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Analysis of the Flow of the Connection Service Process to Achieve an Increase in Electricity Sales Using Application Design

Rizal Bima Bayuaji* , Erma Suryani
Institut Teknologi Sepuluh Nopember, Indonesia
Email: rizalbimabayuaji@gmail.com* , erma.suryani@gmail.com

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Abstract

The electricity customer connection process at PT PLN (Persero) continues to face significant operational challenges, including unintegrated data systems, limited real-time monitoring capabilities, and slow coordination between units. These challenges negatively impact overall service efficiency and electricity sales growth. This study aims to analyze the current customer connection workflow and design an integrated information system application to improve operational effectiveness and service quality. Using a descriptive qualitative approach, data was collected through direct observation, comprehensive operational document analysis, persona canvas, and Root Cause Problem Solving (RCPS) to identify business process issues. Diagnostic analysis revealed that severe data fragmentation and the absence of a centralized monitoring platform were the primary root causes of delays. To address these challenges, the Integrated Customer Connection (ICE) application was designed. This system seamlessly integrates the end-to-end workflow, including initial customer inquiries, technical surveys, field connection execution, and real-time operational monitoring through an interactive dashboard. The application design implementation successfully accelerated kWh sales, with a projected volume increase of 1,867,177 kWh by 2025. This achievement represents a 6.24% increase in sales compared to 2024, reaching a total volume of 13,178,583 kWh while drastically reducing the average service duration to 1.38 days. Furthermore, the software offers advanced functional features, including job status tracking, network load analysis, and market potential mapping.The study concluded that user-centric application development effectively increased process transparency, optimized customer connection efficiency, and drove strategic electricity sales growth at PT PLN (Persero).

INTRODUCTION

Electricity is the main infrastructure in the social, economic, and technological development of a country. The availability and quality of electricity services are important indicators for the progress of a nation, including in ensuring the life of modern society that is highly dependent on electrical energy. Without reliable electricity access, economic activities would stagnate, educational institutions would struggle to operate, healthcare services would be compromised, and overall quality of life would decline significantly. In the era of digitalization, electricity services are no longer just about providing energy, but also include a fast, efficient, and technology-based customer experience that meets the evolving expectations of modern consumers (Gellings 2020; Gonçalves et al. 2020, 2022; Yellanki 2025).

Countries such as the United States, Japan, and South Korea are developing smart grids such as using smart meters, internet of energy, and AI for electricity supply efficiency. Customers can access electricity consumption data in real time, perform self-service, and sell electricity back to the grid (net-metering). According to Kotler & Keller (2016), customer service is an activity designed to increase customer satisfaction by meeting or exceeding their expectations before, during, and after the purchase of a product or service.

South Korea implements a centralized electricity system through KEPCO (Korea Electric Power Corporation) as the main national electricity provider. Electricity connection to customers is regulated systematically from service requests, technical licensing, to installation and operation. According to Yun, Lee, & Jeon (2019), a major transformation in distribution systems is happening with the implementation of Smart Grid and Advanced Metering Infrastructure (AMI) systems that allow customers to connect in real time to their electricity consumption networks and data, thereby enhancing transparency, efficiency, and customer empowerment in managing their energy usage.

As the main provider of electrical energy in Indonesia, PT. Perusahaan Listrik Negara (Persero) (PLN) has a strategic role in supporting national development and improving people's welfare by ensuring that electricity reaches all corners of the archipelago. One of PLN's main functions is to connect new customers, both for the household, commercial, and industrial sectors, which is fundamental to driving economic growth, creating jobs, and improving living standards across the nation.

This connection process not only reflects the expansion of access to electrical energy, but also becomes an important indicator in the quality of public services in the electricity sector, as it directly impacts customer satisfaction and the overall perception of PLN's service reliability. However, the implementation of the customer connection process still faces various challenges that hinder the achievement of optimal service delivery.

Based on the Service Quality Level (TMP) report of PT. PLN (Persero) Sumatra and Kalimantan Region in 2023, the service time for New Connections and Power Changes ranges from 5 to 25 days, which is significantly longer than the expected service standards in the digital era. In addition, the response time to disturbance complaints still takes about 1 hour from the time the report is received (PLN, 2023), indicating that there are still delays in addressing customer issues that could potentially lead to dissatisfaction and loss of trust in the service provider. This data shows that there is still room for improvement in terms of efficiency and speed of customer service, particularly in streamlining the connection process to meet the growing demands of a digitally savvy customer base.

In line with the rapid development of information technology, many sectors including public services have adopted digital applications to improve operational efficiency and service quality, recognizing that technology is a key enabler of organizational transformation and competitive advantage. PLN as a state-owned enterprise oriented to public services, is required to transform through the use of digital technology in order to remain relevant, efficient, and responsive to customer needs in an increasingly competitive and dynamic environment.

According to Sari (2022), the development of internal applications is expected to simplify the customer connection process, starting from registration, data verification, to real-time status monitoring, thereby reducing manual interventions, minimizing errors, and accelerating service delivery. Government regulations also encourage the improvement of PLN's service quality, reflecting the state's commitment to ensuring that public services meet high standards of efficiency and transparency.

The Decree of the Minister of Energy and Mineral Resources of the Republic of Indonesia in 2023 requires each PLN service unit to announce the quality level of electricity services regularly and transparently, thereby promoting accountability and customer trust in the service provider. In addition, PLN's internal regulations related to the Standard Procedures for the Implementation of Electrical Connections per Voltage Segment emphasize the importance of documentation, administration, and reporting of connections that are carried out digitally and integrated through commercial applications (Ministry of Energy and Mineral Resources, 2023; PLN, 2023), ensuring that all processes are properly recorded, monitored, and evaluated for continuous improvement. However, effective in-house application development cannot be done without an in-depth study of the actual needs in the field and the operational challenges faced, as technology solutions must be tailored to the specific context and requirements of the organization and its customers.

Obstacles such as long application waiting times, limited number of field survey officers, and obstacles to meeting service standards are still fundamental problems that require systematic and innovative solutions. Therefore, research is needed to identify the need for an internal information system that is able to answer these challenges comprehensively, integrating both technical and commercial aspects to deliver a seamless and efficient customer experience.

As an illustration, the Tanjung Customer Service Unit (ULP) recorded an average connection time in December 2023 of 5.2 days, which although showing some improvement, still falls short of the ideal service standards expected by customers in the digital age. Customers who experienced TMP for more than 5.25 days were 65 customers with the distribution of 48 new installation applications and 17 power changes (PLN, 2023), indicating that a significant number of customers are still experiencing delays that could impact their business operations, daily activities, and overall satisfaction with PLN's services.

Although this figure shows an improvement from previous years, there is still an opportunity for optimization of the connection business process to further reduce service times and enhance customer experience. Some time ago, there has been an application used such as AP2T, but the application is still lacking because there is no automation available in checking the technical feasibility of connection, clustering of applications according to the length of payment days, recap of ready-to-connect and expansion data, recap of connection data and team productivity, and so on (PLN, 2025), highlighting the critical gaps that need to be addressed through more advanced and integrated technological solutions.

This research is relevant in this context, namely to examine how the development of internal applications can improve the efficiency of the customer connection process, as well as become a strategic instrument in supporting digital transformation in the environment of PT. PLN (Persero). This study will develop a new internal application called ICE (Innovative Customer Experience) as a supporting system and operational dashboard that complements AP2T, addressing the existing gaps and providing enhanced functionalities that are aligned with the operational needs and strategic objectives of the organization.

Based on the literature review and empirical conditions in the field, there are several research gaps that form the basis for conducting this research, highlighting the need for a more comprehensive and integrated approach to studying the customer connection process and the role of technology in improving it. Firstly, from a theoretical perspective, research on the implementation of information technology in the electricity customer connection process is still limited, especially in developing countries like Indonesia where the infrastructure and digital maturity levels differ significantly from developed nations.

Most existing research focuses on either the technical aspects of electricity or business aspects separately, without integrating both into a comprehensive analytical framework that considers the interplay between technical feasibility, operational efficiency, customer satisfaction, and business performance. Yun, Lee, & Jeon (2019) have examined the transformation of distribution systems with Smart Grid and AMI in South Korea, but the context is significantly different from the infrastructure and digitalization conditions in Indonesia, where challenges such as geographical dispersion, varying levels of technological adoption, and resource constraints present unique complexities.

Meanwhile, research on internal applications within PLN is still limited to conceptual studies and has not extensively conducted in-depth analysis of implementation effectiveness and its impact on increasing electricity sales (Sari, 2022; Wahyudi, 2021), leaving a gap in understanding how technology can be leveraged to drive both operational and commercial outcomes. Secondly, from an empirical perspective, although PLN has developed various applications to support operations, such as AP2T, there are still obstacles in its implementation that hinder the achievement of optimal service delivery and operational efficiency.

Based on internal PLN reports (2025), AP2T has not been equipped with features for automation of technical feasibility checking for connections, clustering of applications based on payment days duration, integrated recap of ready-to-connect and expansion data, recap of connection data and team productivity, real-time network load analysis, and market potential mapping based on geospatial data, all of which are critical for efficient and effective connection management. This indicates a gap between operational needs in the field and the features available in existing applications, necessitating the development of a more comprehensive and integrated solution. Previous research by Teguh & Setiawan (2020) and Fajar & Adi (2021) has discussed integrated information systems and the use of GIS in electrical infrastructure development, but has not specifically examined the integration of both into a single integrated application platform for the customer connection process, representing a significant gap in the current body of knowledge.

Thirdly, from a methodological perspective, previous research on PLN's customer connection process has largely used descriptive quantitative approaches or simple case studies (Pramesti & Sari, 2021; Budi & Purnomo, 2019) that do not fully capture the complexity of the issues and the multifaceted nature of the customer connection process. There has been limited research using a comprehensive design thinking approach with stages including customer problem mapping (persona canvas), root cause identification (fishbone diagram and Root Cause Problem Solving), creative idea development (brainstorming), solution narrowing (ERRC Grid), decision making (Impact Effort Matrix and Decision Grid), risk anticipation (Risk Matrix), and implementation commitment (Improvement Initiative Chart), which together provide a holistic framework for understanding problems, developing innovative solutions, and ensuring successful implementation.

Fourthly, from an impact perspective, research on the impact of internal applications on increasing electricity sales is still very limited, with most studies failing to establish a clear link between technology implementation and business performance outcomes. Most research only focuses on time efficiency and service quality aspects, without quantitatively measuring the impact on electricity energy sales (Ramadhan & Prasetyo, 2019; Sutrisno & Setiawan, 2020; Indra & Sukma, 2021), thereby missing a critical dimension of value creation that is essential for justifying technology investments and guiding strategic decision-making. In fact, the acceleration of the customer connection process has direct implications for accelerating the realization of energy consumption and increasing electricity sales, as customers who are connected faster begin contributing to revenue generation sooner, creating a positive impact on the company's financial performance and market competitiveness.

Several factors indicate the urgency of this research, reflecting the pressing need for innovative solutions to address the challenges facing PLN's customer connection process. First, PLN as a state-owned enterprise is required to undergo digital transformation in order to improve the quality of public services and meet the evolving expectations of customers in the digital age. This is in line with government directives through the Ministry of SOEs and the Ministry of Energy and Mineral Resources to optimize the use of information technology in electricity services, recognizing that technology is a key enabler of efficiency, transparency, and customer satisfaction.

This research is important to provide a scientific foundation for the development of effective and efficient internal applications that can support PLN's digital transformation journey and contribute to the achievement of its strategic objectives. Second, PLN has ambitious electricity sales growth targets in order to support national economic growth and meet the increasing demand for electricity across various sectors. Accelerating the customer connection process is one of the key strategies to achieve these targets, as faster connections lead to earlier revenue generation, improved cash flow, and enhanced market penetration.

This research contributes by designing an application that not only improves operational efficiency but also directly impacts increasing electricity sales, thereby creating value for both the organization and its customers. Third, based on PLN TMP data (2023), there are still customer complaints regarding the length of the connection process, indicating that service quality still needs improvement to meet customer expectations and maintain trust in the service provider. This research addresses this need by designing an application that can accelerate the connection process and improve information transparency for customers, enabling them to track their application status in real time and receive timely updates on the progress of their connection requests.

Fourth, the limited number of technical personnel and network assets are obstacles in the connection process, creating bottlenecks that delay service delivery and increase customer wait times. This research designs an application that can optimize the use of existing resources through a scoreboard-based assignment system and accurate network load analysis, ensuring that resources are allocated efficiently and effectively to meet customer demand.

Fifth, the gap between the features available in existing applications (AP2T) and operational needs in the field makes this research highly urgent, as the current system is not adequately equipped to support the efficient and effective management of the customer connection process. The development of the ICE application is expected to bridge this gap and provide comprehensive solutions that address the root causes of delays and inefficiencies, thereby enhancing service quality, customer satisfaction, and organizational performance.

The novelty of this research lies in several aspects that distinguish it from previous studies and contribute to the advancement of knowledge in the field. From a conceptual perspective, this research integrates the design thinking approach (which focuses on user experience and human-centered design) with business analysis (which focuses on operational efficiency and sales increase) within a holistic research framework, thereby bridging the gap between user needs and business objectives. It also develops a user-centric application concept for the electricity connection process by considering aspects of ease of use, information transparency, and performance accountability, ensuring that the application is not only technically sound but also practical and user-friendly for both customers and PLN personnel.

Furthermore, it presents an integrated operational dashboard concept that combines various operational data such as team availability, officer productivity, MVA growth, network load, and market potential in a single display that is easy to understand and access, enabling data-driven decision-making and real-time monitoring of key performance indicators. From a methodological perspective, this research uses a comprehensive multi-stage approach starting from customer problem mapping (persona canvas), root cause identification (fishbone diagram and RCPS 5 Why), creative idea development (brainstorming), solution narrowing (ERRC Grid), decision making (Impact Effort Matrix and Decision Grid), risk anticipation (Risk Matrix), to implementation commitment (Improvement Initiative Chart), providing a structured and systematic framework for problem-solving and innovation.

This research is also one of the first to use persona canvas to understand customer characteristics and needs in the electricity connection process in Indonesia, offering valuable insights into customer expectations, pain points, and preferences that can inform the design of more effective and customer-centric solutions. Moreover, it not only designs the application but also quantitatively measures the application's impact on increasing electricity sales, time efficiency, and officer productivity, providing empirical evidence of the value created by technology implementation.

From a technological perspective, the developed ICE application has a technical feasibility survey automation feature using machine learning designed based on asset data and technical feasibility standards, which is a novelty that did not exist in the previous application (AP2T). This feature enables faster and more accurate technical assessments, reducing the time and effort required for manual surveys and minimizing the risk of errors. The ICE application also integrates GIS data for market potential mapping and distribution analysis, enabling the identification of areas with high customer growth potential and supporting strategic planning for network expansion and resource allocation.

Furthermore, it provides real-time network load data per feeder used by customers, enabling more accurate and faster technical decision-making and ensuring that connections are made in a manner that is sustainable and does not compromise network reliability. Additionally, it has a scoreboard system that assigns different weights to each type of work (PB, PD, migration, expansion), allowing for fairer and more accountable performance evaluation, and motivating officers to perform at their best while ensuring that workload distribution is equitable and aligned with individual capabilities and organizational priorities.

Based on the background, research gaps, urgency, and novelty that have been described, this study is designed to answer several main problems related to the customer connection process at PT. PLN (Persero). The formulation of the problem in this study is as follows: (1) What are the obstacles faced by PT. PLN (Persero) in the process of connecting new customers, and what are the underlying causes of these obstacles? (2) What are the prospects for internal application development in supporting the efficiency and effectiveness of the customer connection process at PT. PLN (Persero), and what features and functionalities are needed to address the identified challenges? (3) How can the strategy of developing customer service and increasing electric power sales be optimized through the utilization of internal applications, and what is the potential impact on organizational performance and customer satisfaction?

This research aims to contribute to efforts to improve the efficiency and quality of customer connection services at PT. PLN (Persero), thereby supporting the organization's strategic objectives of enhancing customer satisfaction, increasing electricity sales, and achieving operational excellence. Specifically, the objectives of this study are as follows: (1) Analyzing the various obstacles faced by PT.

PLN (Persero) in the process of connecting customers, including technical, operational, and systemic challenges that hinder service delivery; (2) Identifying internal application development (ICE) needs that have the potential to improve the efficiency and effectiveness of the customer connection process, based on a thorough understanding of user requirements, operational workflows, and technological capabilities; and (3) Designing application-based solutions and providing strategic recommendations to speed up and simplify customer service, while encouraging an increase in electricity sales within PT. PLN (Persero), thereby creating value for both the organization and its customers.

The benefits of this research are divided into theoretical, practical, and methodological benefits that collectively contribute to the advancement of knowledge and practice in the field. Theoretically, this research contributes to the development of knowledge in the fields of information systems and operational management, particularly in the application of information technology to improve business process efficiency in the electricity sector, thereby enriching the academic literature and providing a foundation for future research.

It also adds to the literature on design thinking implementation in internal application development at state-owned enterprises, offering insights into how user-centered design principles can be applied to create more effective and user-friendly technology solutions in the public sector. Furthermore, it provides an analytical framework for measuring the impact of internal applications on increasing sales and service quality, enabling organizations to quantify the value created by technology investments and make more informed strategic decisions. Practically, for PT. PLN (Persero), this research provides an applicable solution in the form of an ICE application design that can be implemented to improve the efficiency of the customer connection process, information transparency, and officer performance accountability, as well as encourage increased electricity sales.

For customers, it improves the quality of electricity connection services through a faster, more transparent, and accountable process that enhances their overall experience and satisfaction with PLN's services. For PLN officers, it facilitates their duties through an integrated system, automation of technical feasibility checking, and a fair performance assessment system that recognizes their contributions and motivates them to perform at their best. For the government, it provides input for policy formulation on digital transformation in the electricity sector and improving public service quality, contributing to the achievement of national development goals and the enhancement of public welfare. Methodologically, this research provides a research approach model that can be replicated to examine information technology implementation in other sectors, offering a structured and systematic framework for studying technology adoption and impact. It also develops analytical instruments to evaluate the effectiveness of internal applications in supporting organizational business processes, providing tools that can be adapted and applied in various contexts to assess technology performance and guide improvement efforts.

The scope of this research covers substantive, location, time, respondent, and application aspects, ensuring a focused and manageable study that can generate meaningful insights and actionable recommendations. Substantively, this research focuses on analysis of the customer connection business process at PT. PLN (Persero), identification of obstacles and barriers in the customer connection process, design of an internal application (ICE) to support the customer connection process, and analysis of the application's impact on operational efficiency and increasing electricity sales. The research was conducted at the Tanjung Customer Service Unit (ULP), PT. PLN (Persero) Sumatra and Kalimantan Region, as a case study location from January 2025 to December 2025, covering the stages of analysis, design, implementation, and evaluation of the ICE application. Respondents in this research include customers applying for new connections or power changes, customer service officers at ULP Tanjung, technical officers (surveyors, connection executors), and managers and supervisors at ULP Tanjung, ensuring that diverse perspectives are captured and that the research findings are grounded in the realities of the field.

The developed application is ICE (Innovative Customer Experience) which focuses on features including dashboard of team and personnel availability, connection warning sign based on voltage segments and payment days duration, top contributor officer based on performance level, connection productivity between payments and connections, monthly MVA growth analysis, technical feasibility survey automation with machine learning, and system load data per feeder, all of which are designed to address the identified gaps and support the efficient and effective management of the customer connection process.

This research is organized into five chapters that provide a comprehensive and logical presentation of the research process and findings. Chapter I Introduction contains the research background, research gap, research urgency, novelty, problem formulation, research objectives, research benefits, research scope, and writing systematics, setting the stage for the rest of the research. Chapter II Literature Review contains relevant theoretical foundations, including customer service concepts, information technology in public services, management information systems, electricity connection business processes, design thinking, and relevant previous research, providing a solid theoretical basis for the research. Chapter III Research Methods contains the research methods used, including research type, research approach, research stages, data collection techniques, and data analysis techniques, ensuring that the research is conducted in a rigorous and systematic manner.

Chapter IV Results and Discussion contains research results including AP2T analysis, ICE application design, GIS impact analysis, BPM connectivity enhancement, dashboard visualization, risk analysis, performance analysis, and comprehensive discussion, presenting the findings of the research in a clear and organized manner. Chapter V Conclusion contains conclusions from the research results, research implications, research limitations, and suggestions for future research and recommendations for PT. PLN (Persero), providing closure and guidance for future efforts to improve the customer connection process and achieve organizational objectives.

Based on the background described above, this study is designed to address several critical challenges surrounding the customer connection process at PT PLN (Persero). Specifically, the research focuses on identifying the key operational barriers faced by PT PLN (Persero) during new customer connection, evaluating the prospects for developing internal applications to improve service efficiency and effectiveness, and determining how service delivery strategies and electricity sales optimization can be maximized through application utilization.

In line with this research problem formulation, this study aims to make a meaningful contribution to improving the overall efficiency and quality of customer connection services at PT PLN (Persero). Specifically, the research objectives are threefold: analyzing operational barriers within the connection workflow, identifying functional requirements for developing an Integrated Customer Connection (ICE) application to streamline operations, and designing an integrated application-based solution along with strategic recommendations aimed at accelerating service delivery and driving sustainable electricity sales growth.

METHOD

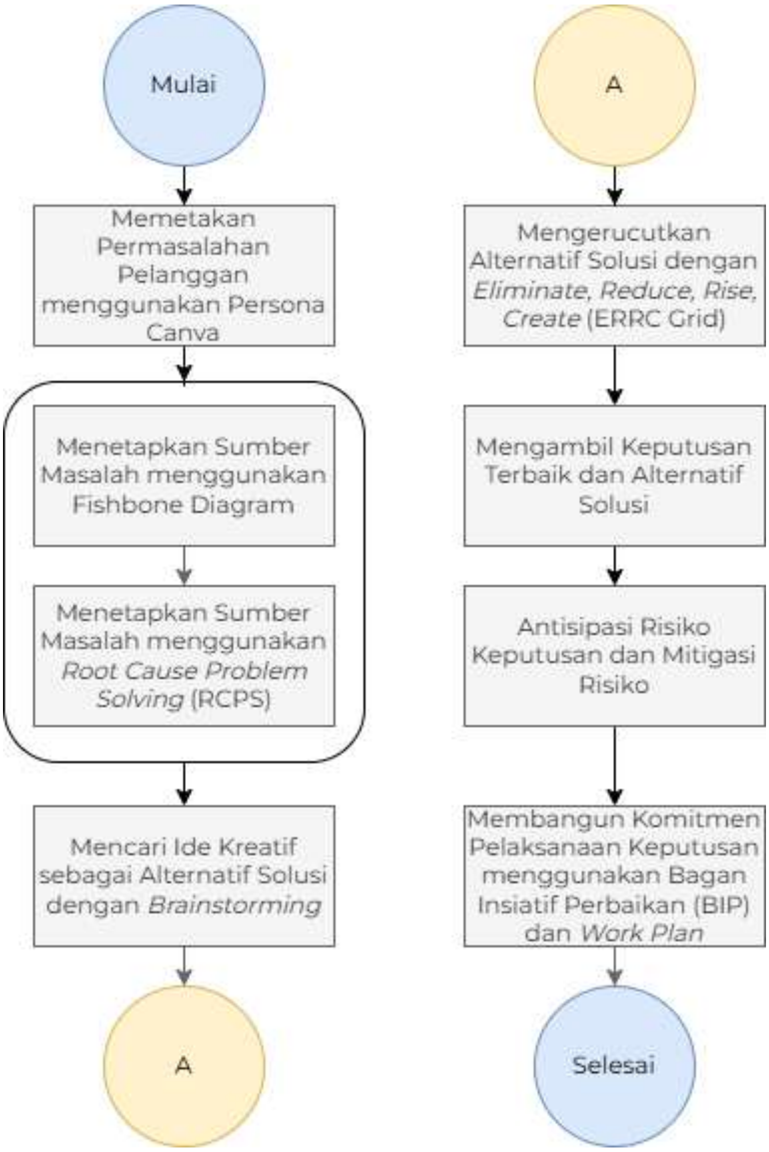


Figure 1. Research Methodology
(Source: Researcher Processing Data, 2026)

The research methodology this time is divided into 7 main stages consisting of mapping customer problems, determining the source of the problem, looking for creative ideas as alternative solutions, narrowing down alternative solutions, making decisions and alternative solutions, anticipating decision risks and mitigating risks, and finally building a commitment to decision implementation.

Stages of Mapping Customer Problems

At this stage, the author maps the potential problems that may be experienced by customers. To support this process, the author uses the Persona Canvas approach as a tool to identify and understand customer characteristics and needs more deeply. The template was first popularized by Design a Better Business – a project of a visual innovation team led by Patrick Van Der Pijl, Justin Lokitz, and Lisa Kay Solomon, authors of the book: *Design a Better Business: New Tools, Skills, and Mindset for Strategy and Innovation* (2016). In the book, the Persona Canvas is introduced as part of a collection of visual innovation tools that can be used in *the design thinking* process, especially at the *empathize* and *define* stage. The mapping process is carried out by digging into detailed information from customers and then grouping it into elements contained in the Persona Canvas. The parts of the Persona Canvas as customer information details are:

1. *Name & Role* : Giving these personas names and roles helps connect them in reality. Using a real person's profile is even better.
2. *Outlines* : What does our customer persona look like? Is it a man? A woman? Is he happy? Or sad? Create a diverse picture.
3. *Need* : Try to identify the persona's needs. What do they really want? What decision will they take?
4. *Positive Trends* : What are the positive trends that personas are experiencing in their lives?
5. *Opportunities* : What are some of the opportunities of positive trends that personas are experiencing in their lives? This opportunity can be in work, or personal life.
6. *Hopes* : What expectations does a persona have for the future?
7. *Negative Trends* : What are the negative trends that personas are experiencing in their lives?
8. *Headaches* : What are the negative things or problems that the persona is experiencing in their life that needs to be solved? This can be in work or personal life.
9. *Fears* : What fears does a persona have for the future? What negative emotions to deal with?

The information collected acts as an initial input in formulating the main problems faced by customers. The elements used in the Persona Canvas in this study were adjusted to the context and needs of the user, which include: name, role, expectations, fears, needs, pain, negative trends, and positive trends. The Persona Canvas was compiled based on the results of a Focus Group Discussion (FGD) with customer service officers, call center operators, and ULP Tanjung technicians who interact directly with customers every day.

The participation of these various parties is expected to be able to provide a comprehensive overview of the real conditions in the field, so that PT PLN (Persero) can formulate problems more precisely on target and based on customer needs and expectations.

Stages of Establishing the Source of the Problem

At this stage, the author will determine the source of the problem that occurs. The results of the canvas persona in the previous stage became the input in this stage. In determining the source of the problem, the author will implement *fishbones* diagram and *Root Cause Problem Solving* (RCPS). The first step in this stage is to use a fishbone diagram to identify several factors that could potentially be the cause of problems in the customer. Some of the factors used by the author are *Man, Machine, Material, Method,* and *Money.*

Fish bone diagram is one of the methods or tools in improving quality. This diagram is often called a Cause and Effect diagram or cause effect diagram. Its inventor was a Japanese scientist in the 60s. Named after Dr. Kaoru Ishikawa, a scientist born in 1915 in Tokyo, Japan who is also an alumnus of chemical engineering at the University of Tokyo, so it is often also referred to as Ishikawa diagram. The method was initially used more for quality management. Which uses verbal (non-numerical) data or qualitative data. Dr. Ishikawa is also suspected to be the first person to introduce the 7 tools or methods of quality control (*7 tools*). Namely *fishbone* diagrams, control charts, run charts, histograms, scatter diagrams, pareto *charts,* and *flowcharts.*

It is said *to be Fishbone* Diagram because it is shaped similar to a fish bone with the snout of its head facing to the right. This diagram will show an impact or effect of a problem, with its various causes. Effects or consequences are written as fish heads. Meanwhile, fish bones are filled with causes according to the approach to the problem. It is said to be *a Cause and Effect* diagram because it shows the relationship between cause and effect. With regard to the control of statistical processes, cause-and-effect diagrams are used to show the causal factors and quality characteristics (consequences) caused by those causal factors.

After identifying the cause of the problem using a fishbone diagram, the cause of the problem experienced today can be known. The next step is to identify the root of the problem. The author will use *Root Cause Problem Solving* (RCPS) as a supporting tool. The author will use the RCPS 5 *Why* diagram.

The Stage of Finding Creative Ideas as Alternative Solutions

At this stage, the author will explore creative ideas that have the potential to be alternative solutions to the root of the problem that has been determined. The *brainstorming* technique was first developed by Alex F. Osborn (1953) as a creative method to produce alternative solutions in groups. Ideas are collected without initial evaluation, then analyzed to find patterns that can be developed into innovative solutions (Paulus & Nijstad, 2003). The results of the previous stage are the roots of the problems that are currently occurring. To explore ideas related to solutions, the author will brainstorm.

Stages of Narrowing Down Alternative Solutions

At this stage, an alternative solution was narrowed down that was produced in the previous stage. To narrow down the existing alternative solutions, the author uses *Eliminate, Reduce, Rise, Create* (ERRC Grid). ERRC Grid is a tool used to drive value innovation by eliminating and reducing elements that are no longer valuable, while improving and creating new elements that the market needs (Kim & Mauborgne, 2005). There are four elements in the ERRC Grid, namely *eliminate* (factors that can be eliminated so that they have competitiveness in the long term), *reduce* (factors that must be reduced to achieve the best efficiency), *rise* (factors that must be improved above the standard), and *create* (factors that must be created and have never been offered by the industry). Here is an example of an ERRC used.

Decision-Making Stages and Alternative Solutions.

At this stage the author takes the best decision and alternative solutions. At this stage, a business impact table is used to evaluate the impacts that can arise with the efforts that must be made. The Impact Effort Matrix is a decision-making tool used to help people manage time more efficiently to choose the best solution based on the book *Running Lean: Iterate from Plan A to a Plan That Works* (Maurya, A. 2012). Organizations, teams and individuals will measure the most appropriate solution based on the level of effort needed and the potential impact/profit that will be obtained. This matrix can be used to:

1. Choosing a number of alternative actions
2. Determining job priorities
3. Decide on the most impactful actions with the least effort
4. Establish decisions based on certain criteria

After filling in the business impact, it can be continued by creating a business impact matrix from the results of the assessment of ideas and ideas on the business impact table. The business impact matrix is used to determine the idea that is the top priority as an alternative solution. In the business impact matrix, the x-axis reflects the amount of effort that must be expended and the y-axis reflects the amount of impact that is incurred. The following is an example of a business impact matrix.

In addition to using the business impact matrix, the author also uses Decision Grid to evaluate alternative ideas for existing solutions. The inputs used are alternative ideas. Each of these ideas will be assessed using several predetermined criteria, namely *effective, simple, feasible, timing,* and *efficient*. Each criterion will be filled in with a score of 1-9 according to the idea, then it will be added as a total. After that, it can be determined that each of these creative ideas will be used, not used, or in need of modification. The following is an example of a *decision grid* used.

Risk Anticipation and Mitigation Stage

At this stage, the author tries to anticipate if a risk occurs by mitigating the risk. The author uses the Risk Mitigation Table, then analyzes the level of risk that can occur with the specified Risk Matrix. Goals/focus are solutions taken from the results of the *decision grid*. *Risk matrices provide a structured approach to evaluate the likelihood and impact of risks, while decision grids support the prioritization of risk mitigation strategies based on weighted criteria* (Dhillon, 2007). Each of these focuses will be identified for risk including risk description, risk causes, and risk impacts. The author also identifies the actions that have been taken, the level of risk that has occurred, the level of risk after control, appropriate mitigation methods, and the attachment of evidence.

Stages of Development of Decision Implementation Commitment

The last stage in this research is that the author needs to build a commitment to the implementation of decisions as a way to execute the solutions that have been found in the previous stage. The author will use the Improvement Initiative Chart (BIP) at this stage. The Improvement Initiative Chart (BIP) contains the title of the initiative, the department responsible, the description of the proposed initiative, the background, details of the actions, the KPI points that will be affected, the level of ease of implementation of the initiative, the benefits and impacts that can occur, the costs required, and the endorsement if approved by the mentor. Commitment to decision implementation is an important stage in the continuous improvement management process. To execute the solutions that have been found, the author uses the Improvement Initiative Chart (BIP) as an implementation planning tool. BIP includes important elements such as the title of the initiative, the department in charge, the background, the description of the action, the performance indicators (KPIs) affected, the estimated cost, the level of ease of implementation, and the approval by the authorities (Liker & Meier, 2006; Imai, 1986).

After the initiative has received approval from the mentor, the next stage is to prepare *a workplan* as an implementation guide. *The workplan* is prepared to detail the action steps, implementation time, persons in charge, and success indicators so that the objectives of the initiative can be achieved systematically (Kerzner, 2013; Bryson, 2018). The *workplan* has been equipped with some information needed during the initiative to be achieved, including competencies, key behaviors, activities, parties involved, information, timeline charts, goals and results, possible obstacles, and efforts. The following is an example of the *workplan* used by the author.

RESULTS AND DISCUSSION

In this chapter, the results of the research that have been developed based on the output of the designed application will be explained.

AP2T Gap Analysis on Operational Needs and Justification for ICE Development

One of the proposed improvements made is the establishment of the ICE application. This application will be used by PLN to support its operational activities, especially in connecting services. There are several features offered in the ICE application, here are some of these features presented in the form of Table 5.1

Table 1. ICE Application

Yes	Data	Remarks
1	View available joining teams	The application *dashboard* displays the number of teams, personnel and fleets available on a daily basis to receive and carry out the connection
2	*Connection warning sign*	Create a marking category for customer requests that have been paid and have not been turned on based on voltage segments and the length of time the request has been since the customer made the payment
3	Top Contributor Officer	Create a calculation of achievement scores per officer to see the level of *performance* of each officer
4	Productivity Connection	Displays connectivity productivity based on total payments made by customers compared to total number connected (rejuvenated) on a daily basis
5	Analysis of *MVA Growth* Achievement Per Month	Displays monthly growth in connected power from customers who add power, install new and customers who apply for unsubscribe and downgrade accumulated on a monthly basis
6	Technical feasibility survey automation	Each application will be directly analyzed for technical feasibility using *machine learning* in a direct application designed based on asset data and technical feasibility standards
7	System load data	Real load data per feeder used by customers with a span of 1 month and the highest usage data taken for 1 month

The features offered are features developed in the ICE application. Starting from available team information, connection *warning signs*, top contributor officers, connection productivity, analysis of mva growth achievements per month, automation of technical feasibility surveys, and system load data. In addition to the added features, the appearance of ICE for these features is also made with *the aim of being user-friendly.* Here is a screenshot of the view from ICE

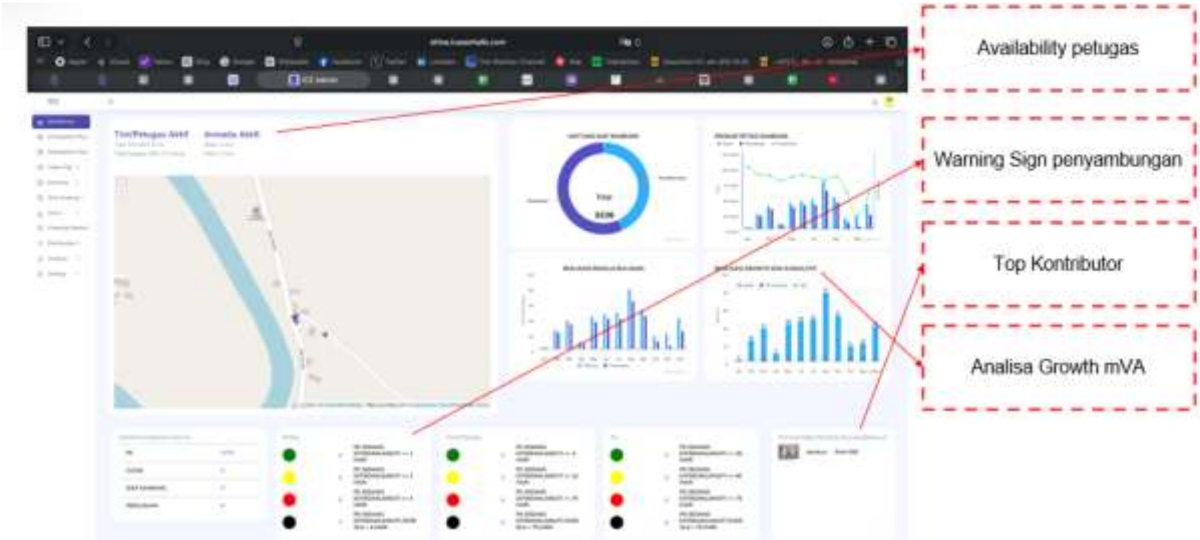


Figure 2. ICE Footage
Researcher & PT PLN ULP Tanjung, 2026

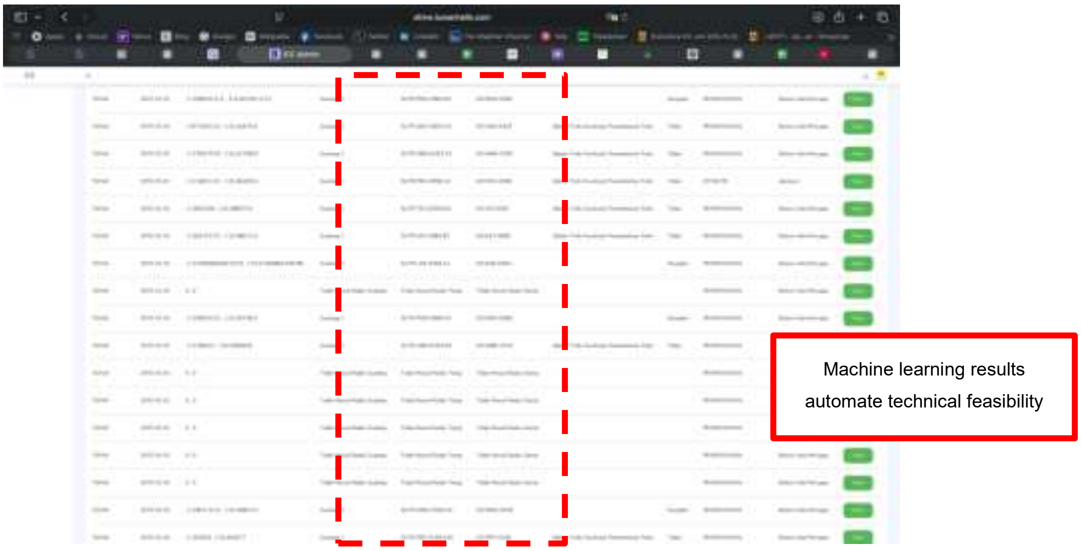


Figure 3. ICE Footage
Researcher & PT PLN ULP Tanjung, 2026

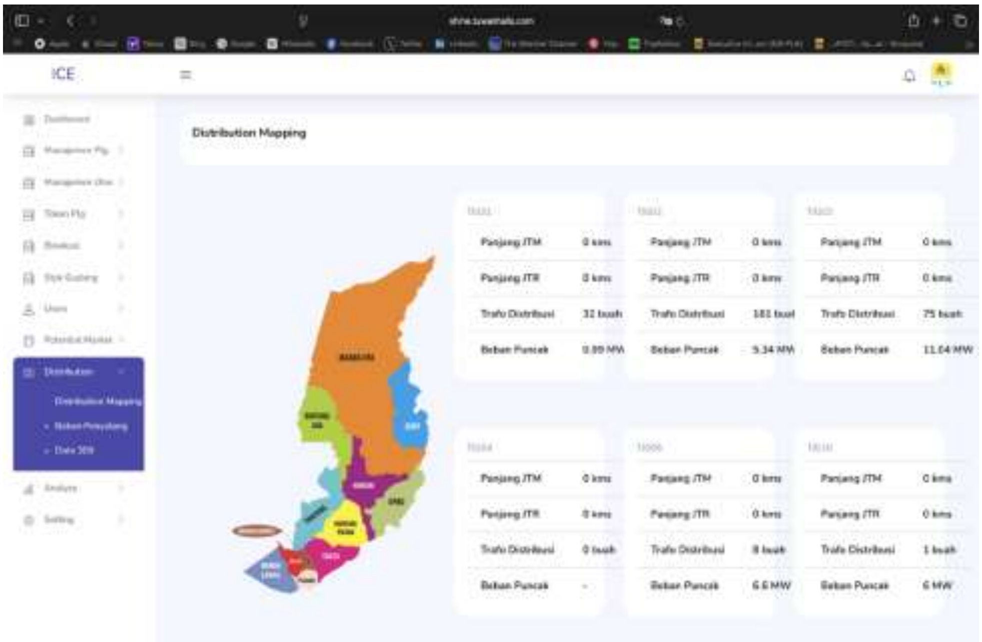


Figure 4. ICE Footage

Researcher & PT PLN ULP Tanjung, 2026

GIS Impact Analysis

The effectiveness of the technical feasibility check previously carried out by the engineering team was at least 30 minutes for 1 customer to 5 minutes for 1 customer. GIS can also be a proposal for the efficiency of location tagging costs based on the unit price on the connection contract of Rp 8,604 per customer application. In addition, GIS is also an acceleration of expansion proposals if it is known that the customer's location needs additional assets to meet the supply needed by customers. Here is the GIS integration flow

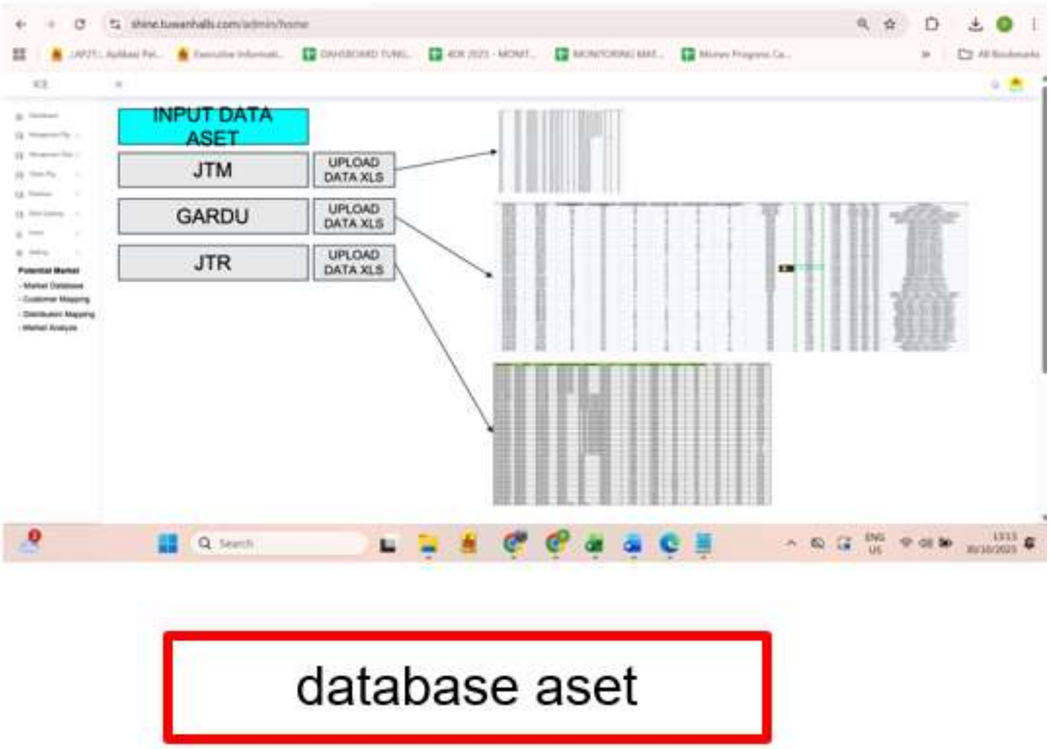


Figure 5. Data Input GIS
Researcher & PT PLN ULP, 2026

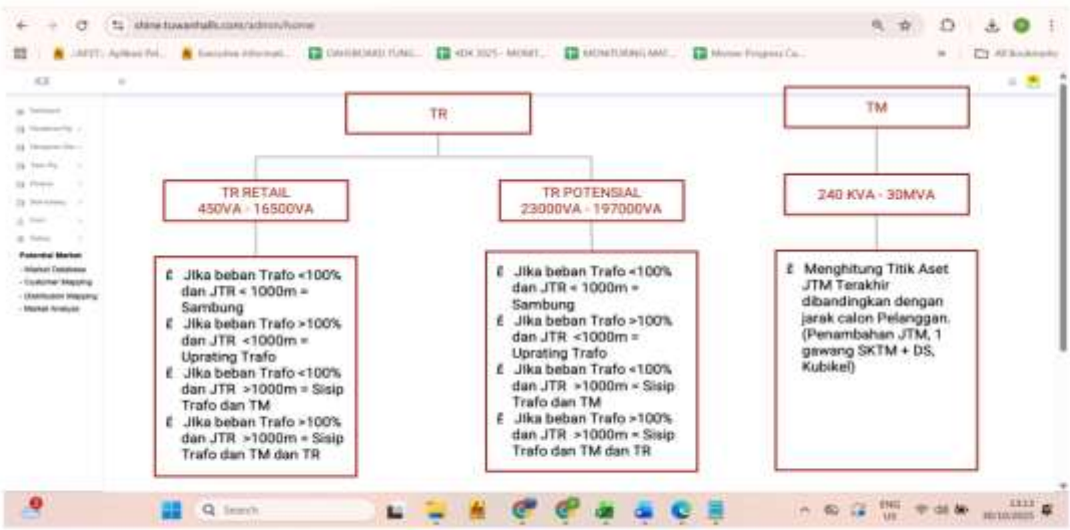


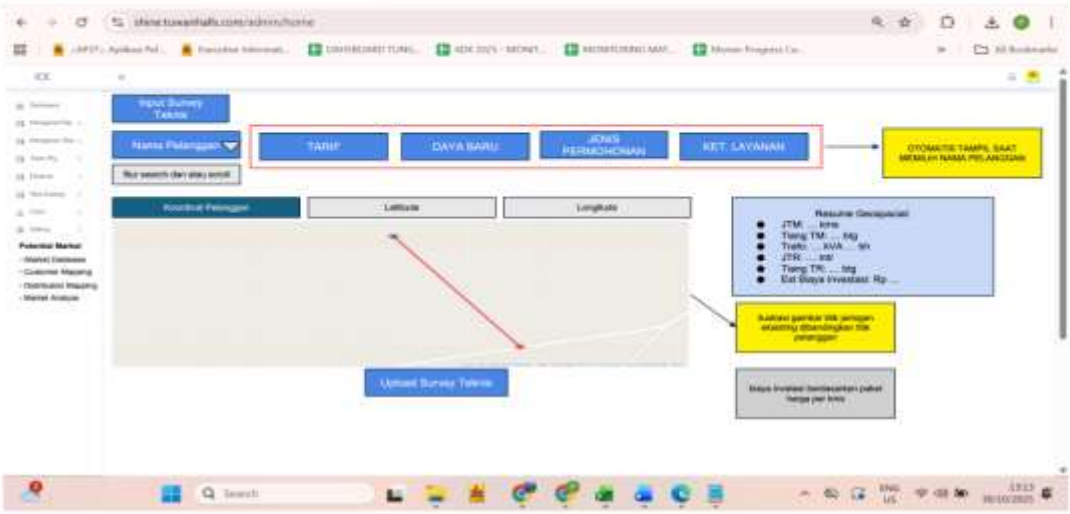
Figure 6. business logic rules of the Market Analyze / Distribution Mapping feature

Researcher & PT PLN ULP, 2026

Basic technical limitations

Figure 7. Basic technical limitations

Researcher & PT PLN ULP, 2026



Output

Figure 8. Output GIS

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Connectivity BPM Enhancements

The condition before the proposed feature improvement, the work order returned due to failure to connect, which was then carried out by a technical survey took at least one week. In addition, technical surveys depend on the technical team where the workload of the engineering team is high and only 2 employees are available

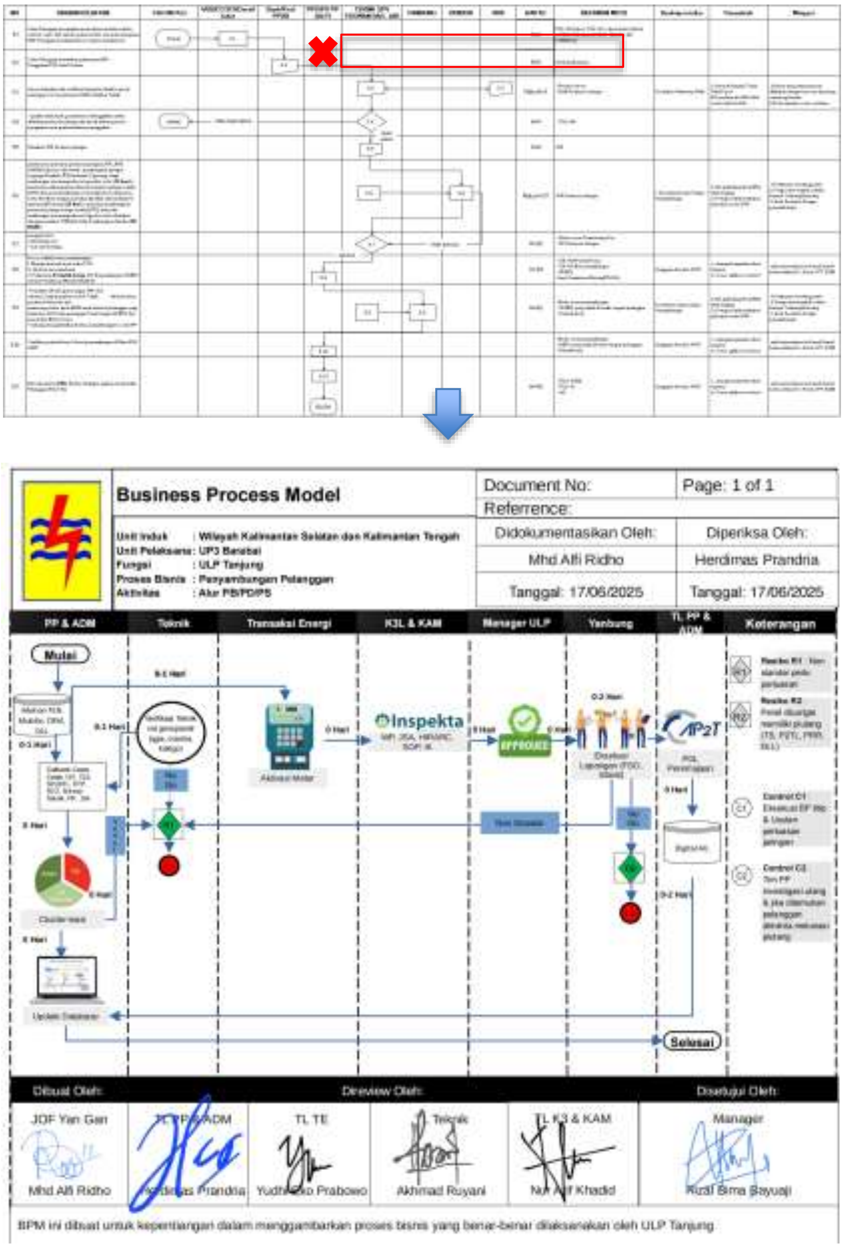

Figure 9. Enhancements of BPM Connectivity

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Data Transparency and Accountability based on Dashboard Visualization

From the results of the ICE application development, the data needed has been arranged in such a way in a *dashboard* to facilitate data visualization. The following is a snippet of the *dashboard* visualization developed.

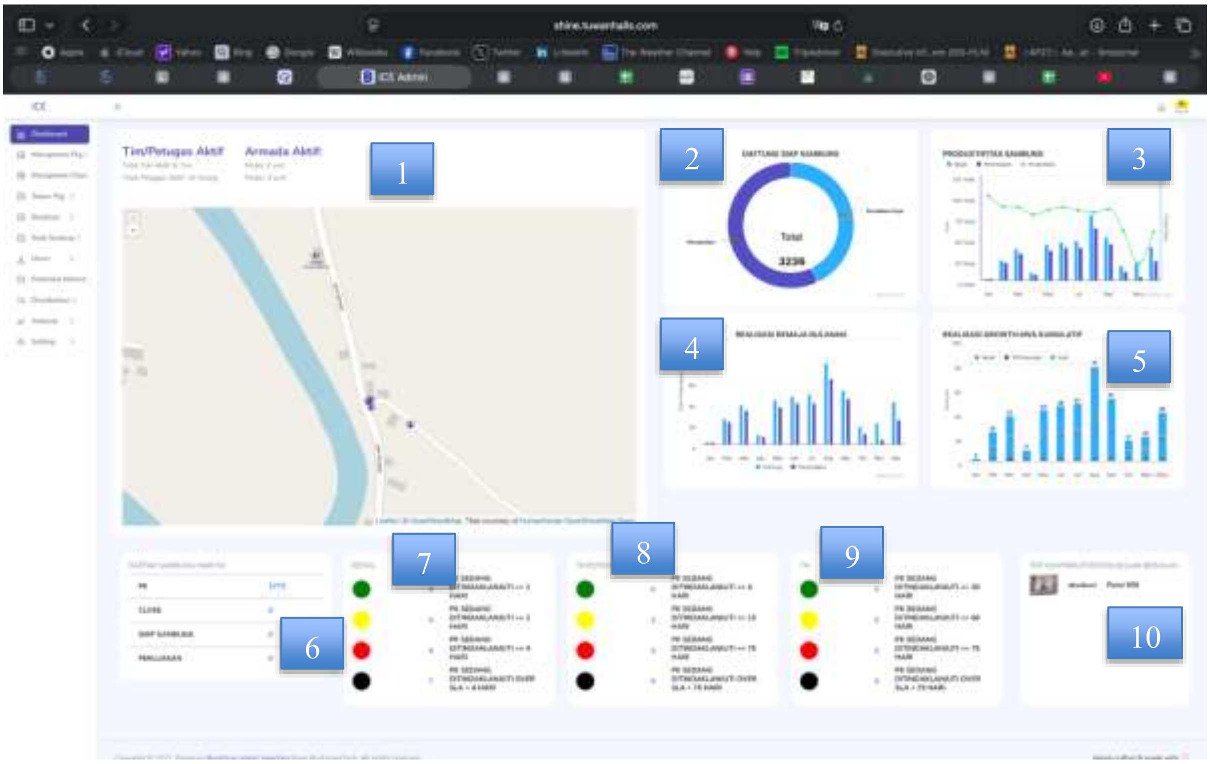

Figure 10. Visualization *Dashboard*

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The following is the function of each data displayed on the *developed dashboard* presented in the form of a table

Table 2. Benefits of each section on visualization *Dashboard*

Yes	Data	User Benefits
1	*Availability* of officers	See the number of teams ready to work
2	Waiting list ready to go	View total waitlists ready to connect (without expansion)
3	Productivity	View a graph between paid and connected customers on a daily basis
4	Monthly youth realization	View the total number of teens who are engaged in monthly activities
5	Monthly *Growth*	View total cumulative power growth on a monthly basis
6	Today's Join List	View the progress of the connection on a daily basis
7	Sign up for retail	Display a list marker that is not connected to retail customers
8	*Sign* a waitlist for potential tr	Display a list marker that is not connected to a potential tr customer
9	*Sign* TM waitlist	Displays a list marker that is not connected to TM customers
7	Top contributors officers	Display the top contributors of the officers based on the realization of the connection

Risk Matrix and Risk Mitigation

The level of risk that can occur with the specified Risk Matrix. Goals/focus are solutions taken from the results of the *decision grid*. \. Each of these focuses will be identified for risk including risk description, risk causes, and risk impacts. In addition, the identification of the actions that have been taken, the level of risk that has occurred, the level of risk after control, appropriate mitigation methods, and the attachment of evidence. The following is the risk matrix used.

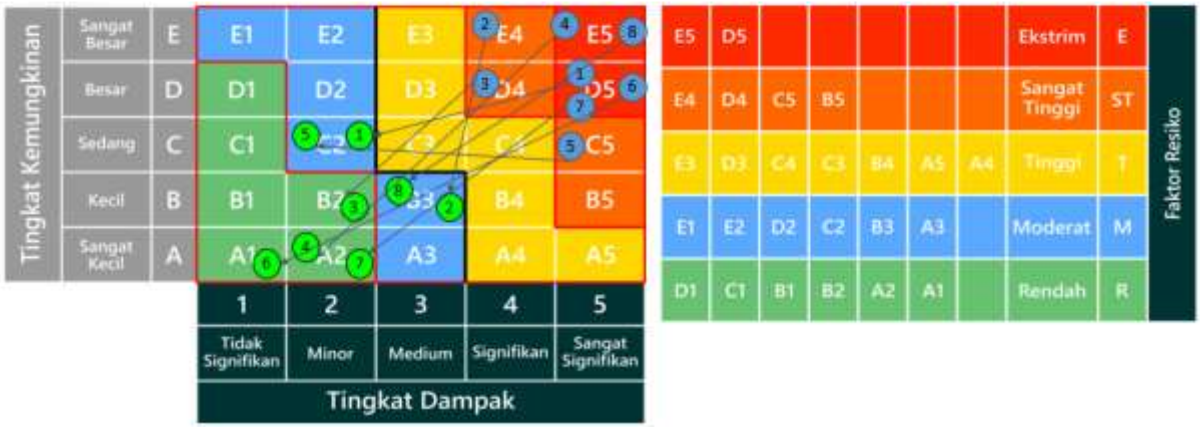

Figure 11. Risk matrix

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Figure 12. Table 4.x Matrix for Identification, Assessment, and Mitigation of Operational Risks for Electrical Connections

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From these results, it is known that risk mitigation carried out for server security includes the WHM management system, installing anti-malware/anti-viru, installing *server* monitoring, using SSL, using complicated password encryption, and *backing* up data periodically.

Performance Analysis of the Electric Power Connection Process

The performance analysis of the connection process was carried out using application status data classified into four main categories, namely Job Application (PK), Ready to Connect, *Close*, and Expansion. This data is obtained from the *application monitoring* dashboard.

Table 3. Classification of Extension Application Status

Application Status	Description	Analysis Function
PK	Initial entry and verification application	Initial workload indicators
Ready to Connect	Administration & technical ready	Indicators of potential backlogs
Close	Connection completed	Performance output indicator
Expansion	Requires additional networking	Complexity indicators

Based on the dashboard recap, it can be seen that before the application is implemented, applications that are ready to connect often experience delays due to limitations in cross-functional monitoring. After the application is implemented, the status of the application can be monitored in real time so that management can immediately allocate officers or materials when there is a build-up on a certain status. The analyzed process performance indicators are the ratio of *close* to total applications, the length of transition time from ready to connect to *close*, and the number of applications held in the expansion status.

Analysis of Productivity of Splicing Officers

Officer productivity is analyzed using *scoreboard data* and a recap of daily activities recorded in the system

Table 4. Officer Productivity Indicators

Indicator	Data Source	Remarks
Number of executions per day	*Execution Dashboard*	Daily work output
Productivity score	*Scoreboard*	Based on job type
Activity level	Activity log	Work discipline
SLA Solution	Data SLA	Target compliance

The scoreboard assigns different weights to each job type (PB, PD, migration, expansion). This approach allows for a fairer evaluation of performance because it takes into account the complexity of the work. The results of the analysis showed that officers with a high level of activity tended to have a better completion rate, score transparency increased motivation and accountability, and job distribution became more even after the application was used.

Distribution Network Readiness and Capacity Analysis

Network readiness analysis was carried out using distribution *mapping data*, feeder load and transformer load.

Table 5. Network Readiness Indicators

Indicator	Parameters	Function
Transformer load	% load	Connect Eligibility
Customer distance	meter	JTR/JTM Requirements
Feeder capacity	MW/MVA	Potential new customers
Types of actions	Connect/Uprating/Insert	Technical decision

The system uses automatic technical rules, such as the transformer load is less than 80%, then it is suitable to connect, the transformer load is more than 80%, then it needs to be uprating/inserted, and if the distance is more than 500 meters, it is indicated by JTM. This approach speeds up the technical survey process and lowers the risk of manual calculation errors.

Impact Analysis on Electricity Sales

The analysis of the impact on sales was carried out by associating new connection data with sales realization data (data 309) and customer transaction data.

Table 7. Indicators of the Impact of Connectivity on Sales

Indicator	Data Source	Interpretation
Number of new customers	Data Connect	Extensification
Delta power absorbed	Date: 309	Immediate impact
Initial consumption	Account/PPOB	Customer activation
Growth MVA	*Dashboard*	Sales contribution

The results of the analysis show that the acceleration of connectivity has a direct impact on accelerating the realization of energy consumption. Customers who connect faster start contributing to the sale of electric power in a shorter period.

Application Implementation Analysis Based on *Workplan*

Application implementation evaluation is carried out based on the suitability between the work plan and *the* actual implementation.

Table 1. Implementation Evaluation *Workplan*

Workplan Stage	Activities	Implementation Status
Data processing	Cleaning & integration	Achieved
Module development	*Dashboard* & input	Achieved
Internalization of SOPs	Socialization of officers	Achieved
Daily monitoring	Update & evaluation	Achieved
Performance evaluation	Output analysis	Achieved

Daily monitoring allows for quick correction of invalid data and ensures the entire process goes as planned. Despite technical obstacles in the field, the implementation of the application is considered effective in supporting connection operations.

Comparative Analysis Before and After Application Implementation

Based on the results of the observation of the customer connection business process at PT PLN (Persero), it was found that there was a difference between the process conditions before and after the implementation of the internal application. Before the implementation, the customer connection process was still carried out separately between functions, with the following characteristics:

1. Customer applications are accepted manually or semi-digitally
2. Data verification is done through multiple non-integrated systems
3. The technical survey process is carried out without a centralized monitoring dashboard
4. Job status information can't be monitored in real-time
5. Coordination between units (service, network, and executor) is carried out through manual communication

This condition causes longer processing times, the potential for an increased backlog of work, and difficulties in tracking the status of applications. After the implementation of the application, the connection process has been improved as follows:

1. All customer requests are input in an integrated system
2. Customer data, network, and system loads are directly connected in a single database
3. Technical survey process using automated data (distance, transformer load, feeder capacity)
4. Job status can be monitored in real-time through the dashboard
5. Officer assignment is carried out system-based (*scoreboard* & *workload distribution*)
6. Execution and closing of jobs are recorded directly in the system

CONCLUSION

Based on the results of the research that has been carried out, there are several conclusions that can be concluded, namely the following: The main obstacle faced by PT. PLN (Persero) in the process of connecting new customers is not only technical, but also systemic and operational. The obstacles faced include the lack of integration of operational, technical, and administrative data in real time, the stages of technical surveys and network verification being the main *bottleneck* points, limited visibility of the availability of materials and work expenses of officers, uneven distribution of officer workload, and limited use of network data and sales data. Internal application development has excellent prospects in supporting the efficiency and effectiveness of the customer connection process at PT. PLN (Persero). The developed application design is able to integrate all important data, provide *a real-time* monitoring *dashboard*, support objective technical decision-making, and improve transparency and performance accountability. The strategy of developing customer service and increasing electricity sales can be significantly optimized through internal applications. The utilization of the application allows for the acceleration of the connection process, the identification of data-driven market potential, the improvement of the quality of customer service, and the synergy between technical and commercial functions. Internal applications act as strategic tools that bridge the improvement of service quality with the achievement of electricity sales targets in a sustainable manner.

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