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Research Article

Optimization of Land and Building Tax Absorption Through 3-Dimensional Modeling and Digital Twin Visualization from Aerial Photogrammetry

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ABSTRACT

The era of digitalization and the advancement of information technology for mapping and modeling three-dimensional (3D) space has become an important factor in various sectors, including in land and building management. In Indonesia, the potential for utilizing 3D mapping technology can be used to optimize the absorption of Land and Building Tax (PBB) which is still not optimal. This is caused by various factors, one of which is the lack of accurate and comprehensive mapping. Aerial photo mapping is the main technology often used in 3D GIS (Geographic Information System) modeling. Visualization of the results of 3D modeling and digital twins in Jawa Village, Samarinda is modeled as an interactive tool for policy makers to improve operational efficiency in property tax management. The results of this study reveal how the geodatabase is compiled, the creation of 3D multipatch from oblique aerial photo acquisition to digital twin visualization with CE90 accuracy of 0.139 m and LE90 of 0.282 m. In addition, the quality of this accurate digital twin is indicated by mean difference 0.473 m and RMSE value of the building height of 0.561 m. The results of the photogrammetry method compared to BAPENDA data on an area of 92 Ha have a mean difference in building area of 73.98 m² and a total area difference of 114,747 m². Finally, this study was able to optimize regional income related to land and building tax from IDR 949,962,806 to IDR 1,112,471,515. This was able to optimize land and building tax in order to increase regional income by IDR 162,508,709 or 17.10%. This study clearly has a significant financial impact on the local government.

Keywords: Digital Twin, Land and Building Tax, 3D Mapping, Oblique Photogrammetry.

INTRODUCTION

Three-dimensional (3D) spatial mapping and modeling in the era of digitalization and the development of information technology have become key elements in various fields including land and building governance. This technology not only provides a more accurate and detailed visual image, but also allows for deeper and more precise analysis in resource management. 3D reconstruction of buildings from aerial imagery has become an active research topic in Computer Vision and Digital Photogrammetry in recent years. This can be explained by the fact that 3D reconstruction of buildings has become increasingly important in practice [1]. Other applications include urban planning, construction, environment, communication, transportation, energy and property management, tourism, and virtual city tours [2]. In Indonesia, the potential for utilizing 3D mapping technology can be used to optimize the absorption of Land and Building Tax (PBB) which is still not optimal. This is due to various factors, one of which is the lack of accurate and comprehensive mapping. Many areas have not been properly mapped, so that information regarding tax objects such as land and building areas often does not match actual conditions. Lack of transparency and unclear implementation of PBB collection as well as lack of proper mapping are the main obstacles in optimizing tax absorption [3]. Lack of proper mapping in the implementation of PBB collection is the main obstacle in optimizing tax absorption. In addition, the slow data updating process and lack of resources to conduct regular field surveys also contribute to this problem. This proves that the lack of mapping infrastructure and technology in many areas is one of the main obstacles in optimizing PBB absorption in Indonesia [4].

Aerial photo mapping is a key technology often used in 3D modeling of GIS (Geographic Information Systems) [2]. Aerial photos obtained by shooting from aircraft or drones provide visual images that are easy to understand and interpret. Aerial photos allow for rapid geospatial data retrieval, but they have limitations in terms of precision in areas covered by thick vegetation [5].

Visualization of 3D modeling and application of the digital twin concept through the WebGIS platform are important steps to increase transparency and understanding in the Land and Building Tax assessment system [6]. By utilizing this technology, policy makers can interactively view and analyze tax objects in the form of 3D representations. Thus enabling more efficient data identification and validation [7]. The integration of 3D visualization into WebGIS not only increases the efficiency of tax management but also strengthens public trust in the tax system [8]. With detailed visual representations, tax authorities can accurately assess property values, monitor physical changes in real-time, and ensure compliance with zoning regulations.

Previous research by Akbulut et al. [9] has compared the effectiveness of LiDAR and photogrammetry in three-dimensional building modeling. The results showed that LiDAR is superior in terms of spatial accuracy and 3D model precision compared to aerial photography. However, the research proposed by the author not only compares geometric accuracy, but also cost and processing effectiveness. Another study by [10] discusses classification techniques for building extraction from LiDAR data. Comparison between various approaches in improving the accuracy of building identification and mapping in urban areas. The study has provided 3D visualization of the model in webGIS. Hu & Minner [11] also discuss how LiDAR data and aerial photography can be used to create high-precision 3D models. This allows for application in urban planning and tax collection. With this background, this study aims to optimize aerial photo mapping and 3D modeling, especially regarding its effect on increasing PBB absorption. This study also highlights the need for visualization of 3D modeling results and digital twins as an interactive tool for policy makers and the public in making better decisions and improving operational efficiency in property tax management. Furthermore, this study aims to show that proper investment in mapping technology and efficient data collection can facilitate the government to improve accurate and up-to-date tax databases, so that tax absorption runs optimally. Optimization of aerial photography and 3D modeling in this study is expected to produce concrete and data-based recommendations for policy makers in evaluating and selecting the most effective and efficient mapping technology to improve the PBB assessment and management system.

MATERIALS AND METHODS

In this paper, we have conducted study area explanation and dataset equipment in this research. Moreover, a systematic literature review to investigate the application of photogrammetry for 3D modeling.

A. Study Area

This study took a study location located in Samarinda City, precisely in Jawa Village. This village borders Dadi Mulya Village and Sidodadi Village in the North, Bugis Village in the East, Mahakam River in the South, and Teluk Lerong Ilir Village in the West. The geographical conditions of the research location have a land height of 500 meters with a rainfall of 250 mm/year. The topography of the research location is included in the low topography with an average air temperature of 20oC - 30oC. This study uses a study area in Jawa Village because this area is a densely populated area that is not structured and is located in the middle of the city center. This is evidenced by the distance of Jawa Village from the center of the City Government, which is 3 km and the distance from the center of the Regency government is only 0.5 km. Aerial photogrammetry data collection was carried out using the DJI Matrice 300 RTK & Zenmuse P1 drone vehicle (oblique aerial photogrammetry). The observation location is shown in Figure 1.

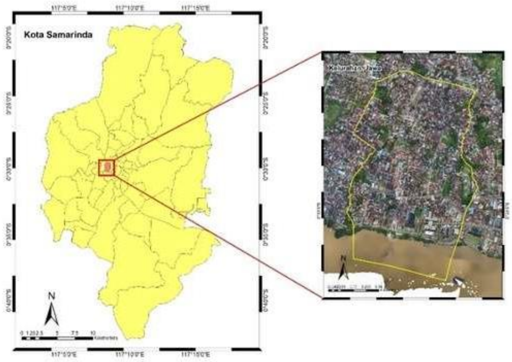

Figure 1. Study Area

B. Dataset and Setup Equipment

The data used in this study consists of:

1. Administrative Boundaries of Jawa Village
2. Land and building tax (PBB) data from Regional Revenue Agency (BAPENDA) Samarinda in 2023. BAPENDA is regional government institutions tasked with managing and increasing regional income.

Primary data in the form of vertical and oblique aerial photographs were obtained from field acquisition, specifically in Jawa Village using drone equipment *DJI Matrice 300 RTK and Zenmuse P1***.** The Matrice 300 RTK can achieve a transmission distance of up to 15 km, providing flexibility in various field conditions. Equipped with an omnidirectional hindrance sensor, the drone has advanced obstacle detection capabilities, enhancing flight safety. The ability to carry a payload of up to 2.7 kg makes it ideal for transporting various sensors and cameras. A visualization of the drone is shown in Figure 2.

Figure 2. DJI Matrice 300 RTK integrated Zenmuse P1 camera

The Zenmuse P1 is an aerial camera sensor that uses a full-frame CMOS sensor with a resolution of 45 MP and is capable of producing high-quality images with great detail. The Zenmuse P1 supports various operating modes such as photogrammetry, oblique, and mapping. Then, the research methodology is illustrated in the following Figure 3.

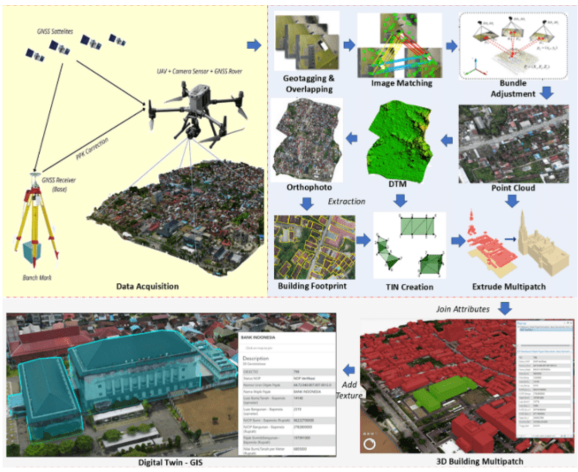

Figure 3. Methodology in Building Digital Twin from Photogrammetry

C. Figures Photogrammetric Data Acquisition

The data collection method in this study involves primary data and secondary data for land and building tax optimization in the aerial photo mapping method. For primary data, aerial photo mapping is carried out using the oblique aerial photo method. Data acquisition specifications can be seen in Table 1 below.

Table 1. Aerial photography acquisition data specifications

Spesifications	Value
Acquisition Date	2-4 December 2024
GSD (Ground Sampling Distance)	1,5 cm/px
Overlap	80%
Sidelap	80%
Flying height	± 120 meters
Camera angle	45^o
Flight mode	Oblique
Number of GCPs & ICPs	12 & 12
Ellipsoid Datum	WGS 84
Projection System	UTM Zone 50 South

Oblique aerial photography will be conducted using a DJI Matrice 300 RTK drone and a Zenmuse P1 camera to capture aerial imagery that will be processed into a 3D model of the study area in Jawa Village, Samarinda City. Data collection for this method is bound by a control network or benchmark. Data obtained will be processed and analyzed the accuracy, resolution, and effectiveness in producing a 3D model. For secondary data, data collection is carried out by direct application to the BAPENDA Samarinda in the form of land and building tax data for land plot objects in Jawa Village, Samarinda City to understand how the mapping results affect the assessment and absorption of land and building taxes. The collected data will be used to evaluate the performance of both mapping methods in the context of their practical application.

D. Structure from Motion (SfM)

SFM is a technique in photogrammetry and computer vision used to reconstruct three-dimensional structures from a series of two-dimensional images. It involves taking images from multiple angles and using that information to build a 3D model of an object or scene [12]. An illustration of the methodology used from data acquisition to processing is shown in Figure 5. The algorithm in Agisoft Metashape [13] generally involves several steps consisting of Image Acquisition, Detection and Image Matching, Coarse Structure Reconstruction, Bundle Adjustment Optimization, Dense Point Cloud Construction, Mesh and Texture Creation, and Export and Analysis. Image matching itself is the process of matching two or more different images, taken from different perspectives or times, with the aim of finding similarities or transformations between the images. In the context of aerial photography, this process can include matching aerial images taken at different times or from different viewpoints. While bundle adjustment is an optimization technique used in photogrammetry to improve the position and orientation of the camera (camera parameters) and the 3D points detected in various images. The main goal of bundle adjustment is to optimize the geometric fit between the image and the 3D model built from that image.

After the bundling adjustment process, the accuracy test process is carried out to determine the quality of the resulting aerial photos. The 3D model provides a more detailed representation of building geometry by adding details to the roof elements and building structures. Building data in this 3D model is very useful in PBB calculations because it can accurately describe the shape and volume of buildings. The results of the aerial photos in the form of orthophotos are adjusted by following the accuracy of the Indonesian Topographic Map (RBI) issued through the Regulation of the Head of the Geospatial Information Agency (BIG) No. 15 of 2014. The results are in the form of accuracy values consisting of Circular Error (CE90) and Linear Error (LE90). Referring to the US NMAS (United

States National Map Accuracy Standards) standard, the CE90 and LE90 values can be obtained using formulas (1) and (2). Where the CE90 value is $\leq 40\ meter$ and LE90 $\leq 2\ meter$.

$$CE\ 90 = 1{,}5175\ x\ RMSEr \qquad (1)$$

$$LE\ 90 = 1{,}5499\ x\ RMSEz \qquad (2)$$

RMSEr : Root Mean Square Error at x dan y position (horizontal)

RMSEz : Root Mean Square Error at z position (vertical)

E. 3D Building Multipatch

3D modeling is a procedure for creating a 3D model. This procedure is part of the process of creating a 3D model form that can represent the entire object being studied. A 3D model is created from the process of connecting points in 3D space with various geometric data such as lines, planes, or curved planes that form a 3-dimensional model. 3D models are created using 4 popular methods, namely a) Primitives modeling b) Polygonal modeling c) Non-Uniform Rational B-Spline (NURBS) d) Patch modeling. This study uses the patch modeling method or commonly called 3D building multipatch. 3D models are created using curved lines to identify visible surfaces. In Patch modeling, 3D objects will be composed of triangular or rectangular surfaces that are interconnected.

F. Building and Land Tax Calculations

In the context of PBB calculations, this geometric data is used to determine the building area, volume, and more accurate estimated tax value. The comparison between the 3D model PBB calculation and the BAPENDA data PBB calculation is expected to produce a more accurate evaluation of property values, which contributes to a more efficient and transparent tax collection system. The PBB calculation is formulated in equation (3) (4) (5) (6) below:

$$PBB = NJOP\ x\ Tax\ Rate \qquad (3)$$

$$NJOP = NJOP\ Land + NJOP\ Building \qquad (4)$$

$$NJOP\ Land = land\ area\ x\ land\ value \qquad (5)$$

$$NJOP\ Building = building\ area\ x\ building\ value \qquad (6)$$

RESULTS AND DISCUSSION

A. Geodatabase

Before constructing a geodatabase for the fusion of BAPENDA tax object data and digitized Building Footprint, it is necessary to test the accuracy of the oblique aerial photo acquisition data through the calculation of CE90 and LE90. Accuracy testing was conducted at the study location of Jawa Village with a total of 12 Independent Control Points (ICP) spread evenly across the study area. ICP observations were conducted using the GNSS differential static – radial method with an observation time per point of 1 hour. In the accuracy calculation explained in section 1.4 at equations (1) and (2), oblique aerial photography produced a CE90 value of 0.139 m and an LE90 of 0.282 m as shown in Table 2 below.

Table 2. Orthophoto accuracy

Point	Terestrial Field			Orthophoto		DEM Elevation (m)
	Easting (m)	Northing (m)	Elevation (m)	Easting (m)	Northing (m)	
ICP 01	515189.24	9945266.73	59.91	515189.19	9945266.69	59.74
ICP 02	515391.17	9945534.46	61.72	515391.24	9945534.47	61.71
ICP 03	515232.79	9945637.96	71.34	515232.89	9945637.96	71.35
ICP 04	515043.28	9944678.35	57.30	515043.24	9944678.31	57.37
ICP 05	515683.91	9944657.70	57.39	515683.95	9944657.78	57.50
ICP 06	515257.15	9944607.79	56.73	515257.18	9944607.74	57.15
ICP 07	515226.81	9944845.38	57.47	515226.81	9944845.26	57.56
ICP 08	515514.59	9945045.82	67.00	515514.56	9945045.79	67.21
ICP 09	515586.60	9945236.30	62.65	515586.77	9945236.22	62.80
ICP 10	515441.37	9944696.55	57.30	515441.39	9944696.52	57.50
ICP 11	515568.55	9945504.44	62.59	515568.52	9945504.36	62.47
ICP 12	515301.84	9945288.59	60.63	515301.80	9945288.67	60.54
CE90 = 0.139 m						
LE90 = 0.282 m						

Extracting building footprint is an important process in geospatial analysis, which is used to identify and extract building shapes and boundaries from raster data such as aerial photographs, satellite imagery, or digital surface models. The building footprint results are regularized to produce geometrically correct building footprints. Manual digitization is performed on orthophoto data from vertical aerial photography. The manual building footprint process with this digitization takes quite a long time, but the building footprint results obtained are close to the actual data (accurate).

The results of the geodatabase in this study can be seen in Figure 4, which consists of Javanese village boundary data, National Land Agency (BPN) land plot data and manual digitization. BPN data that has been integrated with Javanese village building site data can provide information such as plot location (village, district, province), land plot area, amount of Land and Building NJOP, and the amount of land tax (PBB) that must be paid.

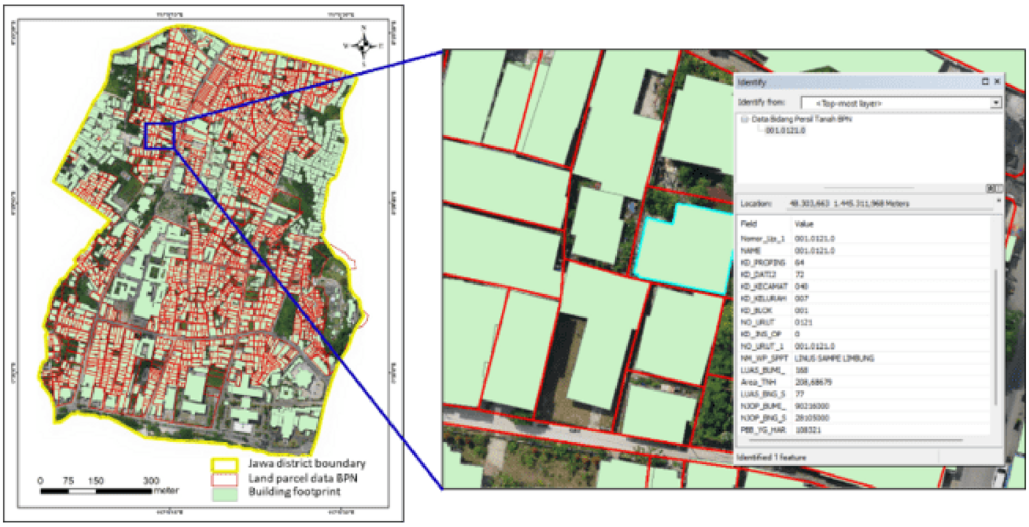

Figure 4. Geodatabase Digitization of Jawa Village, Samarinda

Having a geospatial database has proven to be very useful when considering data integration and processing at the building level. In the literature and statistical databases conducted by [14] and [15], it is very common to observe descriptions of building characteristics and allow for georeferencing of data, which links object attributes to object classes. For example, geometric information about buildings is not available in the BPN statistical database. However, through addresses or spatial coordinates, it is possible to link building data or compare existing data with field data (e.g. PBB type calculated by 3D models with PBB BAPENDA) with certain building attributes (e.g. building shape and building area). Georeferenced databases with detailed building stock information such as 3D Models have proven to be effective in evaluating data quality, combining scattered data with different formats, sources, and spatial resolutions, and in increasing transparency on data assumptions used in government, empowering the reliability of future scenarios on efficiency.

B. 3D Multipatch

In this study, the creation of 3D multipatch is done by extracting 2D buildings into 3D using data from dense cloud data to build a multipatch model. First, dense cloud data containing roof and ground surface points are processed to separate building elements from other objects. Then, points representing the roof of the building are selected, and building footprint polygons are used to limit the extraction area. Using the Triangulated Irregular Network (TIN) method, the roof surface of the building is generated, which is then converted into a multipatch model that includes structural elements such as the roof and walls of the building. Furthermore, a simplification process is carried out to reduce the density of points by adjusting the sampling resolution and simplification tolerance parameters. The formed 3D model is represented in the form of a multipatch, where each building element such as walls and roofs is represented as a separate patch that is connected to each other. This model allows for a more accurate and efficient representation of building geometry for spatial analysis and visualization, and can be used in urban planning applications or other simulations. The results of the creation of the 3D multipatch of Jawa Village are illustrated in Figure 5 below.

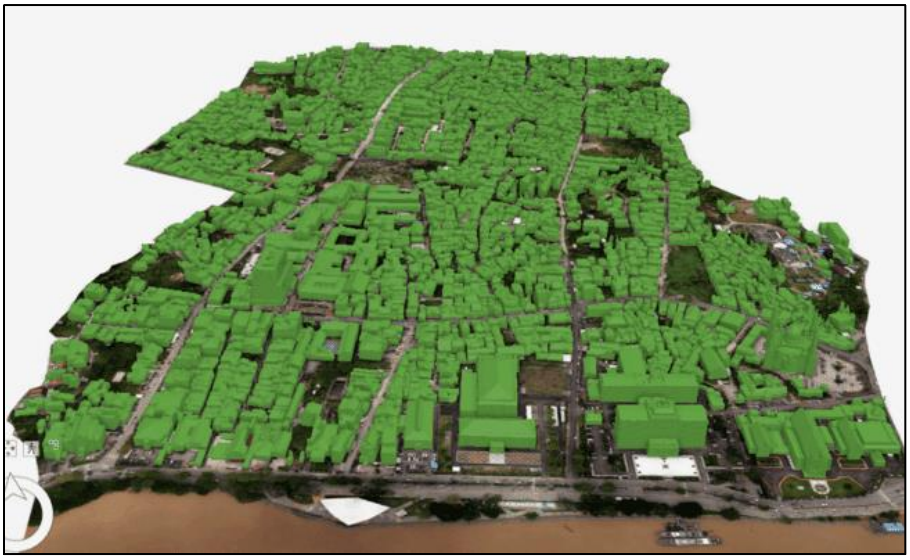

Figure 5. 3D Multipatch of Jawa Village, Samarinda

With multipatch data, buildings are visualized in 3D that depicts the accurate physical condition of each building in the sub-district. This visualization provides an overview of building density, building height distribution, and the interaction between buildings and the surrounding environment. Analysis of the 3D multipatch results in the Jawa Village, Samarinda, which is mapped with its geodatabase, provides a very useful overview in various aspects of urban planning and land management. By integrating 3D spatial data with detailed attributes, stakeholders can identify potential problems, plan infrastructure, and ensure more efficient and sustainable land management and use. However, the creation of 3D multipatch in this study aims to determine the geometry of buildings in order to facilitate the calculation of building taxes and clearly map the boundaries of land plots. Each building resulting from 3D multipatch provides height information from oblique photogrammetry as shown in Figure 6. This model shows a detailed and realistic visual representation of the mapped area, including buildings, roads, and vegetation. Oblique aerial photographs, taken from multiple angles, allow for more complete capture of architectural details and building textures. The result is a 3D model rich in detail, which facilitates visual analysis and a comprehensive understanding of the environmental structure.

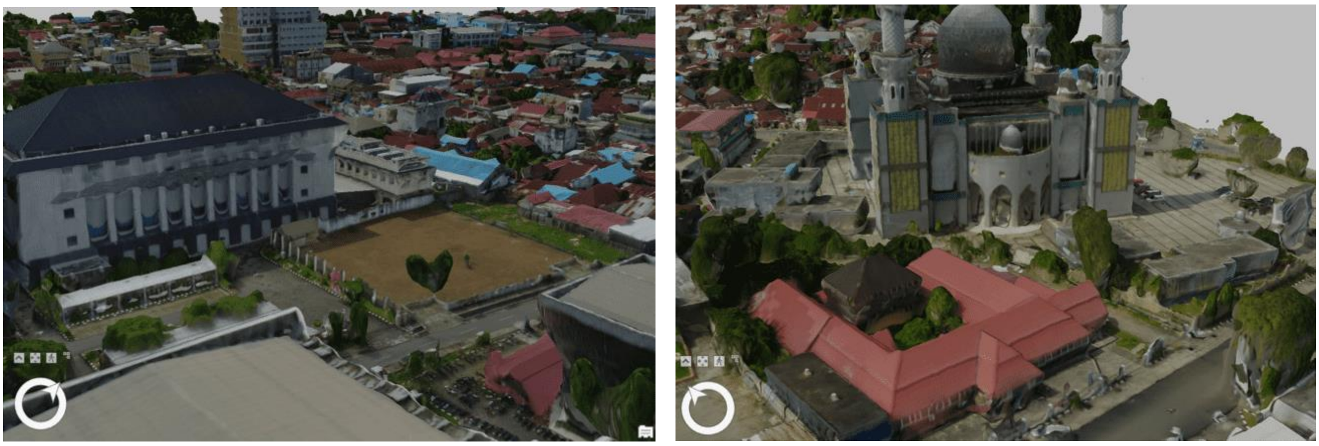

Figure 6. 3D Tiles data from oblique aerial photos

Research conducted by [16], [17] provides strong support for the findings of this study in the context of three-dimensional (3D) visualization. Both studies emphasize the importance of using multipatch models in improving the decision-making process and data analysis, both spatial (related to position or space) and non-spatial (related to attributes or characteristics other than position). This multipatch model allows the organization of objects in a more complex and structured form, making it easier for users to understand and manage data more efficiently.

In addition, the use of multipatch objects allows for the distribution of objects with a high degree of fidelity, which can then be enriched by the provision of textures and images. This texturing is very important because it can provide a deeper visual layer to the object, creating a more realistic and detailed representation. This technique is very useful in applications that require the rendering of complex objects, as it allows for a more realistic representation. Thus, the application of multipatch models can improve the quality of the visualization results, making them more attractive and easier to understand, especially when dealing with objects that have complex structures or complex details. This is especially relevant in fields such as architectural design, urban planning, and geographic modeling, where clear and realistic visualizations are essential in supporting data-driven decisions. Validation of building height is done by direct data measurement in the field using tachymetry method with Total Station Nikon N5 Reflectorless. Table 3. Shows the RMSE value resulting from the validation of building height which is 0.561 m.

Table 3. Sample validasi tinggi bangunan

No	Description	$h_{measured}$ (m)	h_{model} (m)	Δh (m)
1	Check 1	21.447	20.571	0.876
2	Check 2	13.52	12.685	0.835
3	Check 3	13.48	13.186	0.294
4	Check 4	11.577	11.687	0.11
5	Check 5	17.615	17.111	0.504
6	Check 6	21.556	20.649	0.907
7	Check 7	13.781	13.679	0.102
8	Check 8	13.754	13.298	0.456
9	Check 9	11.967	11.432	0.535
10	Check 10	17.978	17.865	0.113
Mean Difference				**0.473**
RMSE				**0.561**

C. Digital Twin Visualization

A digital twin is a digital representation or virtual model of a real-world physical object, system, or process that is used to analyze, monitor, and optimize its performance and functionality. The digital twin resulting from this research is an integration of 3D Multipatch, geodatabase attributes, and 3D Tiles that are arranged in such a way that they can provide more effective information to stakeholders. In its application, the digital twin results of each building is given attributes that can be accessed via click or hover, such as information about tax objects, size, and location. The user interface is designed to be easily accessible via a browser, allowing policy makers and the public to view and analyze their tax objects in real-time, and to visualize them in an intuitive and interactive way. GIS digital twin can be easily accessed at the link here (https://its.id/m/3DModelKelurahanJawa).

The sample of digital twin results in the Jawa Village, Samarinda illustrated in Figure 7 provides information on the tax object serial number, taxpayer name, land area, building area, land tax object sales value, building tax sales value, land and building tax value. The results of this study are sufficient to provide a picture of the actual object, for example the Bank Indonesia building, the State Electricity Company (PLN), Dirgahayu Hospital, and even private homes where the size of the building area can be seen to calculate the tax to be paid.

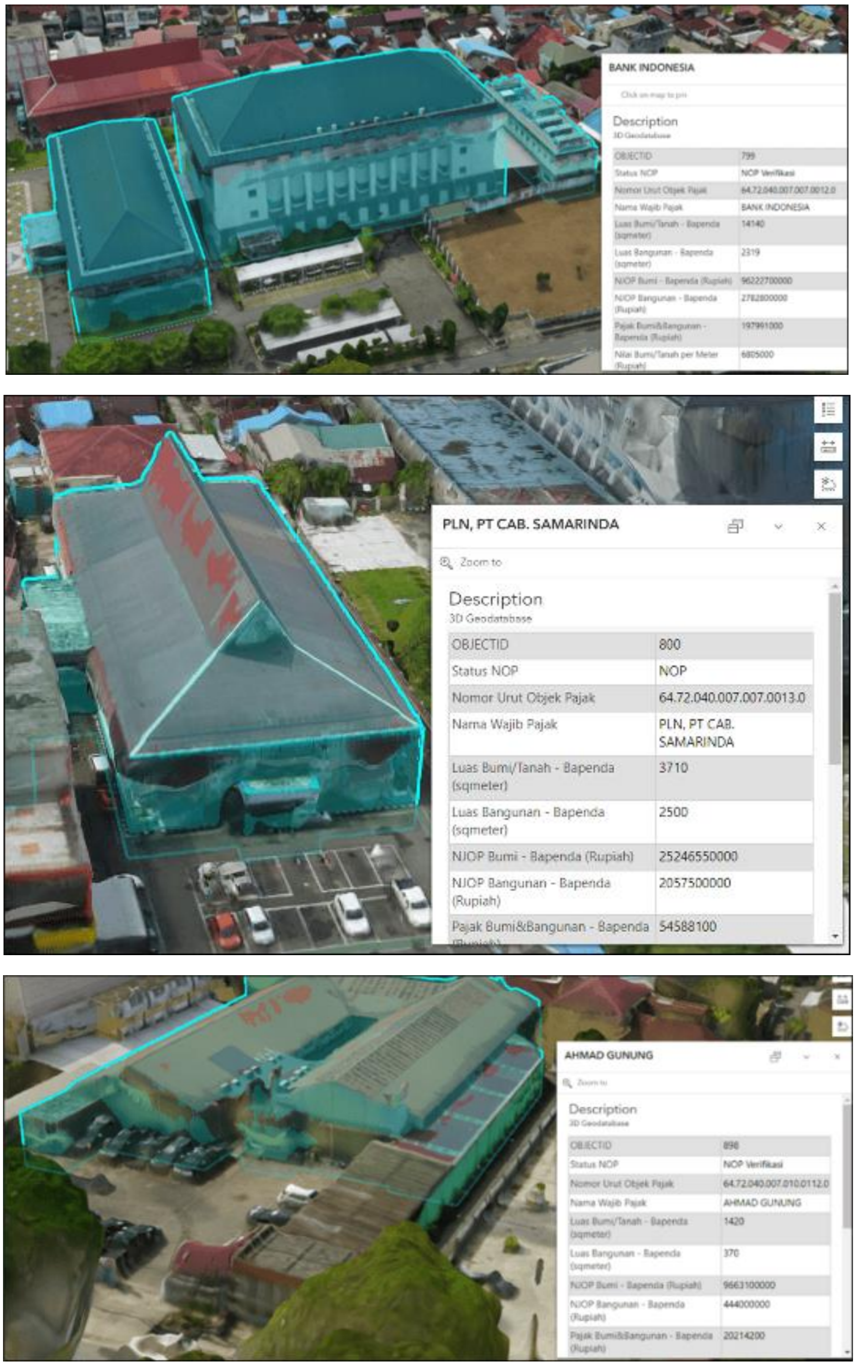

Figure 7 GIS Digital Twin of Jawa Village, Samarinda

With a database like this, stakeholders, especially tax institutions, will easily collect data on each building so that the calculation of land and building taxes is more efficient and especially more in accordance with the actual building area. Research by Lehtola [18] states that the development of 3D digital such as digital twins does not stop at 3D city modeling, but there needs to be integration and harmonization of existing databases. These data sets often come from different updates and are based on languages and data models that are not homogeneous. The data is often in tabular format and is managed by different institutions/agencies and many management systems.

D. Building Footprint Area Quality

Optimizing tax absorption is very important to ensure that regional revenues are targeted and accurate. In this context, one of the steps taken is to manually digitize building area data to avoid errors or data loss that can affect the calculation of Land and Building Tax (PBB). Building area data itself is very crucial basic information in the PBB calculation process, because the accurately recorded building area will determine the amount of tax that must be paid by taxpayers. Therefore, the validity and accuracy of the data must be considered carefully. As part of the data verification effort, a comparison was made between the building area data recorded at BAPENDA with the building footprint data obtained through aerial photo digitization (orthophoto). This aerial photo digitization uses processed aerial imagery to identify and draw building boundaries on the image, which is then compared with data already in the BAPENDA system. To ensure that the results of this comparison are objective and measurable, the mean difference calculation method is used, which measures the average difference between the two sets of building area data.

Mean difference itself is a statistical method used to measure the average difference between two datasets being compared [19]. By calculating the mean difference, it can be seen how big the difference is between the recorded data and the digitized aerial photo data. Altman & Bland's [20] research provides an overview of the use of mean difference in the comparison method between two different measurement techniques, which is very relevant for applications in building area data analysis.

The calculation result of the mean difference of building area in this study shows a value of 73.98 m^2 with a maximum difference of 5757.652 m^2 and a minimum difference of 0.161 m^2. This value indicates a significant difference between the two data sources, which needs to be identified and analyzed further. With this information, data from BAPENDA can be optimized through data correction and adjustment steps to ensure the accuracy of building area data that will be used in calculating PBB tax, thereby reducing the potential for errors that can impact the accuracy of regional tax revenues.

E. Land and Building Tax Comparison

The calculation of land and building tax has been explained in detail in section 1.6. at equations (3), (4), (5), (6). In this study, the tax calculation using digital twin extraction data is compared with official data provided by the Regional Revenue Agency (BAPENDA). Given that the digital twin is used to optimize existing BAPENDA data, it is expected that there will be some differences between the two results being compared. The comparison graph between the tax calculation using aerial photo surveys and the calculation from BAPENDA can be seen in Figure 8 and Figure 9. To facilitate understanding, these differences are presented in percentage form, with the aim of showing the proportion of deviations that occur.

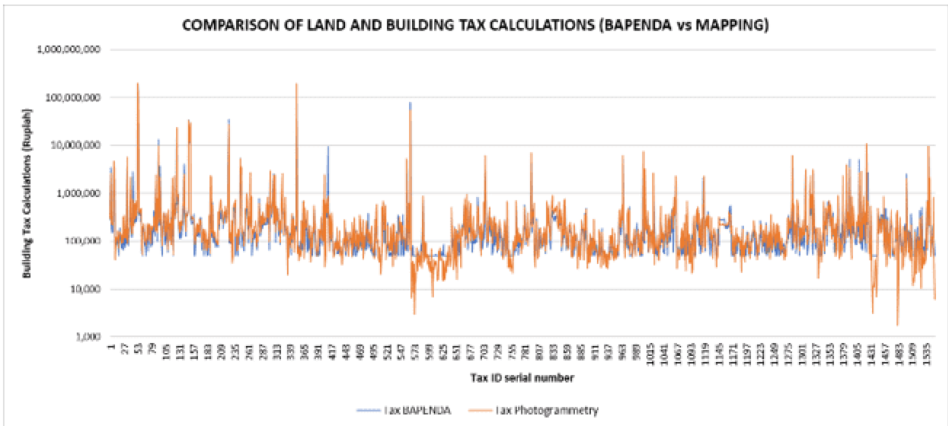

Figure 8 Comparison Graph of Land and Building Tax Calculation (BAPENDA - Oblique Photogrammetry)

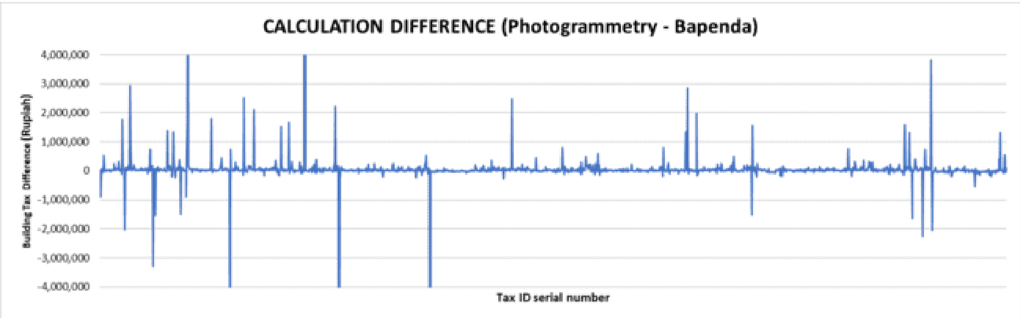

Figure 9 Graph of Land and Building Tax Difference Value (BAPENDA - Oblique Photogrammetry)

The graph above shows a significant difference in the calculation of land and building tax between the photogrammetry method and BAPENDA data. The amount of BAPENDA land and building tax from 1552 tax objects located in Jawa Village, Samarinda is IDR 949,962,806. While the amount of land and building tax using the photogrammetry method is IDR 1,112,471,515. These results show that the photogrammetry method is able to optimize land and building tax by increasing regional income by IDR 162,508,709 or 17.10%. From the analysis of these results, it can be concluded that there are problems related to the current tax cost system. This is supported by the research of Choromanska, A., & Oksanen, J. [21]-[23] which provides a case study of the use of photogrammetry in property tax assessment in Finland, illustrating how photogrammetry techniques are used to obtain accurate spatial data in calculating land and building tax. In addition, [24], [25] describe how photogrammetry and remote sensing are used in property assessment and tax system implementation, and how the resulting spatial data can improve the accuracy of tax calculations. This article discusses how photogrammetry is used to support property assessment systems and data collection for property taxes, with a focus on the use of aerial imagery to obtain information needed in the tax process. the application of photogrammetry together with Geographic Information Systems (GIS) to improve accuracy in property tax assessment systems, and how photogrammetry data supports land and building tax calculations [26]-[28].

CONCLUSION

The main objective of this publication is to illustrate how geospatial databases can support utility cost efficiency and improve overall system functionality. This is achieved by utilizing digital twin technology and a photogrammetry-based mapping system. The methodology proposed in this study has proven to be effective in optimizing state revenues, especially related to land and building taxes. This approach allows for accurate determination of building areas, which is very useful for object identification. Although the coverage area in this study is still limited to the village scale, the results obtained show a significant impact on the existing utility cost system, especially in BAPENDA. This problem clearly has a significant financial impact on local governments. Based on the data collected, we estimate that the inefficiency and delays in the utility cost system cause financial losses that can reach hundreds of millions of rupiah. This paper shows that these problems have the potential to be solved by implementing 3D digital twin technology from photogrammetry.

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