Spatial Information System for Housing Data Collection at The Department Of Public Housing and Settlement Areas

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Abstract

The Bengkulu City Public Housing and Settlement Agency is a government agency tasked with assisting the mayor in administering government affairs related to public housing, settlement areas, and land matters under regional jurisdiction. In addition, the Department of Public Housing and Settlement Areas also has an obligation to serve the community and always strives to provide the best service information to the community, especially in Bengkulu City. This is particularly true in terms of housing data collection processed by the Department of Public Housing and Settlement Areas in Bengkulu City. The housing data collection system used for office purposes in terms of monthly or annual reports and archives at the Public Housing and Settlement Agency is not yet computerized. However, to date, these main activities are still carried out manually. The storage of this data is also still piled up in cabinets, which requires a long time to create reports and search for the data itself. This need can be facilitated by the existence of computational products and algorithms in the Informatics program that synergize with Geophysics in addressing data collection and landscape analysis issues related to housing and settlements. The implementation of this integrated system improves the management process of plot pattern data, basic infrastructure, uninhabitable house, and developer. This research showed that the total calculation, the average System Usability Testing score obtained was 62.5, which falls under the good category. This indicates that the developed system meets usability standards and is well accepted by its users.

Keywords : Bengkulu, Data Integration, Housing and Settlements, Information Systems, Spatial Data; Alphabetic Ordered.

1. INTRODUCTION

The Bengkulu City Public Housing and Settlement Area Agency (Perkim) is a government agency tasked with assisting the Mayor of Bengkulu in administering government affairs in the areas of public housing, settlement areas, and land. Perkim plays a vital role in providing quality public services, particularly in the areas of public housing, settlement areas, and land data collection. However, data management at this agency is still carried out manually, causing various problems in terms of efficient data storage, processing, and presentation for the benefit of the government and the community[1], [2]. The development of information technology has changed the paradigm of administrative management in various sectors, both government and private. Public information disclosure encourages agencies to undergo digital transformation to contribute maximally to public services [3], [4]. One strategic step that can be taken is the development of information systems capable of presenting data and information in an open, easily accessible, and user-friendly manner for people from various educational backgrounds [5]. Several studies have highlighted that the implementation of map-based (spatial) information systems plays a significant role in enhancing the effectiveness of asset management and housing development planning. Through spatial mapping and integration with business intelligence technologies, Geographic

Information Systems (GIS) enable more accurate inventory and classification of land and building assets based on actual field conditions. Moreover, GIS integration supports decision-making in facility and infrastructure management by providing real-time and spatially contextual data [6], [7]. Furthermore, recent works highlight the crucial role of systematic asset inventory and spatial monitoring in ensuring that public housing development aligns with established urban planning standards. For instance, [8] and [9] found that structured asset inventory and data safeguarding have a significant impact on the optimization of regional property management. In a similar context, a web-based GIS housing information system was developed in West Papua, enabling the spatial mapping of residential areas and facilitating transparent permit management [10]. These findings reinforce that integrating GIS-based systems is essential to synchronize field conditions with official housing and settlement data, supporting data-driven decision-making in local government policy formulation. Nonetheless, the Bengkulu City Perkim continues to encounter several challenges in the licensing process and the issue of plot pattern suggestions, including erroneous data regarding housing areas, infrastructure, facilities, and utilities (PSU), as well as data redundancy that leads to information ambiguity.

Government assets that have not been fully digitally recorded also have the potential to cause long-term losses due to weak supervision of changes in ownership status from developers to local governments. The protracted and multi-tiered bureaucratic licensing procedure impedes the efficiency of public services.Computational and geographical analysis methodologies can be employed to resolve these difficulties, facilitating housing data management and decision-making within the Housing and Settlement Agency (PERKIM). A GIS-based system functions as a mechanism for managing spatial data and delivering more thorough analytical outcomes. This study advocates for the creation of a GIS-based information system via the prototyping method, engaging end-users directly to guarantee that the system meets operational requirements in the field. Creating an integrated spatial information system that may provide assistance to the Bengkulu City Housing and Settlement Agency (PERKIM) in the management of housing lot patterns, public facilities (PSU), developer data, and the issue of permit recommendations is the primary purpose of this project. It is anticipated that this system will hasten the processes involved in providing public services and will provide assistance in the deployment of the Electronic-Based Government System (SPBE). [11], [12] within the Bengkulu City Government.

2. METHOD

This research adopted a descriptive and developmental approach to design and implement a web-based housing data information system for the Bengkulu City Housing and Settlement Agency (Dinas Perumahan dan Kawasan Permukiman—PERKIM). The study employed a mixed-method strategy, integrating both qualitative and quantitative procedures to ensure comprehensive data triangulation and system validation. Qualitative techniques, including semi-structured interviews and direct field observations, were utilized to capture contextual insights into existing workflows, data management challenges, and user requirements within the agency. Meanwhile, quantitative evaluation was applied to measure system performance and usability metrics after implementation. In the development phase, a hybrid WebGIS methodology—combining elements of prototyping, iterative evaluation, and continuous user feedback—was implemented to achieve an optimal balance between usability, functional completeness, and system robustness. This adaptive and user-centered design process ensured that the resulting system not only met the agency's operational needs but also supported sustainable data governance and spatial decision-making in urban housing management. [13], [14]

2.1. Data Collection Method

This study employed a qualitative–descriptive research approach, integrating multiple data collection techniques to ensure triangulation and validity of the findings. Data were gathered through

three primary methods. First, semi-structured interviews were conducted with Mr. Ipo Every Ronald, S.T., Head of the Housing and Settlement Office (Dinas Perumahan dan Kawasan Permukiman, PERKIM) of Bengkulu City, to obtain in-depth information regarding the existing workflows of housing data management, archiving mechanisms, and the challenges encountered in compiling technical reports. Second, direct field observations were carried out at the PERKIM office to collect primary data related to land parceling (polakavling), public facilities (Prasarana, Sarana, dan Utilitas Umum or PSU), uninhabitable housing (Rumah Tidak Layak Huni or RTLH), and developer documentation. Third, a comprehensive literature review was conducted by analyzing relevant academic journals, institutional reports, and government regulations concerning information systems, spatial data analysis, and housing development policy. The integration of these three methods provided a robust empirical foundation for analyzing the existing conditions and proposing an improved digital information system framework for housing data management in Bengkulu City.
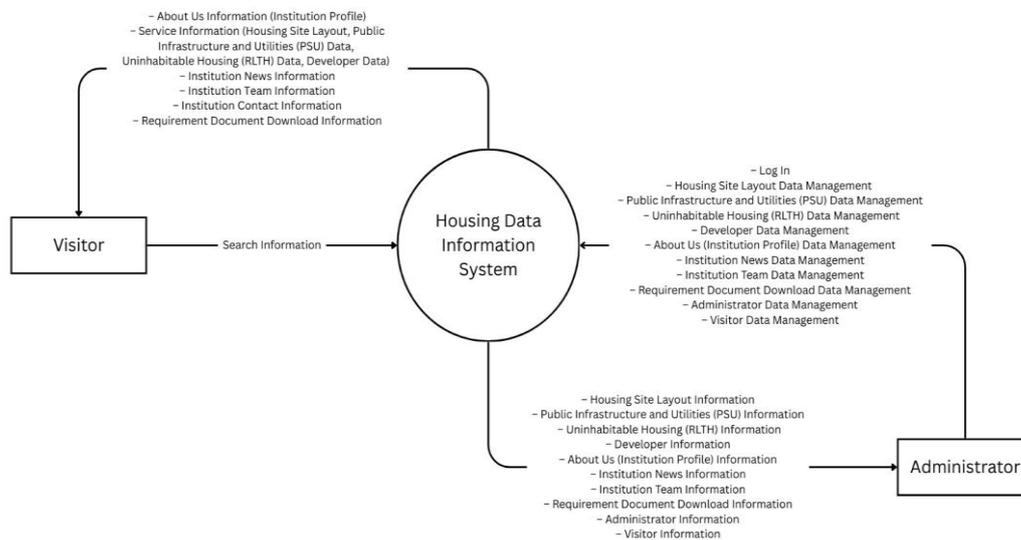

Figure 1. Context Diagram of the Housing Data Information System

2.2. Problem Analysis Method

The system analysis used the PIECES framework Performance, Information, Economy, Control, Efficiency, and Service. This analysis aimed to evaluate the feasibility of developing a new computerized system by identifying limitations of the existing manual process, including slow data retrieval, inefficient report generation, and lack of spatial integration. The PIECES analysis results provided a baseline for determining the system's functional and analytical requirements.

2.3. System Design Method

The system was designed using Data Flow Diagram (DFD) and developed following the Waterfall model, consisting of five stages: analysis, design, coding, testing, and maintenance [15], [16]. At the design stage, process flow modeling was carried out to visualize data movement between entities. The context diagram in Figure 1 represents the top-level process of the housing data information system, showing how administrators and visitors interact with the database and information modules. The database structure was organized using relational modeling to ensure consistency and efficient data retrieval, connecting entities such as developer, PSU, RTLH, and polakavling. The implementation used PHP and MySQL, supported by the CodeIgniter framework for modular and scalable web development.

2.4. System Testing Method

System validation[17], [18] employed the Black Box testing approach to examine system functionality based on user interactions. This method tested whether the interface, data input, and reporting modules operated according to the design specifications. The goal was to ensure that all components performed accurately and met user requirements without logical or structural errors. The testing used in this research employs the black box and white box testing for the implementation of the system. White Box Testing is testing based on detailed procedures and the logical flow of program code. In white box testing, the tester examines the program's source code and finds bugs in the code being tested. Essentially, white box testing involves examining the program code in detail. The tester's activities including the observing the program code and creating test cases to find errors/bugs/errors in the code written by the programmer. This application is tested using black box testing techniques. At this stage, researchers will test the functionality of the application's features.

2.5. Spatial System and Analytical Method

A Geographic Information System (GIS) was integrated into the information system to manage, analyze, and visualize spatially referenced data related to housing and settlement areas [19], [20]. The spatial module enhances the analytical capability of the system by connecting spatial and non-spatial attributes, allowing PERKIM to interpret housing data geographically. The GIS component performs four key functions:

1. Spatial Data Input: Collecting and digitizing coordinate-based data for housing lots, PSU, and RTLH.
2. Spatial Database Management: Storing and linking spatial data with attribute tables (e.g., developer name, housing type, permit status).
3. Spatial Analysis: Conducting analytical operations such as overlay, proximity, and clustering to identify development patterns, service coverage, and priority zones for housing improvement.
4. Spatial Output: Generating map-based visualization and analytical reports that provide insights into the spatial distribution of housing conditions.

This integration of computational and spatial methods transforms the housing information system into an analytical platform capable of supporting data-driven decision-making. Through spatial analysis, PERKIM can assess housing density, identify unfit housing clusters, and monitor urban development in a more systematic and visual manner.

3. RESULT

Figure 2. Main interface of the visitor page showing (a) dashboard, (b) document requirements, (c) service page, and (d) activities page.

The web-based Spatial Information System (SIS) was successfully implemented for the Bengkulu City Department of Public Housing and Settlement Areas (Perkim). The SIS integrates administrative and spatial datasets parcel (Polakavling), Public Service Utilities (PSU), unfit-for-living houses (RTLH), and developer submissions into a single interactive platform. The geospatial engine automatically computes parcel areas, validates topology, and links each attribute record to its corresponding geometry, reducing redundancy and human error. The visitor interface serves as the public-facing section of the system. It provides information on available services, document requirements, and organizational activities. The dashboard displays summaries and quick links, allowing users to access housing information easily. This design promotes transparency and enhances public engagement with Perkim services.
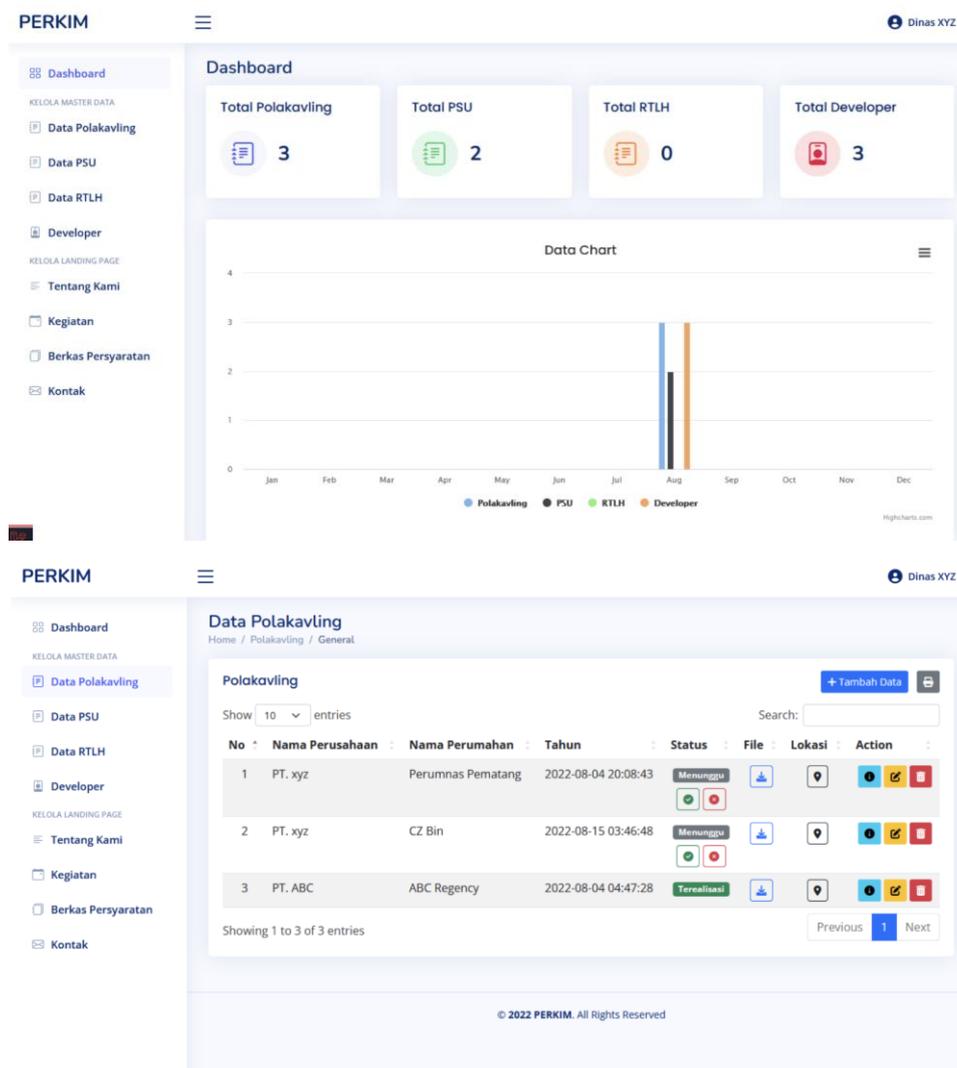

Figure 3. Main interface of the developer page showing (a) registration form, (b) developer dashboard, (c) proposal submission page, and (d) profile page.

The developer interface enables users to register, submit proposals, upload documents, and monitor submission progress. This module digitizes developer-related workflows, reducing manual administrative steps and ensuring faster, traceable submissions. The dashboard provides real-time updates on project status and feedback from administrators.
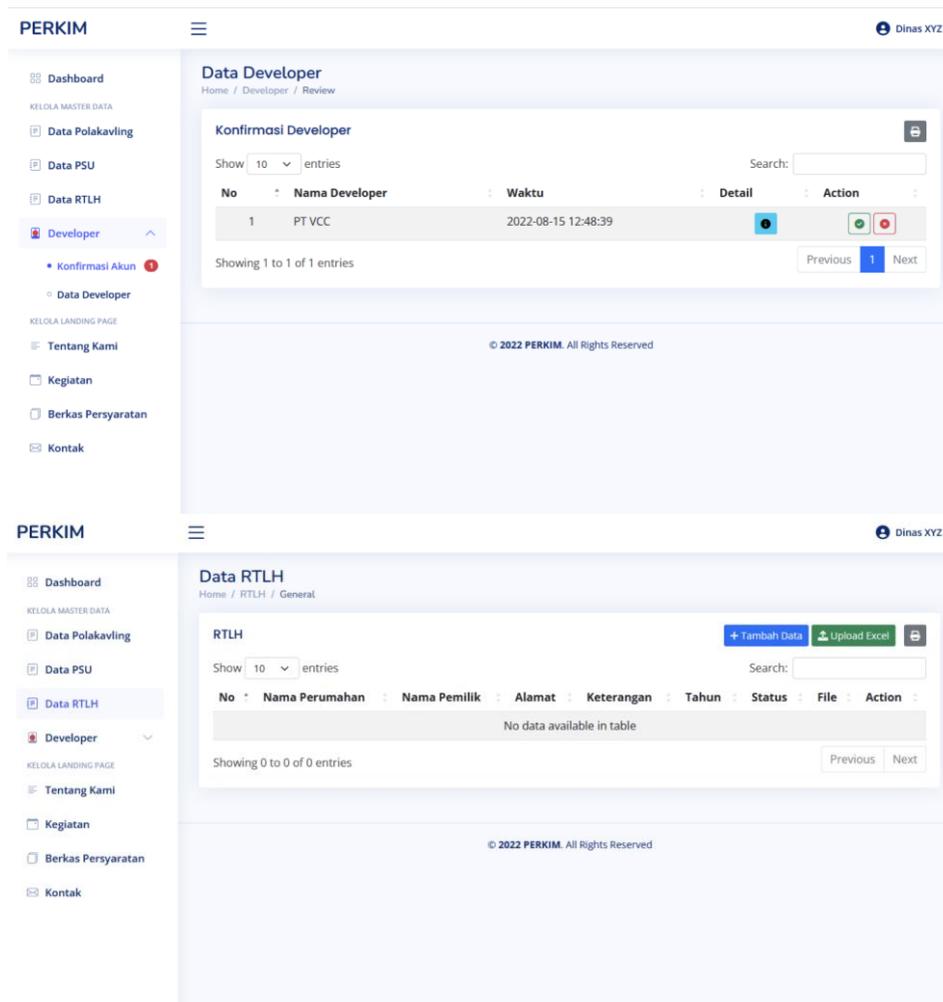
Figure 4. Main interface of the admin page showing (a) admin dashboard, (b) Polakavling management, (c) PSU module, and (d) RTLH data management page

The administrator interface serves as the system's control center. Administrators manage parcel datasets, verify PSU data, and update RTLH records directly on the map. The dashboard summarizes key indicators, while GIS tools support parcel editing, overlay analysis, and topology validation. This centralization improves coordination and efficiency in housing data management.

Performance testing demonstrated that the SIS efficiently executed spatial queries and overlay operations, even when processing hundreds of parcel datasets simultaneously. The geocoding feature enabled administrators to quickly locate PSU and parcel positions, while the thematic mapping module provided rapid visualization of housing and infrastructure distribution. The transition from manual data handling to dynamic GIS-based dashboards improved both the quality and timeliness of decision-making.

System Usability Testing was conducted using the *System Usability Scale (SUS)* method, involving 10 respondents consisting of administrative staff and registered developers. Each respondent performed standard operations such as data entry, spatial visualization, and report generation. The SUS method assigns scores ranging from 0–4 for each statement. Odd-numbered (positive) statements are calculated using the formula *(xi –1)*,while even-numbered (negative) statements are calculated using *(5 – xi)*. The total score is multiplied by 2.5 to produce a final value ranging from 0–100. A SUS score between 70–100 is categorized as *Good*, 50–70 as *Average*, and below 50 as *Poor*. The weighting of responses in the questionnaire can be seen in Table 1.

Table 1. Questionnaire Response Weight

Code	Description	Score
SS	Strongly Agree	5
ST	Agree	4
RG	Neutral	3
TS	Disagree	2
STS	Strongly Disagree	1

Based on the total calculation, the average SUS score obtained was 82.5, which falls under the *Good* category. This indicates that the developed system meets usability standards and is well accepted by its users. The SIS successfully transformed Perkim's workflow by centralizing data management and improving verification efficiency. Spatial integration enabled the immediate detection of inconsistencies such as overlapping parcels in restricted zones or unregistered PSU boundaries. This significantly reduced field verification time and supported compliance with Indonesia's e-government (*SPBE*) framework. Spatial visualization further provided insights into the distribution of housing and infrastructure equity among districts, offering valuable input for policy and development planning.

Compared to traditional non-spatial systems relying on static tables, the SIS introduces deeper analytical capabilities through GIS functions such as overlay, buffering, and topology analysis. This integration bridges informatics and geophysical perspectives, correlating land-surface characteristics (elevation, slope, and soil conditions) with settlement suitability. Such an approach enhances environmental resilience and promotes data-driven housing governance. Although the current implementation focuses primarily on administrative and housing data management, the system's architecture has been designed to support spatial and geophysical analysis in the future. By incorporating additional GIS layers such as slope, elevation, and flood-risk maps the system could be used to assess land suitability, identify environmentally sensitive zones, and perform geophysical evaluations of residential development areas. These capabilities would assist Perkim in implementing sustainable, risk-informed housing and settlement planning. Overall, the implementation of the SIS has significantly improved data accuracy, workflow efficiency, and decision transparency. The combination of spatial analysis and administrative integration provides a solid foundation for sustainable housing management and intelligent urban planning in Bengkulu City.

4. DISCUSSIONS

The execution of the web-based housing data information system at the department of housing and settlement areas indicates that the system has effectively fulfilled its key objectives. The system effectively facilitates the handling of polakavling data, psu (public facilities and infrastructure) data, rtlh (uninhabitable houses) data, and developer data, while also allowing for public information distribution. The employment of php, mysql, and the codeigniter framework offers a structured mvc design that facilitates modular development, data integrity, and maintainability. These outcomes correspond with the primary aim of e-government implementation[21], [22], including enhancing transparency, accessibility, and service efficiency. The system functions as both an internal data management instrument and a communication conduit between the agency and the public. Nonetheless, functional success does not inherently equate to an excellent user experience. This facet is evident in the usability assessment outcomes. The Web-Based[23], [24], [25] Housing Data Information System has effectively achieved its functional goals and enhanced data management and service delivery inside the agency. The usability evaluation score of 62.5 signifies that the system remains in a developing maturity phase, especially for user experience design. The results indicate that although the system's technical

foundation is adequately strong, the subsequent development phase must focus on enhancing usability and fortifying security to guarantee long-term viability, wider public acceptance, and elevated service quality standards. In conclusion, the system signifies a substantial advancement in the digital transformation of the Department of Housing and Settlement Areas; nonetheless, ongoing enhancement informed by user feedback is crucial for attaining optimal performance and acceptance.

5. CONCLUSSION

Based on the results and implementation of the Web Based Housing Data Information System (Case Study: Bengkulu City Housing and Settlement Agency), it can be concluded that the developed system effectively supports the management of housing lot (polakavling) data, public facilities (PSU), unfit housing (RTLH), and developer information. The system also provides accessible housing data to the public, improving transparency and information dissemination. The system was developed using the PHP programming language and MySQL database with the CodeIgniter framework. It functions as an information medium that facilitates two-way communication between the agency and the public. Users can input, update, and delete housing data efficiently, thus enhancing administrative services for stakeholders. To further improve system performance, regular maintenance and continuous development are recommended. Future improvements should focus on expanding information coverage, adding features that simplify public access, and strengthening system security, which has not yet been implemented in the current version. A more secure and user-oriented system will help optimize public services and support the digital transformation of housing data management in Bengkulu City. Future studies may focus on extending this system with higher-resolution geophysical datasets such as Digital Elevation Models (DEM), slope, and flood susceptibility layers to enable risk-aware housing assessments. Further development could also involve automation of parcel extraction using remote sensing or photogrammetric data, aswell as implementation of advanced spatial analytics including suitability and network analysis. Strengthening data security, multi-user audit trails, and developing dashboards for long-term monitoring of urban growth and housing dynamics are also recommended. By advancing these directions, future research can build upon the foundation established in this study creating a more comprehensive, intelligent, and sustainable spatial information system for urban housing governance in Indonesia.

CONFLICT OF INTEREST

The authors declares that there is no conflict of interest between the authors or with research object in this paper.

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REFERENCES

[1] W. A. Winarno and H. S. Putra, "Technology acceptance model of the Indonesian government financial reporting information systems," *International Journal of Public Sector Performance Management*, vol. 6, no. 1, 2020, doi: 10.1504/IJPSPM.2020.105089.

[2] M. T. Chan and L. F. Kwok, "Integrating security design into the software development process for e-commerce systems," *Information Management & Computer Security*, 2001.

[3] F. Darari, "Open Government Data as a Digital Infrastructure for Public Information Services: A Case Study of the City of Denpasar," in *2022 International Conference on Electrical Engineering and Informatics (ICELTICs)*, IEEE, Sep. 2022, pp. 136–142. doi: 10.1109/ICELTICs56128.2022.9932041.

[4] P. Ciancarini, R. Giancarlo, and G. Grimaudo, "Digital Transformation in the Public Administrations: a Guided Tour For Computer Scientists," May 2023.

[5] N. F. Ernungtyas, R. F. Boer, and S. S. Qadrifa, "The government website as user's information source: A model of user satisfaction, information, and system quality," *Informasi*, vol. 53, no. 2, pp. 197–214, Mar. 2024, doi: 10.21831/informasi.v53i2.60579.

[6] E. M. H. Ismaeil, "Asset Information Model Management-Based GIS/BIM Integration in Facility Management Contract," *Sustainability*, vol. 16, no. 6, p. 2495, Mar. 2024, doi: 10.3390/su16062495.

[7] P. Gasbarri, D. Accardo, E. Cacciaguerra, S. Meschini, and L. C. Tagliabue, "Supporting Asset Management with GIS and Business Intelligence Technologies: The Case Study of the University of Turin," *ISPRS Int. J. Geoinf.*, vol. 13, no. 3, p. 65, Feb. 2024, doi: 10.3390/ijgi13030065.

[8] R. L. Karunia and M. M. Ibrahim, "Pelaksanaan Inventarisasi Aset Tetap Di Kementerian Koordinator Bidang Pembangunan Manusia Dan Kebudayaan," *Journal of Business Administration Economic & Entrepreneurship*, vol. 3, no. 2, 2021.

[9] A. Wicaksana, Harmono, and S. Yuniarti, "Pengaruh Inventarisasi Aset, Penggunaan Aset, Pengamanan dan Pemeliharaan Aset Terhadap Optimalisasi Aset TetapTanah Melalui Pemanfaatan Aset Pada Pemerintah Kabupaten Malang," *PUBLISIA(Jurnal Ilmu Administrasi Publik)*, vol. 6, 2021.

[10] A. S. Saban, I. F. Marini, and J. Aninam, "Web-Based GIS Housing Marketing Information System in West Papua," *International Journal Software Engineering and Computer Science (IJSECS)*, vol. 4, no. 3, pp. 871–881, Nov. 2024, doi: 10.35870/ijsecs.v4i3.3195.

[11] M. D. Saputra and Z. Arham, "Sistem Informasi Spasial Berbasis Web pada Sebaran Sarana Perumahan dan Permukiman (Studi kasus)," *Applied Information System and Management (AISM)*, vol. 2, no. 1, 2021, doi: 10.15408/aism.v2i1.20196.

[12] H. Zhou, "An empirical test of the information processing theory," *International Journal of Information Systems and Supply Chain Management*, vol. 4, no. 1, 2011, doi: 10.4018/jisscm.2011010103.

[13] V. Lamas, D. de Castro, A. Cortiñas, and M. R. Luaces, "GIS-Publisher: Simplifying web-based GIS application development for enhanced data dissemination," *SoftwareX*, vol. 28, p. 101942, Dec. 2024, doi: 10.1016/j.softx.2024.101942.

[14] G. Randazzo *et al.*, "WebGIS Implementation for Dynamic Mapping and Visualization of Coastal Geospatial Data: A Case Study of BESS Project," *Applied Sciences*, vol. 11, no. 17, p. 8233, Sep. 2021, doi: 10.3390/app11178233.

[15] B. B. Susetyo, E. Purwaningsih, W. Sutriani, E. Purnamasari, and M. I. Bagus, "Utilization of WebGIS for Visualization of the Distribution of Tourist Destination Religious Objects in Nagari Batuhampar of Lima Puluh Kota Regency, West Sumatera

Province," *JOIV : International Journal on Informatics Visualization*, vol. 8, no. 2, p. 854, May 2024, doi: 10.62527/joiv.8.2.2281.

[16] E. N. Tamu and P. A. R. Leo Lede, "Implementation of the Waterfall Method in Development of Geographic Information Systems Primary School (Case Study: Kambera District)," *Journal of Artificial Intelligence and Engineering Applications (JAIEA)*, vol. 4, no. 3, pp. 2336–2343, Jun. 2025, doi: 10.59934/jaiea.v4i3.1160.

[17] J. F. Andry and A. K. Setiawan, "IT GOVERNANCE EVALUATION USING COBIT 5 FRAMEWORK ON THE NATIONAL LIBRARY," *Jurnal Sistem Informasi*, vol. 15, no. 1, 2019, doi: 10.21609/jsi.v15i1.790.

[18] J. Devos and K. Van De Ginste, "Towards a theoretical foundation of IT governance: the COBIT 5 case," *ELECTRONIC JOURNAL OF INFORMATION SYSTEM EVALUATION*, vol. 18, no. 2, 2015.

[19] W. Li, P. Li, Z. Feng, and C. Xiao, "GIS-Based Modeling of Human Settlement Suitability for the Belt and Road Regions," *Int. J. Environ. Res. Public Health*, vol. 19, no. 10, p. 6044, May 2022, doi: 10.3390/ijerph19106044.

[20] T. H. D. Dao, K. A. Dao, and G. Barboza-Salerno, "Uncovering Spatial Patterns of Residential Settlements, Segregation, and Vulnerability of Urban Seniors Using Geospatial Analytics and Modeling Techniques," *Urban Science*, vol. 8, no. 3, p. 81, Jul. 2024, doi: 10.3390/urbansci8030081.

[21] L. N. Amali, M. R. Katili, S. Suhada, L. Hadjaratie, and H. Mardlatillah, "Technology Acceptance Model in Government Context: A Systematic Review on the Implementation of IT Governance in a Government Institution," *Jurnal Online Informatika*, vol. 7, no. 1, 2022, doi: 10.15575/join.v7i1.853.

[22] M. A. K. Sahide, M. R. Fisher, A. Maryudi, G. Y. Wong, S. Supratman, and S. Alam, "The bureaucratic politics of conservation in governing land conflict: A typology of capacities," *MethodsX*, vol. 6, pp. 2536–2543, 2019, doi: 10.1016/j.mex.2019.10.022.

[23] J. Y. Kim, Y. Do, R.-Y. Im, G.-Y. Kim, and G.-J. Joo, "Use of large web-based data to identify public interest and trends related to endangered species," *Biodivers. Conserv.*, vol. 23, no. 12, pp. 2961–2984, 2014, doi: 10.1007/s10531-014-0757-8.

[24] A. Simão, P. J. Densham, and M. (Muki) Haklay, "Web-based GIS for collaborative planning and public participation: An application to the strategic planning of wind farm sites," *J. Environ. Manage.*, vol. 90, no. 6, pp. 2027–2040, 2009, doi: 10.1016/j.jenvman.2007.08.032.

[25] A. A. Alesheikh, H. Helali, and H. A. Behroz, "Web GIS : Technologies and Its Applications," *Symposium on geospatial theory, processing and applications*, vol. 15, no. March, 2002.