Jurnal Info Sains : Informatika dan Sains
Volume 14 , Number 01, 2024, DOI 10.54209/infosains.v14i01
ESSN 2797-7889 (Online)
https://ejournal.seaninstitute.or.id/index.php/InfoSains

Exploring prototype methodology in land information system development: design and evaluation of an application

Denny Jean Cross Sihombing
Faculty of Engineering, Atma Jaya Catholic University of Indonesia

Article Info
Keywords:
Land Information System,
Design and Evaluation,
Prototype.

ABSTRACT
Land management in the modern era requires efficient and responsive information systems to facilitate timely and effective decision-making. However, the development of land rights information systems is often faced with complex challenges such as diverse user needs, legal uncertainty, and administrative complexity. This research uses a prototype approach to develop a land rights information system application. The first stage involved data collection to identify user needs and the state of existing information systems. The second stage involved developing an application prototype based on the identified user needs. The third stage is prototype testing with end users to gather feedback. The final stage is user acceptance analysis to evaluate the application's performance, functionality, and usability. The result of this research is a prototype of a land rights information system application that has been improved and refined based on user feedback. User acceptance analysis showed a good level of satisfaction and acceptance of the prototype, with the prototype method helping to reduce development time and costs and providing a faster response to changing user needs.

This is an open access article under theCC BY-NClicense

Corresponding Author:
Denny Jean Cross Sihombing
Atma Jaya Catholic University of Indonesia
Jakarta, Indonesia
denny.jean@atmajaya.ac.id

INTRODUCTION

In a modern era where information is an invaluable asset, information systems play a crucial role in facilitating land rights' efficient and effective management. Land rights are not just a physical foundation but an important asset that affects various aspects of life, from agriculture to property investment(Pradeep & Wijesekera, 2020; Rakhmonov et al., 2022). Amidst the complexity and dynamics of population growth and environmental change, reliable and responsive information systems are becoming increasingly important. With the right information system, relevant stakeholders, such as landowners, governments, property developers, and investors, can easily access land ownership, use, and status information. Accurate and real-time data provides a strong foundation for timely and effective decision-making(Abanda et al., 2022; Wang et al., 2023). Along with that, the transparency provided by the information system strengthens trust and openness in the land management process.

Jurnal Info Sains : Informatika dan Sains
Volume 14 , Number 01, 2024, DOI 10.54209/infosains.v14i01
ESSN 2797-7889 (Online)
https://ejournal.seaninstitute.or.id/index.php/InfoSains

The importance of information systems in land rights management is also reflected in their ability to provide easy and equitable access to information for all parties involved. As such, information systems are not only a tool for elites or certain interested parties but also a democratic and inclusive tool for the entire community. By providing easy access, information systems help to reduce information gaps and ensure that decisions are based on accurate and comprehensive data. In the increasingly complex and diverse context of land rights management, information systems are a technical tool and the foundation for sustainable and inclusive development. By providing a reliable information infrastructure, information systems help strengthen the sustainability and efficiency of land management, providing far-reaching benefits to communities and the environment. Therefore, we must recognize and appreciate the vital role of information systems in land rights management as a joint effort to create a better and more sustainable future(Bawa, 2024; Saing et al., 2021; Tóth & Kučas, 2018).

Land rights management is a complex challenge encompassing several administrative processes that require specialized attention. In agriculture, investment, and land development, the importance of land rights management cannot be overlooked. Any transaction or activity involving land, such as purchase, sale, or use for agriculture or development, must be based on clear and properly recorded rights. The complexity of land rights management is reflected in the administrative processes involving recording ownership, land use, and licenses. Proving land ownership, updating ownership status, and scanning and monitoring land use are integral to effective land rights management. The licensing process is also a key element in land development, where strict requirements and regulations must be followed to ensure sustainable land use and conformity with development plans(Bawa, 2024; Madsen & Paasch, 2023; Mationg et al., 2022; Saing et al., 2021).

Land with clear and well-recorded rights provides a strong foundation for agricultural sector growth, property investment, and infrastructure development. In the agricultural sector, landowners with strong, legally recorded rights are more likely to be motivated to increase productivity and adopt sustainable agricultural practices. On the other hand, property investors and land developers seek legal certainty in land ownership and use to reduce risk and increase the value of their investments. Good management of land rights is also essential in the context of infrastructure development. Land with clear and well-recorded rights facilitates land acquisition for public infrastructure projects, such as roads, bridges, or other public facilities. Well-prepared land also enables timely and planned implementation of development projects, improving connectivity, accessibility, and quality of life for communities.

By understanding the complexity and importance of land rights management in agriculture, investment, and land development, we can better appreciate the need for robust and responsive information systems to support successful and sustainable future development. Weaknesses in land rights information systems can significantly impact land management, investment, and overall economic growth. Without solid and reliable information systems, decision-making in land investment, land use, and property

Jurnal Info Sains : Informatika dan Sains
Volume 14 , Number 01, 2024, DOI 10.54209/infosains.v14i01
ESSN 2797-7889 (Online)
https://ejournal.seaninstitute.or.id/index.php/InfoSains

development becomes prone to uncertainty and error. Data deficiencies or information inaccuracies in land rights information systems can lead to sub-optimal decision-making. With sufficient access to accurate and comprehensive information, relevant stakeholders may be able to evaluate the risks and opportunities associated with land investments and land use(Al-Rahmi et al., 2019; Lee et al., 2022). Impacts also include legal uncertainty regarding land ownership and associated rights, hampering investors' ability to make intelligent investment decisions. Poorly managed land with inadequate information systems can hinder sustainable property and infrastructure development, causing delays in implementing projects critical to economic growth and community well-being. In addition, lack of transparency and access to land rights information can reinforce social and economic inequalities by limiting people's access to valuable land and resources. The improvement and modernization of land rights information systems are therefore crucial in ensuring the continuity of inclusive and sustainable development.

Developing a land rights information system is crucial in dealing with the complexities and dynamics of land management in this modern era(He et al., 2023; Omitaomu et al., 2021; Zulfiandri et al., 2022). We can improve overall land rights management by updating and improving existing information systems. Better information systems provide easier access to land ownership, use, and status information and help optimize land administrative processes. Administrative efficiency is key in addressing the challenges faced in land management, including the process of recording, renewing, and monitoring land rights. We can overcome data deficiencies, lack of transparency, and cumbersome bureaucratic processes with better information systems. A responsive and effective information system allows relevant stakeholders to access necessary information and make timely decisions quickly(Aliev et al., 2020; Lin, 2023; Rodger, 2020).

In addition, developing better land rights information systems also provides an opportunity to increase transparency in land management. Providing open and equitable access to land rights information can strengthen public trust and minimize the risk of land conflicts. Clarity and transparency in land rights information systems also allow for better monitoring of unethical or illegal practices, providing a more substantial basis for law enforcement. Overall, developing a land rights information system is a strategic step in improving the efficiency and transparency of land management. By addressing existing challenges and improving the accessibility of information, we can create an environment that is more conducive to sustainable economic growth and community welfare.

Therefore, research in developing a land rights information system is essential to achieve these goals. The prototype method is a practical approach to developing land rights information systems because it reduces development time and costs and responds faster to changing user needs. In developing a land rights information system, a prototype is an early representation of the application designed to provide an overview of the desired features and functionality. One of the main advantages of the prototyping method is its ability to reduce the time required in the development cycle. By introducing early prototypes to users and relevant stakeholders, the development team can gather feedback directly and immediately, allowing for early identification of user needs and preferences.

Jurnal Info Sains : Informatika dan Sains
Volume 14 , Number 01, 2024, DOI 10.54209/infosains.v14i01
ESSN 2797-7889 (Online)
https://ejournal.seaninstitute.or.id/index.php/InfoSains

This minimizes the risk of developing a product that does not meet the end user's expectations, thus saving time and resources that would be used to make changes once the product is completed. In addition, the prototyping method can also reduce overall development costs. By focusing on developing a simple yet representative prototype, the development team can avoid wasting time and resources on features not necessary or desired by users. Thus, the use of prototyping methods can help organizations save development costs that can be allocated to the development of critical features or essential improvements(Gräßler et al., 2022; Gulfan & Vilela-Malabanan, 2021; Knitter et al., 2022; Roveda et al., 2022).

A faster response to changing user needs is also an essential advantage of the prototyping method. With its ability to quickly change existing prototypes, the development team can respond to changing user needs or market conditions with greater flexibility. This enables the development of a more adaptive land rights information system that responds to the rapidly changing environment. Overall, prototyping methods in developing land rights information systems offer several advantages, including reduced development time and costs and faster response to changing user needs. Organizations can achieve development goals more efficiently and effectively by utilizing this approach. While the prototype method offers several advantages in developing land title information systems, further research is needed to understand its potential and limitations in greater depth. Firstly, a more comprehensive review of how the prototype method can be adapted and effectively applied in developing complex land rights information systems is needed(Carvalho et al., 2022; Gulfan & Vilela-Malabanan, 2021; Hamidah et al., 2022; Utomo et al., 2020; Wahyuningrum et al., 2021).

This research can assist in identifying the best strategies for designing relevant and representative prototypes and understanding how such prototypes can be used to gather valuable feedback from end users. In addition, further research can also help in understanding the potential and limitations of the prototyping approach in addressing specific challenges associated with land management, such as legal uncertainty, administrative complexity, and diverse user needs. In addition, further research into the development of prototype-based land rights information systems can contribute to understanding and developing better information systems in the future. By understanding more deeply how prototyping methods can be used effectively in developing land rights information systems, we can identify opportunities to improve land management's efficiency, transparency, and sustainability. Ultimately, this research can provide a firmer foundation for developing a more innovative, responsive, and adaptive land rights information system to meet evolving needs. As such, further research into the development of a prototype-based land rights information system will provide valuable insights into the use of technology in the context of land management and help us towards a brighter and more sustainable future in land management.

Jurnal Info Sains : Informatika dan Sains
Volume 14 , Number 01, 2024, DOI 10.54209/infosains.v14i01
ESSN 2797-7889 (Online)
https://ejournal.seaninstitute.or.id/index.php/InfoSains

METHODS

The first stage was data collection, where the research team identified relevant data sources, designed data collection instruments, and collected information related to the existing state of the land rights information system. The second stage is application development using the prototype method, where the team designs an initial prototype based on user requirements, implements it using appropriate technology, and tests the prototype with end users to gather feedback. The final stage is user acceptance analysis, where the team analyses user feedback on the prototype's performance and usability and uses the analysis results to develop recommendations and strategies for further development. Through this series of steps, the project aims to develop an effective land rights information system that meets users' needs.

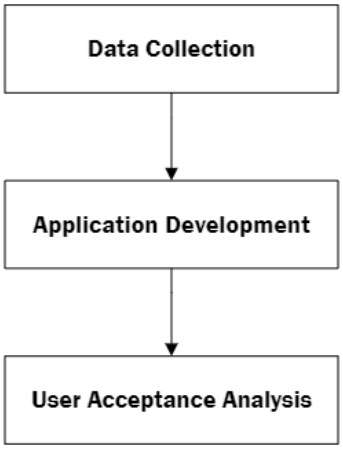

Figure 1. Research Stages

Data Collection

Firstly, in the data collection phase, the research team will identify relevant data sources, such as data on land ownership, land use, and relevant regulations. Next, they will design data collection instruments, such as questionnaires or interviews, according to the research needs. Through field surveys and examination of secondary data from relevant agencies, such as land agencies or the government, they will collect the necessary information to understand the condition of the existing land rights information system.

Application Development

Once the data is collected, the research team will use the prototype method to focus on the application development stage. They will identify user needs and requirements and design an initial prototype based on the analysis. The prototype will be implemented using appropriate technologies and platforms, such as web or mobile application development. Next, end users will test the prototype to gather feedback, which will be used to iterate and refine the application.

Jurnal Info Sains : Informatika dan Sains
Volume 14 , Number 01, 2024, DOI 10.54209/infosains.v14i01
ESSN 2797-7889 (Online)
https://ejournal.seaninstitute.or.id/index.php/InfoSains

User Acceptance Analysis

Finally, the research team will conduct a user acceptance analysis of the developed prototype land rights information system. They will analyze user feedback regarding the application's performance, functionality, and usability. User satisfaction and acceptance levels will be evaluated based on predefined criteria like usability, security, and reliability. The analysis results will be used to develop recommendations and strategies for further development to ensure the development of a practical land rights information system application that meets user needs.

RESULTS AND DISCUSSION

Identifying User Needs and Requirements

The outcome of the user needs and requirements identification phase is a deep understanding of the needs and requirements of users for the land rights information system application. The research team has successfully identified user needs through interviews, surveys, and analysis of related stakeholder requirements. The result is a clear and detailed list of features, functions, and user interfaces, which will serve as the basis for the next stage in application development. By understanding user needs and requirements, the team can ensure that the developed application will effectively meet user expectations and provide significant added value in land rights management.

Table 3. Result of User Requirements Identification

User Requirements	Description
Application Features	Desired features by users, such as property search, ownership status updates, and transaction notifications.
Application Functions	Expected functions of the application, such as land data management, tax payment, and ownership reporting.
User Interface	Intuitive and user-friendly interface design, including clear layouts, meaningful icons, and smooth navigation.
Data Availability	Need for easy and fast access to data related to land ownership, land use, and land regulations.
System Integration	Requirements for integration with other systems, such as the national land database or local government financial systems.
Data Security	Protection of personal data and transaction security within the application, including data encryption and strong user authentication.

Table 3 deeply explains users' expectations and needs related to the land rights information system application. Desired features include property search, ownership status updates, and transaction notifications, while functions such as land data management, tax payment, and ownership reporting highlight specific functional needs. The request for an intuitive and user-friendly interface emphasizes the importance of a good user experience.

Jurnal Info Sains : Informatika dan Sains
Volume 14 , Number 01, 2024, DOI 10.54209/infosains.v14i01
ESSN 2797-7889 (Online)
https://ejournal.seaninstitute.or.id/index.php/InfoSains

At the same time, data security is a top priority, along with protecting personal data and transactions. Integration with other systems is also considered to ensure accurate and consistent data availability. By understanding and meeting these needs and requirements, the development of the land rights information system application can successfully meet user expectations and provide significant added value in land rights management.

Initial Prototype Design

The outcome of the initial prototype design stage is the preliminary design of the land rights information system application prototype. The development team has successfully designed an intuitive user interface layout, a logical workflow, and critical features that align with the previously identified user needs. This prototype design clearly represents how the application will function and how users will interact with the system. Thus, this prototype serves as the basis for further implementation in application development, enabling the team to proceed to the implementation stage with a strong understanding of what needs to be realized in the application.

Prototype Implementation

The outcome of the prototype implementation stage is a functional prototype of the land rights information system application. The development team has successfully implemented the previously designed prototype using appropriate technologies and platforms, such as web or mobile application development. This prototype has been built with carefully identified and designed vital features, allowing the application to be accessed and tested by end-users. Therefore, the result of this stage is a prototype that can provide a realistic glimpse of how the application will operate in a real-world environment, enabling the team to proceed to the testing stage to gather feedback and conduct further iterations if necessary.

Prototype Testing

The prototype testing stage's outcome is the feedback from end-users regarding the land rights information system application prototype. Testing aims to identify performance, functionality, and usability issues in the application that need to be addressed or improved before proceeding to the next stage of development. Feedback from end-users will provide valuable insights to the development team regarding areas requiring further attention or enhancement in the prototype. Thus, the result of this stage will serve as the foundation for further iterations and improvements in application development to ensure that the final product can better meet user expectations and needs.

Prototype Iteration

The outcome of the prototype iteration stage is a refined and improved prototype based on feedback received from testing by end-users. These iterations aim to ensure that the prototype can better meet user needs and expectations and enhance the overall user experience. Upon receiving feedback, the development team makes necessary changes to the prototype, including improvements to the application's performance, functionality, and usability. By engaging in iterations, the prototype can continue to be refined and tailored to user needs, thus ensuring that the final product will be an optimal solution to address challenges in land rights management.

Jurnal Info Sains : Informatika dan Sains
Volume 14 , Number 01, 2024, DOI 10.54209/infosains.v14i01
ESSN 2797-7889 (Online)
https://ejournal.seaninstitute.or.id/index.php/InfoSains

User Acceptance Analysis

The outcome of the User Acceptance Analysis is the evaluation of user acceptance towards the developed land rights information system prototype. The research team has assessed user feedback regarding the application's performance, functionality, and usability. Evaluation is based on predefined usability, security, and reliability criteria. The results of this analysis provide a deep understanding of the satisfaction and acceptance of users towards the prototype. Recommendations and further development strategies will be formulated based on these analysis results to ensure the effective development of the land rights information system application that aligns with user needs.

CONCLUSION

Developing a land rights information system is crucial in efficiently and effectively managing land in the modern era, where information is a vital asset. Through prototyping methods, land rights information system applications can be developed more efficiently, allowing for direct feedback collection from end-users to improve and refine the application. The results of user acceptance analysis indicate the importance of the application's performance, functionality, and usability in meeting user expectations. By understanding and fulfilling user needs effectively, land rights information system application development can provide significant added value in land management, ensuring timely and effective decision-making and promoting sustainable and inclusive economic growth. Therefore, this research provides valuable insights into the use of technology in land management and lays the groundwork for developing more innovative, responsive, and adaptive land rights information systems in the future.

REFERENCE

Abanda, F. H., Chia, E. L., Enongene, K. E., Manjia, M. B., Fobissie, K., Pettang, U. J. M. N., & Pettang, C. (2022). A systematic review of the application of multi-criteria decision-making in evaluating Nationally Determined Contribution projects. *Decision Analytics Journal*, *5*(November), 100140. https://doi.org/10.1016/j.dajour.2022.100140

Aliev, I., Gazul, S., & Bobova, A. (2020). The analysis of changes in the payroll of information system support specialists during the Devops methodology implementing. *IOP Conference Series: Materials Science and Engineering*, *862*(4). https://doi.org/10.1088/1757-899X/862/4/042039

Al-Rahmi, W. M., Yahaya, N., Aldraiweesh, A. A., Alamri, M. M., Aljarboa, N. A., Alturki, U., & Aljeraiwi, A. A. (2019). Integrating Technology Acceptance Model with Innovation Diffusion Theory: An Empirical Investigation on Students' Intention to Use E-Learning Systems. *IEEE Access*, *7*, 26797–26809. https://doi.org/10.1109/ACCESS.2019.2899368

Bawa, D. (2024). Activity Theory Approach and Geographic Information Systems Affordance for Effective Land Management and Administration Actualization. *Scientific African*, *23*. https://doi.org/10.1016/j.sciaf.2023.e01970

Carvalho, J., Ipatov, A., Rodriguez-Lorenzo, L., Garrido-Maestu, A., Azinheiro, S., Espiña, B., Barros-Velázquez, J., & Prado, M. (2022). Towards on-site detection of gluten-containing cereals with a portable and miniaturized prototype combining isothermal DNA amplification and naked eye detection. *Microchemical Journal*, *183*(November). https://doi.org/10.1016/j.microc.2022.108115

Gräßler, I., Roesmann, D., Hillebrand, S., & Pottebaum, J. (2022). Information Model for Hybrid Prototyping in Design Reviews of Assembly Stations. *Procedia CIRP*, *112*(March), 489–494. https://doi.org/10.1016/j.procir.2022.09.054

Gulfan, C. N. A. M., & Vilela-Malabanan, C. M. (2021). Evaluating the usability and user experience of phytoplankton cell counter prototype. *Procedia Computer Science*, *197*(2021), 309–316. https://doi.org/10.1016/j.procs.2021.12.145

Hamidah, M., Mohd Hasmadi, I., Chua, L. S. L., Yong, W. S. Y., Lau, K. H., Faridah-Hanum, I., & Pakhriazad, H. Z. (2022). Development of a protocol for Malaysian Important Plant Areas criterion weights using Multi-criteria Decision Making - Analytical Hierarchy Process (MCDM-AHP). *Global Ecology and Conservation*, *34*(January), e02033. https://doi.org/10.1016/j.gecco.2022.e02033

He, Z., Chen, L., & Zhu, L. (2023). A study of Inter-Technology Information Management (ITIM) system for industry-education integration. *Heliyon*, *9*(9). https://doi.org/10.1016/j.heliyon.2023.e19928

Knitter, R., Blazejewski, A., & Królikowski, T. (2022). Modeling and simulation of Vibro-isolator Rapid Prototyping using additive manufacturing. *Procedia Computer Science*, *207*, 1293–1302. https://doi.org/10.1016/j.procs.2022.09.185

Lee, E. W. J., Lim, V. S. H., & Ng, C. J. K. (2022). Understanding public perceptions and intentions to adopt traditional versus emerging investment platforms: The effect of message framing and regulatory focus theory on the technology acceptance model. *Telematics and Informatics Reports*, *8*, 100024. https://doi.org/10.1016/j.teler.2022.100024

Lin, J. (2023). Measuring and analyzing the information entropy value of key Audit matters (KAMs) disclosure at the system and reporting scale. *Heliyon*, e23255. https://doi.org/10.1016/j.heliyon.2023.e23255

Madsen, M. D., & Paasch, J. M. (2023). 3D real property in vertical mixed-use developments. A comparative analysis of common property and management aspects in selected jurisdictions – The case of British Columbia, Denmark and Sweden. *Land Use Policy*, *134*. https://doi.org/10.1016/j.landusepol.2023.106905

Mationg, M. L. S., Williams, G. M., Tallo, V. L., Olveda, R. M., Aung, E., Alday, P., Reñosa, M. D., Daga, C. M., Landicho, J., Demonteverde, M. P., Santos, E. D., Bravo, T. A., Bieri, F. A., Bedford, A., Li, Y., Clements, A. C. A., Steinmann, P., Halton, K., Stewart, D. E., … Gray, D. J. (2022). "The Magic Glasses Philippines": a cluster randomised controlled trial of a health education package for the prevention of intestinal worm infections in schoolchildren. *The Lancet Regional Health - Western Pacific*, *18*. https://doi.org/10.1016/j.lanwpc.2021.100312

Omitaomu, O. A., Klasky, H. B., Olama, M., Ozmen, O., Pullum, L., Malviya Thakur, A., Kuruganti, T., Scott, J. M., Laurio, A., Drews, F., Sauer, B. C., Ward, M., & Nebeker, J. R. (2021). A new methodological framework for hazard detection models in health information technology systems. *Journal of Biomedical Informatics*, *124*. https://doi.org/10.1016/j.jbi.2021.103937

Pradeep, R. M. M., & Wijesekera, N. T. S. (2020). Incorporating stakeholder concerns in Land Information Systems for urban flood management. *Array*, *8*, 100037. https://doi.org/10.1016/j.array.2020.100037

Rakhmonov, K., Abdurakhimova, M., Uspankulov, B., & Tojiev, Z. (2022). Experience and analysis of formation of land information system. *Transportation Research Procedia*, *63*, 203–213. https://doi.org/10.1016/j.trpro.2022.06.006

Rodger, J. A. (2020). An expert system gap analysis and empirical triangulation of individual differences , interventions , and information technology applications in alertness of railroad workers. *Expert Systems With Applications*, *144*, 113081. https://doi.org/10.1016/j.eswa.2019.113081

Roveda, L., Pesenti, M., Rossi, M., Rodriguez, M. C., Pedrocchi, A., Braghin, F., & Gandolla, M. (2022). User-Centered Back-Support Exoskeleton: Design and Prototyping. *Procedia CIRP*, *107*(March), 522–527. https://doi.org/10.1016/j.procir.2022.05.019

Saing, Z., Djainal, H., & Deni, S. (2021). Land use balance determination using satellite imagery and geographic information system: case study in South Sulawesi Province, Indonesia. *Geodesy and Geodynamics*, *12*(2), 133–147. https://doi.org/10.1016/j.geog.2020.11.006

Tóth, K., & Kučas, A. (2018). Conformance testing of geographic information. A case study on the Land Parcel Identification System. *Computers, Environment and Urban Systems*, *70*, 71–83. https://doi.org/10.1016/j.compenvurbsys.2018.02.003

Utomo, F. S., Maulana Baihaqi, W., Mutiara, D. A., Hermanto, N., & Widianto, R. A. (2020). People Under Surveillance Tracker Prototype Development with Bluetooth Low Energy to Suppress the Covid-19 Spread. *2020 2nd International Conference on Cybernetics and Intelligent System (ICORIS)*, 1–6. https://doi.org/10.1109/ICORIS50180.2020.9320763

Wahyuningrum, T., Fitriana, G. F., Wardhana, A. C., Sidiq, M. A., & Wahyuningsih, D. (2021). Developing Suicide Risk Idea Identification for Teenager (SERIINA) Mobile Apps Prototype using Extended Rapid Application Development. *2021 9th International Conference on Information and Communication Technology (ICoICT)*, 92–97. https://doi.org/10.1109/ICoICT52021.2021.9527508

Wang, K., Li, B., Tian, T., Zakuan, N., & Rani, P. (2023). Evaluate the drivers for digital transformation in higher education institutions in the era of industry 4.0 based on decision-making method. *Journal of Innovation and Knowledge*, *8*(3). https://doi.org/10.1016/j.jik.2023.100364

Zulfiandri, Yasmin, F. D., & Kusumaningtyas, R. H. (2022). Implementation of Critical Path Method and What If Analysis in Project Management Information System. *2022 10th*

International Conference on Cyber and IT Service Management (CITSM), 1–6. https://doi.org/10.1109/CITSM56380.2022.9935912