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# DEVELOPMENT OF MOBILE APPLICATION SOFTWARE FOR PROPERTY VALUATION IN NIGERIA

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## ABSTRACT

The conventional methods of property valuation in Nigeria sometimes face issues such as subjectivity, inefficiency, and lack of data access, leading to inconsistent valuations/valuation reports. This research tends to fill these gaps by providing a mobile application that integrates fundamental valuation methods: Comparative, Profit, and Cost methods in a user-friendly interface. The study utilized descriptive statistics such as simple percentage frequency table and the development of mobile application software using Flutter. Major features of the software include automated data input, image capture, and immediate report generation. There is also uniform support (100%) for the need of a mobile application software in Nigeria's real estate industry. The Depreciated Replacement Cost method is the most often utilized valuation technique. The study also shows that valuation approaches requires various data inputs, with "Location," "Property Type," and "Operating Expenses" being essential, while "Cost of Construction" and "Tenant Capital" are of lesser importance. The research led to the development of a mobile application software, S-Value, using Flutter. The app is integrated with Google Maps for precise property measurements and includes features such as image capture, selection of valuation methods, and automated valuation report generation. Testing confirmed that S-Value improves the efficiency of property valuations. However, challenges related to data accuracy and market fluctuations were identified, highlighting the need for continuous updates to enhance reliability. The study reveals that the mobile application greatly supports the valuation process, however, more adjustments are needed to ensure data quality and flexibility to market fluctuations. The study recommends that to augment the efficacy of the mobile application software, it is advisable to incorporate sophisticated validation tools, including AI-driven image recognition and automated boundary correction algorithms, to enhance precision in property measurements and user-submitted data. Consistent updates, and integrating external real estate market data or expert evaluations, are important to preserve the valuation model's conformity with Nigeria's evolving real estate market. Additionally, training programs must be implemented to guarantee users are adept with the app's features, enabling them to maximize its benefits in their operations.

**Keywords:** Real estate, property valuation, mobile application, area measurement, valuation report.

## 1. INTRODUCTION

Property value, also known as real estate appraisal, plays a key role in a nation's economic and financial stability, it has developed with the advent of new methodologies and developments in spatial science. Traditional valuation methodologies in underdeveloped nations largely focus on physical and economic elements, overlooking spatial aspects (Senadheera & Warusavitharana, 2022).

According to Su and Li (2020), property valuation is affected by various parameters that are related to environmental quality (pollution, land use, and sustainable resources), social and economic quality (vacancy rate, rental growth potential), technical and functional quality (structure, age, size, construction materials, indoor air quality, flexibility and adaptability), process quality (quality control during construction) and site quality (transport access, amenities). The dynamics of various parameters and the lack transparency of the real estate market make it impossible for property valuation professionals to execute an accurate and objective valuation of property prices.

With over 3.0 billion smartphone users worldwide (Technostacks, 2019), mobile technology (MT) is gaining popularity across numerous industries, including real estate. MT provides accessibility to technological platforms in practically every aspect of life (Baum et al., 2020). Its advantages, such as enhanced mobility, location-centric features, and instant notifications, have led to the development of numerous mobile apps aimed at improving customer access, serving as direct marketing channels, managing paperwork, and addressing industry-specific issues (Technostacks, 2019).

Mobile technology comprises a wide range of potential applications and tools that can be employed in numerous businesses and areas. In the healthcare industry, mobile technology has been used to construct Health systems that benefit patients and healthcare professionals (Fleming et al., 2017; Singh, 2022). It has had a huge impact on the real estate business, leading to changes in marketing models and the development of novel applications. The usage of mobile internet technology has enabled the investigation of new marketing methods in the real estate business (Fei, 2022).

In Nigeria and many developing countries, the use of mobile technology is on the rise. For example, Nigeria had an anticipated 25 to 40 million smartphone users out of a population of 200 million in 2020 (O'Dea, 2020). While other industries, like finance, have embraced mobile technology for service delivery, the real estate sector in Nigeria and many underdeveloped nations still lag in its adoption. However, in the Nigerian real estate sector, there are mobile application software which are been utilized for activities such as property administration, rent payment etc, only few software are produced to aide or carryout property valuation and they lack some essential capabilities. Therefore, this study aims to design a mobile application software that can perform area measurement of property, geotag the property, carryout the assessment of the property base on the specified variables and produce a report.

## 2. METHODOLOGY

This research follows a structured methodology consisting of three key stages: Valuation Methods, Automation of Valuation, and Report Generation. The first stage, Valuation Methods, involves identifying the basis, purpose, and appropriate techniques for property valuation. This study focuses on three primary valuation approaches: the Comparative Method, the Cost Method, and the Profit Method.

The Comparative Method assesses the value of a property by comparing it with similar properties in the open market, considering factors such as location, size, condition, amenities, and recent sales or rental prices. The Cost Method estimates the value of a property by determining the cost of constructing or replacing it, factoring in construction materials, labor, and land acquisition costs. The Profit Method evaluates the potential income a property could generate through rental income, resale value, or other financial returns.

The second stage, Automation of Valuation, focuses on leveraging digital tools to enhance the valuation process. This stage is subdivided into three components: Area Measurement, Geo-Tagging of Property, and User-Friendliness. Area Measurement involves determining the size of the property, either through manual input or automated extraction from digital maps. Geo-Tagging of Property assigns geographical coordinates to the property, allowing for easy location and accessibility. User-Friendliness ensures the development of an intuitive interface that facilitates seamless interaction for users.

The third stage, Report Generation, involves the production of a digital valuation report after the valuation process is completed. The mobile application will generate a comprehensive report summarizing the valuation details, including the assessed value, property attributes, and the valuation method applied. This structured approach ensures a systematic and efficient property valuation process, as illustrated in Figure 1.

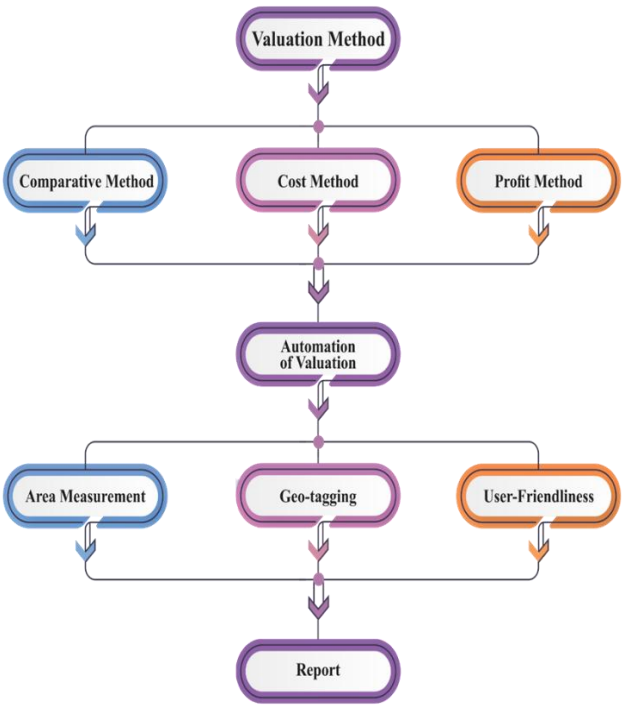



**Figure 1: Diagrammatical Representation of the Research Design**


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## 3. DATA ANALYSIS AND PRESENTATION

### The Data Requirements for Selected Methods of Valuation

The study illustrates the result of the relative importance index of the criteria for the chosen valuation technique. It shows that under the Comparative approach, "Location," "Property Type," and "Price of Comparable Property" possess the lowest RII scores of 0.2, signifying that they are the most critical data requirements. Conversely, "Cost of Construction" and "Tenant Capital" possess the highest RII values of 0.9, categorizing them as the least significant components for this method. Factors such as "Property/Land Size" (0.7) and "Environmental Condition" (0.7) are regarded as moderately important, suggesting they are somewhat relevant but not essential. In the Profit method, "Operating Expenses" and "Property Type" exhibit the lowest RII scores of 0.2, rendering them the most critical factors in profit appraisal. Factors with elevated RIIs, such as "Property/Land Size" and "Cost of Construction" (both 0.9), are deemed the least essential. Additional characteristics such as "Location" and "Gross Income" exhibit modest significance with a Relative Importance Index (RII) of 0.4, indicating a balanced impact on this methodology. In the Cost approach, "Age," "Property/Land Size," "Cost of Construction," and "Land Value" each possess the lowest RII of 0.2, highlighting their critical significance in cost assessments. Conversely, "Gross Income," "Operating Expenses," and "Tenant Capital" possess a RII of 0.9, signifying their minimal significance in cost valuation. Factors such as "Market Condition," "Legal Information," and "Environmental Condition" (each rated at 0.8) have minimal significance. This indicates that, data requirements like "Location," "Property Type," and "Operating Expenses" emerge as vital across diverse techniques. In contrast, "Cost of Construction" and "Tenant Capital" are often less relevant for these valuation methodologies.

### Development of the Software Application

### Project Overview and Scope

This methodology outlines the approach for developing a property valuation mobile application using Flutter, with a focus on real estate appraisal in Nigeria. The app aims to automate the process of capturing property images, integrating Google Maps for accurate size measurements, and performing valuations based on various environmental, social, technical, and site-specific parameters.

### Development Environment

The development of the mobile property valuation application requires a well-structured environment, incorporating various tools and technologies to ensure efficiency, accuracy, and user-friendliness. The key components of the development environment are as follows:

### Programming Language:

Dart – The application is built using Dart, an object-oriented programming language optimized for UI development. Dart offers high performance and efficiency, making it well-suited for developing mobile applications with Flutter.

**Framework:**

Flutter – Flutter is used as the primary framework for cross-platform mobile development. It allows for a single codebase to be deployed on both Android and iOS devices. Flutter provides a rich set of pre-designed widgets, ensuring a smooth and responsive user interface while maintaining high performance.

**APIs:**

Google Maps API – This API is integrated into the application to provide geolocation services and size measurement functionalities. The Google Maps API enables precise tagging of property locations and allows users to measure land or building areas directly from the application, improving the accuracy of valuations.

**Version Control:**

GitHub – GitHub is used for source code management, enabling collaboration, version control, and tracking of changes throughout the development process. It facilitates efficient project management, issue tracking, and continuous integration.

**Integrated Development Environments (IDEs)**

Visual Studio Code (VS Code) – A lightweight and efficient IDE, VS Code is used for writing, debugging, and testing Dart code. It provides excellent support for Flutter, including extensions that improve developer productivity.

Android Studio – Android Studio is used for running and debugging the mobile application on Android devices. It provides an emulator for testing various device configurations and screen sizes, ensuring that the application functions smoothly across different platforms.

**Requirements Gathering**

**User Input Parameters:**

Property Image Capture: The users will capture images of the building using the app's camera functionality. Method of Valuation: The users will be prompted to select the method of valuation (Comparative, Cost, and Profit method). Building Size Measurement: Integration with Google Maps will allow users to draw boundaries around the property to calculate its size in square meters. Additional Property Information: The users will input other relevant data, such as the age of the building, construction materials, amenities, and environmental quality.

**System Design**

**User Interface (UI) Design:**

**Home Screen:** Introduction and quick access to start a new valuation.

**Capture Screen:** Interface for capturing images of the property, with an option to retake if needed.

**Valuation Type Screen:** Drop-down menu for users to select the type of valuation.


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**Google Maps Integration Screen:** Interface where users can draw boundaries on the map to define the property area.

**Application Features and Implementation Plan**

**Input Screen**

The input screen will provide a structured interface for users to enter relevant property details, ensuring accurate valuation. Key features include:

**Forms for Manual Data Entry:** Users can input property details such as:

**Building Materials:** Type of construction materials used (e.g., concrete, brick, wood).

Property Age: Number of years since the property was built.

**Environmental Factors:** Surrounding conditions, including pollution levels, noise, and land use.

**Image Upload and Capture:** Users can upload images or capture real-time photos of the property to provide visual context for valuation.

**Automated Data Retrieval:** Integration with external data sources where possible, such as public property records.

**Results Screen**

**After processing the valuation, the results screen will display:**

**Final Property Valuation:** The estimated market value based on user inputs and valuation algorithms.

**Breakdown of Valuation Factors:** A detailed explanation of how various factors (e.g., location, size, condition) contributed to the final valuation.

**Export Functionality:** Users can generate a detailed valuation report in PDF format for sharing or record-keeping.

**Implementation Plan**

The implementation follows a structured, phased approach to ensure efficient development and deployment.

**Phase 1:** Initial Setup and UI Development

Project Setup: Initialize the Flutter project and configure the necessary dependencies, including Firebase for backend support (if required).

**Basic UI/UX Design:**

- Develop the fundamental user interface, including welcome screens, navigation menus, and input forms.

- Implement UI components for image capture, valuation type selection, and integration with interactive maps.

**Navigation & Screen Transition:** Set up smooth navigation between different sections of the app, ensuring a seamless user experience.

**Phase 2:** Integration with Google Maps

**Google Maps API Implementation:**

- Enable users to search and select property locations.

- Allow users to mark property boundaries using an interactive map.

**Automated Area Calculation:**

- Implement an algorithm to calculate property size (square meters) using the drawn boundaries on Google Maps.

- Provide manual adjustment options if necessary.

**Phase 3:** Valuation Algorithm Development

**Property Valuation Logic:** Develop an algorithm to calculate property value based on input variables such as:

**Environmental Quality:** Pollution levels, land use, and available resources.

**Social and Economic Factors:** Vacancy rates, rental demand, and growth potential.

**Technical and Functional Aspects:** Property age, size, and structural integrity.

**Location & Accessibility:** Proximity to amenities, transport links, and neighborhood desirability.

**Customization Options:**

- Allow users to override or adjust specific valuation parameters based on expert judgment.

- Provide a choice between automated valuation and manual input-based valuation.

**Phase 4:** Automated Reporting

**Report Generation Module:** Implement a feature that generates valuation reports automatically. Reports will include:

**Property Details:** Description, size, location, and images.

**Valuation Summary:** Breakdown of influencing factors and final value estimate.

**Comparative Analysis:** Comparison with similar properties in the area (if data is available).

**Export & Sharing Options:** Users can export reports as PDFs and share them via email or cloud storage.


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**Phase 5:** Testing and Debugging

Unit Testing: Verify individual modules (e.g., input forms, valuation algorithm, reporting) function correctly.

**System Integration Testing:** Ensure all components work together seamlessly.

**User Acceptance Testing (UAT):**

- Conduct testing with a sample group of estate surveyors, property valuers, and real estate professionals.

- Collect feedback on app usability, accuracy, and performance.

- Make necessary refinements based on user feedback.

**Data Input**

**To ensure accurate property valuation, data will be sourced from:**

**Primary Data**

**User Inputs:** Manually entered details such as property dimensions, building materials, and environmental conditions.

**Images & Photos:** Users can capture or upload images of the property for documentation.

**Secondary Data**

**Google Maps API:** Used for geolocation and area measurement, allowing for automated property size calculations.

**External Property Databases (If Available):** Integration with publicly available property records to enhance valuation accuracy.

**Valuation Model Development**

The valuation model will incorporate multiple variables to generate accurate property valuations:

**Variables Considered**

**1. Environmental Quality:**

- Pollution levels (air, water, noise).

- Land use (residential, commercial, mixed-use).

- Availability of green spaces and sustainable resources.

**2. Social and Economic Factors:**

- Market trends (rental demand, property vacancy rates).

- Rental growth potential based on economic indicators.

**3. Technical and Functional Aspects:**

- Building structure and quality of materials used.
- Age and maintenance level of the property.
- Total property size and usable space.

**4. Site & Locational Attributes:**

- Proximity to public transportation, schools, and shopping centers.
- Road access and neighborhood security.

**Model Customization**

- The valuation model will be tailored for the Nigerian real estate market, incorporating local trends and pricing structures.

- Users will have the flexibility to manually input or override certain automated values for greater accuracy.

**User Testing and Feedback**

A structured testing phase will be conducted to refine the application:

**Beta Testing Group:** A sample of estate surveyors, real estate professionals, and property owners will test the app.

**Feedback Collection:** Users will provide insights on:

- The accuracy of property valuation results.
- The ease of navigation and usability of the application.
- Performance and responsiveness of the valuation model.

**Final Refinements:** Necessary improvements will be made based on user feedback before the final release.

**Limitations and Challenges**

**Data Accuracy:** Reliance on Google Maps and user input may lead to inaccuracies in property size calculation.

**Market Dynamics:** The app's valuation model may require regular updates to keep pace with changing real estate market conditions.

**User Variability:** Different users may provide inconsistent data, which could affect the accuracy of valuations.

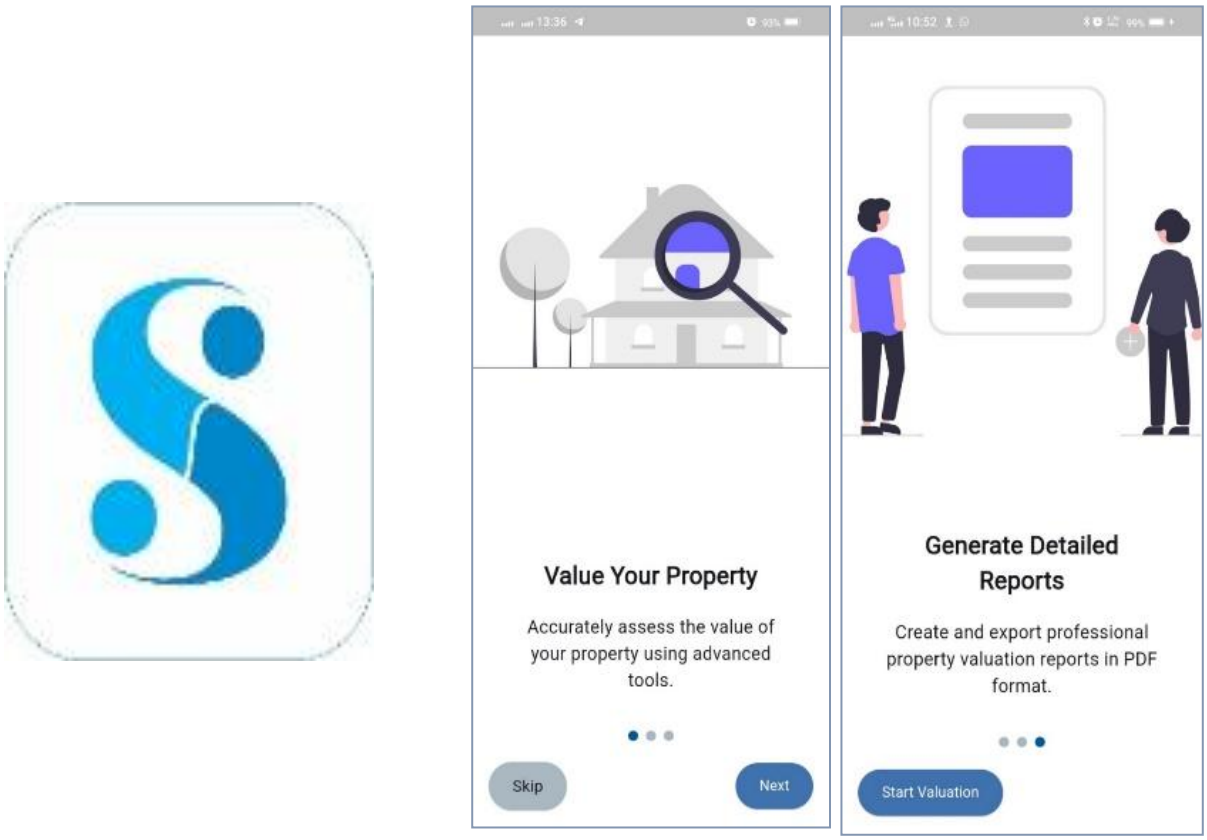
This methodology provides a structured approach to developing a mobile application for property valuation using Flutter. By leveraging mobile technology and integrating with Google Maps, the application aims to simplify and automate the valuation process, making it accessible


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to users in Nigeria and similar developing markets. The combination of manual input and automated processes ensures flexibility and accuracy, tailored to the local context.

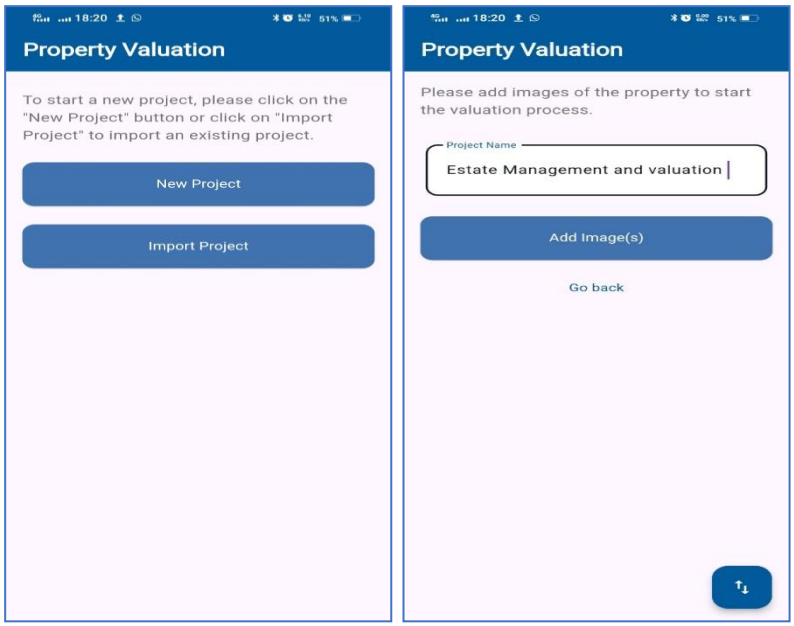
**Case Example**

The study performed a field test on the developed mobile application software using the estate management and valuation departmental library as a case study. The Figure below shows the introductory view of the mobile application (S-Values).




**Introductory Page of S-Value Software Application**

**New Project/Import Project Interface of the Software**



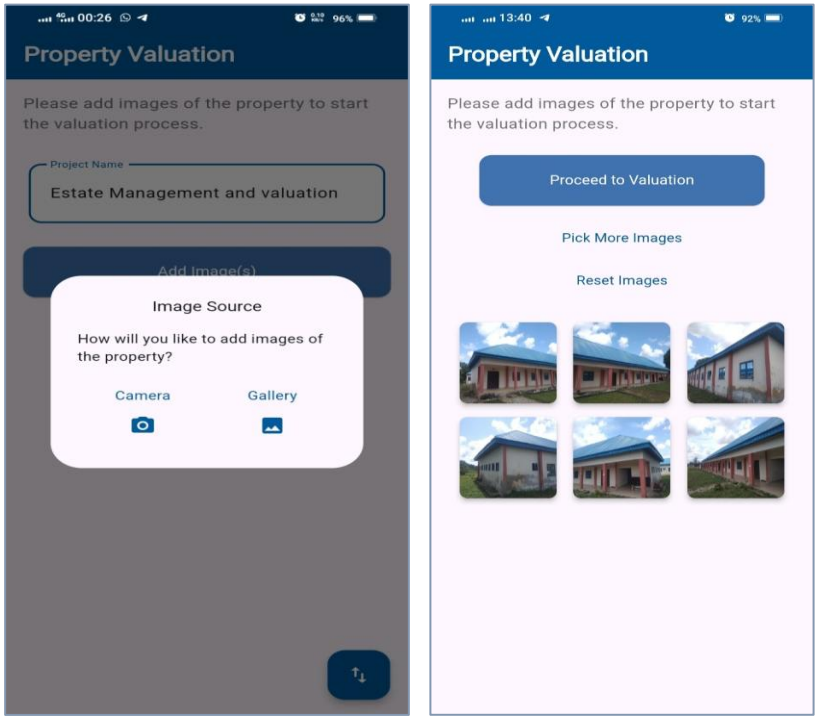
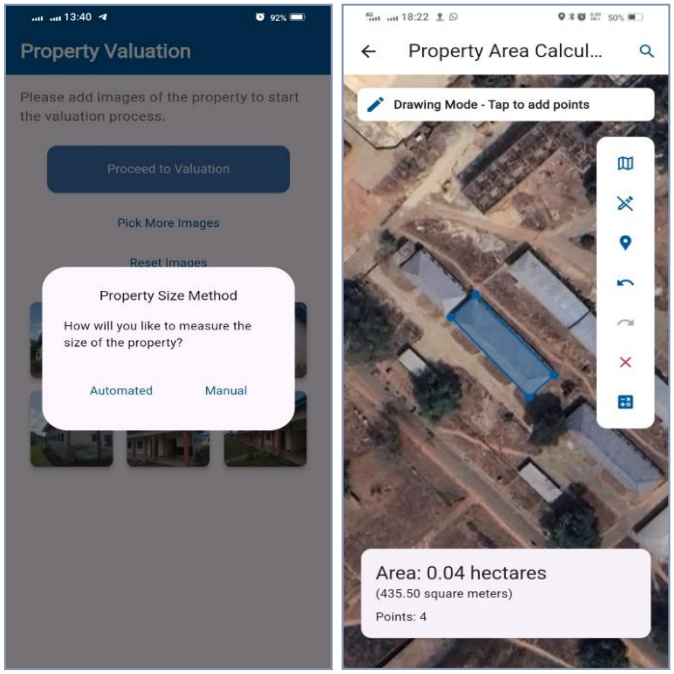
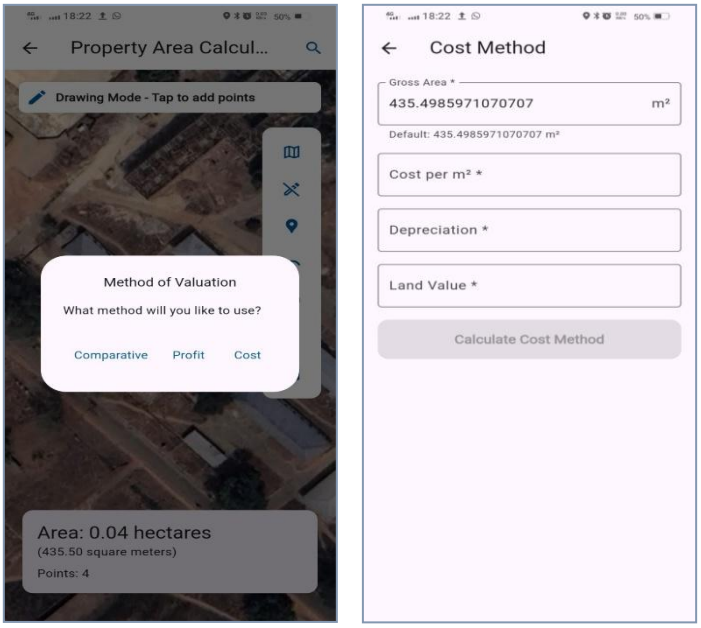



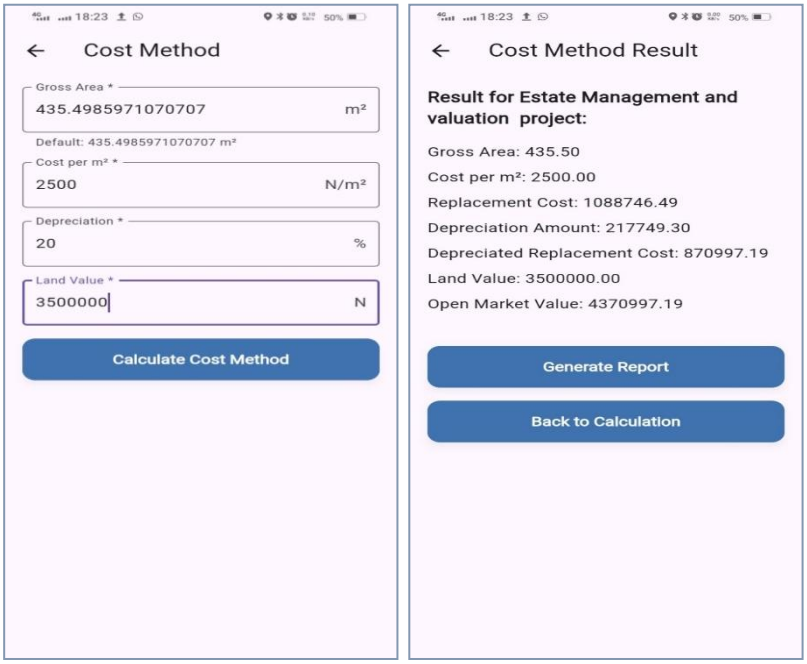

**Image Capture Process of Valuation on S-Value Software**


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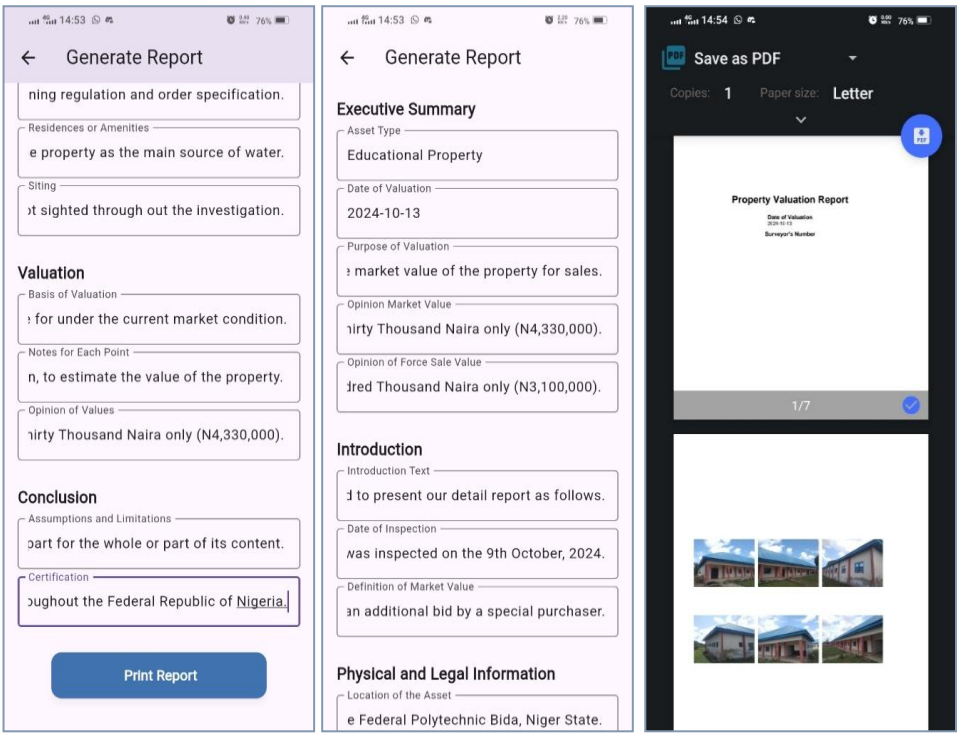

**Area Measurement of Land/Property through an Integrated Map Methods of Valuation and the Interface in S-Value Software**






**Valuation Process and Result Interface in S-Value Software**

**Generation and Storing of Valuation Report on S-Value Software**





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## CONCLUSION

The findings of this study confirm a significant need for technological intervention in the Nigerian real estate sector, particularly in property valuation. The unanimous agreement among estate surveyors and valuers on the necessity of a software application highlights the growing importance of digital solutions in improving efficiency and accuracy in real estate practices. The preference for the Depreciated Replacement Cost Method suggests that this approach aligns well with the current market conditions and valuation needs in Nigeria. The development of the mobile application represents a practical response to these needs, offering a tool that not only simplifies the property valuation process but also incorporates essential features that can make the valuation process much easier. By leveraging mobile technology and integrating with Google Maps, the application is well-positioned to enhance real estate practices in Nigeria and potentially in other developing markets.

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