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Research article

Developing of Construction Permit Application System by Adopting Agile Methodology

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Abstract: Agile methodology is one of the most widely used methodologies in software development in many agencies and organizations thanks to its quick response to user's needs and feedback and high level of user participation in the development process. This research aimed to develop a construction permit application system to enhance local governmental organizations' efficiency in providing services to residents by applying Agile methodology and assessing user satisfaction with the system efficiency. The system was developed in the form of a responsive web application. The research was carried out in 2 parts: 1) System development by applying Agile methodology, and 2) Measuring user satisfaction in the efficiency of construction permit application system using black-box testing with a 5-point scale rating and applying descriptive statistics, namely average and standard deviation. The results from the research indicated that user satisfaction with the efficiency of the construction permit application system by adopting Agile methodology was at a very high level, scoring an average of 4.55 and a standard deviation of 0.57. The developed system using Agile led to the practical construction permit application system, which effectively met user's needs. The system also met the standard criteria, which include the ability to operate according to functionalities designed, user-friendliness, system performance, and satisfaction with security features. Moreover, the system development using Agile also provided quick responses to user needs and thorough, continuous engagements from all users in operations management. This would aid in developing a system that met the users needs and truly addressed current challenges.

Keywords: Agile methodology; Construction permit application; Local government organization; Scrum; Web application

1. Introduction

Thailand's 20-year national strategy ensures it achieves its vision of becoming "a developed country with security, prosperity, and sustainability." The first phase of the strategy focuses on public services and government efficiency to push Thailand to the world's top 60 highly digitalized governments [1]. This will also represent Thailand's success in transforming into a digitalized

government on the global stage. Such transformation is vital to the government's policy on digitalization and meets the needs of the public under the New Normal era, as per the Order of Prime Minister No. 267/2560 dated 15 October 2017, which pursues adaptation of technology under the notion of "smart government service," as a means to drive the country and serve the public by "local governmental organizations," which is one of the government's entities assigned to provide services to residents [2], [3].

Thailand scored a relatively high mark compared with 2018, moving to 57th out of 193 countries and ranking 3rd in ASEAN. Nonetheless, the Local Online Service Index (LOSI), which measures information services, transactions, and participation mechanisms from the local people of the main cities, is down in 2020; therefore, it is important to take into consideration all the measures [4], [5]. Local government organizations play a key role with residents and communities based on their importance. It is also equally important for local government organizations to adopt the policy of digitalization to meet the needs of residents since the policy would be one of the tools to enhance government agencies' capability. Moreover, it is a decisive factor in fully embracing the government's digitalization transformation policy.

"Bureau of Mechanics, Surat Thani City Municipality" is a local organization located in the northernmost province of Southern Thailand or Surat Thani Province. The Bureau holds various responsibilities, such as monitoring, designing, drafting, and keeping records of historical infrastructure, building, and city planning per the Town Planning Act. Building control and inspection per the Act also fall under the Bureau's responsibility. However, data is kept as hard copies and the construction permit application process is outdated. Lack of innovation and digitalization causes negative consequences to operations, management, and service provisions to the public. Information and communication technology are essential in transforming the organization.

Therefore, this research aimed to develop a construction permit application system by applying Agile methodology to enhance local governmental organizations' services to residents. Also, the study aimed to assess user satisfaction with the efficiency of the construction permit application system. System development using Agile methodology will pave the way to gather and store data systematically, access government data, track the status of applications via the LINE online messaging platform, etc. In addition, the methodology will increase speed and accuracy in managing, analyzing, storing, and utilizing data by applying digital technologies to manage the organization's affairs and access from the public on every level. The use of Agile methodology in system development provides quick responses to user needs and thorough, continuous engagement from all users in operations management, which will aid in developing a system that meets the user's needs and truly addresses current challenges.

2. Literature Review

2.1 Background of Surat Thani City Municipality

Surat Thani Municipality began as a community in Talat Sub-district, Mueang Surat Thai District, Surat Thani Province, the northernmost province of southern Thailand. It was governed as a sanitary district until 1932 when Thailand changed from absolute monarchy to democracy. The new form of governance brought new legislation in 1933 that converted Surat Thani Province sanitary districts into municipalities on 7 December 1935 with a total area of 2.67 km^2. On 14 October 1958, Surat Thani Province expanded its area, resulting in a total area of 6.95 km^2. Years later, as the province experienced rapid prosperity and development, new communities and commercial regions were established within and surrounding Surat Thani Municipality. Those areas did not differ much in action and had their local governing entity. As the districts and sub-districts increased, those sanitary districts were later assimilated or converted into districts on 22 December 1994, which enlarged Surat Thani province overall size to 68.97 km^2. Currently, Surat Thani Province has a total population of 127,542 inhabitants.

On 19 April 2007, Mr. Aree Wong-araya, Minister of Interior, signed the regulation, which came into force on 4 May 2007, promoting Surat Thani Town Municipality to become the City Municipality. The City Municipality has 8 offices: Office of Education, Office of Finance, Bureau of Mechanics, Office of Public Health and Environment, Office of the Municipal Clerk, Academic and Planning Division, Social Welfare Division, and Tax Information System Division [6]. This research is an extension of the e-tracking system, which is a part of big data management for enhancing the efficiency of serving people in the old town of Surat Thani

Municipality. The municipality once received support from the program management unit on Area-Based Development (PMUA), the Office of National Higher Education Science Research and Innovation Policy Council, and the Ministry of Higher Education, Science, Research and Innovation in 2020. Those supports were mainly given to the Bureau of Mechanics of Surat Thani City Municipality because much data was still stored in folders as hard copies. Searching for files and information was done manually, which was not in line with the government's digitalization policy, where everything had to be fast and meet user's needs. Moreover, the agency was ready to support and accommodate in terms of personnel and information for this research.

2.2 Agile and Scrum

Agile development methodology and Scrum are one of the most widely-used methods thanks to their fast-paced work by reducing hierarchical bureaucracy and paperwork, thus resulting in a more streamlined, straightforward, flexible, and result-oriented working environment [7], [8] [9], [10], [11], [12], [13], [14]. The frameworks focus on collecting feedback through user testing to rapidly adjust and fix any flaws, fostering faster system development and leading to achieving user needs in a timely fashion [7], [8].

Scrum is an implementation of an agile framework proposed for project management to manage the iterative software development process. It focuses on providing the most value at the earliest. Scrum is a team-oriented agile technique that sets a limited-time boxed iteration called 'Sprint' in which the system is incrementally built and produces different artifacts for its work. It is one of the most popular agile methodologies, thanks to its simplicity and concentration on software management challenges rather than technical software development processes, making it broadly applicable to any domain. Three primary phases of the Scrum life cycle are described below [8].

1) The outline planning phase, also known as the pre-sprint phase, is the first step to describe the general objectives for the system being designed and built. The project team, tools, and resources needed are detailed. It is also known as iteration 0.

• A Product Backlog is created and utilized to document client requirements through user stories and features.

• The requirements are then reviewed and prioritized, and implementation effort is estimated by the product owner, whose role is to keep the product backlog visible and transparent.

• As user stories are created gradually, the product backlog can be continuously updated, and the priority of existing stories may change throughout development.

2) Development phase or sprint phase: It comprises sprint cycles, with the outcome of each cycle being incrementally added to the system. A sprint cycle has the following details:

• Sprints are iterative fixed-length cycles that last between 2-4 weeks.

• Each sprint follows the standard software process steps, starting from requirement analysis or sprint planning from the product backlog and finishing in the delivery phase following the sprint review.

In the sprint planning meeting at the beginning of each sprint, which includes the development team and the product owner, works that must be completed will be agreed. Based on their priority, user stories are incrementally moved from the product backlog to the sprint backlog, and features and functionalities to be implemented are determined. A sprint cycle begins once the pre-sprint planning is completed. During a sprint, the Scrum master isolates the team from external distractions, and the features are built and tested daily through a meeting called daily scrum. Daily scrum meetings are limited to 15 minutes long to improve communication, synchronize activities, refocus the team on the common goal shared by all team members, and resolve any difficulties or hurdles that may arise. The sprint concludes with two meetings: the sprint review meeting, in which the sprint output, a potentially shippable increment, is inspected, analyzed, and assessed, and the sprint retrospective meeting, in which possible future improvements are discussed.

• A burn-down chart is used to track the progress of the sprint.

• Increments may be built by multiple teams, i.e., parallel sprints.

3) The project closure phase occurs when the requirements meet the goals agreed upon by the product owner and the team. The most recent version of the product is now ready for release and distribution, and all the paperwork and user manuals are ready.

It is crucial to work on product quality and measure software development projects to get better insight into the project's progress. Agile methodology addresses quality issues continuously and repeatedly, focusing on software quality through customers, minimizing errors, rapid development, and embracing changes.

Thanks to its flexibility, adaptability, and light documentation, local and international researchers have applied Agile and Scrum in new system developments. In Thailand, many researchers have successfully reached their objectives by applying Agile, such as Lertjabok [15], who researches the implementation of Agile to Design and Develop a Visualization System in Digital Living Book: A Case Study of Office of Academic Resources and Information Technology, Raja Mangala University of Technology Isan which applies the agile methodology to design and develop a digital living book. The design and development are conducted in rapid mode as system users require. Users are, on average, well-received.

Another study is Development of Decision Support System for Asset Budget: A Case Study of Krung Thai Bank Training Center, Khao Yai, Nakhon Ratchasima, which applies the agile methodology to designing and building a decision support system [16]. The system receives a very high level of user satisfaction since it serves as a tool for a training center to allocate budget fairly and appropriately. In addition, the system minimizes errors in asset budgeting. Phusri and Kritworakan's research titled Factor Influencing Employee Motivation and Demotivation: A Study of the Siam Cement Group, Songkhla Province [17] has applied Agile methodology and Scrum to speed up website design for a small and medium enterprise. The research also aids daily interactions and communications between customers and team members to notify customers of any work progress and obstacles continuously, and fosters collaboration in creating the solution, ultimately reducing wasted time.

Overseas researchers such as Hossain and Kashem [18] have stated that Agile techniques are applied to minimize risk factors by developing software quickly. Under agile methodology, any changes are welcome in the software development phase. Ultimately, this paper concludes that Agile techniques can increase software quality and customer value. Muhammad et al. [12] research has collected data from different software development companies' employees to compare factors affecting software quality with agile and scrum methods. The main advantage of the agile technique is its emphasis on customer satisfaction and responsiveness to user requirements throughout its development cycle. By adopting the agile method, the software can capture almost all the required qualities.

Therefore, applying agile methodology to rapidly complete the system development on time to have a system that meets user's requirements becomes an alternative for developers to choose.

3. Materials and Methods

The research was divided into two parts. The first part focused on developing a construction permit application using agile methodology. The second part focused on stakeholders' or users' satisfaction towards the system efficiency using black-box testing [19], [20] with a 5-point Likert scale, then using statistical computation including average (x-bar) and standard deviation (S.D.) to derive the results [21]. Details are shown as follows.

3.1 Development of construction permit application system by applying Agile methodology

Agile methodology was used along with Scrum as shown in Figure 1, to carry out this plan.

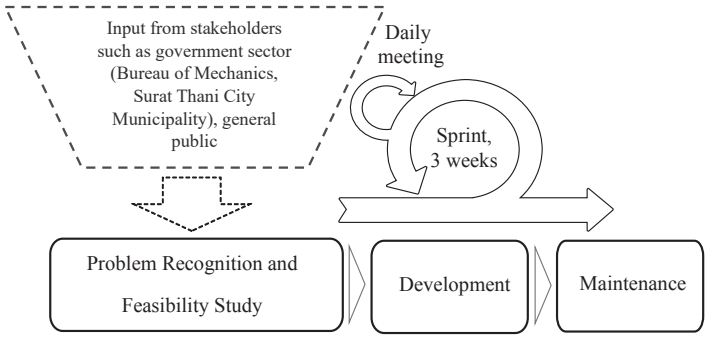


Figure 1. System Development by applying Agile and Scrum.

1) Problem recognition and feasibility study or pre-sprint phase: This step was the most crucial process to understand the user's needs to see the feasibility of changing the system to achieve satisfactory results while

minimizing costs and time to establish clear objectives. The development started with meetings between all stakeholders, such as the government sector (Bureau of Mechanics, Surat Thani City Municipality), the general public, and academics to collect issues, current situations, and organizational needs, to check human resource readiness, to exchange opinions, to collect requirements and expectations to set a scope of work and an operation plan, and to create user stories. The user stories can be summarized as shown in Table 1. For each user story, acceptance criteria were determined to build feasible system capabilities as intended. Each process could be explained as follows:

• Setting up meetings to explain and inquire about user needs: 11 officials (Bureau of Mechanics, Surat Thani City Hall) from various sub-divisions were selected, including Application Form Screening and Evidence Verification Officer, City Planning Auditor, District Monitoring Officer, Engineering Officer, Sanitation Officer, Building Energy Auditor, Chief of Building and City Plan Control Sub-division, Director of Building and City Plan Control Sub-division, Director of Bureau of Mechanics, District Clerk, and Mayor. The public, including owners of local firms, the general public, and academics, were also chosen to understand the responsibilities of all sub-divisions;

• Analyzing related documents, including (1) Application Form for Permission to change the Use of the Building (From Kor.2.), (2) Application Form for Permission to modify or use Parking Spaces, U-turns, and Vehicle Entrances/Exits for Other Purposes (Form Kor.3), (3) Application Form for Renewal of Permit for Construction, Modification, Demolition, or Relocation of Building (Form Kor.4), (4) Application Form for the Substitute of Permit or Substitute of Certificate (Form Kor.5), (5) Summary Report of Application to change the Use of Building (Form Kor.2), (6) Summary Report of Application to modify or use Parking Spaces, U-turns, and Vehicle Entrances/Exits for Other Purposes (Form Kor.3), (7) Summary Report of Application for Renewal of Permit for Construction, Modification, Demolition, or Relocation of Building (Form Kor.4) and (8) Summary Report of Application for the Substitute of Permit or Substitute of Certificate (Form Kor.5);

• A Performing feasibility analysis based on collected data, including assessment of the current information technology system or capital required to install the system, human resources needed to operate the system;

Table 1. User stories.

Step	Stories	Acceptance Criteria
1	As a public user/firm, I want to register and submit an application for different type of construction permit online to register and request a construction permit via the online platform.	1) Register to submit an online application for a construction permit 2) Edit information registered 3) Display a registration result 4) Print out a registration result
2	As a public user/firm, I want to register/save details of construction permit application form to register/save information of construction permit application via an online platform.	1) Register/save details of various construction permit applications 2)Display the result of registration and the information saved 3) Print out the details of the application form
3	As public users/firms, I want to attach and track additional required documents (in case of missing to add) to complete the application.	1) Display required documents (in case of missing to add) 2) Submit additional required documents (in case additional documents are required)
4	As a public user/firm, I want to track an application and approval progress via an online platform and LINE application to check if the application is complete.	1) Display a construction permit application status via an online platform 2) Display the result of the construction permit application via the LINE application

Table 1. User stories. (continue)

Step	Stories	Acceptance Criteria
5	As an official, I want to search and verify applications to approve/deny applications conveniently via an online platform.	1) Search for applications for a construction permit 2) Approve/deny applications 3) Note a reason for denying applications 4) Notify an applicant for additional documents (in case of incomplete application) 5) Display details of approved/denied applications
6	As an officials, I want to see application data online, to manage and print out application data online conveniently.	1) Submit details of different construction permit application forms 2) Display a submission result 3) Print out the information submitted
7	As an official, I want to search for information on construction permit applications submitted with selected conditions to verify information on different types of applications.	1) Print out application documents submitted online. 2) Generate construction permit application letters 3) Generate reports of construction permit application results
8	As an official, I want to specify a level of approvals and centralize the approval permission to delegate approval authority to other officers.	1) Determine a level of approvals to officers 2) Delegate approval authority to officers

2) Development phase or sprint phase: This step was where all stakeholders took part in a meeting to plan the entire system process and then bring user stories to break down into smaller items. Those stories are prioritized based on importance and assigned to sprint cycles. For this system, we assigned 8 sprints for the whole development cycle with a 24-week duration until the completion. For each sprint, user stories were chosen for development, testing, and trial run by a target group to collect user feedback and system functionalities flaws and find a solution to meet user's needs. Details of the development were as follows.

2.1) System Architecture

From data collection and analysis, the development team designed the system architecture by facilitating users or stakeholders, including officials from several sub-divisions of the Bureau of Mechanics and ordinary users, to use the system as a responsive web application on various devices via the internet [22]. Programming languages included PHP and HTML with Bootstrap Framework, jQuery Framework, and LINE Messaging API to accommodate all types of devices. As for storing user data and construction permit applications, MySQL was chosen, as shown in Figure 2 of the system architecture.

2.2) Database Design

The development team and stakeholders designed a database using MySQL to systematically store and display data, as shown in Figure 3 (Entity Relationship Diagram). The diagram consisted of 29 tables with details as follows: user control (syst_avl), API to notify users (syst_avl_api), levels of approval (syst_avl_control), main application submissions (pvs_req), types of application (pvs_req_type), officials' note (pvs_req_note), approved applications (pvs_req_approved), building proprietor form 1 (pvs_req_form1_owner), building proprietor's agent form 1 (pvs_req_form1_agent), land dimensions detail form 1 (pvs_req_form1_land), building proprietor form 6 (pvs_req_form6_owner), building proprietor's agent form 6 (pvs_req_form6_agent), permit application form 6 (pvs_req_form6_land), building proprietor form 7 (pvs_req_form7_owner), building proprietor's agent form 7 (pvs_req_form7_agent), permit transfer details form 7 (transferer) (pvs_req_form7_land_pass), permit transfer details form 7 (transferee) (pvs_req_form7_land_receive), building proprietor form 2 (pvs_req_form2_owner), building proprietor's agent form 2 (pvs_req_form2_agent), land dimensions detail form 2 (pvs_req_form2_land), building proprietor form 3 (pvs_req_form3_owner), building

proprietor's agent form 3 (pvs_req_form3_agent), land dimensions detail form 3 (pvs_req_form3_land), building proprietor form 4 (pvs_req_form4_owner), building proprietor's agent form 4(pvs_req_form4_agent), land dimensions detail form 4 (pvs_req_form4_land), building proprietor form 5 (pvs_req_form5_owner), building proprietor's agent form 5 (pvs_req_form5_agent), land dimensions detail form 5 (pvs_req_form5_land).

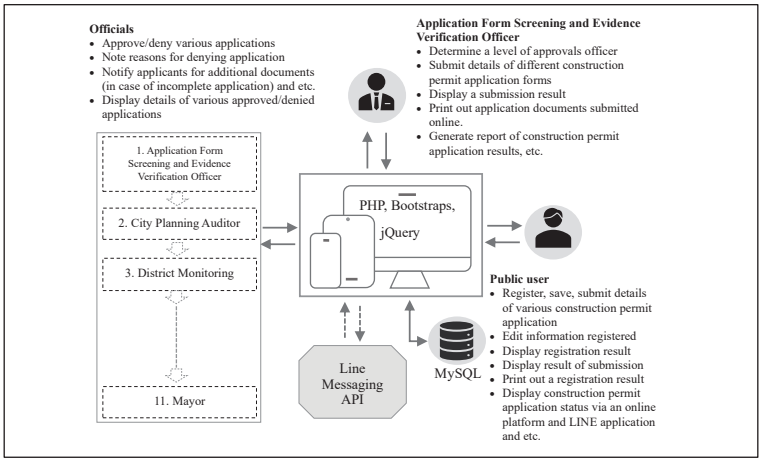


Figure 2. System architecture.

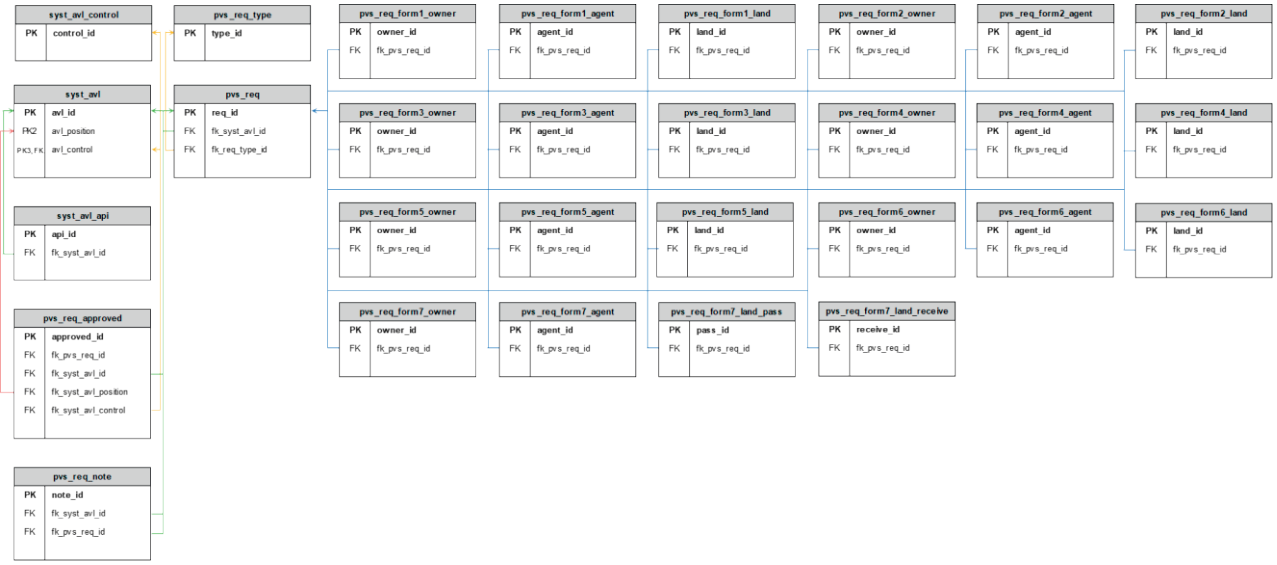


Figure 3. Entity-Relationship Diagram.

3) Maintenance and Project closure phase: This process was divided into two parts. Each part could be explained as follows.

3.1) Maintenance phase: This phase was about testing, fixing, and adjusting the system, which involved users' direct interaction. After system development was complete in each development sprint, the system would be tested to gather inputs from different users, such as the Bureau of Mechanics, ordinary citizens, and the development team. In other words, we conducted a sprint review and then fixed all the bugs and flaws in the system functionalities. With the sprint retrospective for every sprint, we sought solutions to improve the system developed. Also, when an additional fix in each sprint was required, the development team would select works with lower priority from the product backlog or change the priority of each work to run a sprint backlog for each function until the development was complete.

3.2) Project closure phase: This phase is about the requirements that could achieve the development of the operational system as per user stories designed, given the needs met and the goals set as agreed upon

by the system owner and the team. The most recent version of the system was now ready for release and distribution, and at the same time, all the paperwork and user manuals were ready.

3.2 Designing a survey questionnaire to gather data on user satisfaction with the Construction Permit Application System by applying Agile methodology

1) Design a questionnaire to measure the system to validate its accuracy, comprehensiveness, security, and quality, whether it met specifications or objectives, using the black-box testing method [19-20]. The survey comprised 25 questions in 5 dimensions: 1) Function Test, 2) Functional Requirement Test, 3) Usability Test, 4) Security Test and 5) Performance Test. Details of each test are as follows:

- First dimension: The function test was composed of 5 questions measuring the system's ability to search for public user applications, set the level of approval, centralize the approval permission, ability to print application documents submitted, and the ability to generate reports on user applications.
- Second dimension: Functional Requirement Test was composed of 5 questions measuring the system's ability to record the application (officials), verify information and approve applications online (officials), submit applications online (public users), track each application status (public users), and send notification through LINE application.
- Third Dimension: The usability Test was composed of 5 questions measuring the system's user interface design, size of the user interface components, consistency of user interface, font size, and design, icon, and image to convey messages.
- Fourth Dimension: The security Test was composed of 5 questions measuring the system's ability to differentiate types of authorized users, protect users with a username and password, allow users to change the password, protect any technical error when retrieving documents submitted by users, and prevent data breach.
- Fifth dimension: Performance Testing was composed of 5 questions measuring the speed of computation and display of submitted applications, ability to support simultaneous, multiple user access, stability to tolerate heavy continuous usage, stability to store simultaneous, multiple applications and information submitted, and ability to recover data in case of system crash.

2) The questionnaire survey was measured by 3 experts using item objective congruence (IOC) to assess its validity and quality before testing in real situations [23].

3) After the experts reviewed the questionnaire survey, a 5-level Likert rating scale [21] was used to measure user satisfaction with system performance. There were 30 evaluators, including government officials from the Bureau of Mechanics and ordinary citizens.

4. Results and Discussion

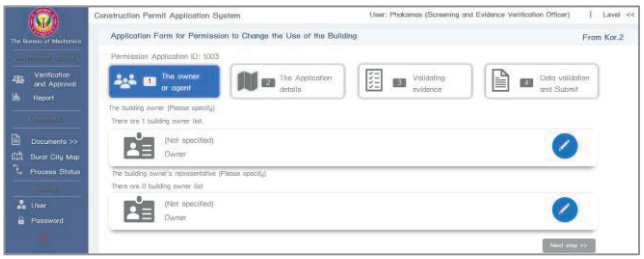
4.1 Results of the development of construction permit application system by applying Agile methodology

With a user-friendly design, the system was in the form of responsive web application designed for two main types of users: officials (government sector) and the general public. Details of the development outcome are shown in Figures 4 and 5:

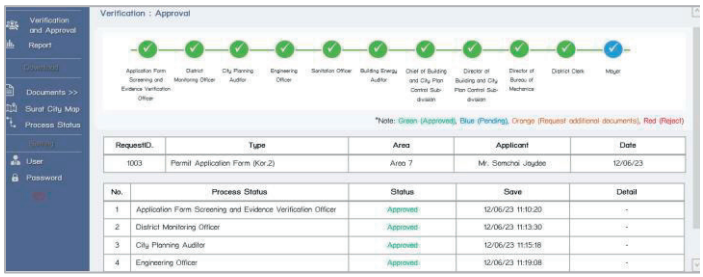
1) Officials (government sector): Officials included officers and personnel of the Bureau of Mechanics, Surat Thani City Municipality, including the Application Form Screening and Evidence Verification Officer, City Planning Auditor, District Monitoring Officer, Engineering Officer, Sanitation Officer, Building Energy Auditor, Chief of Building and City Plan Control Sub-division, Director of Building and City Plan Control Sub-division, Director of Bureau of Mechanics, District Clerk, and Mayor. The system allowed officials to search, review, approve, and deny applications. Also, the system could keep records of approved/denied applications, display details of approved/denied applications, and manage types of applications (Form Kor.2, 3, 4, 5) via an online system (https://etracking.sru.ac.th/login.php). The system was able to authorize and assign different levels of approval. Besides, the system could display reports of different application statuses. Details of the development outcome for officials are shown in Figure 4.

2) Public: Users, including residents, communities, and local firms, were allowed to submit and revise applications (Form Kor.2, 3, 4, 5), and check their application and approval status through the online system and LINE application. Details of the development outcome for the public are shown in Figure 5.

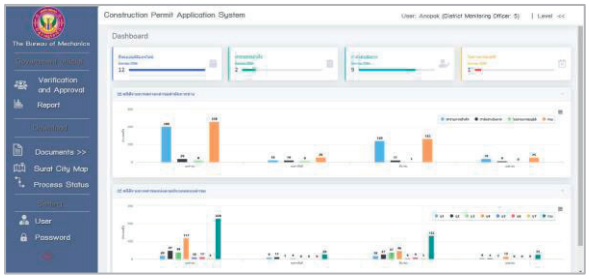
(a) Screen of application form screening and evidence verification officer.



(b) Input screen of form Kor. 2.

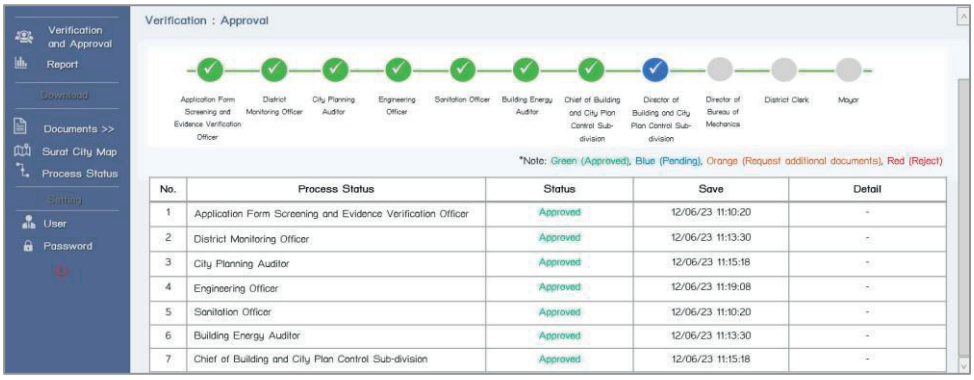


(c) Screen of approval status.

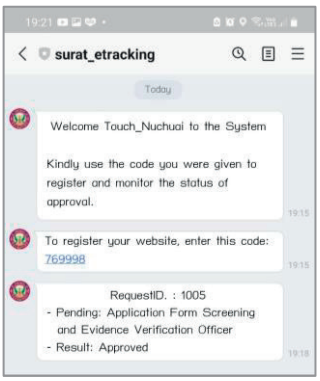


(d) Screen of summary reports.

Figure 4. (a)-(d) Results of system development for officials (government sector users).



(a) Screen of approval status through the online system.



(b) Screen of approval status through LINE application.

Figure 5. (a)-(b) System development results for the public (general public users).

4.2 Results of user satisfaction in the efficiency of the construction permit application system by applying the methodology of Agile

1) The results of designing a tool for assessing user satisfaction are shown below.

Table 2 displays the results of the average IOC score of each item calculated by 3 experts' ratings. The survey comprised 25 questions in 5 dimensions: 1) Function Test, 2) Functional Requirement Test, 3) Usability Test, 4) Security Test, and 5) Performance Test. The average IOC score for the questions was 1.00, within the standard limit of not less than 0.50. Therefore, it can be concluded that all the assessment items of the satisfaction assessment are accurate and can be utilized for evaluation.

2) The results of user satisfaction in developing the construction permit application system. The results are shown below.

Table 2. The results of Item-Objective Congruence (IOC) scores from experts.

Questions	Experts			Total score	IOC	Result
	1	2	3			
Functional Testing						
The ability to search for public user applications	+1	+1	+1	3	1.00	Congruent
The ability to set the level of approval	+1	+1	+1	3	1.00	Congruent
The ability to centralize the approval permission	+1	+1	+1	3	1.00	Congruent
The ability to print application documents submitted	+1	+1	+1	3	1.00	Congruent
The ability to generate reports on user's applications	+1	+1	+1	3	1.00	Congruent
Functional Requirement Testing						
The ability to record the application	+1	+1	+1	3	1.00	Congruent
The ability to verify information and approve applications online	+1	+1	+1	3	1.00	Congruent
The ability to submit applications online	+1	+1	+1	3	1.00	Congruent
The ability to track each application status	+1	+1	+1	3	1.00	Congruent
The ability to send notifications through the LINE application	+1	+1	+1	3	1.00	Congruent
Usability Testing						
User interface design	+1	+1	+1	3	1.00	Congruent
Suitable size of the user interface components	+1	+1	+1	3	1.00	Congruent
Consistency of user interface	+1	+1	+1	3	1.00	Congruent
Font size and design	+1	+1	+1	3	1.00	Congruent
Icon and image to convey messages	+1	+1	+1	3	1.00	Congruent
Security Testing						
The ability to differentiate types of authorized users	+1	+1	+1	3	1.00	Congruent
Protecting users with a username and password	+1	+1	+1	3	1.00	Congruent
Allowing users to change the password	+1	+1	+1	3	1.00	Congruent
Protecting any technical error when retrieving documents submitted by users	+1	+1	+1	3	1.00	Congruent
Preventing data breaches	+1	+1	+1	3	1.00	Congruent
Performance Testing						
The speed of computation and display of submitted applications	+1	+1	+1	3	1.00	Congruent
The ability to support simultaneous multiple-user access	+1	+1	+1	3	1.00	Congruent
The stability to tolerate heavy continuous usage	+1	+1	+1	3	1.00	Congruent
The stability to store simultaneous multiple applications and information submitted	+1	+1	+1	3	1.00	Congruent
The ability to recover data in case of system crash	+1	+1	+1	3	1.00	Congruent

Table 3. User satisfaction in the development of the construction permit application system.

Feature Tested	$\overline{x}$	S.D.	Level
Functional Testing	4.55	.59	Highest
Functional Requirement Testing	4.67	.51	Highest
Usability Testing	4.54	.53	Highest
Security Testing	4.47	.63	Highest
Performance Testing	4.53	.58	Highest
Total	**4.55**	**.57**	Highest

Table 3 displays user satisfaction with developing the construction permit application system, ranging from least to most satisfied. Regarding efficiency in meeting the user's needs (Functional Requirement Testing), it was at the highest level with an average and standard deviation of 4.67 and .51, respectively, followed by the ability to operate according to functionalities designed (Functional Testing), which scored at the highest level with an average and standard deviation of 4.55 and .59 respectively, user-friendliness (Usability Testing) which scored at the highest level with an average and standard deviation of 4.54 and .53 respectively, system performance (Performance Testing) which scored an average and standard deviation of 4.53 and .58 respectively, and satisfaction in security features (Security Testing) which scored at the highest level with an average and standard deviation of 4.47 and .63 respectively.

This research aimed to develop a construction permit application system to enhance local governmental organizations' efficiency in providing services to residents and assess users' satisfaction with the system efficiency. The Methodology was carried out in 2 parts. The first part focused on system development by applying agile methodology, which included 3 main phases: problem recognition and feasibility study or pre-sprint phase, development phase, and maintenance phase. The second part focused on stakeholders' or users' satisfaction with the system efficiency. The result of system development was divided into two main sections: officials (government sector) and the general public. There were various functionalities of the system to use depending on the demands of the users, such as approving or denying various applications, notifying applications for additional documents, displaying details of various approved or denied applications, determining a level of approval officers, submitting details of different construction permit application forms, display construction permit application status via an online platform and LINE application, etc. The developed system is conducted rapidly and flexibly as required by system users and supports user involvement, resulting in a successful mission according to its goals. This is consistent with Muhammad et al. [12], Hossain [18], and Lertjabok [15], who found that the system is fast and meets the needs of users. Moreover, Phusri and Kritworakan [17] found that applying Agile methodology could speed up web application design and aid daily interactions and communications between customers and team members to continuously notify customers of any work progress and obstacles, and foster collaboration in creating the solution which ultimately reduced time wasted. Moreover, the result of assessing user satisfaction showed that user satisfaction with the efficiency of the construction permit application system was at a very high level, scoring an average of 4.55 and a standard deviation of .57. The system also met the standard criteria, which include the ability to operate according to functionalities designed, user-friendliness, system performance and satisfaction in security features. Since the average score for users' overall satisfaction with the system was at a high level, it shows that the developed system by applying agile led to the practical construction permit application system that effectively meets users' needs and could enhance local administrative organizations' efficiency in providing services to residents and help the mission successful according to its standard criteria.

5. Conclusions

In this study, the research team designed the system in a responsive web application accessible via the internet by using PHP language storing data in the MySQL database. The system was developed by applying Agile methodology and Scrum with the participation of all stakeholders, including the government and general public sectors. The result of user satisfaction analysis, which was obtained via a tool developed by black-box testing in conjunction with a 5-level rating scale, concluded that users had a high level of

satisfaction with the efficiency of the system adopted Agile with an average score of 4.55 and a standard deviation of .57. The system was functional and could facilitate users very well. This was consistent with Muhammad et al. [12], Hossain [18], and Lertjabok [15], meaning that the system was fast and met the needs of users. Although the agile approach is popular and effective in developing a system that delivers value to users. However, it also comes with its own set of challenges and some limitations that can affect the speed and collaboration of the research, such as adding new requirements to a system that was not planned initially. To prevent this, it's important to define and prioritize the user stories, involve the user and stakeholders in the planning and review process, and get their feedback regularly.

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