Agile-Based B2B Web Application Development Approach for Enhancing Competitive Advantage

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Abstract **– This research addresses the gap in agile software development methodologies for cooperative enterprises by investigating the implementation of a Business to Business (B2B) web application for wholesale distribution systems. The study aims to develop a system using Agile methodology with Scrum framework and evaluate user acceptance through System Usability Scale (SUS) assessment. Data collection for user story creation employed purposive sampling to conduct structured interviews with key stakeholders to generate comprehensive user stories. The web application focused on functional requirements and user experience preferences to inform the iterative development process. The developed system incorporates eight core functionalities: distributor information management, geographical store mapping, map-based order reporting, delivery documentation, order history tracking, payment monitoring, accounts receivable management, and customizable sales analytics. System evaluation yielded a SUS score of 91, indicating excellent usability The application enables strategic customer segmentation based on order volume and geographical distribution, facilitating data-driven marketing strategies through behavioral analytics.**

Implementation results demonstrate enhanced operational efficiency with real-time accounts receivable monitoring providing critical financial insights for strategic decision-making. The system contributed to increase in Ultra-High Temperature (UHT) milk market share compared to the previous year, validating its business impact. Statistical analysis demonstrates Agile methodology' s effectiveness in developing stakeholder-aligned applications for agricultural enterprises. Ultimately, this research highlights how adaptive software development can drive modernization and economic resilience in the dairy sector.

Keywords **– Agile methodology, B2B systems, competitive advantage, software development, digital transformation.**

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1. Introduction

Thailand's dairy industry is the largest in the ASEAN region, with an annual raw milk production capacity exceeding 1 million tonnes. The majority of raw milk produced is processed domestically, primarily for the ready-to-drink milk industry and school milk programs. Between 2019-2023, milk consumption demand is projected to increase by 0.44% annually. In 2023, raw milk production is estimated at 1.240 million tonnes, a 1.61% decrease from 1.260 million tonnes in 2022 [1]. The dairy business plays a crucial role in Thailand's agricultural sector and overall economy. Promoting the dairy industry can generate income and economic opportunities for small-scale farmers, elevating living standards and alleviating poverty. It also contributes to national food security and sustainable economic growth, aligning with the United Nations' Sustainable Development Goals (SDGs).

Phatthalung Dairy Cooperative engages in the procurement and distribution of raw milk, as well as the production of various dairy products including pasteurized milk, UHT milk, milk tablets, and a variety of flavored ice creams (e.g., strawberry, green tea, chocolate, orange, coffee, pineapple, Thai tea) and yogurt ice cream.

These products are marketed under the local brand "Phatthalung Milk." The cooperative's market is divided into commercial milk and school milk segments, with the latter allocated by the Dairy Farming Promotion Organization of Thailand (DPO). However, Thailand's dairy industry faces a highly competitive and volatile market environment, characterized by VUCA (Volatility, Uncertainty, Complexity, Ambiguity) [2]. Volatility is evident in the fluctuating prices of raw milk, influenced by factors such as energy costs, labor expenses, and rapidly changing consumer preferences. Uncertainty stems from government policies regarding school milk programs and potential new market entrants, which can impact sales. Complexity is inherent throughout the supply chain, from raw material procurement to production, distribution, and sales. Ambiguity arises from unclear market and competitor information, as well as the uncertain impact of emerging technologies on the UHT milk industry. In this challenging business environment, dairy cooperatives must adapt quickly, flexibly, and agilely. The implementation of digital technology in sales management, particularly for wholesale or B2B (Business-to-Business) distribution through agents and department stores, has become essential. This approach allows businesses to reach target markets more effectively through geographical distribution, rapidly increase sales, reduce marketing and sales costs, enhance competitiveness, respond promptly to demand, and improve adaptability to change.

2. Related Work

This section analyzes three important areas of relevant literature for this topic. First, the literature examines how companies use digital technology to compete. Second, the paper explores Agile software development concepts and techniques. Finally, the paper examines Agile system testing issues and methods.

2.1. Creating Competitive Advantage through Digital Technology

Business competitiveness comprises the ability to compete in terms of cost, quality, flexibility, delivery, and innovation. Digital innovation is crucial for organizations to enhance their competitiveness by implementing new technologies to improve work processes, increase operational efficiency, and reduce time and errors in management. Moreover, it enables organizations to adapt rapidly to changing business environments [3].

Business-to-Business (B2B) refers to transactions between business entities, as opposed to selling directly to end consumers (Business-to-Consumer: B2C). B2B has a positive impact on the sustainability of SMEs in Thailand and leads to improvements in sales efficiency and marketing outcomes [4]. Consequently, digital platforms such as web applications and distribution systems play a significant role in marketing management, especially at the B2B level, as they are essential tools for sales management and strategy formulation [5]. These platforms can quickly increase sales and serve as data collection tools to support decision-making for developing effective sales strategies [6]. Additionally, they reduce redundant processes, save time, and minimize errors in ordering and inventory management.

Among the well-known Software Development Life Cycle (SDLC) approaches, the Waterfall model is a traditional method where the development process follows a sequential order. Each phase begins only when the previous one is completed, with the output of one phase serving as input for the next [7]. The process typically consists of system requirements, analysis, design, testing, deployment, and maintenance (Figure 1).

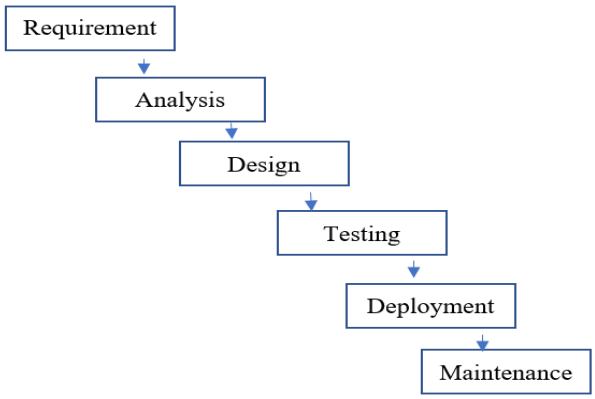

Figure 1. Traditional waterfall SDLC

However, the Waterfall SDLC faces various challenges, such as communication issues with clients, inflexible timeframes, delayed delivery due to sequential processes, and inability to adapt to changing requirements, which may lead to project failure [8]. Furthermore, there are risks of design misalignment with user needs [9] or user acceptance issues as all client requirements may not be defined at the project's outset [10]. Subsequent additions can result in time-consuming system modifications. The model also faces challenges in continuous improvement, which requires ongoing software updates based on feedback [11].

Therefore, software development approaches that focus on Customer Centric Development, rapidly responding to customer needs and delivering continuously, such as Agile methodologies, help address issues related to delays and reduce the risk of developing systems that do not meet user requirements [12]. These approaches facilitate more efficient and responsive software development processes.

2.2. Agile for Software Development

Agile software development is an approach that divides work into small iterations, enabling delivery within short timeframes. It emphasizes flexibility, team collaboration, and customer satisfaction, while promoting adaptive planning and continuous improvement. The focus is on rapid delivery of functional software, prioritizing individual interactions and collaboration over processes and tools [13]. This aligns with the four core values of Agile software development as outlined in the Agile Manifesto [14], which emphasizes teamwork, customer collaboration, and responsiveness to change. This method positively impacts productivity and quality, fostering satisfaction among both development teams and clients [15]. Agile software development encompasses various models, including Scrum, eXtreme Programming (XP) [16], and Kanban [17]. However, Scrum is the most popular Agile methodology due to its capacity to deliver high-quality software in rapidly changing environments, with new software iterations every 2-4 weeks, and its development flexibility [18], [19].

The Scrum Cycle consists of six main steps: 1) Product Backlog: A prioritized list of software features and requirements; 2) Sprint Planning: Team collaboration to define goals and scope for the upcoming Sprint; 3) Sprint: A 2-4 week period where the team works on planned items to produce a functional product increment; 4) Daily Scrum: Brief daily meetings where team members report progress, challenges, and plans; 5) Sprint Review: Presentation of completed work to stakeholders at the end of each Sprint; and 6) Sprint Retrospective: Evaluation of the previous Sprint's process to identify areas for improvement. This cycle repeats with Sprint Planning for the next iteration until a complete product is achieved [20], [21].

2.3. System Testing in Agile

Unlike traditional development methods where system testing occurs at the end of software development, Agile integrates testing into every iteration or Sprint in the Scrum model [22]. This approach allows for early detection of defects or issues and continuous feedback from product owners.

The testing process in Agile methodology is integrated into each iteration, encompassing test design, execution, and bug reporting [23]. In Scrum, software testing is incorporated into the development process, with testers working closely with developers to ensure quality throughout each Sprint [24], [25].

However, while testing occurs in every Sprint, a comprehensive usability test with actual users upon completion of the system enhances the quality of Agile development. This reduces risks associated with technical issues and poor user experiences, as software testing not only identifies application defects but also integrates quality assurance from requirements specification through to user delivery. The System Usability Scale (SUS), developed by [26], is a tool for measuring perceived usability. It consists of a 10-item questionnaire with responses on a 5-point Likert scale. The scoring method involves subtracting 1 from odd-numbered items and subtracting the score from 5 for even-numbered items. The sum of these adjusted scores is then multiplied by 2.5 to obtain a final score out of 100. SUS has gained popularity across various contexts, from interface system studies [27] to e-commerce evaluations [28], [29].

3. Research Methodology

This research employs the Scrum Agile Framework, a method that facilitates rapid software development by dividing the project into sprints and emphasizing team collaboration with the product owner for joint software design and testing (Figure 2).

The process is as follows:

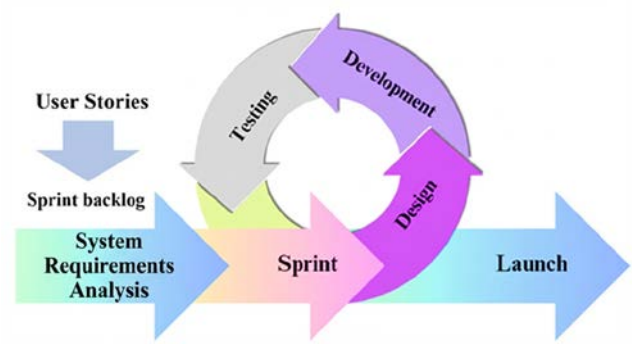

Figure 2. Application development framework

3.1. System Requirements Analysis

The process begins with establishing system objectives through collaborative meetings between the development team and software owners. Data collection involves in-depth interviews and workshops with the Phatthalung Dairy Cooperative. Use the purposive sampling method, including the manager, deputy manager, sales manager, and sales staff, to gather user stories.

These are then summarized and transformed into a Sprint backlog encompassing system requirements. The backlog is analyzed to prioritize tasks and plan each sprint (Sprint Planning).

3.2. The Sprint Phases

Web application development proceeds according to the prioritized backlog. Each sprint involves design, coding, and testing, and review with the output of each iteration incrementally adding to the system. Data on issues and system test results are collected in each sprint through observation and recording of development team meetings. This is followed by a reflection phase, involving a retrospective meeting with the cooperative team to review problems, causes, and system improvement methods.

System testing occurs throughout each sprint iteration and includes:

- Test planning: Defining scope, objectives, and types of testing (e.g., functional testing, non-functional testing), reviewing user stories and acceptance criteria for clarity.
- Creating test cases based on user stories and acceptance criteria, ensuring coverage of all functionalities and edge cases.
- Continuous integration and testing in every sprint to ensure new code compatibility with existing functions.
- Conducting tests, recording errors, and holding daily summary meetings on testing progress and issues, providing feedback to the development team for quick error resolution.

3.3. System Delivery

Upon completion of all planned iterations, a final check is conducted to ensure the system meets all acceptance criteria. This is followed by a usability evaluation using the System Usability Scale (SUS) with five representative users, a sample size deemed appropriate according to [30], selected through purposive sampling. The evaluation results are summarized, and improvements are made based on recommendations. The finalized software is then installed, complete with user manuals and system maintenance guidelines.

4. Results

Based on in-depth interviews and analysis of the cooperative's wholesale data, it was identified that the primary issues were the lack of a systematic recording system for distributor information, which hindered decision-making processes, and the inefficient reporting of product deliveries via Line application, which did not facilitate data storage for future use. The challenge was to develop a system rapidly that would be timely for implementation and incorporate functionalities aligned with user requirements. Through in-depth interviews and meetings with the dairy cooperative, user stories were formulated for each application function, as illustrated in Figure 3.

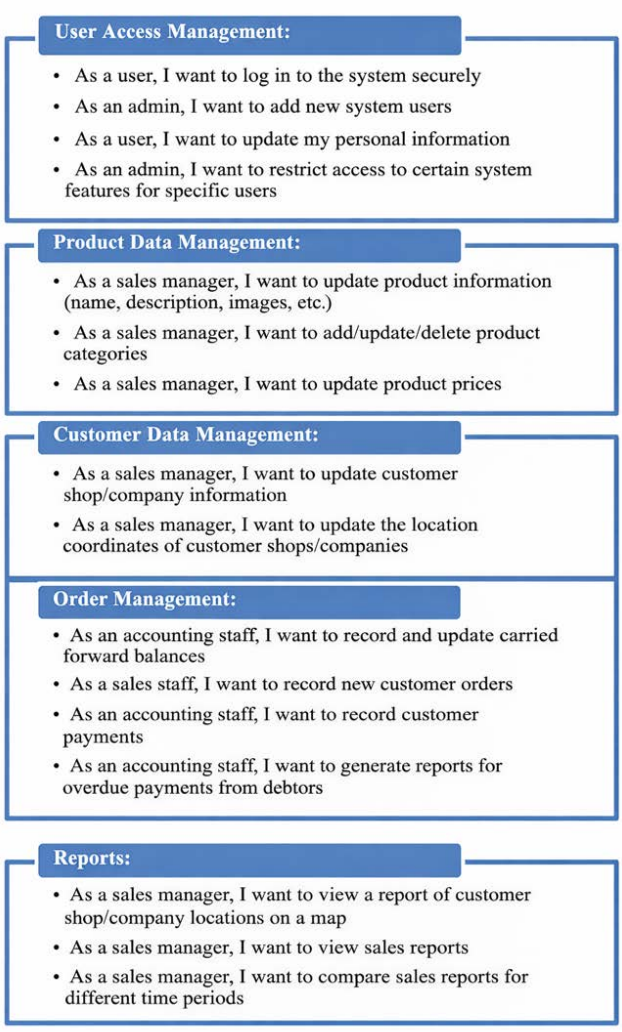

Figure 3. Sample user stories

These user stories were subsequently analyzed to create the Sprint Backlog for the system, as shown in Figure 4.

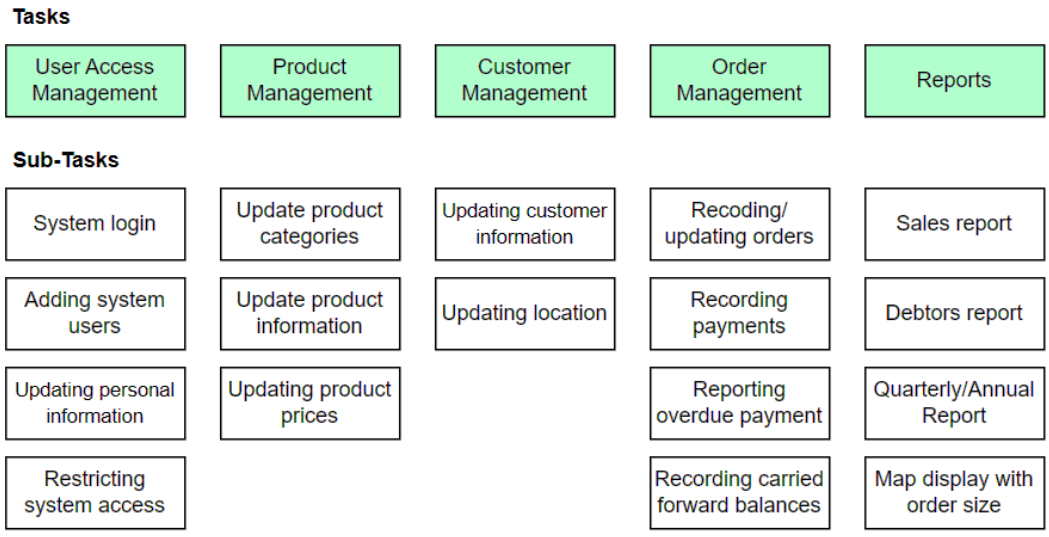

Figure 4. Sample sprint backlog

The developed Web Application was successfully delivered and installed within the specified timeframe. The system fully met all functional requirements as per the system specifications. It enables users to record, edit, and search product information, customer data, and order details.

Additionally, it can generate delivery notes/tax invoices, display dashboards, and produce various reports as required. Sample system interfaces are presented in Figure 5 and Figure 6.

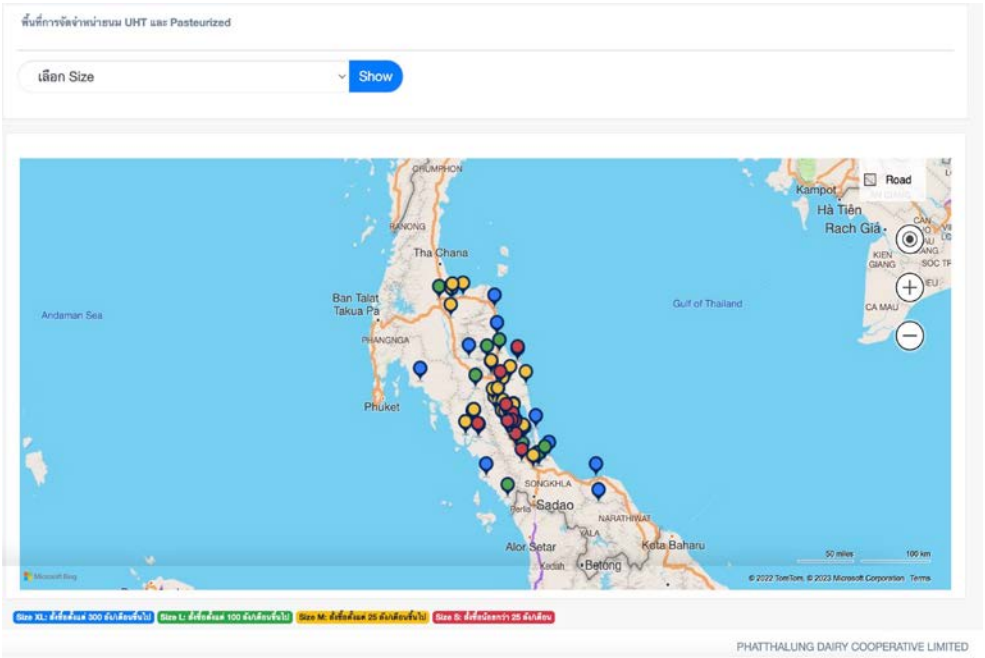

Figure 5. The distributor location map interface

Figure 5 displays the distributor location map interface. This screen shows the geographical locations of customer stores/ companies, which are categorized into four groups based on average monthly order volume, with color- coded pins representing different order volume categories:

1) Blue pins (order volume >=300 boxes/month,
2) Green pins (order volume >=100 boxes/month,
3) Yellow pins (order volume >=25 boxes/month, and
4) Red pins (order volume <25 boxes/month).

This visualization provides a spatial overview that can be utilized for strategic marketing decisions.

Figure 6 presents the sales graph interface, which displays UHT milk sales data. Users can select custom time periods for data visualization according to their needs.

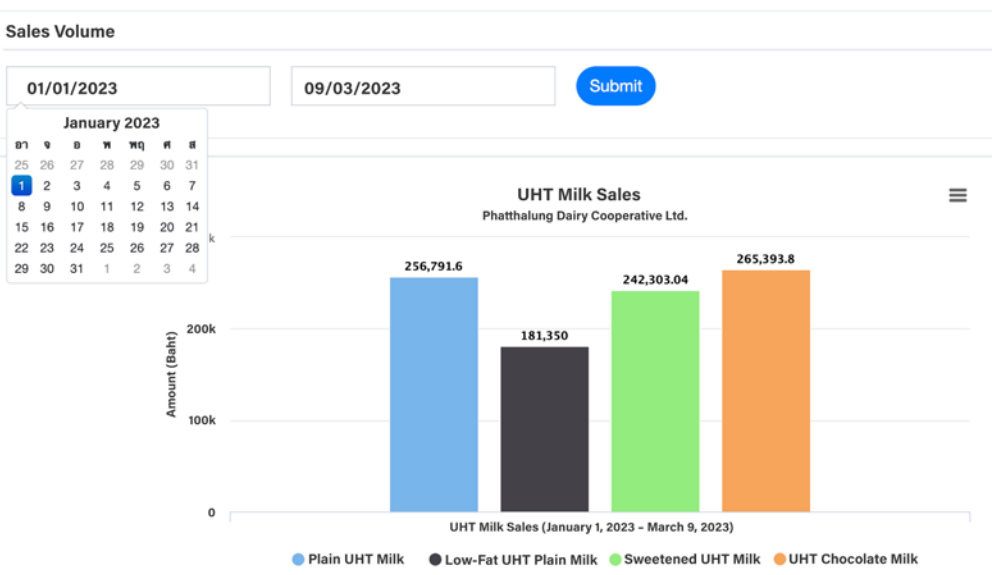

Figure 6. The sales graph interface

Based on this customer segmentation and sales reporting, the cooperative can implement data-driven marketing strategies to develop appropriate marketing approaches tailored to each customer group. Furthermore, continuous brand awareness building through social media and promotional marketing activities has resulted in increased recognition and enhanced sales of UHT milk products, which represents the target product of Phatthalung Dairy Cooperative. When comparing the cooperative's sales performance during the same period in 2023, there was an average increase of 44.55%, consequently leading to a 7% increase in UHT milk sales proportion from 46% to 53% of the total sales revenue of Phatthalung Dairy Cooperative Limited.

This achievement successfully fulfills the cooperative's business development objectives regarding market expansion and increasing the proportion of UHT milk sales. System Testing Results in the Agile software development process, functional testing was conducted. Test case descriptions were prepared for each system function to facilitate testing in each sprint, as shown in Table 1. This approach ensures comprehensive testing and validation of all system functionalities throughout the development cycle. This methodology allowed for rapid system development that addressed the cooperative's immediate needs while ensuring flexibility for future adaptations and improvements based on user feedback and changing requirements.

Table 1. An example of order entry testing

Test Scenario Description	Test Case ID	Test Case Description	Expected Result
Verification of incomplete and incorrect order entry data	TC-INV001	This test is designed to ensure that the system has appropriate safeguards against the insertion of empty (null) records into the database, which could potentially compromise data integrity and system functionality.	The system displays comprehensive data entry notifications for the order submission process. In the event of incomplete data entry, the system generates alerts in the following sequential order: Tax invoice date, Shop/Company name, Tax invoice number, Payment method, Order items, and Product quantity. The system employs a data validation mechanism that precludes the storage of order information until all required fields are populated. This ensures data completeness and integrity within the order entry process.
	TC-INV002	Test case: Order entry data submission by sales personnel with incomplete information	The system implements a field-specific notification mechanism, displaying alerts for any unfilled data fields. Additionally, it employs a data validation protocol that prevents the persistence of order information until all required fields in the order entry form are comprehensively populated.
	TC-INV003 mm	Test case: Order entry data submission by sales personnel with incorrect data type input. Scenario: The salesperson attempts to submit an order with incorrect data types in specific fields, such as entering non-integer values for product quantity where only whole numbers are permissible.	The system notifies the user to input only integer values and displays a status indicating that the entry cannot be saved.

Subsequently, integration testing is conducted when new functions are added in each sprint. Upon completion of all backlog items, performance testing and usability testing are performed by system users utilizing the System Usability Scale (SUS). The answers in the assessment are divided into 5 levels.

Calculation is done as follows: For odd-numbered items, subtract 1 from the score; for even-numbered items, subtract the score from 5. Then, sum up the scores from all items and multiply by 2.5, as shown in Equation 1:

$$SUS = 2.5 \times \left[\sum_{n=1}^{5}(U_{2n-1} - 1) + (5 - U_{2n})\right] \quad (1)$$

The SUS evaluation results (Table 2), obtained from a purposive sample of 5 representative users, yielded an average score of 9 1points, corresponding to grade A.

This indicates that the application's usability is considered excellent by the system users.

Table 2. The SUS assessment scores

No.	Questions	User1	User2	User3	User4	User5
1.	You think you will need to use the web application frequently.	5	5	5	5	5
2.	You find that your web application is unnecessarily complex to use.	2	1	1	1	1
3.	You think web applications are easy to use.	5	5	4	5	5
4.	You consider that you need personal technical advice to use the web application.	2	2	5	2	2
5.	You think that the menus or functions of the web application are very usable and consistent	5	5	5	5	5
6.	You think the web application system is inconsistent in use.	1	1	1	1	1
7.	You'd think that most people using web applications would quickly learn to use the system.	5	5	5	5	5
8.	You feel that using web applications is difficult to use.	1	1	2	1	2
9.	You are confident that your web application will always work.	4	5	5	5	5
10.	You feel like there are a lot of things you need to learn before you can use the web application.	2	1	2	2	2
	Score	**90.00**	**97.50**	**80.00**	**95.00**	**92.50**
	Average	**91.00**				

5. Discussion

This study shows how well Agile development and user-centered design methods work in making the PTLmilk web app. The Agile methodology enables iterative improvements and rapid response to feedback, which aligns with recent research emphasizing the role of Agile in enhancing user satisfaction and software quality [31]. This corresponds with [32], which states that Agile is a tool or set of best practices that can be implemented to improve the development process. Particularly in contexts characterized by high uncertainty and constantly changing requirements, the principles that integrate user-centered design further contribute to an intuitive interface and engaging user experience. This enhances the significance of human-computer interaction in software utilization [33].

The development process promotes continuous collaboration between developers and users. By integrating Agile and user-centered design, it enables the rapid identification and resolution of usability issues. This approach aligns with Agile UX principles, which advocate for the integration of UX research into Agile workflows to enhance software efficiency [34].

Additionally, the incorporation of SUS into the Agile development process in this research facilitates user-friendly design.

6. Conclusion

The application of the Scrum model in software development has led to several significant outcomes: Customer Centric Development: The continuous integration of customer feedback ensures that the software aligns more closely with client requirements. Reduced Time to Market: The iterative nature of development and rapid delivery cycles facilitate quicker product launches. Increased Team Efficiency: Enhanced team collaboration and communication lead to more effective problem-solving and improved overall team performance. Adaptability to Change: Agile methodologies enable teams to swiftly respond to market shifts or evolving customer needs. System Usability Evaluation: The System Usability Scale (SUS) was employed to assess the ease of use of the web application. This reliable tool measures usability without relying on statistical methods, instead utilizing usability scores from a sample group. Notably, accurate assessments can be achieved with as few as five users, resulting in cost-effective UI evaluation.

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