

Transformation of Service Quality through Digital-based Waste Management in Semarang City

Transformasi Kualitas Pelayanan melalui Pengelolaan Sampah Berbasis Digital di Kota Semarang

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Abstrak

Penelitian ini bertujuan untuk menganalisis implementasi aplikasi Silampah dalam transformasi pengelolaan limbah di Kota Semarang. Aplikasi Silampah merupakan platform digital yang memungkinkan masyarakat melaporkan limbah secara real-time kepada otoritas. Melalui analisis deskriptif dengan pendekatan kualitatif, penelitian ini mengumpulkan data melalui wawancara, observasi lapangan, dan studi dokumenter. Responden penelitian meliputi pekerja sanitasi, pengelola aplikasi, dan komunitas pengguna. Temuan penelitian menunjukkan bahwa implementasi Silampah telah memberikan kontribusi signifikan terhadap peningkatan efisiensi pengumpulan dan pengelolaan limbah di Kota Semarang. Fitur-fitur teknologinya seperti pelaporan limbah real-time, respons cepat pekerja sanitasi, dan kesadaran lingkungan yang ditingkatkan telah meningkatkan kualitas pelayanan public. Namun, tantangan seperti infrastruktur teknologi yang belum merata dan partisipasi masyarakat yang belum merata masih perlu diatasi untuk memaksimalkan manfaat pelaksanaan Silampah. Studi ini memberikan wawasan berharga bagi pemerintah daerah dan pemangku kepentingan untuk terus meningkatkan sistem pengelolaan limbah berbasis teknologi guna mencapai tujuan pembangunan berkelanjutan di kota-kota lain di Indonesia.

Kata Kunci: transformasi, kualitas pelayanan, pengelolaan sampah, pemerintah, partisipasi.

Abstract

This study aims to analyze the implementation of the Silampah application in the transformation of waste management in Semarang City. The Silampah application is a digital platform that allows people to report waste in real-time to the authorities. Through descriptive analysis with a qualitative approach, this study collects data through interviews, field observations, and documentary studies. The respondents to the study included sanitation workers, application managers, and the user community. The findings of the study show that the implementation of Silampah has made a significant contribution to improving the efficiency of waste collection and management in Semarang City. Its technological features such as real-time waste reporting, quick response of sanitation workers, and improved environmental awareness have improved the quality of public services. However, challenges such as uneven technological

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infrastructure and uneven community participation still need to be overcome to maximize the benefits of Silampah implementation. This study provides valuable insights for local governments and stakeholders to continue to improve technology-based waste management systems to achieve sustainable development goals in other cities in Indonesia.

Keywords: transformation, service quality, waste management, government, participation.

1. INTRODUCTION

Waste management poses a serious challenge for many cities in Indonesia, including Semarang City. Rapid population growth, urbanization, and consumptive lifestyles have significantly increased the volume of waste, while limited waste management infrastructure often fails to address this issue effectively (Wikurendra et al., 2024). The negative impacts of uncontrolled waste management include environmental pollution, economic losses, and public health risks. To improve the efficiency and effectiveness of waste management, many city governments are beginning to adopt technology-based solutions (Abubakar et al., 2022). One of the latest innovations in this regard is the Waste Reporting System Application (Silampah), a platform that allows the public to report waste in real time to the authorities. Through Silampah, information about the location, type, and volume of waste can be quickly communicated to sanitation workers, enabling them to respond more efficiently.

Based on data from Bappeda 2020, waste management in Semarang faces significant challenges with the increasing amount of waste every year. According to Jakstrada's achievement data in 2019, Semarang produces approximately 1,276 tons of waste per day, with 1,071 tons of it being sent to the Jatibarang landfill daily. The capacity of the Jatibarang landfill is estimated to only accommodate waste until 2021. However, since 2019, the Silampah application has experienced technical and operational issues that hinder its effectiveness. The shift of services to Semarang city's social media and the lack of socialization and budget have caused many residents to be unaware of or not optimally use this application (Latupeirissa, J. et.al 2024; Widiyanto, 2023). This research is necessary to identify and evaluate the factors that influence the successful implementation of Silampah in waste management in Semarang. Additionally, there are still waste management issues in Semarang involving technical, social, economic, and environmental aspects. The research results are expected to contribute to existing knowledge and offer more targeted policy recommendations. Furthermore, this study aims to explore ways to increase community participation in waste reporting, and identify the solid technology infrastructure needs to support the sustainability of the (Acevedo Correa et al., 2023).

The state of the art in waste management technology in Semarang includes a number of the latest innovations designed to overcome the complex challenges of managing waste. Silampah is a digital platform that allows the public to report waste in real-time to the authorities. Through Silampah, information about the location, type, and volume of waste can be quickly conveyed to the cleaning crew, enabling them to respond more efficiently and swiftly. Additionally, the use of sensor technology and smart monitoring is also an important part of this state-of-the-art system. Sensors and smart monitoring systems are used to monitor waste volume in strategic places, such as disposal sites and residential areas, enabling more accurate and efficient decision-making in waste management. Furthermore, automatic sorting and counting technologies are also rapidly evolving. These systems use computer vision technology and artificial intelligence to automatically separate and count various types of waste, improving the efficiency of recycling processes.

Innovative approaches in technology-based training and education are also a crucial part of this sophistication. The use of digital platforms and mobile applications to provide information, guidance, and training on waste management to the community can enhance awareness and participation in sustainable waste management efforts. Factors such as digital literacy levels, environmental awareness, and individual motivations can influence how many people actively use these apps. Therefore, effective communication and education strategies need to be developed to increase public awareness and participation in the use of Silampah. Furthermore, financial aspects also need to be considered in the research plan. The development, implementation, and maintenance of the Silampah application requires significant investment from local governments or other parties involved (Phonchi-Tshekiso et al., 2020). Questions about funding sources, efficient use of funds, and financial sustainability in the long term must be answered clearly.

In addition, a cost-benefit analysis is also important to evaluate whether the investment in these applications is worth the expected benefits in terms of better waste management and a cleaner environment (Cahyati, 2023). Environmental issues are also an important focus in this study. Although Silampah aims to improve the efficiency of waste management, its impact on the environment needs to be evaluated comprehensively. For example, has the use of this app reduced the amount of waste dumped illegally or increased the amount of waste recycled? Evaluation of the impact of the application on reducing the generation of organic waste and water also needs to be done to ensure that the use of Silampah does not just move the problem from one area to another. In addition, aspects of social justice also need to be considered. Questions about the accessibility of the Silampah application for all walks of life, including those who may not have access to a smartphone or the internet, should be noted.

Based on these issues, this research aims to thoroughly investigate the implementation of Silampah and its impact on the transformation of waste management in the city of Semarang. By understanding the experiences and perceptions of stakeholders, including cleaning staff, application managers, and user communities, this research is expected to provide valuable insights for local governments and related stakeholders to sustainably improve technology-based waste management systems and ensure that the implementation of the application does not increase social inequality or discrimination in access to waste management services. Considering these issues, the research on the implementation of Silampah for transforming waste management in the city of Semarang can be holistically designed to address existing challenges and optimize the benefits of technology use in the development of sustainable cities. Thus, this research will help create a more effective and sustainable waste management strategy in Semarang and can be applied in another cities that face similar problems.

2. LITERATURE REVIEW AND PREVIOUS RESEARCH

2.1 Public Service Transformation

Service quality transformation refers to the profound changes that occur in the way a service is provided, accessed, and enjoyed by users or customers. This includes not only improvements in service standards themselves, but also changes in processes, organizational culture, and the underlying mindset of service providers (Osborne, 2020). More specifically, the transformation of service quality through the implementation of the Waste Report System Application (Silampah) in Semarang City includes various positive changes in waste management. This includes increased efficiency in the waste reporting process and response

from authorities, increased transparency and accountability in waste management, increased community participation in waste monitoring and management, and increased environmental awareness among residents.

This transformation is driven by the use of information and communication technology, which allows waste management services to be more responsive, scalable, and integrated (Väyrynen et al., 2022). Through Silampah, communities can report waste directly and in real-time, allowing cleaners to respond quickly and efficiently. The data collected from this application also allows local governments to conduct more accurate monitoring of the performance of waste management services and make better decisions in overall waste planning and management. Thus, the transformation of service quality through the implementation of Silampah includes fundamental changes in the way waste management services are delivered and managed, with the ultimate goal of increasing user satisfaction, operational efficiency, and positive impact on the environment.

Public service transformation refers to the process of fundamental change in the way public services are delivered, managed, and organized to better meet the needs of citizens and communities. This transformation is driven by the realization that traditional public services are often inefficient, ineffective, and inaccessible to many, particularly those most in need. The transformation process involves a complete overhaul of public services, including the way they are designed, delivered, and managed. This includes a shift away from a focus on organizational silos and bureaucratic structures to a more integrated and collaborative approach that prioritizes people's needs and outcomes (Amador & Earnest, 2018). At the core of public service transformation is a commitment to co-production, where citizens, communities, and public servants work together to design and deliver services tailored to local needs and contexts. This requires a significant change in mindset and culture, as public servants must be willing to listen to and learn from the public, and empower them to play an active role in shaping services that impact their lives (O'Leary, 2023). This co-production approach also requires the development of new skills and competencies, such as community engagement, facilitation, and partnership building (Markowski, 2021; Osborne, 2020).

Another important aspect of public service transformation is the application of digital technologies to improve service delivery, accessibility, and transparency. This includes the development of online platforms and mobile applications that allow people to access services remotely, as well as the use of data analytics and artificial intelligence to improve service efficiency and effectiveness (Murdock, 2021; Moore, 2019). In addition, public services should be designed to be more responsive to the needs of diverse communities, including persons with disabilities, and to address the root causes of social and economic inequality. Public service transformation also requires significant changes in the way public services are funded and resourced. This includes exploring new funding models, such as social impact bonds and performance-based payment contracts, as well as leveraging private sector investment and philanthropic support to support innovative service delivery models (Avgouleas & Marjosola, 2021; Murdock, 2021; Larsson & Teigland, 2019).

Debnath et al., (2023) delves into sustainable e-waste management, emphasizing the integration of information and communication technologies (ICT) with green recycling techniques to develop intelligent and smart systems. It research can benefit from addressing several gaps identified include the integration of ICT and green recycling technologies, which emphasizes the importance of integrating ICT with green recycling technologies, and the research in Semarang can explore how to effectively implement these technologies in the local context. Additionally, multidisciplinary interventions are highlighted in the book, and this research can involve various stakeholders such as local government, private sector, and community organizations. Addressing the challenges within the e-waste supply chain, such as logistics and coordination among different stakeholders, can help improve the overall

efficiency of waste management in Semarang. Incorporating real-life case studies from Semarang can provide practical insights and examples of successful digital waste management applications. Lastly, enhancing community participation through digital platforms and mobile applications can be a key focus area to ensure sustainable waste management practices. By addressing these gaps, the research can contribute to the development of more effective and sustainable waste management strategies in Semarang.

Mehmood et al., (2022) focuses on the concept of "Smartness" in emerging environments and applications, particularly through the lens of the Internet of Things (IoT). They examine smartness from four main perspectives: Sensors, IoT, and Data Generation; Data and Information Processing; Actuation; and Digital Systems and Infrastructure. This multidisciplinary approach provides a comprehensive view of how smart systems can be embedded, how data is processed, how systems interact with their environment, and the implications of ubiquitous versus limited systems. In addressing the gaps contributing to the research entitled Transformation of Service Quality through Digital-based Waste Management in Semarang City, Mehmood et al., (2022) focus on smart systems and IoT can provide valuable insights into the integration of these technologies in waste management. Exploring the application of sensors, data processing, and digital infrastructure in waste management can help enhance service quality and efficiency. Additionally, its discussion on multidisciplinary interventions and the importance of technology-based solutions can guide the development of comprehensive waste management strategies in Semarang City, ensuring sustainable and intelligent systems are in place.

The research on transforming service quality through the implementation of digital-based waste management in Semarang City brings forth new insights and approaches by synthesizing and building upon existing studies. The novelty of this research lies in its innovative approach to integrating information and communication technology (ICT) with community-based waste management practices through the Silampah application. This approach provides new insights into the potential for digital technologies to transform waste management in urban environments. By leveraging real-time reporting, enhancing transparency, and increasing community participation, this study explores how digital platforms can fundamentally change waste management systems. Additionally, the research addresses social justice concerns by ensuring that the application is accessible and usable for all community members, thereby minimizing social inequality and discrimination. This comprehensive approach not only aims to improve operational efficiency and user satisfaction but also contributes to a more sustainable and environmentally conscious waste management system in Semarang City.

Moreover, this study identifies several gaps in the current literature, such as the need for effective implementation of ICT in local contexts, the importance of multidisciplinary interventions, and the challenges within the e-waste supply chain. By addressing these gaps, the research suggests future directions for improving waste management strategies, including enhancing digital literacy, ensuring equitable access to technology, and fostering collaboration among various stakeholders. This detailed exploration of previous studies provides a clearer understanding of the context and the transformative potential of digital-based waste management systems. Consequently, the research highlights the significance of the proposed study and its potential contribution to the field, offering valuable insights and practical solutions for sustainable waste management in Semarang City.

2.2 Research Gap

Several studies have been conducted to evaluate various applications and systems aimed at improving the efficiency and effectiveness of waste management, including Arisman & Fatimah (2023), the study explores how soft management styles, employee behaviours, and the adoption of digital technologies in factories can influence the creation of digital waste. Researchers interviewed managers and employees at two manufacturing plants in Norway and Sweden. The findings suggest that strong leadership, employee education, and a focus on work-life balance can be beneficial during digital transformation. However, some aspects like employee training and creativity might be negatively affected. The study also highlights the potential for digital waste and the importance of prioritizing specific management practices and employee behaviours to minimize it. This research sheds light on how to navigate the digital transformation process in manufacturing while considering both human factors and potential downsides.

Another study, by Sharma et al., (2023), found that digital-based waste management application successfully increases the efficiency of waste collection and reduces the amount of waste illegally dumped in the region. These results show the potential application of technology in changing the paradigm of waste management from conventional to more efficient and sustainable. Janagi et al., (2015) discuss the impact of using the "Trashout" application in several cities in the United States. They found that the app successfully increased community participation in reporting waste spots and provided valuable data for local governments for more effective waste management planning. The study provides a global perspective on the potential of similar applications in improving transparency and public participation in waste management.

At the conceptual level, the concept of community-based waste management has been the focus of attention in various studies. According to Tarigan et al., (2020), Successful waste management requires active community involvement, both in the planning and implementation stages of waste management programs. The use of applications such as Silampah can be one way to encourage community participation and build awareness of the importance of responsible waste management. However, it is also necessary to pay attention to social justice aspects in technology-based waste management. Ubasart-González & Minteguiaga (2022) show that the use of technology in waste management can increase social inequality if not all levels of society can access or use the application. Therefore, in designing and implementing applications such as Silampah, it is important to pay attention to the needs and limitations of diverse communities.

Vishwakarma et al., (2022) highlight the important role of information technology in improving the efficiency and effectiveness of public services. They found that the use of technology-based applications, such as Silampah, can speed up the process of reporting and responding to waste problems by local governments. With the ability to report waste in real-time through the app, cleaners can respond more quickly and precisely, reducing the potential negative impact of waste on the environment and public health. Li et al., (2020) show that digital-based waste management has resulted in significant improvements in the quality of urban waste management services. They found that these apps not only improve waste collection efficiency but also increase transparency and accountability in waste management. With data available in real-time through Silampah, local governments can more accurately monitor and evaluate the performance of waste management services. However, it should also be noted that the implementation of Silampah can also pose several challenges in transforming the quality of public services in Semarang City.

Research by Jiang et al., (2023) highlights several issues related to the use of these applications, including accessibility, digital literacy, and technical uncertainty. They found

that not all levels of society can easily access and use the Silampah application, which can reduce its effectiveness in increasing community participation in waste management. Research by Hertati & Arif (2022) highlights the importance of ensuring that the use of these applications does not increase social inequality or discrimination in access to waste management services. Therefore, efforts need to be made to ensure that Silampah is accessible and usable by all walks of life, including those who may not have access to digital technology. Overall, this literature review shows that the implementation of the Waste Report System Application (Silampah) has had a positive impact on transforming the quality of public services in Semarang City, especially in waste management. Nonetheless, challenges such as accessibility, digital literacy, and social justice need to be overcome for the full potential of using these apps to be realized. Thus, further research and holistic strategy development efforts are needed to ensure that the transformation of service quality through the implementation of Silampah can take place inclusively and sustainably in Semarang City.

The novelty of this research lies in its comprehensive approach to integrating information and communication technology (ICT) with community-based waste management practices through the Silampah application. By leveraging digital platforms for real-time reporting, enhancing transparency, and increasing community participation, this study offers new insights into the potential for digital technologies to transform waste management in urban environments. Additionally, the research focuses on addressing social justice concerns by ensuring accessibility and usability of the application for all community members, thereby minimizing social inequality and discrimination. This innovative approach not only aims to improve operational efficiency and user satisfaction but also contributes to a more sustainable and environmentally conscious waste management system in Semarang City.

Furthermore, this study identifies several gaps in the current literature, such as the need for effective implementation of ICT in local contexts, the importance of multidisciplinary interventions, and the challenges within the e-waste supply chain. By addressing these gaps, the research suggests future directions for improving waste management strategies, including enhancing digital literacy, ensuring equitable access to technology, and fostering collaboration among various stakeholders. This comprehensive framework underscores the significance of the proposed research and its potential contribution to the field, providing a deeper understanding of the context and the transformative impact of digital-based waste management on public services in Semarang City.

3. RESEARCH METHOD

The research methods employed in this study are closely aligned with the objectives of thoroughly investigating the implementation of the Silampah application and its impact on waste management transformation in Semarang City. The chosen methods include qualitative interviews, surveys, and case studies involving key stakeholders such as cleaning staff, application managers, and user communities. These methods aim to achieve a comprehensive understanding of the experiences and perceptions of stakeholders, providing valuable insights for improving technology-based waste management systems. Through qualitative interviews and surveys, the research will identify and analyze the impact of the Silampah application on service quality in waste management. This will include examining changes in efficiency, transparency, accountability, community participation, and environmental awareness. Case studies will offer practical examples and real-life insights into the successes and challenges faced during the implementation of Silampah.

By employing these methods, the research will provide a holistic view of how the application influences waste management practices and offer targeted recommendations for

sustainable and inclusive waste management strategies in Semarang. These findings will help ensure that the application does not exacerbate social inequality or discrimination and will contribute to the development of more effective and sustainable waste management practices in other cities facing similar challenges. Qualitative survey research is a methodological approach used to gather in-depth information about people's experiences, perceptions, and motivations regarding specific topics. This type of research is particularly valuable in understanding complex issues where numerical data alone may not provide a complete picture. In the context of the implementation of the Silampah application for waste management in Semarang, qualitative surveys can play a crucial role in exploring various dimensions of stakeholder experiences.

Data Collection Procedures:

1. In-depth Interviews

- a. Semi-structured interview guides will be developed to ensure consistency while allowing for flexibility in responses. Interviews will be conducted face-to-face, depending on the informants' preferences and availability. Each interview will last approximately 30-45 minutes, and informed consent will be obtained from all participants.
- b. Informants will be selected based on their involvement and experience with the Silampah application. This includes cleaning staff, app managers, and community users. The selection criteria will include their role in waste management, familiarity with the application, and willingness to participate. The determination of the informants in this study is to obtain a broader and deeper perspective on the implementation of Silampah and its impact on waste management in Semarang. The profiles of the informants are arranged in the following Table 1:

Table 1. Informant Profile

Name	Age	Experiences	Role	Usage of Silampah
Initial A	35	10 years as a cleaning staff at the Semarang City Hygiene Office	Responsible for collecting garbage in specific areas, ensuring environmental cleanliness, and reporting hygiene issues to superiors	Use the app to receive waste reports from the community and follow up on the reports immediately.
Initial B	29	5 years as a cleaning staff in the private sector	Supervising waste management in residential areas and educating residents about the importance of waste separation	Use the app to report irregular garbage issues and provide suggestions for improvement.
Initial C	40	(Bachelor of Informatics Engineering, Master of Technology Management.) Work Experience: 15 years in the field of information technology management and applications	Managing the operation and development of the Silampah application, ensuring that the application runs smoothly, and addressing any technical issues that arise	Coordinate with related parties, provide training to cleaning staff, and collect application performance data.

Name	Age	Experiences	Role	Usage of Silampah
Initial D	38	(Bachelor of Information Systems). Work Experience: 12 years in the field of application development and Technology project management.	Responsible for the maintenance and update of the Silampah application, as well as ensuring integration with other relevant systems	Develop application development strategies, monitor performance, and provide solutions to problems faced by users
Initial E	28	(Elementary School Teacher). Role in Community: Active in environmental activities and community care	Actively use the app to report illegal waste points and provide feedback for service improvement	Has been using Silampah for 2 years and feels that this application helps improve the cleanliness of the environment around his residence
Initial F	45	The head of the RT who is active in coordinating environmental cleanliness activities	Using the app to report hygiene issues in the RT environment and organizing mutual cooperation to clean up the affected areas	Supporting the use of Silampah as a tool to increase citizens' awareness of the importance of maintaining cleanliness

Source: Data Processing Results, 2023.

2. Surveys

- a. The structured questionnaire will be designed to capture quantitative data on the use and impact of the Silampah application. The survey will include questions on user satisfaction, response times, transparency, community participation, and environmental awareness (This survey is used only to describe the impact of its use). Surveys will be distributed both online and in-person to a representative sample of the community, ensuring diverse demographics are included. Additionally, the structure of qualitative surveys can be adjusted during the data collection process based on initial findings, allowing researchers to delve deeper into emerging themes or issues with adaptability.
- b. The decision to reduce the survey sample size from 388 to 100 respondents, despite the initial calculation using the Slovin formula (The survey involving population of 12,610 users and sample size 388, with significant 0,95 and margin error 0,05), can be justified on several grounds. Firstly, qualitative research often values depth over breadth, prioritizing the richness of insights gathered from respondents. A smaller sample size allows for more in-depth and focused interviews, enabling researchers to explore complex themes and obtain detailed responses. Secondly, logistical and practical considerations, such as time constraints, budget limitations, and resource availability, might necessitate a smaller sample size. Focusing on a smaller group can ensure that the research remains feasible and manageable. Lastly, by carefully selecting a representative sample of 100 respondents that reflects the diversity of the Silampah application users, expected the research can still achieve meaningful and insightful results while maintaining a practical and efficient approach.

3. Data Organization

- a. All interviews will be audio-recorded (with consent) and transcribed verbatim to ensure accuracy. Survey responses will be digitized and organized in a database.
- b. A coding framework will be developed to categorize and organize data. This will involve identifying key themes and patterns related to the impact of Silampah on waste management.

4. Qualitative Data Analysis

- a. Thematic analysis will be used to identify and analyze patterns within the qualitative data. Initial coding will involve open coding, followed by axial coding to identify relationships between themes. Selective coding will then be applied to integrate and refine the themes.
- b. Interpretation: The coded data will be interpreted to understand the experiences and perceptions of stakeholders, focusing on the impact of the Silampah application on service quality and community participation.

4. RESULT AND DISCUSSION

4.1 Survey Results Analysis

Based on the survey conducted among 100 respondents, the results for each indicator are as follows: Satisfaction with the usage of the Silampah application is very high, with 78% of respondents rating it as very high and 15% as high. The response time from authorities is also highly rated, with 70% of respondents indicating it as very high and 20% as high. Community participation in waste management through the application is similarly impressive, with 75% of respondents rating it as very high and 18% as high. However, the results for transparency and environmental awareness are significantly lower. Only 10% of respondents rated transparency as very high, while 30% rated it as low and 20% as very low. Environmental awareness saw even lower ratings, with only 8% of respondents rating it as very high and 35% rating it as low and 25% as very low. These findings suggest that while the Silampah application excels in user satisfaction, response time, and community participation, there is considerable room for improvement in enhancing transparency and fostering greater environmental awareness among users (see in Image 1).

The lower ratings for transparency in the Silampah application could be attributed to several factors. One key issue is the lack of clear communication regarding the waste management process and the outcomes of reported incidents. Users may not have sufficient access to information about how their reports are handled and the actions taken by authorities. This lack of visibility can lead to perceptions of opacity and undermine trust in the system. Additionally, if the platform does not provide regular updates or feedback on the status of reported issues, users may feel disconnected and uncertain about the effectiveness of their participation. Another challenge related to transparency could be the limited integration of the Silampah application with other governmental or public platforms. If the application operates in isolation and does not sync with broader public service systems, it may restrict the flow of information between different stakeholders. This fragmentation can hinder comprehensive tracking of waste management activities and reduce the overall accountability of the system. Furthermore, there is a lack of training and awareness among the application managers and cleaning staff on the importance of maintaining transparency resulting in inconsistent information sharing practices.

The low environmental awareness among users, this could stem from insufficient educational initiatives and community engagement efforts. The Silampah application not be

effectively promoting environmental education or providing users with information on best practices for waste management. Without a strong emphasis on environmental awareness, users not fully grasp the broader impact of their actions and the importance of responsible waste disposal. Additionally, if the application is primarily focused on reporting and resolving waste issues, it may miss the opportunity to raise awareness about the environmental consequences of improper waste management.

Another contributing factor to the low environmental awareness could be the lack of incentives or motivators for users to adopt environmentally friendly behaviors. If the application does not offer rewards, recognition, or other forms of positive reinforcement for users who demonstrate environmentally conscious practices, it struggle to drive meaningful behavioral change. Moreover, the absence of community-driven initiatives or campaigns within the application can limit opportunities for users to learn from each other and collectively enhance their environmental consciousness. By addressing these challenges, the Silampah application can improve its transparency and foster greater environmental awareness among its users, leading to a more effective and sustainable waste management system in Semarang.

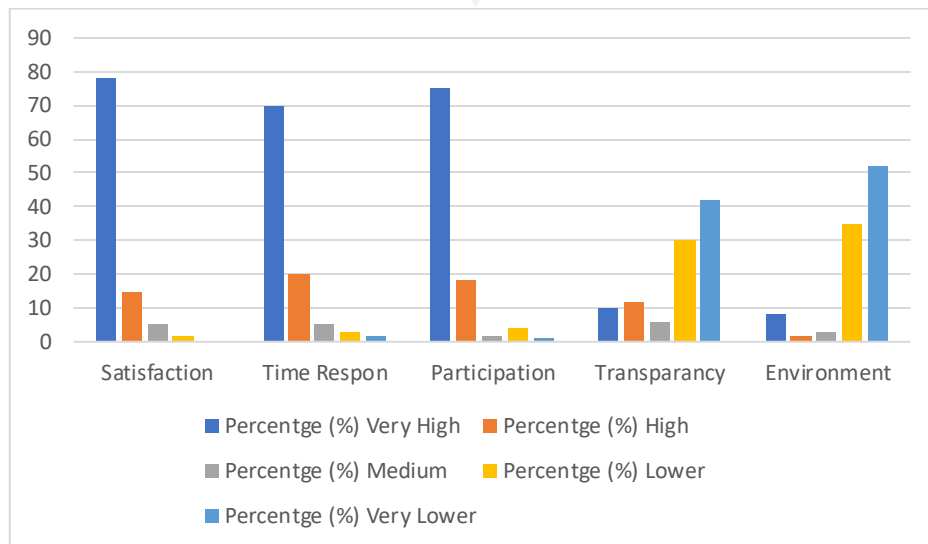


Image 1. Silampah Application Survey in Semarang City in (%)

Source: Researcher, 2023.

Providing a clearer understanding of the relative effectiveness of the Silampah application, this study compares it with other waste management applications or methods. One similar method is the use of blockchain technology in waste management systems (Farizi & Sari, 2021). The Silampah application can increase transparency by adopting blockchain features that allow real-time tracking and auditing of waste data (Inayatulloh, 2024). This will give users greater confidence in the waste management process and increase community participation. In addition, the Silampah application can also utilize deep learning technology for waste identification and segregation (Saboor, 2024). By using deep learning models, applications can automatically recognize the type of waste and provide suggestions for appropriate management. This will improve operational efficiency and ensure that waste is disposed of in the most environmentally friendly way.

Comparison with conventional methods such as manual waste collection also shows the advantages of the Silampah application (Suretno & Ranggadara, 2022). The app allows users to report waste online, which speeds up the waste collection and handling process. In addition, the Silampah application can provide incentives in the form of awards or recognition

to users who are active in cleaning activities, thereby encouraging greater community participation. By comparing the performance of the Silampah application with other waste management solutions, this study can see that this application is not only effective in improving user satisfaction and community participation, but also has the potential to increase transparency and environmental awareness with the adoption of advanced technology. This will help create a more sustainable and efficient waste management system in Semarang City.

4.1 The Implementation of The Waste Report System Application (Silampah) in Semarang

The implementation of the Silampah has resulted in a significant transformation in the quality of waste management services in the region. Through Silampah, various aspects of waste management, ranging from the reporting process, and response to waste problems, to community participation, have undergone positive changes. One of the main results of Silampah's implementation is increased efficiency in the waste reporting process. With the ability to report waste in real-time through this application, the people of Semarang City can quickly and easily inform the authorities about the location and condition of waste that needs to be addressed (Milakovich, 2021). This has significantly reduced the response time and resolution of waste problems, speeding up the overall waste collection and management process. When analyzed more deeply related to this description, the results of this study highlight various aspects that are at the core of transforming the quality of waste management services through the implementation of the Waste Report System Application (Silampah) in Semarang City (see Image 2 and Image 3).

First of all, the statement highlighted that the implementation of Silampah has resulted in a significant transformation in the quality of waste management services in the Semarang City area. This transformation includes striking and meaningful changes in the way waste management services are delivered and accessed by communities. This indicates that the implementation of Silampah is not just a technological update, but also produces a real impact in improving the quality of life and the environment in Semarang City (Baimenov & Liverakos, 2022). Furthermore, the sentence emphasizes that Silampah influences various aspects of waste management, including the reporting process, response to waste problems, and community participation. This shows that this application does not only focus on one particular aspect of waste management but aims to thoroughly improve the overall effectiveness and efficiency of the waste management system in Semarang City (Cahyati, 2023).

One of the key outcomes revealed was increased efficiency in the waste reporting process. With the ability to report waste in real-time through the Silampah application, the public can quickly and easily inform authorities about the location and condition of waste that needs to be addressed. This shows that Silampah provides practical and efficient solutions for the community to contribute to maintaining the cleanliness of their environment. Furthermore, the statement highlighted that the use of Silampah has significantly reduced the response time and resolution of waste problems. With real-time information available, cleaners and related parties can quickly respond to incoming waste reports, optimize resource allocation, and speed up the overall waste collection and management process (Latupeirissa, J. J. P., Dewi, N. L. Y., Prayana, I. K. R., Srikandi, M. B., Ramadiansyah, S. A., & Pramana, 2024). This shows that Silampah not only facilitates waste reporting but also improves the operational efficiency of the authorities in handling waste problems in Semarang City.

In addition, it shows that the use of Silampah has increased community participation in waste management. By enabling communities to play an active role in reporting and

monitoring waste problems in their environment, this application encourages the creation of a climate of cooperation between local governments and communities in maintaining the cleanliness of the city. This indicates that Silampah is not only a technological tool, but also plays an important role in building environmental awareness and responsibility among the people of Semarang City, so by increasing efficiency, effectiveness, and community participation, Silampah has brought a real positive impact in maintaining the cleanliness and beauty of Semarang City and improving the quality of life of the community as a whole (Tarigan et al., 2020).

This increased participation has created a climate of cooperation between the local government and the community in maintaining the cleanliness and beauty of Semarang City, as well as encouraging the adoption of clean and healthy living behaviours at the individual and community levels. However, although the transformation of service quality through the implementation of Silampah has brought various positive benefits, there are still some challenges that need to be overcome. One of them is the issue of accessibility and digital literacy among the public. Although Silampah is designed to be user-friendly, there are still some people who may have difficulty accessing and using this application. Therefore, efforts need to be made to improve digital literacy and provide technical support for those who need it so that all levels of society can make optimal use of Silampah (Sekarningrum et al., 2020).

"Sustainability in the application of Silampah is also an important concern. Continuous maintenance and updates to these applications are necessary to ensure their performance remains optimal and relevant to the evolving needs and demands of society. In addition, secure data management and user privacy are also aspects that need to be considered so that Silampah remains a trustworthy and effective tool in waste management in Semarang City. However, since 2019, due to a lack of socialization among the public and technology not being optimal, it has been temporarily allocated to social media platforms such as Facebook, IG, and WhatsApp". [Informant]

"The transformation of service quality through the implementation of Silampah in Semarang City has brought various positive changes in waste management. Through increasing efficiency, effectiveness, community participation, and sustainability in implementation, Silampah has great potential to continue to be an effective instrument in maintaining the cleanliness and beauty of Semarang City and improving the quality of life of the community as a whole. Efforts to solve problems in the implementation of the Waste Report System Application (Silampah) in Semarang City and its relationship with efforts to improve service quality are very important aspects of understanding the impact and effectiveness of the implementation of this technology". [Informant]

"One of the problems often faced in the application of technology such as Silampah is the low level of digital literacy among the community. Although Silampah is designed to be user-friendly, there are still some people who may have difficulty accessing and using this application properly. To overcome this problem, efforts are needed to increase digital literacy among the public, especially for those who are less skilled in the use of technology". [Informant]

The local government of Semarang City can work with educational institutions and community organizations to organize training and socialization on how to use Silampah effectively so that digital literacy is more effective. In addition, relevant parties can also develop clearer and easier-to-understand user guides, and provide technical support to people who need it. In addition to digital literacy issues, other issues that may arise are

technical issues related to the performance and reliability of the Silampah application itself. As is the case with other technologies, this application is prone to technical glitches, bugs, or unexpected system updates.

“To overcome Silampah application performance issues, application developers need to carry out regular maintenance and regular system updates to ensure optimal application performance and reliability. In addition, relevant parties also need to ensure that there is an effective communication channel between users and application developers to report issues or provide feedback so that technical issues can be identified and resolved quickly”. [Informant]

“Regarding technical issues, there are issues related to security and data privacy are also an important concern in the implementation of Silampah. Given that these apps collect sensitive information from users, such as location and garbage reporting details, it's important to ensure that the data is stored and processed securely. The local government of Semarang City needs to implement strict data security measures, including data encryption, limited access to sensitive information, and regular audits of systems to identify and prevent potential security threats. In addition, it is also important to provide clear information to the public about how their data will be used and guarantee privacy so that they feel comfortable and trust to use Silampah”. [Informant]

“Capacity and human resource issues can also be obstacles in the implementation of Silampah. The implementation and management of these applications require sufficient technical and managerial expertise, as well as a trained and skilled workforce to operate and maintain the system. To address this issue, the local government of Semarang City needs to invest in training and developing human resources for cleaners and other relevant staff responsible for the use and management of Silampah. In addition, related parties may also consider involving partners or third parties who have special expertise in the development and management of technology applications to provide additional support and ensure sustainability in the operationalization of Silampah”. [Informant]

“Semarang City Government is still constrained by social and cultural problems related to the adoption and use of Silampah among the people of Semarang City. Although this application offers a practical and efficient solution in waste management, people's acceptance and adoption of this technology can be influenced by various factors, including attitudes, cultural values, and existing habits. To overcome this problem, local governments and related parties need to conduct a planned and targeted socialization campaign to increase public awareness and understanding of the benefits of using Silampah, as well as change attitudes and behaviours that support the adoption of this technology in 2025 ahead, while waiting for the preparation of the technology. In addition, it is also important to actively involve the community in the development and implementation process of Silampah, so that this application can better suit their needs and preferences”. [Informant]

Overall, efforts to solve problems that arise in the implementation of the Silampah in Semarang are important steps in improving the quality of waste management services. By overcoming various technical obstacles, data security, human resource capacity, and socio-cultural factors, the local government of Semarang City can highlight various important aspects that affect the implementation and effectiveness of the Silampah application in

improving the quality of waste management services. The following is a comprehensive analysis of how the public policies adopted by the Semarang City Government impact the implementation and use of Silampah (Acevedo Correa et al., 2023).



Image 2: Application Silampah Profile
Source: <https://dlh.semarangkota.go.id/silampah/>
(2023)

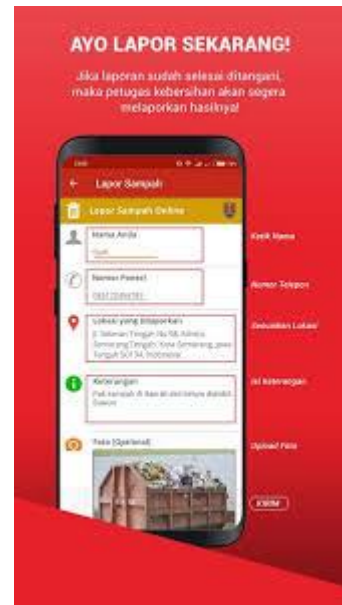


Image 3: Menu Work in Silampah
Source: <https://dlh.semarangkota.go.id/silampah/>
(2023)

Semarang City Government has taken proactive steps in supporting the implementation of the Waste Report System Application (Silampah) as part of a more modern and efficient waste management strategy. One of the public policies taken is to create regulations that support and encourage the use of Silampah by the community. Through the regulations that have been made, the Semarang City Government encourages people to actively use this application as a means to report and monitor waste problems in their environment. This regulation covers various things, ranging from providing free internet access to access Silampah to incentives for residents who actively report waste (Widianto, 2023). In addition to creating supportive regulations, the Semarang City Government has also made significant investments in technological infrastructure and human resources to support the implementation of Silampah. For example, they have allocated a budget for the development and maintenance of this app, as well as training and education for cleaners and other relevant staff on how to use and manage Silampah effectively. This step shows the strong commitment of the local government to ensuring the sustainability and successful application of this technology in improving the quality of waste management services in Semarang City.

Furthermore, the public policy adopted by the Semarang City Government also includes efforts to involve various stakeholders in the development and implementation of Silampah. Local governments are working with nongovernmental organizations, universities, and the private sector in designing, testing, and deploying these applications to communities. This collaboration not only ensures that Silampah matches the needs and desires of users, but also expands the reach and impact of implementing this application (Broekhuizen, 2022; Hertati & Arif, 2022). In addition, the public policy taken also focuses on building the capacity of the community to use Silampah. Semarang City Government realizes the importance of digital literacy and technology skills for people to be able to make good use of this application. Therefore, they organize various trainings, workshops, and socialization campaigns to

improve people's understanding and skills in using Silampah. This step aims to reduce the digital divide and ensure that all levels of society can benefit from using this application. In terms of public policy, it is also important to note that the Semarang City Government does not only focus on the technical aspects of waste management but also on the social and cultural dimensions of implementing Silampah. They understand that the adoption of technology like this requires a change in attitudes and behaviours from the community, so they take steps to increase public awareness and participation in waste management. This includes outreach campaigns on the importance of keeping the environment clean and minimizing waste, as well as changing people's mindsets about their role in keeping the city clean (Larsson & Teigland, 2019).

Overall, the public policy taken by the Semarang City Government in supporting the implementation of the Waste Report System Application (Silampah) reflects a strong commitment to utilizing technology to improve the quality of waste management services. By creating supportive regulations, investing in infrastructure and human resources, involving stakeholders, building community capacity, and paying attention to social and cultural dimensions, the local government has created a conducive environment for the successful implementation of Silampah and improved the cleanliness and beauty of Semarang City as a whole.

5. CONCLUSION

The implementation of the Silampah application in transforming waste management in Semarang City has shown great potential in improving the efficiency and transparency of waste collection processes. Through the adoption of information technology and active community participation, the Silampah application has facilitated real-time waste reporting, accelerated the response of sanitation workers, and increased environmental awareness among residents. However, there are still challenges that need to be addressed to maximize the implementation of Silampah. Uneven technology infrastructure and uneven community participation are two of the most critical issues. To address this, proper program socialization and intensive technological assistance are required. Additionally, social justice aspects must be considered to ensure that all societal layers can access this service without discrimination. Previous studies have shown that the use of technology in waste management can enhance the effectiveness of waste collection and reduce illegal waste dumping. The Silampah application has also successfully increased community participation in reporting waste spots and provided valuable data for local governments to plan more effective waste management. The Semarang City Government can enhance the effectiveness of this application by involving various stakeholders, such as educational institutions and community organizations, and developing awareness campaigns that promote clean and environmentally friendly behavior. These steps will enable Silampah to become a sustainable instrument in maintaining cleanliness and quality of life. Thus, the implementation of Silampah is not only effective in increasing user satisfaction and community participation but also has the potential to enhance transparency and environmental awareness through the adoption of technology. This will help create a more sustainable and efficient waste management system in Semarang City and other regions in Indonesia.

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