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# ENHANCING NATIVE PIG MANAGEMENT: A COMPREHENSIVE ANALYSIS OF THE DEVELOPMENT OF A MORPHOLOGICAL DATA INFORMATION SYSTEM

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**Abstract**

The development of a Morphological Data Information System is vital for enhancing the management of native pigs at the Markaduke Research and Development Center. By incorporating both qualitative and quantitative traits, this system caters to the center's needs effectively. It enables swift collection and monitoring of pigs' gross morphology and morphometric data, ensuring seamless daily operations. Developed with input from end-users, the system aligns with organizational processes, offering features like record management, data analysis, and report generation. Through a prototyping approach, flaws were addressed, resulting in a system that met the ISO 25010 software quality model standards, scoring an impressive 4.416 on average, indicating its high quality. This project exemplifies the importance of tailored solutions in agricultural research, demonstrating how technology can streamline processes and enhance overall efficiency in managing native pig data.

**Keywords:** Native Pig, Data Analysis, MARKADUKE, Morphology, Morphological Data.

## 1. INTRODUCTION

The indigenous native pig of the Philippines evolved from five widespread wild species ("baboy damo") namely Sus philippensis, Sus cebifrons, Sus ahoenobarbus, Sus oliveri, and Sus mindanensis. They are described as having black coat color, eyes, small ears, and a longer snout. Native pigs are strict "stashes" generally brought up in patios 9 by a large number of little ranchers all through the country as an additional source of revenue [1]. Native animals are recognized as an essential component of the rural agricultural production system. In agriculture, especially in raising native pigs, one must first learn and adopt natural farming protocols, breeding, managing, feeding, housing, and caring of pigs. Native pigs have evolved distinct behavioral patterns due to natural selection, enhancing its adaptability to local conditions and resilience to climatic extremes. Native pigs are precious in extra money, high-quality source of protein food, and socio-economic as well as cultural services, especially during special traditional parties and ceremonies. Other notable traits of native pigs are their adaptability to local environmental

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circumstances, apparent disease resistance, and the meat's distinct quality and flavor [2]. The reproductive performance of native pig sows can last up to 7 parity, or three years longer, after which it will be culled. Boars which are 8-12 months old can be utilized for insemination at least once a week, whereas boars more than 1-year-old may be used twice a week. Semen collection is usually done early in the morning or late in the afternoon since boar semen is temperature-sensitive.

MARKADUKE native pig raised at the nucleus farm in Marinduque State College (MSC) is considered an essential component in agricultural fields. The MARKADUKE Team practiced ear notching as a way to properly identify native pigs. The Monitoring Team conducts monthly data gathering related to the qualitative, quantitative traits, and morphometric data of all native pigs inside the farm. All collected data from the farm will be the basis of the organization to select a quality breed generation to sustain the reproductive and growth performance of native pigs. The qualitative traits being collected and monitored are the hair type, ear type, coat color, head shape, skin type, among others. Quantitative information consists of the bodyweight, head-length, birth weight, pelvic-width, etc. Predicting and monitoring the reproductive performance of sow native pig is based on several economically important traits such as total litter size born, male born, female born, pre-weaning mortality, and litter size weaned.

The monitoring team faces challenges in gathering and managing information using manual procedures. Currently, they rely on a paper-based method to record qualitative and quantitative data of native pigs. Retrieving historical data proves difficult at times, and the process is time-consuming. Morphological data collection is done manually, recorded in a logbook during scheduled data collection sessions, and later transferred to an Excel file. This process significantly delays the analysis of pig reproductive performance, as identifying the quality sow and boar generation takes considerable time.

Collecting both quantitative and qualitative data is crucial for assessing the production performance of native pigs, particularly in Marinduque Province [3]. This data collection aids in selecting and predicting the potential outcomes and quality of native pig breeding pairs. Additionally, maintaining records of native pigs helps track reproductive performance, allowing smallholders to monitor farrowing rates accurately [4]. Sows exhibiting increased litter sizes born alive in their first parity serve as reliable indicators for predicting future performance quality.

In response to the organization's current operational challenges, the proponent has pioneered an innovative solution aimed at revolutionizing the monitoring process. This cutting-edge development seeks to streamline and elevate the existing method by facilitating the seamless retrieval and analysis of vast volumes of morphological data. Through this innovation, the organization stands poised to transcend its current limitations, ushering in a new era of efficiency and effectiveness in data management and analysis.

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## 2. AIM OF PAPER

This paper seeks to advance native pig management through a comprehensive analysis of morphological data at the Markaduke Research and Development Center (MRDC), expediting Pig Data Visualization. Additionally, it aims to evaluate the system's performance according to the ISO 25010 software quality model standard.

## 3. RESEARCH DESIGN

The Comprehensive Analysis of the Development of a Morphological Data Information System represents a significant advancement for managing native pig data at the Markaduke Research and Development Center (MSC Torrijos Campus). This web-based platform streamlines the collection and generation of essential pig information, including gross morphology, morphometric measurements, and weight records. By analyzing reproductive performance and qualitative/quantitative traits, the system provides valuable insights based on historical data. Its primary functions operate within a user-friendly web interface, allowing users to browse, manage, and generate information as needed.

Users of the system fall into three categories: The Project Leader/Administrator oversees all functionalities, modules, reports, and system maintenance; the farm encoder/monitoring team collects and provides native pig data; and the Project Staff has access for viewing and accessing reports. This system empowers stakeholders with efficient tools to enhance native pig management practices effectively.

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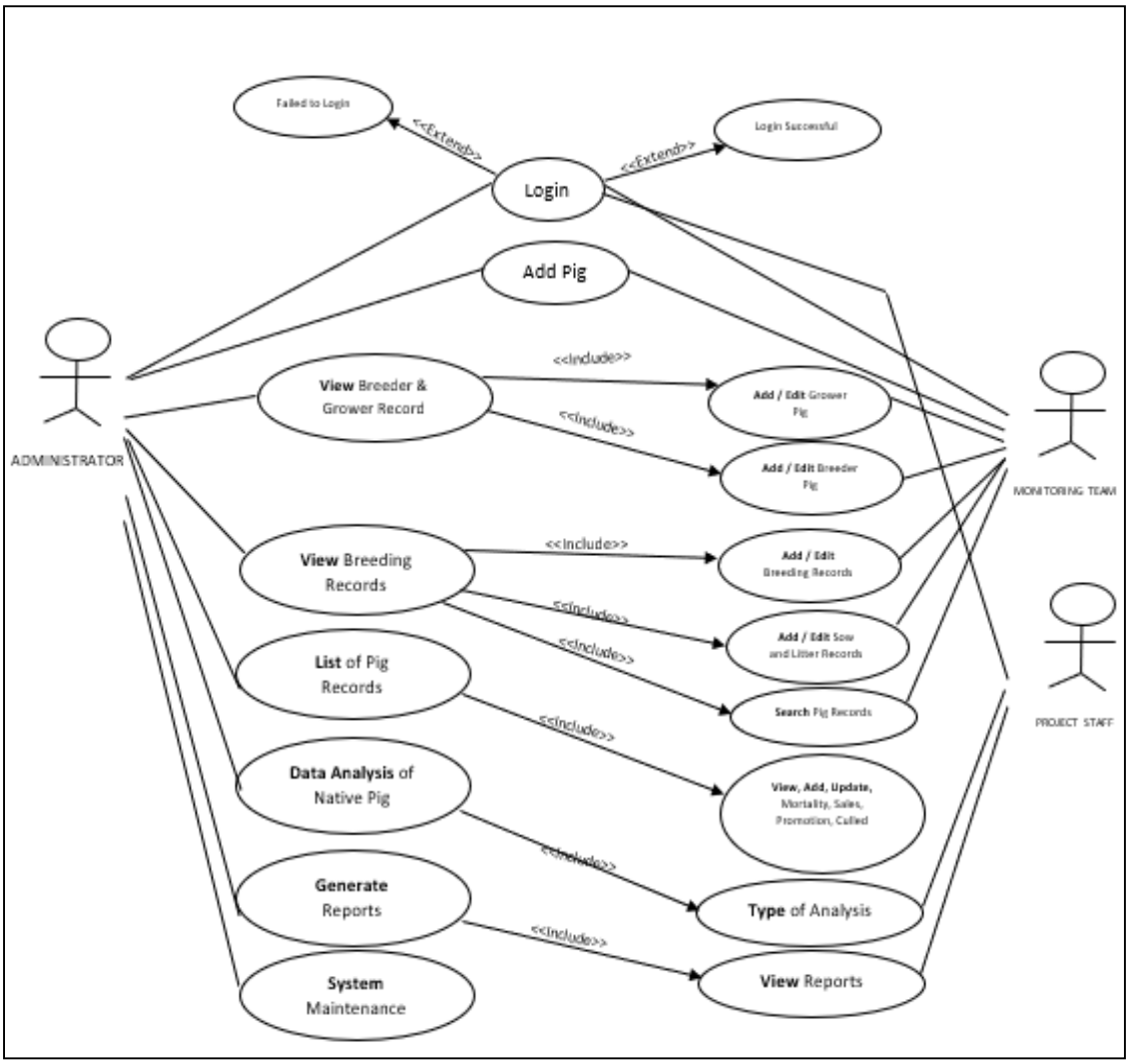


**Figure 1: Use Case Diagram of Comprehensive Analysis of the Development of a Morphological Data Information System (Web-Based Platform)**

Figure 1 provides a Use Case (UML) Diagram depicting the functionality and flow of the Information System, a web-based platform. This diagram illustrates the roles and interactions of three key users: the Administrator/Project Leader, Monitoring Team/Farm Encoder, and Project Staff. Accessing the system's main dashboard requires users to log in with their respective credentials. Both the Administrator and Monitoring Team have the capability to add and update native pig records. To view breeder and grower native pig records, users navigate through the main navigation/module button and select a sub-menu containing sorted and filtered information. The system's primary functions include adding and updating Gross Morphology, Morphometric, and Weight Data for breeder and grower records. Additionally, users can view and manage breeding records, ensuring completeness before saving data. This intuitive system design optimizes user experience and enhances native pig management efficiency.

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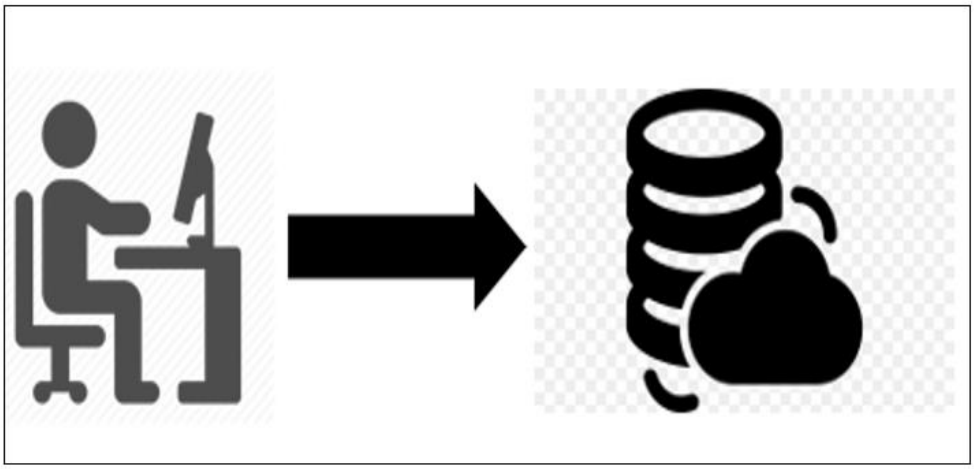

**Figure 2: Architectural Design of Comprehensive Analysis of the Development of a Morphological Data Information System (Web Platform)**

Figure 2 presents the Architecture Design of the Comprehensive Analysis of the Development of a Morphological Data Information System (Web-Platform), elucidating its structural framework. Users interact with the system to input qualitative and quantitative traits data, facilitating seamless data analysis. This system expedites information processing, yielding precise results in response to user commands. All native pig data is securely stored and archived via cloud-based databases, ensuring robust data management and accessibility. This architectural layout underscores the system's efficiency and reliability in empowering users with swift and accurate data-driven insights for effective native pig management.

## Project Development

In the project development phase, the Prototyping Model depicted in Figure 3 serves as a guiding framework for understanding the organization's daily processes. This model facilitates the identification of project requirements and enables prompt error rectification. Within the Prototyping Model, various processes and procedures are employed, including:

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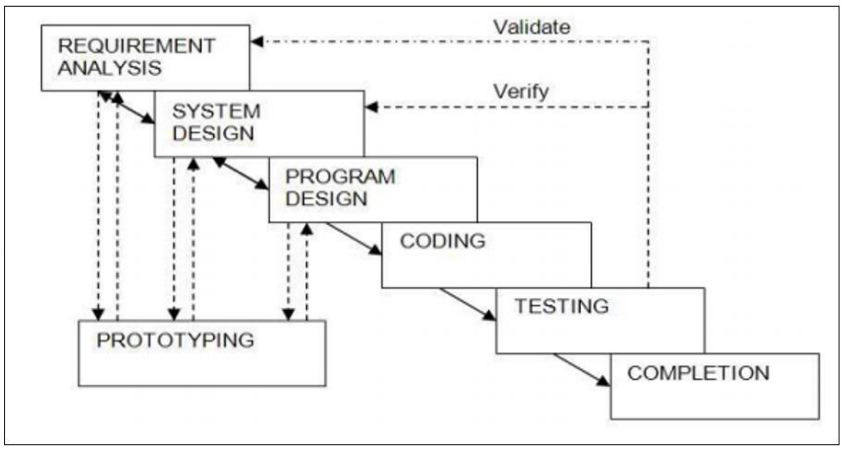


**Figure 3: Prototyping Model**

## Operation and Testing Procedure

To ensure the system's quality, a series of tests were performed on each module of the system, and the system was run an actual operation, specifically in the Monitoring of native pigs in the MARKADUKE Research and Development Center.

## Functionality Test

The examination of the system's functionality was carried out to verify that it aligns with the organization's criteria and processes. Following the creation stage, the examiner undertook the following steps:

1. Development of test cases for each functionality within the system's modules.
2. Execution of the test cases.
3. Documentation of the test results.
4. Analysis of failed test cases to identify and rectify system anomalies and bugs.
5. Re-execution of failed test cases to confirm improvements in system performance.

Each test case included a set of inputs, execution preconditions, and expected outcomes. The test cases were structured according to Table 1.

**Table 1: Test Case Form**

| | | |
|---|---|---|
| Test Case ID: | | |
| Objective: | | |
| Assumptions / Preconditions: | | |
| Actions | | Expected Results |
| 1. | | |
| 2. | | |
| 3. | | |
| Status | Severity | Priority |

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The table includes the following information:

1. Test Case ID: This unique numerical identifier distinguishes each test case from others.
2. Objective: This section outlines the intended purpose or goal of the test case.
3. Assumptions/Preconditions: These criteria specify the conditions that must be met before executing the test procedure.
4. Actions: Here, the sequential steps required to carry out the test case are outlined.
5. Expected Results: This column defines the anticipated outcome or output of the test.

Actual result Indicates whether the application passed or failed the test case. Additionally, severity and priority markers are provided to denote the significance and urgency of any issues encountered during testing.

**Table 2: Severity Classification and Priority Level of Errors**

| Severity | Description | Priority |
|---|---|---|
| Critical (Severity 1) | These issues are showstoppers and productivity is severely stuck and no workarounds exist and require immediate resolution | High |
| Major (Severity 2) | These are issues that have impact to productivity but can be worked around | Medium |
| Minor (Severity 3) | These are issues that do not prevent productivity to be carried over. All issues have workaround | Low |

Thorough assessment of the test outcomes was conducted upon completion of the testing phase. Functional testing procedures were concluded, and the system's acceptability was contingent upon meeting specific exit criteria:

1. Execution and documentation of 100% of the designated test cases, with results duly recorded.
2. Absence of any unresolved Severity 1 issues.

The testing process comprised two cycles. Following the initial cycle, any test cases that failed were meticulously examined and debugged until resolution. Subsequently, these rectified test cases underwent retesting during the second cycle to validate bug fixes. A summary report form, as depicted in Table 2, served as a tool to ascertain adherence to the test criteria.

## Evaluation Procedure

The following activities were carried out to evaluate the performance of the system:

1. A demonstration session was conducted by the developer, with participation from an expert and a farm staff member from MRDC, showcasing the system's functionality.
2. The application was downloaded and installed on relevant devices.
3. The evaluator was provided with adequate time to thoroughly explore the system's features and functionalities.

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4. A panel and evaluator were tasked with assessing the application using the ISO 25010 Software Materials Evaluation Criteria. Ratings were assigned on a scale of 1 to 5, with 5 representing the highest score and 1 the lowest. Data was collected and tabulated to determine both the overall mean and mean for each criterion, as illustrated in Table 3.
5. The numerical values obtained were then interpreted using the descriptive rating scale outlined in Table 4 to provide corresponding qualitative assessments.

**Table 3: Rating Scale for Evaluation**

| Rating | Description |
|---|---|
| 5 | Excellent |
| 4 | Very High |
| 3 | High |
| 2 | Medium |
| 1 | Low |

The Evaluation Rating Scale is shown in Table 3. It is a standard instrument that is commonly used in questionnaire-based research. It is primarily used to interpret survey research responses.

**Table 4: Numerical Rating and its Descriptive Rating**

| Numerical Scale | Description |
|---|---|
| 4.56 – 5.00 | Excellent |
| 3.56 – 4.55 | Very Good |
| 2.56 – 3.55 | Good |
| 1.56 – 2.55 | Fair |
| 1.00 – 1.55 | Poor |

The numerical rating was used to determine the system's performance based on the obtained rating.

## 4. RESULTS AND DISCUSSION

The "Comprehensive Analysis of the Development of a Morphological Data Information System" is meticulously crafted to offer precise monitoring and in-depth Pig Data Analysis, aiming for enhanced outcomes in every transaction and report within the organization, specifically at the "Markaduke Research and Development Center."

The system comprises essential modules including a user login form, dashboard panel, record management for adding new pigs, breeder records, grower records, breeding records, a comprehensive list of pig records, data analysis tools, reporting functionalities, and a maintenance section. The dashboard panel offers graphical representations of key metrics such as growth performance, inventory, sales, promotions, and culled information, facilitating convenient report generation.

Module for adding new native pigs ensures data accuracy by identifying existing records before submission. Breeder and grower modules allow for the updating and insertion of

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morphometric and gross morphology information, while the breeding records form page simplifies the process of adding multiple native pig siblings simultaneously. Users can easily save and modify records. The system also features pedigree data analysis functions, enabling the viewing of native pig generations with corresponding information on parity and services.

Moreover, the system accurately monitors native pig reproductive performance and analyzes performance based on morphological information. Report generation, including Morphometric Data, Gross Morphology Data, Mortality, Sales, experimental and promotional reports, Inventory Reports, Breeding Records, and Prediction of Reproductive Performance, is streamlined through parameter setting and automated printing.

Importantly, the system is designed exclusively for native pig monitoring and does not cover other pig species. Features unrelated to the research project, such as native pig breeding, are intentionally omitted from the system functionalities.

## Evaluation Results

The software's quality performance was assessed utilizing the ISO 25010 criteria, which encompass Functionality, Reliability, Portability, Usability, Performance Efficiency, Security, Compatibility, and Maintainability. Table 10 provides a comprehensive summary of the evaluation outcomes, including the weighted mean for each criterion and the corresponding qualitative interpretation. Additionally, the table presents the grand mean, calculated by averaging the means of the eight criteria.

**Table 5: Summary of Evaluation Results**

| Criteria | Mean | Qualitative Interpretation |
|---|---|---|
| Functionality Sustainability | 4.50 | Very Good |
| Reliability | 4.35 | Very Good |
| Usability | 4.37 | Very Good |
| Performance Efficiency | 4.40 | Very Good |
| Maintainability | 4.33 | Very Good |
| Security | 4.36 | Very Good |
| Compatibility | 4.60 | Excellent |
| **Grand Mean** | **4.416** | **Very Good** |

*Range of values: 4.20 – 5.00 = Excellent; 3.40 – 4.19 = Very Good; 2.60 – 3.39 = Good; 1.80 – 2.59 = Fair; 1.00 – 1.79 = Poor

The functionality performance of the system obtained very good rating with a mean of 4.50. This standard got the highest rating based on the evaluation results by the end-users. It means that the functionality of the system meets the requirements needed by the organization when it comes to processing, monitoring, and generating qualitative and quantitative data. Moreover, the evaluation results imply that the output of the system is correct and suitable to use in the daily operation of MARKADUKE Farm.

Furthermore, in the reliability evaluation, the system got an average of 4.35, resulting in very good results. The evaluation results show that the system or the software is reliable

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and enough to use in day-to-day operation, and it can perform its functions depending on the end user's command.

The usability evaluation was marked as very good, with an average mean of 4.37. The evaluation results show that the specific users can use the system functionalities and modules with different credential type status that will achieve the set objectives with optimal effectiveness, efficiency, and satisfaction.

On the other hand, the performance evaluation was also conducted and got an average mean result of 4.40. As the result of the assessment, it interpreted as very good. It implies that the response and processing time of every functionality and page of the system met the requirements set.

Likewise, in the security evaluation of the system, it obtained an average of 4.36. The results of the evaluation translate to very good interpretation. The method implies that the system can ensure data privacy, especially native pig records, and it is only accessible and delimited only to the authorized users of the system.

Moreover, the results of the evaluation of compatibility, show an average mean of 4.60. It proves that the system can perform its required functions according to the command of the end-user efficiently. Also, the system module is integrated successfully with no other issues with the functionality and responsiveness of the software.

Lastly, the maintainability evaluation got a results average mean of 4.33, resulting in an "very good" interpretation. As a result, the set evaluation met the organization's requirements and processes in actual operation. The specification and functionality of the system are maintainable and flexible enough to handle the changing needs and requirements of the user.

## 5. CONCLUSION

Based on the findings of the study, the following conclusions were drawn regarding the developed system:

1. Based on the result of the developed system, it is technically, operational, and economically feasible and it met the objectives of the organization.
2. The assessment conducted using the ISO 25010 framework revealed an overall mean average of 4.416, indicating a classification of "Very Good." This underscores that the system's functionality and features align effectively with the organization's requirements and processes for gathering, monitoring, and generating native pig data.
3. Based on the evaluation conducted by the system's end-user in Markaduke Research and Development Center, the software is fully functional and meets the specification and compatibility needed on the Farm.
4. Based on Browsers testing, the system was fully functional and compatible in size, loading and waiting time, user-friendly, and system responsiveness.

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