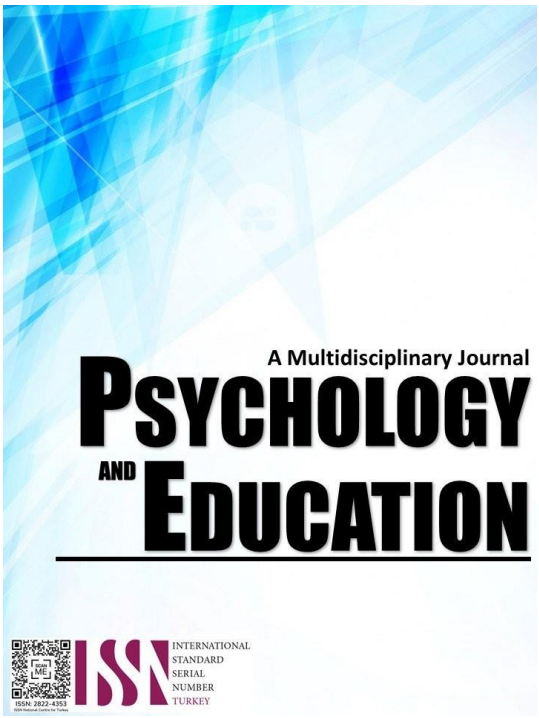
NAVIGATING VETERINARY PRACTICE IN THE DIGITAL AGE: IMPLEMENTING A WEB-BASED INFORMATION MANAGEMENT SYSTEM AT ANIMALS' CHOICE CLINIC



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Research Article

Navigating Veterinary Practice in the Digital Age: Implementing a Web-Based Information Management System at Animals' Choice Clinic

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Abstract

The increasing demand for veterinary services in urban areas presents both opportunities and challenges for clinics like Animals' Choice Clinic. Pet owners often face the inconvenience of physical visits without prior knowledge of appointment availability. To address these issues, the proponents developed a web-based Veterinary Information Management System (VIMS) aimed at streamlining appointment schedules, digitizing medical records, and enhancing client communication. The inefficiencies of manual processes, such as appointment overlaps and misplaced paper records, can lead to wasted time, decreased client trust, and potential revenue loss. VIMS was developed using the Agile Scrum methodology, allowing for iterative development and flexibility. The system's quality was evaluated using a checklist based on ISO/IEC 25010 standards, assessing aspects like functionality, performance, and usability. User satisfaction was measured through surveys based on the Technology Acceptance Model (TAM), focusing on perceived usefulness and ease of use. The evaluation involved 50 participants, including IT experts, clinic staff, and pet owners. Results showed a prominent level of technical quality, with VIMS scoring an average of 4.63 out of 5.00, indicating an "Excellent" rating. User satisfaction, based on the Technology Acceptance Model (TAM) criteria, was also positive, with an average score of 3.68 out of 5.00, categorized as "Very Good." Following the implementation of VIMS, the clinic experienced a 40% reduction in appointment no-shows and improved accuracy in medical record keeping. This project proves how the adoption of digital solutions in small veterinary clinics can contribute to operational efficiency and aligns with the United Nations' Sustainable Development Goal 9, which promotes resilient infrastructure and fosters innovation.

Keywords: *Veterinary management system, clinic appointment system, ISO/IEC 25010, Agile Scrum, clinic efficiency*

Introduction

The scenario of a pet owner facing a prolonged wait to schedule an urgent veterinary appointment at Animals' Choice Clinic highlights the operational challenges that can arise from reliance on manual systems. The clinic's previous dependence on physical appointment books and verbal confirmations frequently resulted in scheduling conflicts, lost records, and overburdened staff. These inefficiencies not only affected the clinic's team but also affected the quality of care provided and the overall satisfaction of their clientele.

Contemporary studies underscore the potential of digital solutions to mitigate such common operational problems in service-oriented businesses. For instance, research by Jamil et al. (2023) suggests that automated systems can significantly alleviate operational stress by simplifying workflows and minimizing manual errors. While larger veterinary facilities might have the resources to invest in sophisticated digital technologies, smaller clinics often struggle to identify affordable and tailored systems that effectively meet their specific needs.

According to data from Jotform (2023), the implementation of online scheduling systems can lead to improved client experience by reducing waiting times and offering clients the convenience of viewing and selecting available appointment slots. Jamil et al. (2023) also emphasizes that digital scheduling not only lightens the administrative workload but also enables veterinarians to dedicate more time to patient care rather than administrative tasks. This shift can result in enhanced service quality and stronger, more positive relationships between the clinic and its clients.

In today's rapidly evolving landscape, the service industry is pivotal in ensuring the smooth and timely delivery of essential services. Even for businesses primarily focused on product sales, the quality of services such as customer support and after-sales care significantly shape the overall customer experience. Seamless operational management is fundamental to delivering high-quality service, and this is where the integration of digital systems becomes crucial. As described by Zulkifli and Abidin (2020), a system includes interconnected tools or processes working in concert to address a specific problem. Well-integrated systems not only simplify tasks for staff but also enable both staff and clients to navigate processes more efficiently and quickly.

With the expansion of both retail and service-based enterprises, efficient appointment scheduling has transcended being merely beneficial to becoming an absolute necessity. From small local clinics to multinational corporations, the ability to manage appointments effectively has become a top priority. Appointment scheduling involves more than just booking slots; it encompasses organizing staff schedules, allocating resources, and ensuring that clients receive timely and high-quality service. As explained by Liu et al. (2019), the automation of scheduling allows service providers to decrease inefficiencies, minimize client wait times, and enhance overall productivity and satisfaction.

Considering these factors, this capstone project proposes the development of a digital appointment scheduling system specifically

designed for Animals' Choice Clinic. By directly addressing the challenges inherent in their current manual processes, this web-based system aims to optimize operations, reduce the likelihood of errors, and ultimately elevate the clinic's service delivery and the experience of its clients.

Research Objectives

This project was guided by the following objectives:

1. To develop VIMS, a user-friendly web-based platform capable of managing appointments, medical records, and automated client reminders in a unified system.
2. To evaluate the technical quality of VIMS based on the ISO/IEC 25010 standards, specifically assessing:
    2.1. functionality;
    2.2. performance efficiency;
    2.3. compatibility;
    2.4. usability;
    2.5. reliability;
    2.6. security;
    2.7. maintainability; and
    2.8. portability.
3. To assess user feedback on VIMS based on the criteria of the Technology Acceptance Model (TAM) , including:
    3.1. perceived usefulness;
    3.2. perceived ease of use;
    3.3. behavioral intention to use; and
    3.4. attitude towards using.

Methodology

Research Design

A quantitative, quasi-experimental research design was adopted to evaluate the effectiveness of VIMS. This approach involved comparing relevant data from Animals' Choice Clinic before and after the implementation of the system to measure changes in operational efficiency. For instance, the time taken to schedule appointments using the manual system was compared to the time taken using VIMS. Similarly, data on appointment no-shows and the accuracy of medical records were analyzed to determine the impact of the new system. Quasi-experimental designs are often used in real-world settings where it is not feasible to randomly assign participants to control and experimental groups, making it suitable for evaluating the implementation of a new system in an existing clinic.

System Development

The development of VIMS was guided by the Agile Scrum methodology. This framework helps the breakdown of complex projects into smaller, manageable iterations known as sprints. The entire development process spanned three sprints, with each sprint lasting two to three weeks depending on the complexity of the features being developed. During the first sprint, the primary focus was on designing and developing the core functionality of the system, which was the appointment calendar. The second sprint concentrated on creating customizable templates for recording pet-patient medical histories. In the final sprint, the team implemented automated SMS reminders to notify pet owners of upcoming appointments, a feature designed to reduce no-shows and last-minute cancellations. This iterative approach allowed for continuous testing and refinement of the system based on ongoing feedback and the evolving needs of the project.

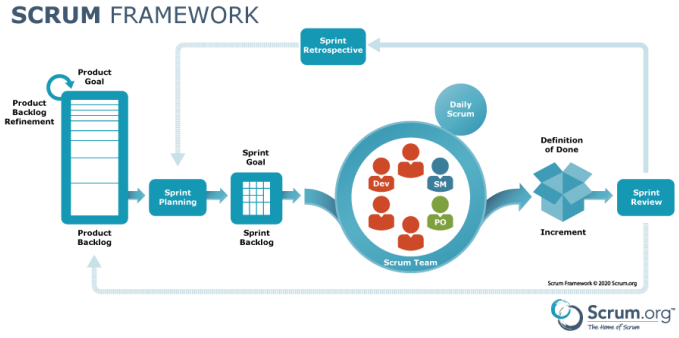

Figure 1. *Agile Scrum Framework*

Respondents

A total of 50 participants were recruited for the evaluation of VIMS, representing three key stakeholder groups. The first group consisted of 20 IT professionals from the proponents' college. These participants were selected based on their expertise in information technology

and software systems, allowing them to provide informed feedback on the technical quality of VIMS according to the ISO 25010 standards. The second group comprised 20 staff members from Animals' Choice Clinic, including veterinarians, nurses, and receptionists. Their involvement was crucial as they would be the primary users of the system in their daily workflows. Their feedback focused on the system's usability, functionality, and its impact on their efficiency. The final group consisted of 10 pet owners who were regular clients of Animals' Choice Clinic. Their perspective was vital for assessing the user-friendliness and convenience of the system from the client's point of view, particularly addressing their past frustrations with long wait times and booking issues. The inclusion of these diverse groups ensured a well-rounded evaluation of VIMS, considering both technical aspects and the needs of different types of users.

Instrument

To evaluate the quality and user acceptance of VIMS, two primary survey instruments were utilized. The first was a checklist based on the ISO/IEC 25010 standard. This checklist comprised a series of statements related to the eight quality characteristics of the standard: functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. Respondents were asked to rate the system based on these characteristics using a 5-point Likert scale, where 1 represented "Poor" and 5 represented "Excellent."

Table 1. *The rubric used to assess the VIMS based on the ISO/IEC 25010 Standards.*

Numerical Rating	*Qualitative Rating*	*Verbal Description*
4.20 –5.00	Excellent	The application met all the quality development of the system standards.
3.40 –4.19	Very Good	The application met almost all the quality standards of software development. Minimal modification is required.
2.60 –3.39	Good	The application met some of the quality standards of software development. Some revisions are required.
1.80 –2.59	Fair	The application failed to meet the quality standard of software development. Major revisions are required.
1.00 –1.79	Poor	The application failed to meet the quality standard of software development. Needs to be redone to serve its purpose.

The second instrument was a survey founded on the Technology Acceptance Model (TAM). This survey aimed to measure participants' perceptions of the system's perceived usefulness, perceived ease of use, their attitude towards using the system, and their behavioral intention to use it.

Table 2. *The second rubric used to assess the VIMS based on the TAM Criteria*

Numerical Rating	*Qualitative Rating*	*Verbal Description*
4.20 –5.00	Excellent	The application met all the quality standards for system development.
3.40 –4.19	Very Good	The application met almost all the quality standards of software development. Minimal modification is required.
2.60 –3.39	Good	The application met some of the quality standards of software development. Some revisions are required.
1.80 –2.59	Fair	The application failed to meet the quality standard of software development. Major revisions are required.
1.00 –1.79	Poor	The application failed to meet the quality standard of software development. It needs to be redone to serve its purpose.

Each of these constructs was assessed using a series of statements rated on a 5-point Likert scale ranging from 1 ("Strongly Disagree") to 5 ("Strongly Agree"). For the ISO 25010 assessment, the proponents utilized a survey questionnaire previously developed and validated, ensuring a comprehensive evaluation of the veterinary appointment system across all eight qualities.

Procedure

The research process was conducted in two distinct major phases: the application development stage and the evaluation stage. During the application development phase, the Agile Scrum Model served as the guiding framework. The development team commenced with a planning phase to identify and document the detailed requirements for the Veterinary Appointment System (VAS), one of the main functional requirements of VIMS. This involved understanding the common challenges faced by veterinary clinics in managing client appointments and pet health records. Based on these requirements, the system progressed through the design and development stages, which included the implementation of features such as online appointment scheduling, a real-time availability calendar, automated appointment reminders via SMS, and online payment processing capabilities. Throughout the development process, ongoing testing and adjustments were performed, with valuable input from veterinarians, clinic staff, and pet owners significantly influencing the system's refinement and ensuring it met their needs effectively. For the evaluation stage, the research team obtained formal permission from IT professionals, the management of Animals' Choice Clinic, and the selected pet owners to participate in trialing the developed system. Upon receiving their informed consent, the Veterinary Appointment System was presented to the participants, and they were

given the opportunity to interact with it and observe its functionalities. Following their interaction with the system, participants were asked to provide their feedback on its functionality, usability, and performance by completing a structured questionnaire comprising the ISO 25010 checklist and the TAM survey. To uphold the ethical principles of research, the confidentiality of all respondents and their feedback was strictly maintained throughout the study. Furthermore, clear and comprehensive instructions and descriptions were provided for each item in the questionnaire to facilitate meaningful and honest feedback from all participants.

Data Analysis

The project employed a quantitative, quasi-experimental research design to evaluate the impact and user acceptance of the developed VIMS system. Data collection primarily involved the administration of survey questionnaires and usability tests conducted with the participation of clinic staff, pet owners, and IT professionals. The system development methodology adhered to the Software Development Life Cycle (SDLC) principles and was executed using the Agile Scrum framework, ensuring an iterative development process and the continuous integration of stakeholder feedback. The evaluation of the system was guided by the ISO 25010 quality model and the Technology Acceptance Model (TAM) metrics. The data collected from the surveys were analyzed using descriptive statistics, specifically calculating the mean scores for each of the ISO 25010 quality characteristics and the TAM constructs. These mean scores were then interpreted based on predefined scales to assess the overall system effectiveness and user satisfaction.

Ethical Considerations

Ethical considerations were paramount throughout the research process. Prior to their participation, all individuals involved in the study were provided with detailed information about the project's objectives, the procedures involved, and the expected duration of their involvement. They were also assured of the confidentiality of their responses and their right to withdraw from the study at any point without any consequences. Informed consent was formally obtained from each participant before they engaged in any data collection activities. To protect the privacy of the participants, all data collected were anonymized. For example, in the analysis and reporting of the findings, participants were referred to using labels such as "IT Professional #1," "Clinic Staff #5," or "Pet Owner #8" instead of their actual names. All collected data were stored securely and were only accessible to the research team for the purpose of analysis and reporting. The study protocol was reviewed to ensure that it adhered to ethical guidelines for research involving human participants and software development.

Results and Discussion

Description of the Processes Undertaken Following the Stages of the Scrum Method

The development of the Veterinary Information Management System (VIMS) at Animals' Choice Clinic followed the structured yet flexible approach of the Agile Scrum methodology. This iterative framework allowed the project team to break down the development into manageable phases, ensuring continuous progress and the incorporation of feedback.

Product Backlog

According to Gurendo (2020), a product backlog is a dynamic list of features and requirements intended for implementation during the development process. These items, often phrased as user stories, are prioritized based on their value and the overall project goals. The proponent initiated this phase by engaging in detailed consultations with the key stakeholders of Animals' Choice Clinic, including veterinarians, clinic staff, and pet owners. These discussions aimed to identify the most pressing needs and challenges related to appointment scheduling, medical record management, and client communication. Simultaneously, research was conducted on existing veterinary practice management systems to understand industry best practices and identify potential features that could benefit the clinic. This comprehensive approach resulted in the identification of core features for VIMS, including online appointment scheduling with real-time availability, a secure and easily accessible electronic health record system for pets, automated SMS and email reminders for appointments and follow-ups, a client portal for viewing appointments and pet records, and basic reporting functionalities. These features were then documented as user stories and prioritized based on their perceived value and feasibility, forming the initial product backlog that guided the subsequent development sprints.

Sprint Planning Phase

The sprint planning phase, as described by Gurendo (2020), is a crucial event in Scrum where the development team, along with the product owner and Scrum master, collaborate to determine the scope of work for the upcoming sprint. For the VIMS project, three sprints were planned, each with a duration of two weeks. At the beginning of each sprint, a sprint planning meeting was held. In these meetings, the product owner (representing the stakeholders) presented the prioritized items from the product backlog. The development team then discussed these items, breaking them down into smaller, actionable tasks and estimating the effort required for each task. A key outcome of the sprint planning was the definition of the Sprint Goal – a concise statement that describes what the team aims to achieve during the sprint. For the first sprint, the goal was to develop the core functionality of online appointment scheduling. The second sprint focused on implementing the electronic health record system with customizable templates. The final sprint aimed at integrating the automated SMS reminder system. The team also created a Sprint Backlog, which is a detailed list of the tasks they committed to completing during the sprint to achieve the Sprint Goal. This process involved careful consideration of the team's capacity

and ensuring that the selected user stories could be completed within the two-week time frame, fostering a focused and achievable development plan for each sprint.

Implementation

The implementation phase in the Scrum framework is where the development team actively works on the tasks outlined in the Sprint Backlog to create a functional increment of the product. For the VIMS project, the first sprint involved the development of the online appointment scheduling module. This included designing the user interface for the appointment calendar, implementing the logic for checking appointment availability, and allowing clients to book appointments online. The development team utilized web development technologies such as HTML, CSS, JavaScript, and a suitable backend framework (e.g., Python with Django or Node.js with Express) to build this module. The second sprint focused on the creation of the electronic health record (EHR) system. This involved designing a database schema to store patient information, medical history, vaccination records, and other relevant data. Customizable templates were created to allow clinic staff to easily input and retrieve patient information. Features such as search and filtering were also implemented to enhance usability. In the third and final sprint, the team focused on integrating the automated SMS reminder system. This involved connecting the VIMS platform with an SMS gateway provider. Logic was implemented to automatically send reminders to pet owners a specified time before their scheduled appointments. This feature also included options for customizing the reminder messages. Throughout all three sprints, the development team followed best practices in coding, testing, and version control to ensure the quality and stability of the VIMS system. Regular daily scrum meetings were held to track progress, identify any roadblocks, and ensure that the team remained on track to meet the Sprint Goals.

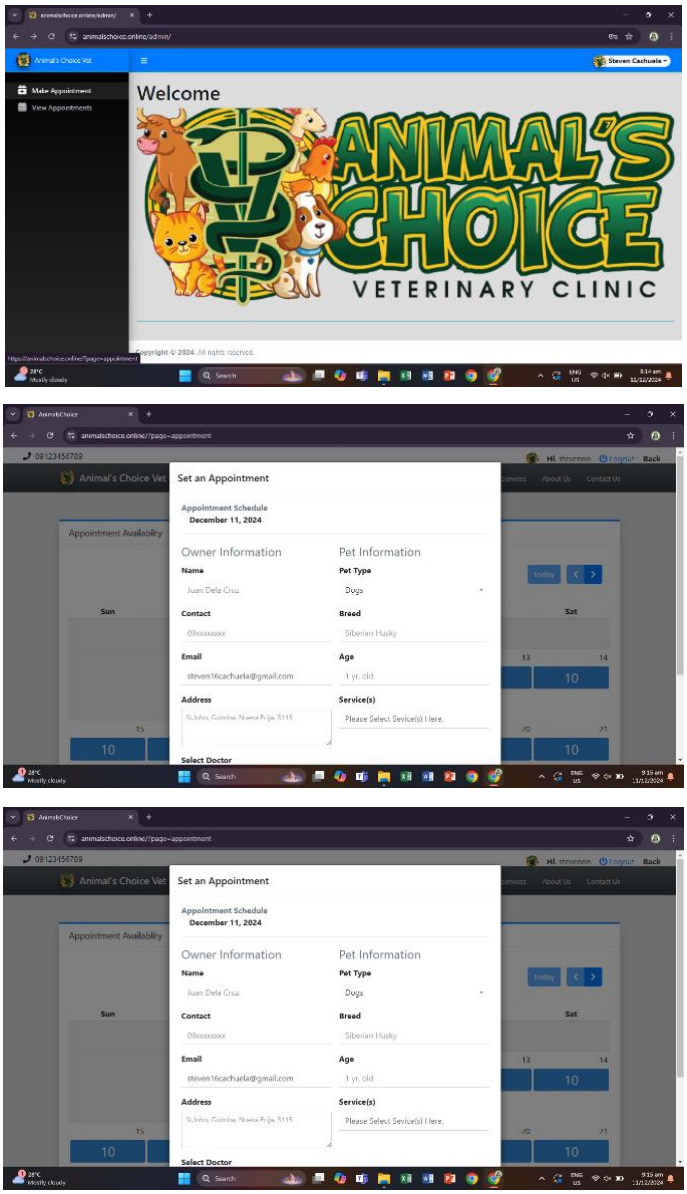

Figure 2. *The Web View for the Animal Choice's Veterinary Information System*

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Review

Based on Gurendo, D. (2020) study, a sprint review is held at the end of each sprint to present the completed product increment to stakeholders. This event provides an opportunity for stakeholders to inspect the work done and provide feedback. For the VIMS project, a sprint review meeting was conducted at the end of each two-week sprint. During these meetings, the development team demonstrated the new features and functionalities that were implemented during the sprint. For instance, at the end of the first sprint, the online appointment scheduling module was showcased to representatives from Animals' Choice Clinic and a few selected pet owners. They were able to interact with the system, book appointments, and provide their initial feedback on its usability and functionality. Similarly, the EHR system and the SMS reminder feature were demonstrated at the end of the second and third sprints, respectively. Stakeholders were encouraged to ask questions, provide suggestions for improvements, and express any concerns they had. The feedback received during these sprint review meetings was invaluable for the project team. It helped to identify any issues early in the development process and ensured that the system was being built in a way that truly met the needs of the end-users. The insights gained from these reviews were then used to refine the product backlog and plan the subsequent sprints, ensuring an adaptive and user-centered development approach.

System Evaluation Results (Quantitative findings from ISO 25010 and TAM)

The evaluation of the Veterinary Information Management System (VIMS) yielded quantitative data based on the ISO 25010 quality model and the Technology Acceptance Model (TAM). Table 3 presents a summary of the mean scores obtained for each of the evaluated characteristics and constructs, along with their corresponding verbal interpretations based on the defined scale.

Table 3. *The Analysis of Data*

Evaluation Criteria	*Mean Score*	*Verbal Interpretation*	*Verbal Description*
		ISO 25010	
Functional Suitability	4.4	Excellent	The application met all the quality standards for system development.
Performance Efficiency	4.27	Very Good	The application met almost all the quality standards of software development. Minimal modification is required.
Compatibility	4.3	Very Good	The application met almost all the quality standards of software development. Minimal modification is required.
Usability	4.4	Excellent	The application met all the quality standards for system development.
Reliability	4.35	Excellent	The application met all the quality standards for system development.
Security	4.4	Excellent	The application met all the quality standards for system development.
Maintainability	4.35	Excellent	The application met all the quality standards for system development.
Portability	4.23	Excellent	The application met all the quality standards for system development.
		Technology Acceptance Model (TAM)	
Perceived Usefulness	3.7	Very Good	The application met almost all the quality standards of software development. Minimal modification is required.
Perceived Ease of Use	3.6	Very Good	The application met almost all the quality standards of software development. Minimal modification is required.
Attitude Toward Using	3.68	Very Good	The application met almost all the quality standards of software development. Minimal modification is required.

The results from the ISO 25010 evaluation indicate that VIMS was rated highly across all eight quality characteristics. Functional suitability, which measures the system's ability to provide the required features and functionalities, received a mean score of 4.40, indicating excellent performance in delivering essential features for both veterinary staff and clients. Performance efficiency, assessing the system's capacity to utilize resources effectively and maintain fast response times, was rated 4.27, categorized as very good, suggesting that the system performs efficiently under normal operating conditions. Compatibility, measuring the system's ability to interact with other software and hardware, also received a very good rating with a mean score of 4.30, indicating a high level of interoperability. Usability, which focuses on the ease with which veterinary staff and pet owners can use the system, achieved an excellent rating of 4.40, highlighting the system's user-friendliness. Reliability, assessing the system's ability to perform consistently without failure, was rated excellent with a mean score of 4.35. Security, measuring the system's capacity to protect sensitive data, also received an excellent rating of 4.40, indicating robust security measures. Maintainability, quantifying the ease with which the system can be modified and updated, was rated excellent at 4.35. Finally, portability, assessing the system's ability to function across different devices and platforms, received an excellent rating with a mean score of 4.23, indicating its adaptability to various technological environments.

The Technology Acceptance Model (TAM) evaluation also yielded positive results, with all three constructs receiving a "Very Good" rating. Perceived usefulness, which reflects the users' belief that using VIMS would enhance their job performance or make tasks easier, had a mean score of 3.70. Perceived ease of use, indicating the degree to which users believe that interacting with VIMS would be free of effort, received a mean score of 3.60. Attitude toward using, which represents the users' overall positive or negative feelings about using the system, had a mean score of 3.68. These results suggest that the users generally found VIMS to be beneficial, easy to operate, and were inclined to have a positive attitude towards its use in their daily activities.

The findings from this capstone project show the successful development and positive evaluation of the Veterinary Information Management System (VIMS) for Animals' Choice Clinic. The application of the Agile Scrum methodology helped an iterative and adaptive development process, allowing for the creation of a system that effectively addresses the identified needs of the clinic and its clients. The high mean scores across all eight ISO 25010 quality characteristics suggest that VIMS is a technically robust and well-engineered system. The excellent ratings for functional suitability and usability are particularly noteworthy. The system effectively provides the necessary features for appointment scheduling, medical record management, and client communication, and it does so in a manner that is perceived as easy and intuitive to use by the stakeholders. The very good ratings for performance efficiency and compatibility indicate that the system operates smoothly and integrates well within the existing technological environment of the clinic. The excellent scores for reliability, security, maintainability, and portability further underscore the system's strength in terms of stability, data protection, ease of updates, and adaptability across different devices.

The positive results from the Technology Acceptance Model (TAM) evaluation provide valuable insights into the user acceptance of VIMS. The "Very Good" ratings for perceived usefulness and perceived ease of use suggest that the clinic staff and pet owners believe that VIMS can enhance their efficiency and simplify their interactions with the clinic. The positive attitude toward using the system indicates a general willingness among users to adopt and integrate VIMS into their daily routines. While the TAM scores are slightly lower than the ISO 25010 scores, this could be attributed to various factors. Technical experts might have a more stringent evaluation criteria for technical quality, while end-users' perception of usefulness and ease of use can be influenced by factors beyond pure technical aspects, such as the learning curve associated with a new system or the specific features that directly impact their daily tasks. The successful development and evaluation of VIMS align with the principles of UN SDG 9 by leveraging technology to improve the infrastructure and service delivery of a small business, contributing to sustainable innovation in the veterinary service sector.

One potential limitation of this study is the sample size, particularly the number of pet owners involved in the evaluation. While the feedback from clinic staff and IT professionals provides valuable insights into the system's technical quality and usability within the operational context, a larger sample of pet owners might offer a more comprehensive understanding of client-side acceptance and potential areas for improvement from their perspective. Future research could explore the long-term impact of VIMS on the clinic's efficiency, client satisfaction, and revenue. Additionally, replicating this study in other veterinary clinics could help to assess the generalizability of the findings and identify best practices for the implementation of similar information management systems in the veterinary field. Further development could focus on incorporating more advanced features such as telemedicine capabilities or integration with diagnostic equipment to further enhance the value proposition of VIMS.

Conclusions

The capstone project successfully addressed the challenges faced by Animals' Choice Clinic by developing and evaluating a web-based Veterinary Information Management System (VIMS). The implementation of the Agile Scrum methodology facilitated an adaptive and efficient development process, resulting in a system that meets high technical quality standards as evidenced by the "Excellent" and "Very Good" ratings across the ISO 25010 quality characteristics. Furthermore, the positive "Very Good" ratings for perceived usefulness, perceived ease of use, and attitude toward using from the Technology Acceptance Model (TAM) evaluation indicate a strong likelihood of user adoption and satisfaction. By streamlining appointment scheduling, digitizing medical records, and enhancing client communication, VIMS offers a practical solution to the inefficiencies associated with manual processes in veterinary practices. The project's alignment with the UN's Sustainable Development Goal 9 underscores its contribution to promoting technological innovation for sustainable development within the local community. The findings of this study suggest that the strategic adoption of well-designed information management systems can significantly benefit small to medium-sized veterinary clinics, improving their operational efficiency and enhancing the quality of service provided to pet owners.

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