p-ISSN: 2460–7223
e-ISSN: 2964-9870

Optimalization Design of User Services in E-Government Waste Management Apps

Firmansyah, Y.A
IIB Darmajaya *Faculty of Economic and Business,* Bandar Lampung, Indonesia
firmansyah@darmajaya.ac.id

Singagerda, F.S
IIB Darmajaya *Faculty of Economic and Business,* Bandar Lampung, Indonesia
faurani@darmajaya.ac.id

Muludi, K
IIB Darmajaya *Faculty of Computer Science,* Bandar Lampung, Indonesia
k.muludi@darmajaya.ac.id

Meizari, A
IIB Darmajaya *Faculty of Economic and Business,* Bandar Lampung, Indonesia
Meizari@darmajaya.ac.id

Abstract - This study aimed to address Indonesia's critical environmental issue of waste management by designing optimal user services for an e-Government waste management application. The research is exploratory in nature, employing a combination of qualitative and quantitative methods to develop an integrated digital solution. Our methodology includes data analysis from World Bank reports, insights from the Ocean Conservancy, and the examination of government policies and advanced technological applications. The results demonstrated the urgent need for efficient waste management systems, as Indonesia is the second-largest contributor to oceanic plastic waste. We propose a framework for an e-Government application that leverages Internet of Things (IoT), big data, and digital platforms to monitor, manage, and optimize waste management processes, enhancing transparency and effectiveness. Our findings suggested that the application's user-centric design significantly improves community engagement and participation in sustainable waste practices. The implications of this research point towards a scalable and sustainable model for waste management that can be adopted by other regions facing similar challenges. We recommend further development of the application with a focus on user feedback and iterative design to ensure adaptability to diverse waste management contexts. The contribution of this study lies in its potential to revolutionize waste management practices through digital transformation, providing a blueprint for environmental sustainability initiatives within e-Government frameworks.

Keywords: waste management, digital transformation, E-Government Applications, sustainability, user services

I. INTRODUCTION

In Indonesia, waste has become a pressing environmental issue. According to World Bank data from 2019, Indonesia produces approximately 175,000 tons of waste daily, and it is estimated that only 60% of this total waste successfully reaches the landfill. Meanwhile, about 20% of the produced waste is plastic, with the majority of this plastic waste ending up in the oceans. In the 2017 Ocean Conservancy report, Indonesia ranked second after China as the world's largest contributor of plastic waste to the oceans [1]. The accumulation of waste not only spoils the scenery but also poses a serious threat to public health and ecosystems, especially when plastic waste contaminates our waters and threatens marine life. However, if managed properly, waste can be a valuable resource [2]. From organic waste, we can produce compost and biogas, while non-organic waste, like plastics and metals, can be recycled into new products. Capitalizing on this waste can offer a profitable and sustainable business opportunity, ultimately enhancing community welfare [3][4]

The Indonesian government has recognized the importance of sustainable waste management. Through various policies and programs, the government seeks to encourage communities and industries to reduce, recycle, and utilize waste [5]. The goal is to make Indonesia free from waste problems and optimize waste utilization as an economic opportunity.

Technological advancements create significant potential for integrating advanced technological solutions in waste management [6] [7] [8] [9]Technologies such as automatic waste sorting, thermal conversion technology, and advanced recycling techniques can enhance waste management efficiency and transform it into a more valuable resource [10].

Furthermore, according to [11] [12][13]digital technologies, such as the Internet of Things (IoT), big data, and digital platforms, can be employed to monitor, manage, and optimize waste management processes. By integrating these digital technologies, we can enhance transparency, accountability, and effectiveness in waste management.

One technology showing significant potential in waste management is artificial intelligence (AI). Through AI, we can develop algorithms that predict waste disposal patterns, optimize waste collection routes, and even identify types of waste for recycling purposes.

Previous research, such as those conducted by [14][15] [16]has explored the use of technology in waste management. Generally, these three studies delve into AI applications in urban and environmental contexts. Abdallah et al. systematically reviewed its role in solid waste management, [14] discussed the interplay between big data, AI, and smart city development, while [16][17] investigated AI's potential in sustainable energy planning and waste management. On the other hand, [13] elucidated the role of artificial intelligence (AI) in urban waste management and energy recovery processes, as well as its impact and relationship with economic stability. However, the distinction between the four papers lies in their thematic focus and how they integrate or separate certain concepts in the application of AI in waste management.

Service quality, a frequently discussed topic in marketing and management studies, is known to influence customer satisfaction and behavior [18][19][20]. This notion is centered around how customers perceive and evaluate the services provided by a business [20]. Typically, service quality involves assessing both the tangible aspects, such as physical settings and service ambiance, and the intangible services delivered by staff [20]

Service quality is commonly recognized as a precursor to customer satisfaction and allegiance (as mentioned in works like [18][19][20]. The idea relates to how customers view and evaluate the services provided by a business organization). Typically, the quality of service is gauged based on both tangible aspects, like the physical environment, and intangible offerings delivered by staff member [20]. One of the models frequently used to measure customer satisfaction is SERVQUAL [21]. The SERVQUAL framework, introduced by [20], defined service quality as the difference between what a customer expects from a service and their actual experience of the service delivered. Service quality and satisfaction are correlated [22]. Furthermore, [23] explored the topic by emphasizing the quality of the digital platform and the content providers' satisfaction.

Given the rapid advancements in technology and digitalization in recent years, artificial intelligence (AI) has been adopted and utilized more broadly within the community. AI integration into digital platforms, though researched, still lacks a comprehensive understanding from a service quality perspective. The SERVQUAL model, developed by [20] in the late 1980s, provides a framework to measure service quality through five dimensions: tangibles, reliability, responsiveness, assurance, and empathy. According to a study by [24], the application of the SERVQUAL model in various industry digital platforms shows that user satisfaction and platform adoption are highly influenced by perceptions of service quality. This is reinforced by [25], who found that SERVQUAL dimensions play a pivotal role in the

success of digital platforms. However, the application of the SERVQUAL model in the development of digital platforms by optimizing AI is still a subject of debate [18][23], [26]. Specifically, there is a significant gap in understanding how AI capabilities align with SERVQUAL dimensions. This indicates a crucial research path, as understanding this alignment can provide insights into designing AI-enhanced platforms that not only optimize waste management processes but also deliver a high-quality service experience to users.

The urgency for digital transformation in waste management is escalating, aligned with the growth of waste volume and the need for more efficient and sustainable waste management solutions. According to data from the World Bank (2020), given current trends, global waste production is projected to increase by 70% by 2050 [27]. Therefore, the implementation of digital technology in waste management is not an option, but a necessity [28] [27]Several studies concerning the potential of digital technology in addressing waste management issues [29], exploring research on the utilization of sensor technology to optimize waste collection routes. Meanwhile, [30]highlighting the use of big data in analysing waste disposal patterns to enhance management efficiency. There is also a study by [17] [31] that evaluated the use of AI-based applications in supporting recycling. [15] [32] investigated how the Internet of Things (IoT) can be integrated into urban waste management systems to create sustainable "smart cities." Lastly, [33] [34] focused on the role of blockchain in enhancing transparency and accountability in the recycling supply chain.

Despite the significant role these issues can play, previous studies have primarily focused on the use of AI in optimizing user services in the context of customer satisfaction [18], [35][23][26][35]Therefore, the objective of this research is to design a framework for a smart government service application to manage community-based waste using AI technology.

II. METHODOLOGY

Based on the background and research objectives you mentioned, this study will employ a qualitative approach [36] using [37] case study method to delve into how digital technology, specifically AI, can be implemented in e-government applications for community-based waste management. Data collection will be conducted through in-depth interviews with stakeholders, such as government officials, technology developers, and the community involved in waste management. Additionally, document analysis will be carried out to review existing literature related to the application of digital technology in waste management. The aim is to understand trends, challenges, and existing gaps. Based on findings from the interviews and document analysis, a framework for an e-government application integrating AI technology will be developed [38]. This framework will then be validated by experts in waste management and information technology. Subsequently, a prototype of the application will be developed based on the designed framework, followed by testing and evaluation to assess the application's effectiveness and efficiency in the context of community-based waste management.

Below is a flowchart depicting the design framework based on workflow sequences, beginning with a qualitative approach through the case study method, and then proceeding with data collection via in-depth interviews. Once the data and information are gathered, an analysis of the data/information and documents is performed to review existing literature, eventually yielding findings that will serve as the foundation for constructing the framework. After the framework is set up, the next step involves validation by experts, leading to the creation of an application prototype based on the validated framework, followed by trials and evaluations to determine the application's effectiveness and efficiency.

The flowchart serves to visually illustrate the workflow and provide a general overview of the steps to be taken in the research.

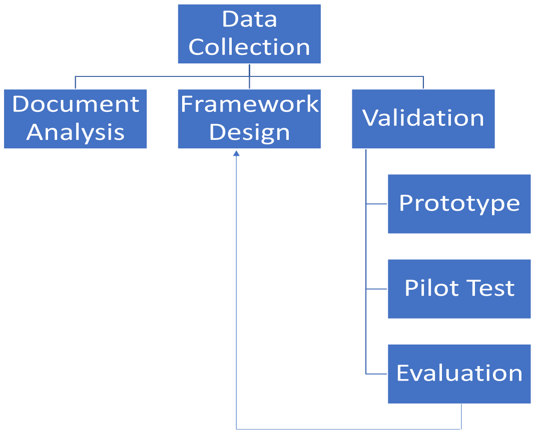

Figure 1. Research Flowchart
Source [36] [37]

After creating a flowchart to design the framework used in designing the application, the functions within the platform/application are intended to be easily understood, managed, and utilized [39] [40] [41].

One of the renowned frameworks is the Zachman Framework, first introduced by John Zachman in 1987 and later expanded and formulated by Sowa and Zachman in 1992. The Zachman Framework provides a robust model for organizing the diverse perspectives involved in enterprise architecture [41]. It outlines six primary perspectives: What, How, Where, Who, When, and Why. Each of these perspectives is analyzed across six different categories of thought: data, function, network, people, time, and motivation. By comprehending and implementing each of these aspects, companies can formulate a structured strategy to merge technology with business objectives. Each framework model defines architectural entities into rows and attributes for each entity into columns [40] [42]

As previously mentioned, this study adopts a qualitative approach. The methodology employed for this research is anchored in the Enterprise Architecture (EA), utilizing the Zachman framework method for the documentation process, complemented by literature reviews [39] [40][42] The methods include:

a. Literature exploration, which involves scouring relevant libraries and sources pertinent to the research topic.

b. Hands-on observations at the site to directly witness the ongoing processes during production, essential for research preparation such as documentation analysis. Engagements were made with stakeholders pertinent to the platform's information architecture, like business architects, developers, product managers, and IT personnel.

The selection and profile of participants were tailored to ensure the acquisition of pertinent and representative insights. Analytical outcomes will be comprehensively interpreted to sketch an image of the Zachman Framework's application in shaping the information architecture of the waste management platform. The discoveries from the research will be correlated with associated literature and presented as a research document.

III. DISCUSSION

Design of Waste Management Application Based on Artificial Intelligence

In designing an e-government-based waste management application utilizing AI technology, data acquisition is crucial to ensure the application operates optimally and meets user needs. Firstly, geographic and demographic data are essential to understand the location and characteristics of the communities that will use the application [43] This information aids in identifying efficient waste collection routes and targeting specific waste management education campaigns to particular communities.

Furthermore, historical data concerning the volume and type of waste produced by the community is vital for analysis [11] With AI technology, the application can forecast future waste volumes, assisting governments in planning the required resources. Information on recycling facilities and final disposal sites is also necessary to ensure waste is managed in the most sustainable manner.

According to[20] [20] [32] information about user habits and preferences is also crucial, especially during the user interface design phase. Surveys and community interviews can provide insights into the most desired features and how users interact with the application.

Additionally, financial and operational data from waste banks and other relevant parties will assist in designing features that ensure transparency and accountability in managing funds and resources [21]. Finally, feedback from the application's beta version should be collected and analysed to make adjustments and improvements before launching the full version [17]. Thus, ensuring the completeness and accuracy of this data will be key to designing an application that is not only functional but also positively impacts the community and environment.

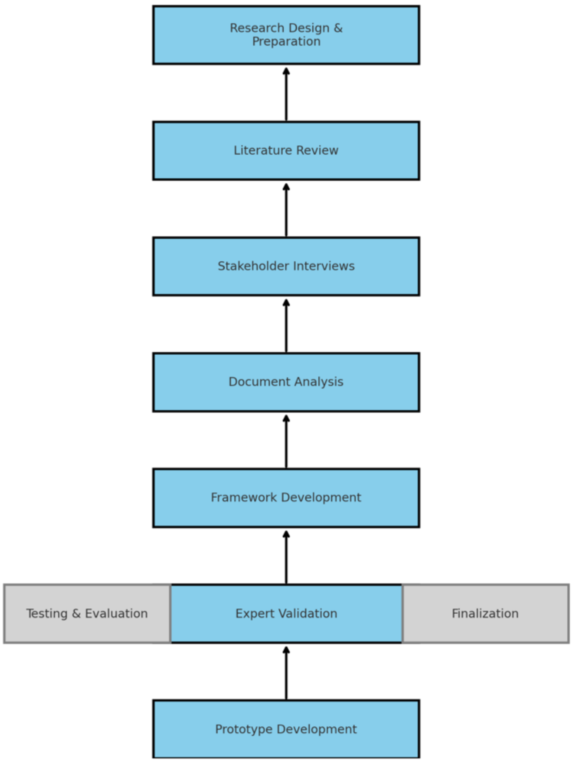

Figure 2. Framework of Waste Management Based on AI Prototype
Source: [36] [37] [38]

Based on the background and research objectives you mentioned, this study will employ a qualitative approach using a case study method to delve deeper into how digital technology, especially AI, can be integrated into e-government applications for community-based waste management. Data collection will involve in-depth interviews with stakeholders, such as government officials, technology developers, and the community involved in waste management. Additionally, document analysis will be carried out to review existing literature related to the deployment of digital technology in waste management. The objective is to understand trends, challenges, and existing gaps. Based on findings from interviews and document analysis, a framework for an e-government application integrating AI technology will be developed. This framework will subsequently be validated by experts in waste management and IT. A prototype of the application will then be crafted based on the established framework, followed by testing and evaluation to gauge the application's effectiveness and efficiency in the context of community-based waste management. In executing this approach, this study will refer to the methods detailed by [36] [37] [38].

Artificial Intelligence-Based Waste Management Application Blueprint

In the design of a local government and community waste management application utilizing AI technology, various types of data are required to ensure the application is effective, efficient, and meets user needs. Here are some essential data points:

1. User Demographic Data, which consists of:
   - Age, gender, occupation, and educational background of users.
   - Technology usage preferences and habits.
2. Waste Location Data:
   - Waste accumulation points.
   - Waste transportation routes.
   - Location of the nearest waste disposal sites.
3. Waste Type Data:
   - Waste categorization (organic, inorganic, hazardous, etc.).

- Estimated volume or weight of waste.
- Information regarding waste sources (household, industrial, commercial, etc.).

4. Financial Data:
   - Operational costs of waste management.
   - Revenue from recycling or waste sales.
5. Technology Data:
   - Availability of technology infrastructure on-site (e.g., sensors, IoT, etc.).
   - Integration with other technologies (e.g., geographic information systems or GIS).
6. User Feedback and Reviews:
   - User input regarding desired features.

In designing an e-government-based waste management application with AI technology, the data required is crucial to ensure the application functions optimally and meets user needs. Firstly, geographic and demographic data are needed to understand the location and characteristics of the communities that will utilize the application. This information aids in identifying efficient waste collection routes and targeting waste management education campaigns to specific communities. Next, historical data on the volume and type of waste produced by the community is important for analysis. With AI technology, the application can predict future waste volumes, assisting governments in resource planning[13] [16]. Data on recycling facilities and final disposal sites are also vital to ensure waste is managed sustainably. Information about user habits and preferences is also crucial, especially during the user interface design phase. Surveys and community interviews can provide insights into the most needed features and how users interact with the application. Additionally, financial and operational data from waste banks and other relevant parties will assist in designing features enabling transparency and accountability in managing funds and resources. Finally, feedback from the application's beta version should be gathered and analyzed for adjustments and improvements before launching the full version [41] [40] [42]. Ensuring the completeness and accuracy of this data will be key to designing an application that is not only functional but also brings positive impacts to the community and environment.

Regarding the design architecture using the Zachman method [42] [43] [44]the designed framework consists of:

1. Focus Areas, based on the statements provided, the focus areas that can be used to design an AI-based waste management application are:
   • Data: Needed for this application includes geographic and demographic data, historical data on waste volume and type, data on recycling facilities and final disposal sites, information about user habits and preferences, and financial and operational data from waste banks and other related parties.
   • Function: This application must have functions to collect, process, and analyze waste data. It should also provide information and services to users.
   • Network: This app should connect with various systems and devices.
   • People: The application should be user-friendly for various users.
   • Time: The application should operate in real-time.
   • Motivation: To encourage sustainable waste management.
2. AI Technology Integration Design:
   AI technologies for this application include:
   • Machine learning to predict future waste volumes and identify patterns in waste data.
   • Natural language processing to understand user language.
   • Computer vision to identify types and conditions of waste.
   Steps for integrating AI technology with the application:
   1. Collect and process waste data.
   2. Build an AI model based on the collected waste data.
   3. Implement the AI model into the application.
3. Entities and Databases:
   Required entities for this application include Users, Waste Types and Categories, Recycling Facilities, Final Disposal Sites, and Waste Management Processes.
   The required databases for this application include a sensor data database, waste type information database, and a process notification database.
4. Blueprint:
   Here is a visual diagram blueprint of the AI-based waste management application. The diagram depicts the relationships between various application components, including data, functions, networks, people, time, and motivation.

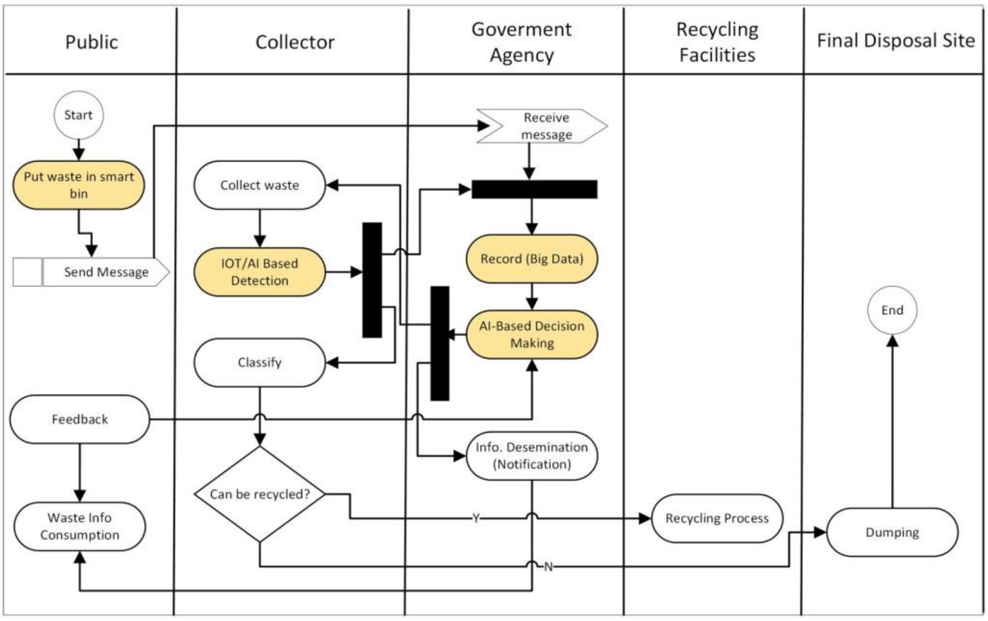

Figure 3. Waste Management Based on AI Technology Blueprint
Source: [44] [31] [42]

The design prototype for the Waste Bank Management application integrates key aspects from the SERVQUAL theory, waste management principles, and the application of artificial intelligence (AI). Based on the SERVQUAL model, the application is designed to ensure high service quality through dimensions such as Tangibles, Reliability, Responsiveness, Assurance, and Empathy. The intuitive and responsive application interface reflects the Tangibles and Responsiveness dimensions, while AI integration ensures data reliability and accuracy, mirroring the Reliability dimension [20].

Waste management is a crucial aspect of urban resource management. Waste management theory emphasizes the importance of a sustainable and efficient approach to managing this resource [44] With the aid of AI, this application can identify waste disposal patterns and provide recommendations for collection and recycling optimization, reflecting sustainable waste management principles.

The integration of AI in this application is not just an added feature, but the backbone of its operations. AI enables real-time data analysis, waste management trend predictions, and the automation of some processes that previously required human intervention, such as resource allocation and capacity monitoring [31]

The implications of this prototype design are profound. Theoretically, it demonstrates how concepts from three distinct fields (service quality, waste management, and AI) can be integrated to create an innovative solution. Practically, this application has the potential to enhance the operational efficiency of Waste Banks, improve user satisfaction, and support environmental sustainability objectives. The results from this design prototype provide a significant contribution to the literature on the application of technology in waste management and offer fresh insights for practitioners in this industry [31] [44].

IV. CONCLUSION

This study has comprehensively explored the digital transformation in e-government waste management services. We have identified key factors that contribute to the optimal design of user-centric online platforms, which facilitate efficient waste management in urban environments. Through rigorous analysis and design methodologies, we have proposed a framework that integrates technological innovation with user satisfaction.

Our findings indicated that a combination of accessibility, user-friendliness, and informative content significantly enhances public engagement with e-government waste management services. The implementation of our proposed design principles has the potential to streamline waste management processes, reduce environmental impact, and foster a culture of sustainability among citizens.

While our research provided a robust foundation for the digital optimization of waste management services, we acknowledge certain limitations. These include the variability of technological adoption rates across different demographics and the evolving nature of digital platforms. We recommend future studies to focus on longitudinal analyses of user behaviour and the impact of emerging technologies on e-government services.

In conclusion, the digital transformation in e-government waste management services offers a promising avenue for enhancing service delivery and promoting environmental stewardship. By embracing user-centric design and continuous innovation, government agencies can significantly improve waste management outcomes and set a precedent for digital excellence in public services.

REFERENCES

[1] M. R. Cordova and I. S. Nurhati, "Major sources and monthly variations in the release of land-derived marine debris from the Greater Jakarta area, Indonesia," *Sci Rep*, vol. 9, no. 1, 2019, doi: 10.1038/S41598-019-55065-2.

[2] F. O. Ajibade, B. Adelodun, K. H. Lasisi, … O. O. F.-… mediated remediation of, and undefined 2021, "Environmental pollution and their socioeconomic impacts," *Elsevier*, pp. 321–354, 2021, doi: 10.1016/B978-0-12-821199-1.00025-0.

[3] U. Kanchan, N. Kumar, A. G.-J. of P. R. in Social, and undefined 2015, "GREEN BUSINESS-Way to achieve globally sustainable competitive advantage," *CiteseerU Kanchan, N Kumar, A GuptaJournal of Progressive Research in Social Sciences, 2015•Citeseer*, vol. 2, 2015, [Online]. Available: https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=8a8cb1806f39074b0fd686e94535b0936bce28ed

[4] S. Nosratabadi, A. Mosavi, S. Shamshirband, E. Kazimieras Zavadskas, A. Rakotonirainy, and K. Wing Chau, "Sustainable business models: A review," *mdpi.comS Nosratabadi, A Mosavi, S Shamshirband, EK Zavadskas, A Rakotonirainy, KW ChauSustainability, 2019•mdpi.com*, vol. 11, 2019, doi: 10.3390/su11061663.

[5] I. Irwanto, "Pelatihan Masyarakat Dalam Pengelolaan Sampah Rumah Tangga," *To Maega | Jurnal Pengabdian Masyarakat*, vol. 2, no. 2, p. 11, 2019, doi: 10.35914/TOMAEGA.V2I2.238.

[6] G. Beier, S. Niehoff, and B. Xue, "More Sustainability in Industry through Industrial Internet of Things?," *Applied Sciences 2018, Vol. 8, Page 219*, vol. 8, no. 2, p. 219, 2018, doi: 10.3390/APP8020219.

[7] P. K. R. Maddikunta *et al.*, "Industry 5.0: A survey on enabling technologies and potential applications," *J Ind Inf Integr*, vol. 26, p. 100257, 2022, doi: 10.1016/J.JII.2021.100257.

[8] S. Nižetić, N. Djilali, A. Papadopoulos, and J. J. P. C. Rodrigues, "Smart technologies for promotion of energy efficiency, utilization of sustainable resources and waste management," *J Clean Prod*, vol. 231, pp. 565–591, 2019, doi: 10.1016/J.JCLEPRO.2019.04.397.

[9] P. Hayat, "Integration of Advanced Technologies in Urban Waste Management," pp. 397–418, 2023, doi: 10.1007/978-3-031-21587-2_23.

[10] Y. A. Fatimah, K. Govindan, R. Murniningsih, and A. Setiawan, "Industry 4.0 based sustainable circular economy approach for smart waste management system to achieve sustainable development goals: A case study of Indonesia," *J Clean Prod*, vol. 269, p. 122263, 2020, doi: 10.1016/J.JCLEPRO.2020.122263.

[11] Q. Liu, A. H. Trevisan, M. Yang, and J. Mascarenhas, "A framework of digital technologies for the circular economy: Digital functions and mechanisms," *Bus Strategy Environ*, vol. 31, no. 5, pp. 2171–2192, 2022, doi: 10.1002/BSE.3015.

[12] M. Hrouga, A. Sbihi, and M. Chavallard, "The potentials of combining Blockchain technology and Internet of Things for digital reverse supply chain: A case study," *J Clean Prod*, vol. 337, 2022, doi: 10.1016/J.JCLEPRO.2022.130609.

[13] R. Naveenkumar, J. Iyyappan, R. Pravin, … S. K.-B., and undefined 2023, "A strategic review on sustainable approaches in municipal solid waste management and energy recovery: Role of artificial intelligence, economic stability and," *Elsevier*, [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0960852423004704?casa_token=Y3WaM6AZ5sQAAAAA:feSVG3bORwzbv5XVytkhQLveSqHUpxOvr2tlxBxDTXDMPd1xDXsMrcgFj3RtDaXJBUCsJdRbshQ

[14] Z. Allam and Z. A. Dhunny, "On big data, artificial intelligence and smart cities," *Cities*, vol. 89, pp. 80–91, 2019, doi: 10.1016/J.CITIES.2019.01.032.

[15] M. Abdallah, M. Abu Talib, S. Feroz, Q. Nasir, H. Abdalla, and B. Mahfood, "Artificial intelligence applications in solid waste management: A systematic research review," *Waste Management*, vol. 109, pp. 231–246, 2020, doi: 10.1016/J.WASMAN.2020.04.057.

[16] J. Huang and D. D. Koroteev, "Artificial intelligence for planning of energy and waste management," *Sustainable Energy Technologies and Assessments*, vol. 47, 2021, doi: 10.1016/J.SETA.2021.101426.

[17] L. C. Fernandes *et al.*, "Ionic-triggered magnetoelectric coupling for magnetic sensing applications," *Appl Mater Today*, vol. 29, 2022, doi: 10.1016/J.APMT.2022.101590.

[18] C. Prentice, … S. D. L.-J. of H., and undefined 2020, "The impact of artificial intelligence and employee service quality on customer satisfaction and loyalty," *Taylor & FrancisC Prentice, S Dominique Lopes, X WangJournal of Hospitality Marketing & Management, 2020•Taylor & Francis*, vol. 29, no. 7, pp. 739–756, 2020, doi: 10.1080/19368623.2020.1722304.

[19] Y. Shi, C. Prentice, and W. He, "Linking service quality, customer satisfaction and loyalty in casinos, does membership matter?," *Int J Hosp Manag*, vol. 40, pp. 81–91, 2014, doi: 10.1016/J.IJHM.2014.03.013.

[20] A. Parasuraman, V. A. Zeithaml, L. B.-1988, and undefined 1988, "SERVQUAL: A multiple-item scale for measuring consumer perceptions of service quality," *books.google.comA Parasuraman, VA Zeithaml, L Berry1988, 1988•books.google.com*, [Online]. Available: https://books.google.com/books?hl=en&lr=&id=pGIPEAAAQBAJ&oi=fnd&pg=PA30&dq=Parasuraman,+A.,+Zeithaml,+V.A.,+%26+Berry,+L.L.+(1988).+SERVQUAL:+A+multiple-item+scale+for+measuring+consumer+perceptions+of+service+quality.+Journal+of+Retailing,+64(1),+12-40.&ots=whnSInDZE_&sig=DqHjEWqMjQY1dO8OwDD91vwxsOA

[21] A. F. Fainusa, R. Nurcahyo, and M. Dachyar, "Conceptual Framework for Digital Wallet User Satisfaction," *ICETAS 2019 - 2019 6th IEEE International Conference on Engineering, Technologies and Applied Sciences*, 2019, doi: 10.1109/ICETAS48360.2019.9117285.

[22] H. S. Bansal and S. Taylor, "Investigating the Relationship Between Service Quality, Satisfaction and Switching Intentions," *Developments in Marketing Science: Proceedings of the Academy of Marketing Science*, pp. 304–313, 2015, doi: 10.1007/978-3-319-13141-2_107.

[23] J. Kim, "Platform quality factors influencing content providers' loyalty," *Journal of Retailing and Consumer Services*, vol. 60, 2021, doi: 10.1016/J.JRETCONSER.2021.102510.

[24] R. S. Sumi and G. Kabir, "Satisfaction of e-learners with electronic learning service quality using the servqual model," *Journal of Open Innovation: Technology, Market, and Complexity*, vol. 7, no. 4, 2021, doi: 10.3390/JOITMC7040227.

[25] A. Demir, L. Maroof, N. U. Sabbah Khan, and B. J. Ali, "The role of E-service quality in shaping online meeting platforms: a case study from higher education sector," *Journal of Applied Research in Higher Education*, vol. 13, no. 5, pp. 1436–1463, 2020, doi: 10.1108/JARHE-08-2020-0253.

[26] A. P. Omoge, P. Gala, and A. Horky, "Disruptive technology and AI in the banking industry of an emerging market," *International Journal of Bank Marketing*, vol. 40, no. 6, pp. 1217–1247, 2022, doi: 10.1108/IJBM-09-2021-0403.

[27] D. Teh and T. Rana, "The Use of Internet of Things, Big Data Analytics and Artificial Intelligence for Attaining UN's SDGs," *Handbook of Big Data and Analytics in Accounting and Auditing*, pp. 235–253, 2023, doi: 10.1007/978-981-19-4460-4_11.

[28] S. Goundar, A. Purwar, and A. Singh, "Applications of Artificial Intelligence, Big Data and Internet of Things in Sustainable Development," *Applications of Artificial Intelligence, Big Data and Internet of Things in Sustainable Development*, 2022, doi: 10.1201/9781003245469.

[29] G. K. Ijemaru, L. M. Ang, and K. P. Seng, "Transformation from IoT to IoV for waste management in smart cities," *Journal of Network and Computer Applications*, vol. 204, 2022, doi: 10.1016/J.JNCA.2022.103393.

[30] S. M. Wu, T. Chen, Y. J. Wu, M. L.-Sustainability, and undefined 2018, "Smart cities in Taiwan: A perspective on big data applications," *mdpi.comSM Wu, T Chen, YJ Wu, M LytrasSustainability, 2018•mdpi.com*, vol. 10, no. 1, 2018, doi: 10.3390/su10010106.

[31] O. Okorie, J. Russell, R. Cherrington, O. Fisher, and F. Charnley, "Digital transformation and the circular economy: Creating a competitive advantage from the transition towards Net Zero Manufacturing," *Resour Conserv Recycl*, vol. 189, 2023, doi: 10.1016/J.RESCONREC.2022.106756.

[32] K. Wang, Y. Zhao, R. K. Gangadhari, Z. L.-Sustainability, and undefined 2021, "Analyzing the adoption challenges of the Internet of things (Iot) and artificial intelligence (ai) for smart cities in china," *mdpi.comK Wang, Y Zhao, RK Gangadhari, Z LiSustainability, 2021•mdpi.com*, vol. 13, no. 19, p. 10983, 2021, doi: 10.3390/su131910983.

[33] B. Esmaeilian, J. Sarkis, K. Lewis, and S. Behdad, "Blockchain for the future of sustainable supply chain management in Industry 4.0," *Resour Conserv Recycl*, vol. 163, 2020, doi: 10.1016/J.RESCONREC.2020.105064.

[34] M. El Khatib, A. Al Mulla, and W. Al Ketbi, “The Role of Blockchain in E-Governance and Decision-Making in Project and Program Management,” *Advances in Internet of Things*, vol. 12, no. 03, pp. 88–109, 2022, doi: 10.4236/AIT.2022.123006.

[35] D. E. Bock, J. S. Wolter, and O. C. Ferrell, “Artificial intelligence: disrupting what we know about services,” *Journal of Services Marketing*, vol. 34, no. 3, pp. 317–334, 2020, doi: 10.1108/JSM-01-2019-0047.

[36] J. W. Creswell and W. Zhang, “The application of mixed methods designs to trauma research,” *J Trauma Stress*, vol. 22, no. 6, pp. 612–621, Dec. 2009, doi: 10.1002/JTS.20479.

[37] R. K. Yin, “Case study research and applications,” *Sage*. 2018. [Online]. Available: https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Yin%2C+R.+K.+%282017%29.+Case+Study+Research+and+Applications%3A+Design+and+Methods.+Sage+Publications.&btnG=

[38] N. K. Denzin and Y. S. Lincoln, “The SAGE Handbook of Qualitative Research,” *experts.illinois.edu*, 2011, [Online]. Available: https://experts.illinois.edu/en/publications/the-sage-handbook-of-qualitative-research/publications/?type=%2Fdk%2Fatira%2Fpure%2Fresearchoutput%2Fresearchoutputtypes%2Fcontributiontobookanthology%2Fchapter

[39] M. H.-J. I. I. K. F. Ilmu and undefined 2015, “Pendekatan zachman framework untuk Integrasi Tatakelola Sistem Informasi Perguruan Tinggi,” *ejournal.fikom-unasman.ac.idM HattaJurnal Ilmiah Ilmu Komputer Fakultas Ilmu Komputer, 2015•ejournal.fikom-unasman.ac.id*, vol. 1, no. 2, 2015, [Online]. Available: http://ejournal.fikom-unasman.ac.id/index.php/jikom/article/view/68

[40] T. Iyamu, “Implementation of the enterprise architecture through the Zachman Framework,” *Journal of Systems and Information Technology*, vol. 20, no. 1, pp. 2–18, 2018, doi: 10.1108/JSIT-06-2017-0047.

[41] S. Bondar, J. C. Hsu, A. Pfouga, and J. Stjepandić, “Agile digital transformation of System-of-Systems architecture models using Zachman framework,” *J Ind Inf Integr*, vol. 7, pp. 33–43, 2017, doi: 10.1016/J.JII.2017.03.001.

[42] A. P. Aslam, W. Rahayu, A. I.-I. J. of, and undefined 2023, “Implementation of Enterprise Architecture Zachman Framework at PT. Shopee Internasional Indonesia (Shopee Application),” *journal.lontaradigitech.comAP Aslam, W Rahayu, A IsmaIndonesian Journal of Enterprise Architecture, 2023•journal.lontaradigitech.com*, vol. 1, no. 1, 2023, [Online]. Available: https://journal.lontaradigitech.com/IJEA/article/view/54

[43] B. Fang *et al.*, “Artificial intelligence for waste management in smart cities: a review,” *Environ Chem Lett*, vol. 21, no. 4, pp. 1959–1989, 2023, doi: 10.1007/S10311-023-01604-3.

[44] C. Zurbrügg, S. Drescher, A. Patel, and H. C. Sharatchandra, “Decentralised composting of urban waste - An overview of community and private initiatives in Indian cities,” *Waste Management*, vol. 24, no. 7, pp. 655–662, 2004, doi: 10.1016/J.WASMAN.2004.01.003.