

Digital Receipts for a Greener Future: Web-Based Innovation in Toll Payment Systems

Asriani^{1*}, Mashuri Said², Ahmed H. Arnous³

¹Digital Business, STIE Makassar Maju, Makassar, Indonesia

²Informatics, Universitas Teknologi Akba Makassar, Makassar, Indonesia

³College of Information Science and Technology, Dalian Maritime University, Dalian, China

Abstract

This study presents the implementation of a web-based digital receipt system in the transaction processes of PT. Makassar Metro Network and PT. Jalan Tol is a strategic response to operational challenges during the COVID-19 pandemic. The reliance on printed receipts led to increased operational expenses and issues in receipt management, including frequent loss and negative environmental impact. To address these issues, a web-based application was developed to facilitate access to digital receipts, aiming to reduce the use of thermal paper and improve cost efficiency. The research adopts the System Development Life Cycle (SDLC) methodology using the Waterfall model, which encompasses stages of planning, requirements analysis, system design, implementation, and maintenance. Testing results indicate that all application features functioned as intended, enhancing both accessibility and transaction efficiency. These outcomes suggest that digital receipts can significantly reduce environmental footprints and streamline operational workflows. Furthermore, the developed model offers potential for broader adoption across various industries seeking sustainable and digital transaction solutions. The integration of digital receipts thus emerges as a viable, eco-friendly alternative in the modernization of toll payment systems.

Keywords: Digital Receipt; Toll Payment System; Web-Based Application; Operational Efficiency; Environmental Sustainability.

Received: 28 January 2024

Revised: 15 April 2025

Accepted: 19 April 2025

Introduction

During the Covid-19 pandemic from 2020 to 2021, which hit various corners of the world, it had a major impact on economic growth and human interaction patterns in carrying out various activities, both individually and corporately (Nations, 2020; Sasmiharti & Karyati, 2021). Companies are making various improvements in the application of technology to reduce operational costs and improve efficiency in various sectors, especially by involving IT (Burhan, 2020; Cionta, 2021). In the scope of toll road companies, it also has an impact on PT. Makassar Metro Network (PT. MMN) and PT. Jalan Tol Bagian Empat (PT. JTSE) is the organizer of toll road operations, especially in Makassar. The company management has taken initiatives with various improvements with the aim of operational cost efficiency and ISO implementation, one of which is the ISO 4001 standard on the internationally applicable Environmental Management System standard (Abdul-Rashid et al., 2022; Manninriang, 2013).

Based on this, changes have been made to the payment system for transactions on toll roads by not automatically printing transaction receipts when a transaction is completed (Ristyaningrum, 2019). Drivers can print receipts according to their own needs, so that receipts that were previously printed automatically and were not needed for documentation purposes by toll road users can reduce the use of thermal paper and operational costs of toll equipment (Ashari & Meicahayanti, 2023). By reducing the use of thermal paper, the company will have an impact on environmental management as stipulated in the ISO 4001 standard, in this case reducing the use of paper made from trees (Certification, 2023). As we know, the need for paper made from trees will cause the area of forests to decrease, thus having an impact on global warming and climate change (Ashari & Meicahayanti, 2023; Irsyad, 2022).

Companies can also reduce maintenance and spare part costs for toll equipment by increasing the usage period of thermal printer devices for printing receipts (Ruhuleessin, 2023). With an average of 100 thousand to millions of vehicles transacting every day, of course, the operational costs of transaction devices that must operate 24 hours to serve

*Corresponding author.

E-mail address: asrianinaimah@gmail.com (Asriani)



transactions of drivers on toll roads are very significant and must be prepared by the company (Work, 2023). Minimum Service Standards or SPM required by the Toll Road Regulatory Agency (BPJT) as a government regulator in supervising and controlling the operation of toll road services for toll road drivers (BPJT, 2014). The implementation of this SPM is a standard for periodic increases in toll road rates during the concession period and in accordance with the company's investment (PUPR, 2023).

This research is in line with research Fong (2022), entitled Web-Based Receipt Key Information Extraction System, this study aims to develop a system for extracting key information from receipts automatically, considering the importance of proper receipt management by the community to increase financial awareness. Facing the challenges of handling many receipts, this system is designed to make it easier for users to extract and store important information. the final result of the system can upload several receipts for processing and store records. And also research (Mwende & Kasamani, 2018), titled Integrated Paperless Receipts for Shoppers, aims to address the issues associated with paper-based receipts, which are often lost, damaged, and environmentally unfriendly. With millions of purchases made every day, the process of printing receipts has become expensive for businesses and individuals. To address this, an integrated system has been developed that allows customers to receive and store receipts directly through their customer accounts, thereby reducing the need for paper receipts. The methodology used in this research is prototyping, which supports the development of a digital-based solution for more efficient and practical receipt storage.

The IT department, as the person in charge of the toll equipment system in the company, is required to innovate and improve the toll equipment transaction system with a web-based information system for toll transaction information media (Augustine et al., 2024; Kahar et al., 2024; Wardana & Hidayat, 2020). The target of operational cost efficiency of the toll equipment system by prepare an information system application for easy information to drivers on the toll road and provide a profitable impact in the future for the company. Therefore, the researcher chose the title of Application of Web-Based Digital Receipts on the Transaction System of PT. Makassar Metro Network and PT. Jalan Tol.

Method

This research method is designed to develop a web-based application in the toll payment transaction system at PT. Makassar Metro Network and PT. Jalan Tol Bagian Empat. This study aims to improve operational efficiency and provide convenience for toll road users through the implementation of digital receipts. The methods used are the System Development Life Cycle (SDLC) and the Waterfall Method, which will guide the research process from planning to system maintenance (Borecky et al., 2016; Firera & Iskandar, 2022; Senarath, 2021; Tekno, 2021). The research stage begins with planning, where researchers identify problems in the current transaction system and analyze user needs (Agency, 2024; Meilinaeka, 2023).

Next, in the requirements analysis stage, data is collected through interviews and surveys to develop detailed system specifications. The system design stage involves creating flowcharts and data models, followed by implementation, where the application is developed using the Laravel framework (Fadilah et al., 2023; Iqbal, 2023; Pricillia & Zulfachmi, 2021). Testing is done to ensure the quality and functionality of the system before launch (Peled et al., 1999; Setiawan, 2021; Wicaksono, 2022). The black box method is used in this study to test the functionality of the system that has been designed (Dashti & Basin, 2020; Patria, 2023; Verma et al., 2017). The diagram and receipt printing on the Web can be seen in Figure 1.

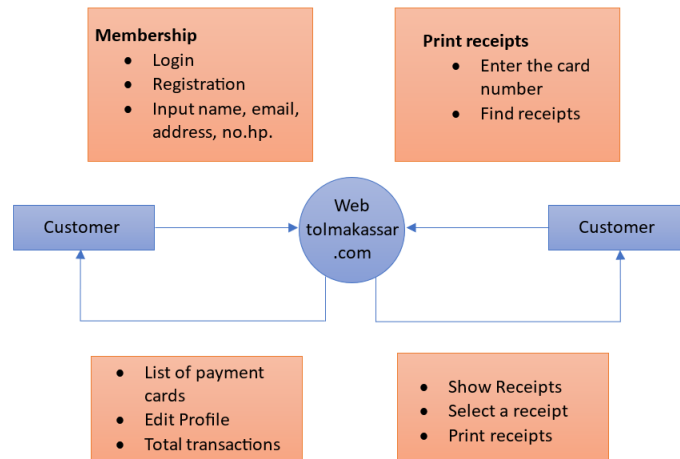


Figure 1. Membership dashboard context diagram and receipt printing on the Web

In Figure 1, the system design is in the form of a dashboard context diagram and printed receipts on the web. This system design was developed directly by updating several lines of code in the previously existing code script. After implementation, users are trained to use the new application, and maintenance is carried out to maintain system performance. By implementing this method, it is expected that the research can produce an efficient and effective application in the toll transaction system, reduce paper use through digital receipts, and improve user experience with easy access to transaction data. The final results are expected to provide a real contribution to the development of a more environmentally friendly and efficient toll transaction system.

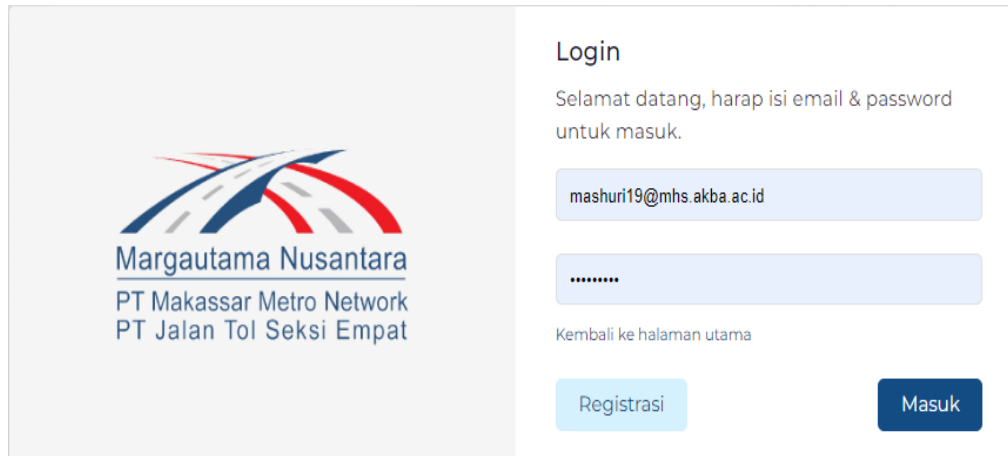
Results and Discussion

Results

In an effort to improve operational efficiency and provide convenience for toll road users, this study has succeeded in developing a web-based application for the transaction system at PT. Makassar Metro Network and PT. Jalan Tol Bagian Empat. The implementation of digital receipts as part of this innovation is not only aimed at minimizing paper use but also at improving user experience through easier access to transaction data. The design results of the application development are as follows (Figure 2).

Figure 2. Member account registration page

Figure 2 shows the appearance of the member account registration page on the *tolmakassar.com* website, which is designed to facilitate users in creating an account to access the various services offered. This page asks for important information such as full name, email address, mobile phone number, and address according to KTP, which aims to verify the user's identity and ensure account security. In addition, users are required to create a strong password with a minimum of six characters and confirm the password to prevent errors in the registration process.



Login

Selamat datang, harap isi email & password untuk masuk.

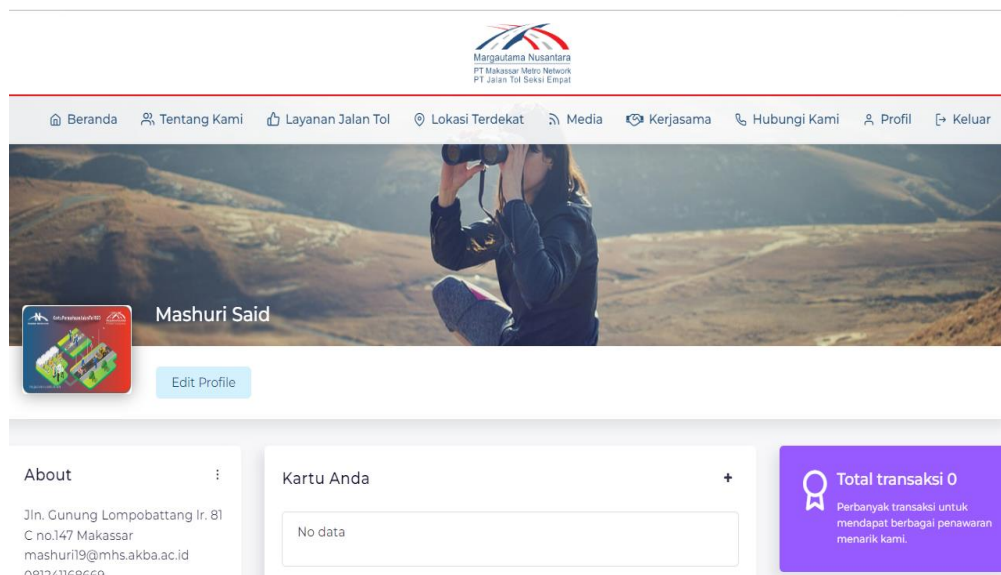
mashuri19@mhs.akba.ac.id

[Kembali ke halaman utama](#)

[Registrasi](#) [Masuk](#)

Figure 3. Member login page

Figure 3 shows the member login page on the *tolmakassar.com* website, which is designed to allow registered users to easily access their accounts. This page asks users to enter their previously registered email address and password and provides an option to return to the main page if needed. This simple and clear design makes it easy for users to authenticate so they can quickly access the features available on the platform, such as transaction history, balance information, and other services. With this login system, the website not only offers user data security but also improves user experience by providing fast and efficient access to relevant services, increasing interaction between users and toll road service providers.



Margautama Nusantara
PT Makassar Metro Network
PT Jalan Tol Seksi Empat

Beranda Tentang Kami Layanan Jalan Tol Lokasi Terdekat Media Kerjasama Hubungi Kami Profil Keluar

Mashuri Said

Edit Profile

About

Jln. Gunung Lompobattang Ir. 81
C no.147 Makassar
mashuri19@mhs.akba.ac.id
081241168669

Kartu Anda

No data

Total transaksi 0

Perbanyak transaksi untuk mendapat berbagai penawaran menarik kami.

Figure 4. Member profile page

Figure 4 shows a view of the member profile page on the *tolmakassar.com* website, which provides users with their personal information and transaction history in a structured manner. On this page, users can see their name, address,

mobile phone number, and registered email address, providing a comprehensive overview of the data associated with their account. There is also an option to edit the profile, allowing users to update information if necessary. At the bottom, information regarding total transactions is displayed, although in this example it shows "0 data," which may indicate that the user has not made any transactions.



Figure 5. Display of the main page of the tolmakassar.com website

Figure 5 shows the interface of the tolmakassar.com website, which is designed to facilitate toll road users managed by PT. Makassar Metro Network and PT. Jalan Tol Bagian Empat. This website provides various important features, such as a location map showing nearby places, a Print Receipt option to print digital transaction receipts, and Live CCTV access that allows users to see traffic conditions directly. In addition, this website is integrated with social media such as Instagram and Twitter and provides call center contact information for easy communication. The intuitive interface design and these features aim to increase user satisfaction and provide effective solutions in managing transactions on toll roads.



Figure 6. Print the receipt page

Figure 6 shows a guide from the tolmakassar.com website explaining how to print digital receipts, with the tagline #BeralihKeE-Struk. This guide consists of three simple steps: first, users are asked to enter their toll card number in the column provided; second, users select the type of receipt they want to print based on the transactions they have made; and third, users click the print button to download the receipt in PDF format. With clear and easy-to-follow steps, this

feature aims to make it easier for users to manage their transaction documentation digitally, thereby supporting the reduction of paper use and increasing efficiency in the transaction process on toll roads.

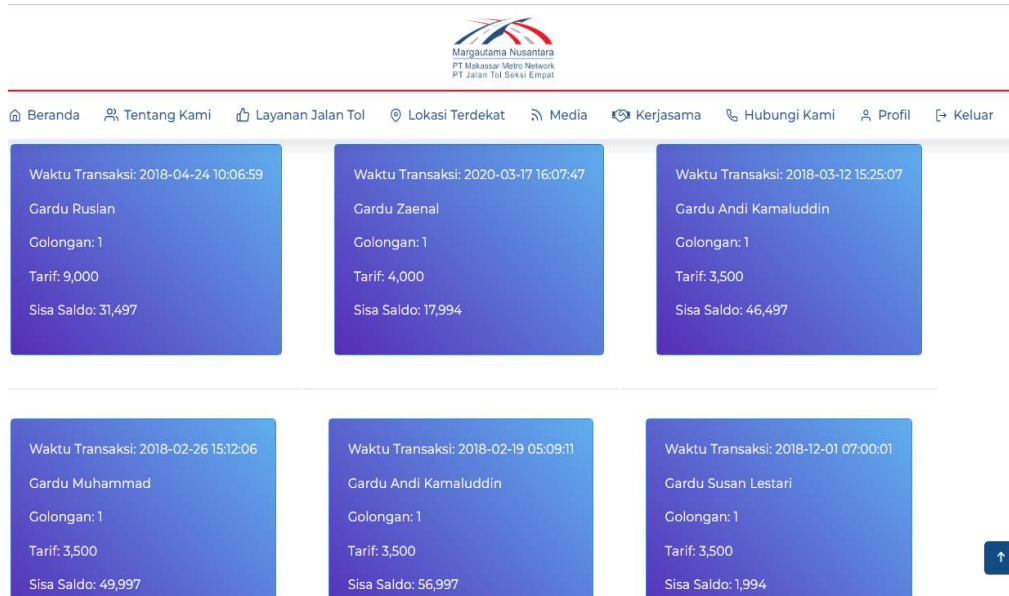


Figure 7. Search receipt page

Figure 7 shows the Cari Struk feature on the tolmakassar.com website, which allows users to access their transaction history easily and efficiently. In this view, users can see transaction details, including transaction time, booth location, user name, vehicle class, fare charged, and remaining balance after the transaction. This structured information not only provides transparency to users regarding their spending on toll roads but also makes it easier for them to track and manage their toll card usage history. Thus, this feature contributes to a better user experience and supports personal financial management in toll road use.



Figure 8. Printed receipt result

Figure 8 shows a printed receipt from the tolmakassar.com website, which provides clear and formatted details of toll transactions. On the receipt, important information such as the company name, receipt number, available balance, transaction time, and the rates charged for each user can be seen. In addition, the receipt lists the payment method used, such as payment through a specific bank. This neat and informative design not only ensures that users have clear and accurate records of their transactions but also makes it easier to verify and track if necessary. With this digital receipt, users can more easily manage their finances related to toll road use while supporting efforts to reduce paper use by switching to a digital format.

Table 1. Blackbox testing results

Feature	Input	Output Expectations	Test Results	Status
Account Registration	Name, Email, Phone Number, Password	Account created successfully, confirmation message	A confirmation message appears	Succeed
Member Login	Email, Password	Access to the main page	The main page opens	Succeed
Search Receipt	Card Number	Display transaction history	Transaction data is displayed	Succeed
Print Receipt	Receipt Number	Receipt successfully printed	The receipt appears in PDF format	Succeed
Edit Profile	New data	Profile updated successfully	New data is visible in the profile	Succeed

Based on the blackbox testing table 1 presented, it can be concluded that all features tested in the application function well and meet the specified expectations. The process of account registration, login, receipt search, receipt printing, and profile editing all produce the expected output, such as the appearance of a confirmation message, access to the main page, display of transaction history, and updating profile data. Success in all aspects of this test indicates that the application has a good level of reliability and performance and is able to provide a positive user experience. Thus, the application is ready for further use, although continuous monitoring and evaluation still need to be carried out to ensure its performance is in line with the development and changes in user needs.

Discussion

The results of this study indicate that the development of a web-based application for the toll payment transaction system at PT. Makassar Metro Network and PT. Jalan Tol Bagian Empat has succeeded in increasing operational efficiency and providing significant convenience for toll road users. The implementation of digital receipts not only reduces paper use but also improves user experience by facilitating fast access to transaction data. One of the main advantages of implementing digital receipts is the reduction in operational costs associated with printing paper receipts. By switching to a digital system, companies can reduce the use of thermal paper, which is often expensive and has a negative impact on the environment. Research conducted by Ashari and Meicahayanti (2023) shows that reducing paper use can contribute to better environmental management, in line with the ISO 14001 standard on Environmental Management Systems.

In addition, this application increases transparency and accuracy in transaction management. With the digital receipt search feature, users can easily access their transaction history, which makes it easier to track and verify. This is supported by the findings Fong (2022), which emphasizes the importance of digital systems in facilitating information management for users. Another positive impact is increased user satisfaction, as indicated by blackbox testing showing all features working properly. A better user experience can increase customer loyalty, which in turn has a positive impact on company revenue. This research is also supported by Mwende and Kasamani (2018) highlighting that efficient digital systems can increase customer satisfaction and retention.

Overall, the results of this study provide a significant contribution to the development of a more environmentally friendly and efficient toll transaction system. These findings are not only relevant to PT. Makassar Metro Network and PT. Jalan Tol, but also offers a model that can be adopted by other industries in implementing digital solutions for transactions, supporting efforts towards sustainability, and better resource management. User involvement in training and the use of new applications is also an important aspect to ensure the long-term success of this system.

Conclusions and Suggestions

Conclusions

The development of the *tolmakassar.com* web application can have a positive impact on toll road users by providing easy access to e-payment card transaction data on toll roads with digital receipt printing facilities, and becoming a member of the *tolmakassar.com* web application. Toll road users can not only view transaction data but also print e-

payment card transaction data in the form of digital receipts in the form of PDF files. The company can make efficient use of thermal roll paper by replacing it with digital receipts and also have toll road customer data that is a member of the tolmakassar.com web application, so that it can use the data for customer loyalty programs and be stored as a customer database of toll road users in the Company PT Makassar Metro Network and PT Jalan Tol Bagian Empat.

Suggestions

To create an Android-based application to make it easier for toll road users to quickly access the transaction information system on the toll road. Companies can introduce service products, brands, and create mutually beneficial programs through the Android application. In the future, students will be given the opportunity to collaborate with toll road companies to learn and implement knowledge and skills from campus. Of course, this activity greatly helps students prepare themselves for the world of work that they will face in the future. Collaboration between companies and students should continue to provide opportunities for students to develop their innovations, and existing innovations should continue to be developed to better answer the needs of companies related to the digitalization of business processes.

References

- Abdul-Rashid, S. H., Mohamad, M. N., Sakundarini, N., Ghazilla, R. A. R., & Thurasamy, R. (2022). Modelling sustainable manufacturing practices effects on sustainable performance: The contingent role of ownership. *The International Journal of Advanced Manufacturing Technology*, 122(9), 3997–4012. <https://doi.org/https://doi.org/10.1007/s00170-022-10140-3>
- Adminlp2m. (2022, June). *Metode Waterfall*.
- Agency, T. D. (2024). Metode Waterfall: Pengertian, Proses hingga Kelebihannya. *Teroopong.Com*.
- Ashari, A. F., & Meicahayanti, I. (2023). Pengaruh Produksi Kertas terhadap Deforestasi di Indonesia. *Jurnal Silviculture IPB*.
- Augustine, O., Saidu, I. C., Ekwomadu, N. G., & Olaoluwa, O. M. (2024). Development of a Secure Web Application for Digital Receipt Generation with Integrated Digital Signatures. *Faculty of Natural and Applied Sciences Journal of Computing and Applications*, 2(1), 72–85.
- Borecky, J., Kohlik, M., & Kubátová, H. (2016). Parity Waterfall Method. *2016 IEEE 19th International Symposium on Design and Diagnostics of Electronic Circuits & Systems (DDECS)*, 1–6.
- BPJT, B. P. J. T. (2014). *Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat No. 16 Tahun 2014 tentang Standar Pelayanan Minimal Jalan Tol*.
- Burhan, F. A. (2020). Perusahaan Digitalkan Bisnis Saat Pandemi, Kuncinya Inovasi. *Katadata Indonesia*.
- Cionta, N. C. (2021). Pentingnya Manufaktur Digital pada Masa Pandemi COVID-19. *Student Activity BINUS*.
- Dashti, M. T., & Basin, D. (2020). A Theory of Black-Box Tests. *ArXiv Preprint ArXiv:2006.10387*.
- Fadilah, M. I., Kusumasari, T. F., & Suakanto, S. (2023). Implementation of MVC Architecture on RESTful API for Monitoring Covid-19 Patient Condition Parameters using Laravel Framework with Waterfall Method. *International Conference on Enterprise and Industrial Systems (ICOEINS 2023)*, 258–270. https://doi.org/10.2991/978-94-6463-340-5_23
- Firera, R., & Iskandar, A. (2022). Community Service Monitoring Information System at The Level of Community Harmony of Citizens. *Ceddi Journal of Information System and Technology (JST)*, 1(1), 28–34. <https://doi.org/10.56134/jst.v1i1.6>
- Fong, J. Y. (2022). *Web-based receipt key information extraction system*. UTAR.
- Iqbal. (2023). Apa Itu Metode Waterfall Serta Kelebihan, Kekurangan dan Tahapannya. *Nextgen.Co.Id*.
- Irsyad, A. (2022). *Dukung Penerapan E-Receipt untuk Mengurangi Sampah Kertas*.
- Jesus, V. (2020). Towards an accountable web of personal information: The web-of-receipts. *IEEE Access*, 8, 25383–25394. <https://doi.org/https://doi.org/10.1109/ACCESS.2020.2970270>
- Kahar, N. W., Malik, A., Hasanuddin, M., Harike, M. H., & Bantun, S. (2024). Design and Development of a Web-Based Cashier and Accounting System Using CodeIgniter 4. *Journal of Embedded Systems, Security and Intelligent Systems*, 5(2), 139–146. <https://doi.org/10.59562/jessi.v5i2.3305>
- Karya, H. (2023). *Hingga Oktober 2023, Rata-Rata Lebih dari 210.000 Kendaraan Per Hari Melintas di Jalan Tol Hutama Karya*.
- Koh, C. H. (2011). *Light-Weight Digital Receipt System*.

- Lillthors, C. (2014). *Digital receipt services: an analysis from a consumer perspective*.
- Manninriang. (2013). *Implementasi Sistem Manajemen Lingkungan ISO 14001 di PT PLN Sulselrabar Sektor Tello Makassar*.
- Meilinaeka. (2023). Metode Waterfall dalam Pengembangan Perangkat Lunak. *Telkomuniversity*.
- Mwende, F. J., & Kasamani, B. S. (2018). Integrated Paperless Receipts for Shoppers. *Journal of Systems Integration* (1804-2724), 9(3).
- Nations, U. (2020). COVID-19 Akan Memangkas Output Ekonomi Global. *United Nations Indonesia*.
- Patria, R. (2023, April). *Black Box Testing: Metode Pengujian Perangkat Lunak Sederhana - DomaiNesia*. DomaiNesia.
- Peled, D., Vardi, M. Y., & Yannakakis, M. (1999). Black box checking. *International Conference on Protocol Specification, Testing and Verification*, 225–240. https://doi.org/https://doi.org/10.1007/978-0-387-35578-8_13
- Pricillia, T., & Zulfachmi. (2021). Perbandingan Metode Pengembangan Perangkat Lunak (Waterfall, Prototype, RAD). *Jurnal Bangkit Indonesia*, 10(1), 6–12. <https://doi.org/10.52771/bangkitindonesia.v10i1.153>
- PUPR, K. P. U. dan P. R. (2023). *Penyesuaian Tarif Tol Dibagi Empat Kelompok Sesuai Regulasi*.
- Ristyaningrum, A. (2019). JTSE Kurangi Penggunaan Kertas Karcis Tol. *Bisnis Ekonomi*.
- Ruhulestin, M. F. (2023). *Tiap Hari 3,4 Juta Kendaraan Lintasi Jalan Tol Milik Jasa Marga*.
- Sasmiharti, J., & Karyati, E. (2021). Dampak Pandemi COVID-19 terhadap Ekonomi Indonesia. *Jurnal Ekonomi Dan Manajemen*.
- Senarath, U. S. (2021). Waterfall methodology, prototyping and agile development. *Tech Rep*, 1–16.
- Sertifikasi, I. S. O. (2023). *Sertifikasi ISO 14001*.
- Setiawan, R. (2021). *Black Box Testing Untuk Menguji Perangkat Lunak*. Dicoding Blog.
- Tekno. (2021). Metode Waterfall Menurut Para Ahli, Begini Penjelasannya. *Kumparan.Com*.
- Verma, A., Khatana, A., & Chaudhary, S. (2017). A comparative study of black box testing and white box testing. *International Journal of Computer Sciences and Engineering*, 5(12), 301–304. <https://doi.org/https://doi.org/10.26438/ijcse/v5i12.301304>
- Wardana, A. R., & Hidayat, H. (2020). Rancang Bangun Aplikasi Kasir Pencetak Struk Belanja Kode Quick Response berbasis Website dan Android. *JOINS (Journal of Information System)*, 5(2), 208–220. <https://doi.org/10.33633/joins.v5i2.3809>
- Wicaksono, S. R. (2022). *Black Box Testing Teori Dan Studi Kasus*. February, 1–163.