital Technology, Innovation Management, Electricity Loss Application, Customer Service, PLN, SEM-PLS***

Introduction

The development of information technology (IT) has brought significant changes to various sectors of life, including public services. Governments and state-owned enterprises (SOEs) are required to undertake digital transformation to improve operational efficiency, performance effectiveness, and the quality of public services (Dwivedi et al., 2019). In the energy sector, PT PLN (Persero), as the main national electricity provider, is not only responsible for ensuring the continuity of energy supply but also must be adaptive in responding to the dynamics of customer needs in the digital era. One of the main challenges facing PLN is the increasing loss rate, which is the loss of electrical energy that should have been supplied but is not used by customers because they switch to alternative sources such as generator sets. This situation results in potential lost revenue for the company and also reflects a lack of public trust in PLN's electricity services in certain situations, such as large-scale events (PLN, 2022. This phenomenon is often encountered at weddings and other social events, where people prefer generators due to their perceived flexibility, despite higher operating costs and greater environmental impact. To address this issue, PLN developed the Electricity Loss App, a digital-based service innovation that allows people to request multi-purpose electricity services more easily, quickly, and affordably, especially for temporary needs such as weddings. Digital innovations like these align closely with Erwansyah's (2023) research, which emphasizes the importance of digital-based consumer behavior. In the context of public services, digital approaches serve not only as a tool for internal efficiency but also as a strategic tool for shaping more environmentally conscious user behavior and a focus on safer, more reliable, and cleaner formal services. This application not only offers easy access to services but also offers competitive and environmentally friendly rates, considering that using the PLN electricity grid is cleaner than using

generators, which produce carbon emissions and noise (IEA, 2023). This innovation aligns with PLN's agenda to support sustainable development and its Green Energy Transition strategy. From a service management perspective, this application also represents an improvement in customer service quality through process digitization. Services that previously required time and manual procedures can now be accessed online in just a few steps, providing a better customer experience (Kotler & Keller, 2016). This transformation is expected to increase customer satisfaction, strengthen the company's image, and reach new markets in the informal sector that have previously been underserved. Overall, the Electricity Loss App reflects PLN's efforts to integrate digital technology, service innovation, and customer focus into a single platform. This step aims not only to optimize revenue but also to strengthen PLN's position as a modern and adaptive energy company.

This research focuses on four main variables as follows:

- Implementation of Digital Technology (X1): The ability of technology to increase the effectiveness and speed of response to requests for electricity services.
- Innovation Management (X2): Innovation strategies to facilitate access and improve the quality of customer service.
- Customer Service (Y): Level of customer satisfaction as a result of implementing the Electricity Loss Application.
- Electricity Loss Application Innovation (Z): The direct impact of application innovation on increasing revenue and service quality.

With this digital approach, PLN hopes to accelerate the application service process, improve the customer experience, and directly impact increased electricity usage and more optimal energy (kWh) sales.

Formulation of the problem

The formulation of the research problem is as follows:

1. Does the Implementation of Digital Technology have a positive and significant impact on Customer Service at PLN ULP Bukit Tinggi?
2. Does Innovation Management have a positive and significant impact on Customer Service at PLN ULP Bukit Tinggi?
3. Does the Implementation of Digital Technology have a positive and significant impact on the Innovation of Electricity Loss Applications at PLN ULP Bukit Tinggi?
4. Does Innovation Management have a positive and significant effect on the Innovation of Electricity Loss Applications at PLN ULP Bukit Tinggi?
5. Does the Electricity Loss Application Innovation have a positive and significant impact on Customer Service at PLN ULP Bukit Tinggi?
6. Does the Implementation of Digital Technology have a positive and significant impact on Customer Service at PLN ULP Bukit Tinggi through the Innovation of Electricity Loss Applications?
7. Does Innovation Management have a positive and significant impact on Customer Service at PLN ULP Bukit Tinggi through the Electricity Loss Application Innovation?

Research purposes

ObjectiveThis research is as follows:

1. To study and analyze the influence of the implementation of digital technology on customer service at PLN ULP Bukit Tinggi
2. To study and analyze the influence of innovation management on customer service at PLN ULP Bukit Tinggi
3. To study and analyze the influence of the application of digital technology on innovation in electricity loss applications at PLN ULP Bukit Tinggi
4. To study and analyze the influence of innovation management on innovation in electricity loss applications at PLN ULP Bukit Tinggi.
5. To study and analyze the influence of electricity loss application innovation on customer service at PLN ULP Bukit Tinggi
6. To study and analyze the influence of the application of digital technology on customer service at PLN ULP Bukit Tinggi through the innovation of electricity loss applications.
7. To study and analyze the influence of innovation management on customer service at PLN ULP Bukit Tinggi through the innovation of electricity loss applications.

Literature review

Implementation of Digital Technology

The application of digital technology in public services refers to the use of technology-based information systems to improve service efficiency and effectiveness. According to Kotler and Keller (2016), digital technology enables companies to provide faster, more accurate, and more accessible services to customers. In the context of PT PLN (Persero), applications such as PLN Mobile have been shown to increase customer satisfaction by providing various electricity services digitally.

IndicatorImplementation of Digital Technology

Pedrosa et al. (2020) Digital Technology Implementation Indicators:

1. Ease of Use
   The extent to which users find a digital system or service easy to use without requiring in-depth technical training.
2. User Data Security (Trustworthy)
   User confidence that digital systems are secure, reliable, and provide services fairly and transparently.
3. Simplicity of Service (Simple)
   The process of user interaction with digital services is uncomplicated, without excessive steps or confusing bureaucracy.
4. 24/7 Service Availability (Available)
   The ability of the system to continue functioning without interruption, and to be accessible anytime and anywhere by users.
5. Customer Support Availability (Understandable)
   The extent to which the information presented in digital services is easy for users to understand, with a clear and informative design.
6. Application Performance Consistency (Consistent)
   Regularity and uniformity in the appearance and function of the system, so that users can easily adapt and use it.
7. Application Processing Speed (Fast)
   Fast response and processing times in digital services, providing an efficient and satisfying user experience.

Innovation Management

Innovation management in public services encompasses the process of developing and implementing new ideas to improve the quality and efficiency of public services. Tidd and Bessant (2014) state that effective innovation management can result in services that are more responsive and adaptive to customer needs. PT PLN (Persero) has demonstrated its commitment to innovation management through the development of the Electricity Loss Application, which is part of the company's digital transformation.

IndicatorInnovation Management

Silitonga, et al. (2020) Innovation Management Indicators:

1. Identify innovation opportunities
   Measuring how many new ideas are generated and how relevant they are to emerging market needs and technologies.
2. Strategic Planning
   Measuring efficiency in terms of the time and cost required to develop and launch new innovations.
3. Innovation Implementation
   Assess the extent to which innovative ideas are successfully implemented into new products or processes that can be applied in the company.
4. Evaluation of Innovation Results
   Assess the extent to which the resulting innovation has a positive impact on company performance, such as increased revenue, operational efficiency, or customer satisfaction.
5. Ability to Adapt to Technological Changes
   Measuring the extent to which a company is able to adapt and adopt new technologies to support the innovation process.

Customer service

According to Mukarom & Laksana (2015), service quality is the result of the interaction of various aspects such as service systems, human resources, and customer strategies. Quality service is assessed from a good system,

able to respond to customer needs, and provide effective control mechanisms to detect deviations. Good customer service contributes directly to the level of customer satisfaction. Parasuraman, Zeithaml, and Berry (2018) developed the SERVQUAL model that identifies five main dimensions of service: tangible, reliability, responsiveness, assurance, and empathy. In the context of the Electricity Loss Application, these dimensions can be measured to assess customer satisfaction with the services provided.

IndicatorCustomer service

Customer Service and Customer Satisfaction Indicators Mukarom & Laksana (2015):

1. Ease of Service Access (Reliability)
   The ability to provide the promised service consistently and accurately and easily.
2. Response Speed (Responsiveness)
   Willingness and ability of service to provide prompt service.
3. Interaction Quality Assurance
   The ability to instill trust and confidence in customers through competence, courtesy, and the ability to respond to questions or complaints.
4. Information Availability
   Availability of complete information, equipment, staff and materials used in service delivery.
5. Customer Satisfaction
   The level of customer satisfaction with the service received, which reflects the extent to which their expectations are met.
6. Customer Loyalty
   Customers' willingness to continue using a company's services or products in the future, as well as their likelihood to recommend it to others.

Electrical Loss Application Innovation

According to AdamsR et al. (2006)The innovation of the Electricity Loss application functions as an intervening variable that mediates the relationship between the application of digital technology and innovation management with customer service. The Electricity Loss application can explain how digital technology and innovation management contribute to improving customer service.

IndicatorInnovation

Seven indicators of innovation according to Adams, R et al. (2006):

1. Creativity in Idea Development
   Ideas are the “raw material” of innovation. Creativity in idea development falls into two main categories:
   - Management inputs, particularly on people and tools. Employee creativity is a key input. Factors such as the number of ideas generated, team diversity, the use of creative tools (e.g., brainstorming tools, TRIZ), and creativity training are benchmarks. Adams notes that individuals with diverse backgrounds, extensive experience, and higher education tend to be more creative and drive innovation.
   - Knowledge Management, especially in idea generation. Organizations that successfully create an environment that supports the free, participatory, and open exploration of ideas will generate more innovative alternatives.
2. Implementation of New Solutions
   Implementation is a crucial stage after an idea is developed. It consists of two main frameworks:
   - Project management encompasses managing time, costs, and resources to bring ideas to life. Time-to-market efficiency, project management quality, and the use of methods such as Stage-Gate or Agile are important aspects measured.
   - Commercialization indicates successful implementation when an innovation is actually launched, accepted by the market, or adopted by internal users. This includes activities such as market testing, product launches, and user training.
3. Service Quality Improvement
   Commercialization is the final phase of innovation that has a direct impact on users. Service quality improves if:
   - Innovations are market tested or used to better understand customer needs.

- There are measurements of the performance of new services: customer feedback, complaint rates, or response to needs.

There is involvement of marketing, distribution, and customer support teams in the launch of innovation.

4. Operational Efficiency
   Good innovation is not just "new" but also "better," in terms of costs and processes. Measures of operational efficiency include:
   - Project efficiency: Was the innovation project completed on time and within budget?
   - The use of tools and technology to speed up or simplify work.
   - Slack resources (spare capacity): can be used to test innovations without disrupting core operations.

   Reduction of waste, redundancy, or processes that do not provide value.
5. Impact on Community Satisfaction
   Innovation must have a real impact on stakeholders, including the community/customers. This is measured through:
   - User adoption rate: Does the public welcome the innovation enthusiastically?
   - User satisfaction: Satisfaction surveys, customer retention, reduced complaints.
   - Public acceptance: how society responds to innovation in the context of public or social services.

   On the organizational culture side, it is important to create a user-oriented culture, where innovation is directed towards meeting people's expectations, not just technological results or internal efficiency.
6. Collaboration with Stakeholders
   Collaboration is at the heart of modern innovation. In Adams' framework:
   - Organization and Culture highlights the importance of a collaborative, cross-functional work climate and internal stakeholder engagement.
   - Knowledge Management includes external networking, for example collaboration with universities, customers, business partners, or communities.

   *linkage measures*as a metric to assess the strength of external relationships that support innovation (such as the number of research collaborations, collaborations with NGOs, or community feedback)
7. Sustainability of Innovation
   Sustainable innovation is not just a single completed project, but rather a continuous process consisting of two sides:
   - Innovation Strategy: An organization's long-term commitment to innovation. This is reflected in the existence of a formal innovation strategy, the sustainable allocation of resources, and the leadership's role in driving innovation.
   - Knowledge Management: Sustainability is achieved when an organization is able to store, disseminate, and use knowledge consistently over time. This includes tacit knowledge, organizational learning, and absorptive capacity.

   Organizations with a clear vision and innovation strategy will be better able to maintain their ability to innovate amidst external change.

Conceptual framework

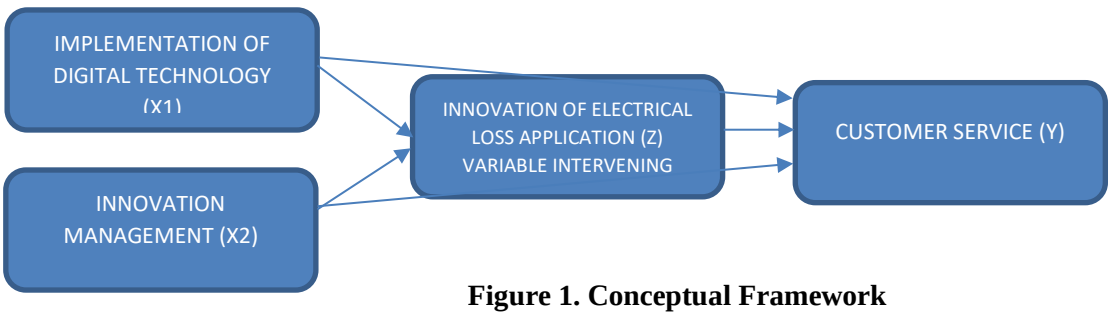

Figure 1. Conceptual Framework

Hypothesis

H_1: The application of digital technology has a positive impact on the innovation of the Electricity Loss Application.
H2: Innovation management has a positive influence on the innovation of the Electricity Loss Application.
H3: The Electricity Loss Application Innovation has a positive impact on customer service.
H4: The implementation of digital technology has a direct positive impact on customer service.
H5: Innovation management has a direct positive impact on customer service.
H6: The Electricity Loss Application Innovation mediates the relationship between the application of digital technology and customer service.
H7: The Electrical Loss Application Innovation mediates the relationship between innovation management and customer service.

Research methods

This study used a quantitative approach with a causal associative design, which aims to determine the influence between two or more variables. The quantitative approach was used because it can objectively measure the relationship between variables through numerical data and statistical tests (Sugiyono, 2018).

Research Time

This research was conducted from May to July 2025.

Population and Sample

The population in this study were PT PLN (Persero) customers who had used the Electricity Loss Application for weddings. Purposive sampling was used to select respondents who met the following criteria:

- Customers who have used the Loss Listrik application at least once in the last 12 months.
- Customers who access services through KUA or independent applications.

Determining the number of samples refers to the theory of Hair et al. (2010), which states that the minimum number of samples in SEM or linear regression research is 5–10 times the number of indicators, with an ideal minimum number of 100 respondents.

Feasibility test

The feasibility test that will be used in this study is the outer model test in order to obtain the outer loading value that meets the validity and reliability requirements. The structural model test (Inner model) which includes the coefficient of determination (R2) test to measure how far the model's ability to explain the variation of the dependent variable. The coefficient of determination value / is in the range of zero (0) and one (1).R^2 The Goodness fit test is used to determine the extent to which the observed data conforms to the theoretical distribution assumed by the model or hypothesis and the hypothesis test (T-Statistic Test) which consists of a path coefficients test to test how the direct influence of each independent variable individually affects the dependent variable as well as the indirect influence of the intervening variable in influencing the independent variable on the dependent variable. This test is used to determine the direction of the relationship between variables (positive/negative). If the value is 0 to 1, then the direction of the relationship between the variables is stated as positive. Meanwhile, if the value is 0 to -1, then the direction of the relationship between the variables is stated as negative. The hypothesis is said to be accepted if the t-statistic value is greater than the t-table. According to (Ghozali & Latan, 2014) the criteria for the t-table value is 1.96 with a significance level of 5%.

RESULTS AND DISCUSSION

Research result

Outer Model Analysis

The outer model testing in this study uses algorithm analysis on *SmartPLS software version 4.0,*in order to obtain outer loading values that meet validity and reliability requirements.

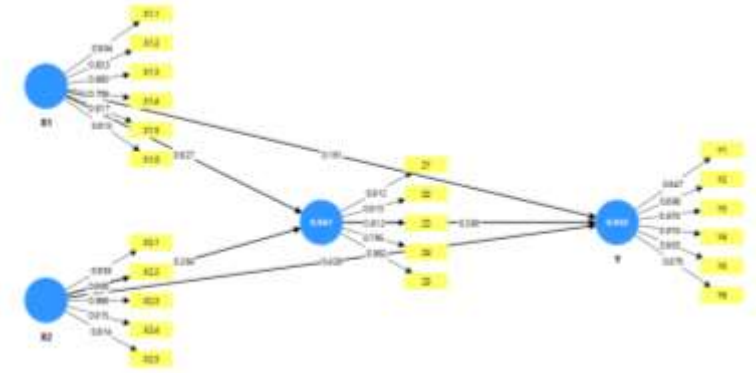

Figure 2. Outer Model Test Results

Convergent Validity Test Results

Convergent validity is demonstrated by the outer loading and AVE values. Indicators are considered valid if they have an outer loading > 0.7 and an AVE > 0.5. The processing results show that all indicators meet these requirements.

Table 2. Outer Loading

Indicator	*Outer Loading*	Information
IMPLEMENTATION OF DIGITAL TECHNOLOGY(X1)		
X1.1	0.904	Valid
X1.2	0.833	Valid
X1.3	0.86	Valid
X1.4	0.709	Valid
X1.5	0.917	Valid
X1.6	0.913	Valid
INNOVATION MANAGEMENT (X2)		
X2.1	0.939	Valid
X2.2	0.906	Valid
X2.3	0.868	Valid
X2.4	0.915	Valid
X2.5	0.814	Valid
ELECTRICAL LOSS APPLICATION INNOVATION (Z)		
Z1	0.912	Valid
Z2	0.913	Valid
Z3	0.912	Valid
Z4	0.795	Valid
Z5	0.962	Valid
CUSTOMER SERVICE (Y)		
Y1	0.847	Valid
Y2	0.898	Valid
Y3	0.876	Valid
Y4	0.819	Valid
Y5	0.903	Valid
Y6	0.876	Valid

Source: Smart PLS Output, 2025

Based on Table 2, all indicators have loading factor values > 0.60. According to Ghozali, Imam & Latan (2014), an indicator is considered valid if its loading factor value is > 0.60. Therefore, all indicators in this study are valid and can be further researched. The following is displayed in the form of a structural model, as shown in the following figure:

Discriminant Validity Test Results

The next test is discriminant validity. This test aims to determine whether a reflective indicator is a good measurement of its construct based on the principle that the indicator is highly correlated with the construct. The following table shows the cross-loading results from the discriminant validity test:

Table 3. Discriminant Validity

Indicator	X1	X2	Y	Z
X1.1	0.904	0.846	0.853	0.891
X1.2	0.833	0.739	0.78	0.804
X1.3	0.86	0.816	0.829	0.824
X1.4	0.709	0.602	0.627	0.631
X1.5	0.917	0.828	0.842	0.878
X1.6	0.913	0.854	0.873	0.885
X2.1	0.839	0.939	0.881	0.864
X2.2	0.773	0.906	0.83	0.81
X2.3	0.84	0.868	0.847	0.855
X2.4	0.896	0.915	0.91	0.911
X2.5	0.703	0.814	0.754	0.707
Y1	0.779	0.789	0.847	0.802
Y2	0.845	0.827	0.898	0.867
Y3	0.829	0.87	0.876	0.845
Y4	0.767	0.786	0.819	0.78
Y5	0.875	0.853	0.903	0.893
Y6	0.793	0.845	0.876	0.8
Z1	0.921	0.823	0.839	0.912
Z2	0.842	0.869	0.889	0.913
Z3	0.831	0.853	0.872	0.912
Z4	0.801	0.712	0.743	0.795
Z5	0.918	0.944	0.947	0.962

Source: Smart PLS Output, 2025

Composite reliability test results

The next test determines the reliable value with the composite reliability of the indicator block that measures the construct. A construct value is said to be reliable if the composite reliability value is above 0.60. In addition to looking at the composite reliability value, the reliable value can be seen from the variable construct value with the Cronbach's alpha of the indicator block that measures the construct. A construct is declared reliable if the Cronbach's alpha value is above 0.7. The following table shows the loading values for the research variable constructs generated from running the Smart PLS program in the following table.

Table 4. Construct Reliability and Validity

Construct	Cronbach's Alpha	Composite Reliability	AVE
X1	0.927	0.936	0.944
X2	0.933	0.938	0.95
Z	0.936	0.937	0.949
Y	0.94	0.946	0.955

Based on the table above, it can be explained that the AVE value for each tested variable has a value > 0.5, indicating that all variables in this study meet the criteria for discriminant validity. To determine reliability in this study, the composite reliability value was used. The accepted value for the reliability level is > 0.7. Based on these criteria, it can be seen that all variables in this study have a value > 0.70, so it can be stated that all variables tested meet construct reliability.

Structural Model Evaluation (Inner Model)

Inner model evaluation is carried out to measure the relationship between latent constructs and determine the significance of the influence between variables.

Results of the Determination Coefficient Test (R^2 and Adjusted R^2)

The coefficient of determination (R2) test is used to determine whether a particular independent latent variable has a substantive influence on the dependent latent variable. Based on data processing using the SmartPLS 4.0 program, the R Square value is obtained as shown in the following table.

Table 5. R Square Results

Endogenous Variables	R^2	Adjusted R^2	Interpretation
Z (Application Innovation)	0.942	0.94	Very strong
Y (Service)	0.941	0.94	Very strong

Source: Smart PLS Output, 2025

Based on the results of data processing using SmartPLS 4, it is known that the endogenous variables in the research model, namely Electricity Loss Application Innovation (Z) and Customer Service (Y) have very high coefficient of determination (R^2) values, namely 0.948 for Z and 0.944 for Y. The Adjusted R^2 value also shows very good model consistency, namely 0.946 for Z and 0.943 for Y.
The interpretation of these values is as follows:

1. Electrical Loss Application Innovation (Z)
   The R^2 value of 0.948 means that 94.8% of the variation in application innovation can be explained by two exogenous variables, namely the Application of Digital Technology (X1) and Innovation Management (X2). In other words, these two variables have a very strong contribution in influencing the formation of Electrical Loss application innovation at PLN ULP Bukittinggi.
2. Customer Service (Y)
   The R^2 value of 0.944 indicates that 94.4% of changes or variations in customer service can be explained by the combination of Digital Technology Implementation (X1), Innovation Management (X2), and Application Innovation (Z). This means that the quality of customer service provided by PLN ULP Bukittinggi is greatly influenced by how technology and innovation are managed and implemented effectively.

Goodness of Fit Test Results

A goodness of fit test is a statistical method used to evaluate how well a model or statistical distribution being tested fits the observed data. The goodness of fit test aims to determine the extent to which the observed data conforms to the theoretical distribution assumed by the model or hypothesis. The goodness of fit of a model can be determined by looking at the NFI value in the program. If the NFI value is greater than SRMR and closer to 1, the better the model fit. Based on data processing performed using SmartPLS 3.0, the Model Fit values are as follows.

Table 6. Fit Model

	Saturated Model	Estimated Model
SRMR	0.054	0.054
d_ULS	0.739	0.739
d_G	1,862	1,862
Chi-Square	753,177	753,177
NFI	0.769	0.769

Source: Smart PLS Output, 2025

Based on the table above, it can be seen that the NFI value is 0.769 > 0.054, so it can be stated that the model in this study has sufficient goodness of fit and is suitable for use in testing the research hypothesis.

Hypothesis Testing Results

After conducting the inner model analysis, the next step is to evaluate the relationships between latent constructs to answer the research hypothesis. Hypothesis testing in this study was conducted using T-statistics and P-values. The hypothesis is accepted if the T-statistic is >1.96 and P-values are <0.05. The following table shows the path coefficients for the direct influence between variables.

Table 7. Path Coefficients (Direct Effect)

VARIABLE	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
IMPLEMENTATION OF DIGITAL TECHNOLOGY -> CUSTOMER SERVICE	0.161	0.166	0.109	1,476	0.135
IMPLEMENTATION OF DIGITAL TECHNOLOGY -> INNOVATION OF ELECTRICAL LOSS APPLICATIONS	0.627	0.628	0.108	5.81	0.000
INNOVATION MANAGEMENT -> CUSTOMER SERVICE	0.439	0.439	0.097	4.53	0.000
INNOVATION MANAGEMENT -> ELECTRICITY LOSS APPLICATION INNOVATION	0.364	0.363	0.111	3,279	0.001
POWER LOSS APPLICATION INNOVATION -> CUSTOMER SERVICE	0.39	0.385	0.126	3.103	0.002

Source: Smart PLS Output, 2025

Based on the results of the path coefficient analysis using SmartPLS, it is known that the effect of digital technology implementation on customer service is not statistically significant, with a coefficient value of 0.161 and a p-value of 0.14 (> 0.05). This indicates that the implementation of digital technology has not been able to provide a strong direct impact on improving customer service. However, the implementation of digital technology has a positive and significant influence on innovation in electricity loss control applications, with a coefficient value of 0.627 and a p-value of 0.000. This means that the higher the level of digital technology implementation, the more it will encourage increased innovation in electricity loss control applications. Furthermore, innovation management is

proven to have a positive and significant effect on customer service, with a coefficient value of 0.439 and a p-value of 0.000. In addition, innovation management also has a significant effect on innovation in electricity loss applications, with a coefficient of 0.364 and a p-value of 0.001. This shows that good innovation management not only contributes to service improvement but also encourages the development of innovation in technical management such as electricity loss control.

Finally, the innovation of electricity loss applications has a significant influence on customer service, with a coefficient of 0.390 and a p-value of 0.002. This finding indicates that success in developing technical innovations in energy management contributes to providing better service to customers. Based on these overall results, it can be concluded that although the implementation of digital technology does not directly affect customer service, the indirect influence through innovation of electricity loss applications appears significant, thus opening up the possibility of a mediation effect that can be further explored in the indirect influence between variables as shown in the following table.

Table 8. Indirect Effect

VARIABLE	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
IMPLEMENTATION OF DIGITAL TECHNOLOGY -> ELECTRICITY LOSS APPLICATION INNOVATION -> CUSTOMER SERVICE	0.245	0.243	0.093	2,628	0.009
INNOVATION MANAGEMENT -> ELECTRICITY LOSS APPLICATION INNOVATION -> CUSTOMER SERVICE	0.142	0.138	0.057	2,491	0.013

Source: Smart PLS Output, 2025

The results of the indirect effect analysis indicate that the application of digital technology has a positive and significant indirect effect on customer service through innovation in electricity loss control applications. This is indicated by a coefficient value of 0.245 with a t-statistic value of 2.628 and a p-value of 0.009 (<0.05). This means that although the direct effect of the application of digital technology on customer service is not significant, through the mediation channel of innovation in electricity loss applications, the effect becomes significant. This finding confirms that application innovation in electricity loss management plays an important role in bridging the influence of digital technology on improving the quality of customer service. In addition, innovation management also has a significant indirect effect on customer service through innovation in electricity loss control applications, with a coefficient value of 0.142, a t-statistic of 2.491, and a p-value of 0.013. This indicates that the better the innovation management, the higher the level of technical innovation in electricity loss applications, which ultimately has a positive impact on customer service. Thus, innovation in electricity loss applications acts as an effective mediator in strengthening the relationship between innovation management and customer service quality.

Discussion

The results of the study indicate that the implementation of digital technology does not have a significant direct impact on customer service, with a coefficient value of 0.161 and a p-value of 0.135. This indicates that although digitalization has been implemented in the form of service applications such as the Electricity Loss Application, its existence has not been fully able to provide a direct impact on improving the quality of service

perceived by customers. This finding reinforces the view of Kotler and Keller (2016) that the implementation of digital technology must be accompanied by a deep understanding of user needs so that the results have a real impact on customer experience. Conversely, the application of digital technology has a very significant influence on innovation in electricity loss applications (coefficient = 0.627; p-value = 0.000). This indicates that the digital technology used by PLN supports the creation of innovative solutions in the form of multi-purpose digital electricity service applications. According to Laudon and Laudon (2020), a good information system can increase organizational effectiveness in providing innovative, efficient, and customer-oriented services. Therefore, although it has not had a direct impact, the application of digital technology has an influence through the development of innovative products and platforms.

Innovation management was also shown to have a positive and significant impact on customer service (coefficient = 0.439; p-value = 0.000), as well as on innovation in electricity loss applications (coefficient = 0.364; p-value = 0.001). These findings align with Tidd and Bessant (2018), who stated that effective innovation management can improve public service performance through more adaptive and relevant solutions. Well-managed innovation will create systems and applications that can address community challenges and needs quickly and accurately. Furthermore, the innovation in electricity loss applications significantly impacted customer service (coefficient = 0.390; p-value = 0.002). This innovation represents a concrete demonstration of successful digital transformation and directly impacts accessibility, service speed, and customer satisfaction. According to Adams et al. (2006), the success of innovation in the public sector is determined by an organization's ability to develop user-focused solutions that directly add value.

In the indirect effect, the results show that the implementation of digital technology has a significant influence on customer service through innovation in electricity loss applications as a mediating variable (coefficient = 0.245; p-value = 0.009). Similarly, innovation management also has an indirect influence on customer service through innovation in electricity loss applications (coefficient = 0.142; p-value = 0.013). This finding refers to the mediation theory proposed by Baron and Kenny (1986), which states that intervening variables can explain how and why an influence occurs. In this context, innovation in electricity loss applications significantly mediates the relationship between digital strategy and internal innovation on customer satisfaction.

Conclusion

Based on the results of research that has been conducted and supported by relevant scientific literature, the following conclusions were obtained:

1. The application of digital technology does not have a significant direct impact on customer service, so the effectiveness of technology in this context has not been optimally felt by customers directly (Kotler & Keller, 2016).
2. The application of digital technology has a positive and significant impact on innovation in electricity loss applications, which proves that technology is an important driver in the creation of customer-based digital service solutions (Laudon & Laudon, 2020).
3. Innovation management has a significant impact on customer service, proving that a good innovation strategy can produce higher quality and adaptive services (Tidd & Bessant, 2018).
4. Innovation management also has a significant influence on innovation in electricity loss applications, so that a systematic managerial approach to innovation supports the birth of impactful technological solutions (Silitonga & Sitepu, 2021).
5. The innovation of electricity loss applications has a positive and significant impact on customer service, because this digital service provides faster, more efficient and more satisfying access for customers (Adams et al., 2006).
6. The application of digital technology has an indirect influence on customer service through innovation in electricity loss applications, which means that the effects of digital transformation will be felt if it is packaged in the form of application innovations that suit customer needs (Baron & Kenny, 1986).
7. Innovation management also has an indirect effect on customer service through innovation in electricity loss applications, showing that the results of innovation that are managed properly will have an impact on better service quality (Tidd & Bessant, 2018).

Thus, the innovation of electricity loss application is proven to be a crucial mediating factor in bridging the role of technology and managerial innovation towards customer service in the PLN ULP Bukittinggi environment.

Suggestion

Based on the research results and empirical findings obtained, the researcher provides several suggestions aimed at PT PLN (Persero) ULP Bukittinggi to strengthen the effectiveness of application innovation and improve customer service:

1. Strengthening the Implementation of Digital TechnologyPLN ULP Bukittinggi is advised to continue improving the quality of its digital infrastructure, including the integration of internal and external systems that support the operation of the Electricity Loss application. The use of technologies such as the Internet of Things (IoT), big data, and real-time monitoring dashboards needs to be developed.
2. Improving Innovation Management StrategyInnovation management needs to be improved through a cross-unit collaboration-based approach, ongoing employee training, and strengthening a culture of innovation within the workplace. PLN ULP Bukittinggi can establish a dedicated digital innovation management team tasked with conducting routine evaluations and developing application features according to customer needs.
3. Increased Customer EngagementPLN ULP Bukittinggi is advised to open an active feedback channel integrated with the application. Regular customer satisfaction surveys and online discussion forums can be effective tools for capturing user feedback and identifying areas for improvement.
4. Data-Based Monitoring and EvaluationEvery report, response, and resolution of a service request or disruption report submitted through the app must be recorded and processed as an evaluative database. PLN needs to utilize this data to compile periodic reports, assess service unit performance, and set data-driven service targets.

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