Information System Development for Managing Waste Data to Promote Income Generation of the Community

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Abstract

This study aims at developing an information system for waste data management to promote income generation for the community, through a case study of Ban Khlong Sam Phraek community, Nai Khlong Bang Pla Kot Subdistrict, Phra Samut Chedi District, Samut Prakan Province. By developing the Zero Waste Shop web application, the quality of the information system developed is evaluated by applying five steps of the Scrum process, wherein the application is divided into sub-tasks. The Product Backlog is arranged in order of work using the Stack Ranking method, divided into Sprints. In addition, PHP V.8, JavaScript, Ajax, jQuery, HTML5, Laravel Framework 10 and Bootstrap 5.0, MySQL database as well as JWT techniques to encrypt data security are key factors considered in the development of web application. The findings reveal that the overall efficiency first evaluated by the experts is at the highest level (4.66±0.21). Second, the web application design evaluated by the community committee which shows their satisfaction of the overall design is found at the highest level (4.35±0.49). Next, the assessment by two groups of users, namely 15 community committee members and 50 community members reflects the overall satisfaction at a high level (4.27±0.51 and 4.35±0.63, respectively). Finally, technology acceptance evaluated by 15 community members is found at the highest level (4.56±0.50). Thus, the findings also indicate users are aware of how to use the application and accept the use of technology created.

Keywords: Laravel Framework; Web Application; Agile; Scrum; Community Waste Management

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1. Introduction

Thailand has conducted a survey on the amount of solid waste in the country, it was found that in 2023 there were approximately 26.95 million tons of solid waste, of which 9.31 million tons could be reused (Chusod, 2024), while in 2022 there were approximately 25.70 million tons of solid waste, of which 8.80 million tons could be reused (Pollution Control Department, 2023). In comparison, the amount of waste in 2023 will increases by approximately 4.86 percent by 2022, and the proportion of the amount of waste that can be reused are different at only 0.31 percent. This reflects the fact that the ability to manage waste is still an issue for the country. When considering the report on the situation of municipal solid waste disposal sites in Thailand in 2022 (Pollution Control Department, 2023), it shows that 21 percent of the amount of solid waste generated was disposed of incorrectly. Waste management is, therefore, a problem that the government must give importance to, and it is a dilemma mainly in developing countries because the waste generated by rapidly resulting from city expansions. This has placed a heavy burden on local authorities or governments (Marshall and Farahbakhsh, 2013). Hence, the Pollution Control Department has prepared the second waste management master plan for Thailand (2022-2027) by specifying three measures to solve the waste problem: managing waste at the source, increasing the efficiency of waste disposal systems, and developing waste management tools. In the third measure, emphasis is placed on promoting the development of innovations that support waste management, such as developing a database and linking waste management information, developing a waste exchange platform to promote utilization, etc. (Chanbunna, 2024). Based on the studies of current research related to waste management, iGIS systems and dashboards have been used to analyze spatial waste data that relates it to income, economy, society, population, and others (Xu, 2024; Shabani, Defe, Mavugara, Mupepi, & Shabani, 2024). Researchers are beginning to explore the feasibility, benefits, challenges, and implications of implementing AI-powered waste management systems in communities around waste collection, recycling, and environmental sustainability planning. Nwokediegwu and Ugwuanyi (2024) conclude that AI technology can lead to effective waste management approaches, but this is an approach that is planned for future research. Another study indicates the application of GIS and AI technology for improving the landfill site selection process as a guideline for future research (Kuhaneswaran, Chamanee, and Kumara, 2024). Several studies tend to focus on the relevance of GIS or AI technology to help collect waste generation data, providing waste management resources. However, only a few studies are carried out to emphasize participatory waste management that takes into account the promotion of income generation for those involved both for themselves and others. At this point, the present study aims at developing an information system for managing waste data that promotes income generation for the community, being explored at Ban Khlong Sam Phraek community, Nai Khlong Bang Pla Kot Subdistrict, Phra Samut Chedi District Samut Prakan Province, as a case study. With the community key members, the researchers assist in initiating a concept of “Waste separation” among the household of villagers in the community. Therefore, a community-run waste management project is implemented in the form of a community store, called “0 Baht Shop” with the slogan that “The shop which needs no money to buy...but just exchange with recycled materials. You can come and exchange things now.” Villagers can sell their garbage for money or exchange it for consumer products to use instead. The only limitation in community operations is they do not have a concrete accounting of income and expenses from garbage trading. Therefore, the aspect of their revenue and fixed cost cannot be summarized. This makes it less probable to apply the data in planning the implementation of community projects in various areas to maximize their needs, such as community welfare and distribution of dividends. However, the information system for waste data management has been introduced to promote income generation for the community in the form of a web application, contributing to the community project without cost burdens especially in terms of technology application.

A web application is a computer program that works through a web browser and web technology which works through the internet network. That is, users do not need to download web applications and store them on their computers because they can access them through a web browser. This also enables them to work on multiple platforms regardless of the operating system of the machine or device if the machine has a compatible browser (SEO WINNER, 2022). The study indicates that developing web applications for small and medium-sized businesses with the Laravel Framework based on the PHP language is an appropriate tool (Amini, et al., 2021). Therefore, Laravel Framework is used to develop web applications to support various functions, for example, web applications that provide food menus, food ordering, and seat reservations and receiving payments by efficient money transfer methods based on the Laravel Framework and MySQL database (Sinaga and Samsudin, 2021). A web application for providing community services in the village office using Laravel Framework has been implemented in Ranjeng, Ciruas sub-districtin the Serang district, Banten province, Indonesia. The developed web application can help improve village services (Damyati, Nuryani, Hasanah, Ruhiawati, and Oktavani, 2024). Meanwhile, sales support web application for Tart TunsShop Sales Pontianak powered by Laravel Framework's MVC architecture helps manage product orders, transaction list and categorize products more easily (Valenty, Kosasi, Gat, David, & Kuway, 2024) as well as in the study by (Melati, 2024; Evendi, Setiawati, & Wulandari, 2024). From the previous studies, it can be concluded that the Laravel Framework-based web applications with the basic computer language PHP will help develop web applications with high flexibility. Hence, the present study aims to develop an information system for managing waste data that promotes income generation for the community using the Laravel Framework more applicable to PHP language and other related languages and to assess the quality of the information system for waste data management that promotes income generation for communities developed from the perspective of each group of users.

2. Methodology

This research and development of information systems for waste data management aims at promoting income generation for communities. Applying as a case study of Ban Khlong Sam Phraek community, Nai Khlong Bang Pla Kot Subdistrict, Phra Samut Chedi District, Samut Prakan Province, the emphasis is on creating a Zero Waste Shop web application. It will be designed to be more applicable to communities that have small to medium sized business needs and have little understanding of information system development. Based on the Agile concept, the guideline is applied in software development and project management that emphasizes flexibility and effective adaptation to changing needs and situations (Uriawan, et al., 2024). In addition, the

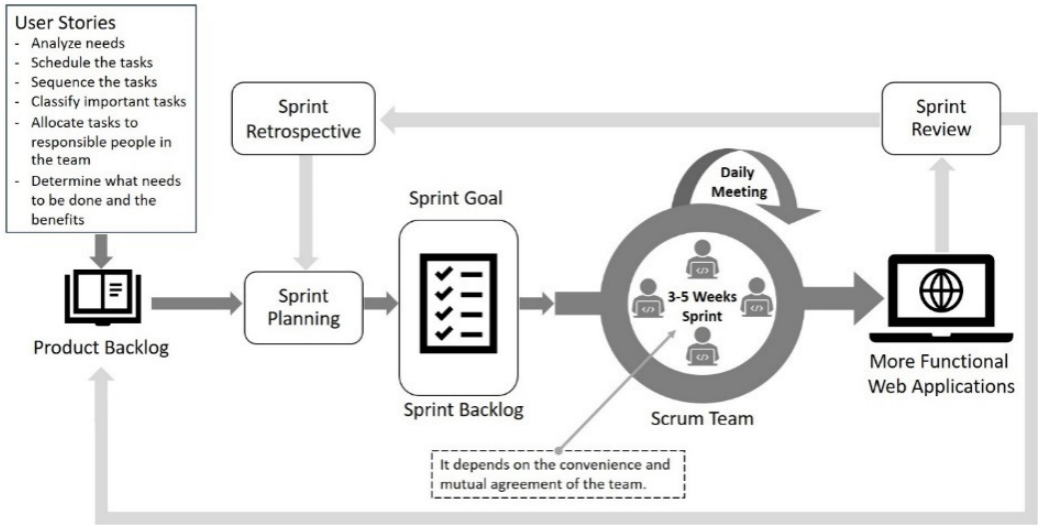

Figure 1. Scrum system development method (Adapted from Scrum.org, 2024.; Srisura, R., et al., 2022: 70)

researchers choose the Scrum system development method, which is one of the Agile system development processes (Srisura, Wayalun, Salee, and Sinjungreed, 2022). Five steps are involved in the research process: 1) analyzing User Stories, 2) creating a Product Backlog, 3) defining Sprint Planning, 4) developing web applications, and 5) evaluating the quality of web applications. The system will be developed one work system at a time and the next work system will be developed when the previous work system has been developed successfully. This cycle continued until the entire system was complete. The Scrum system development method is illustrated in Figure 1.

2.1 Analyzing User Stories

The researchers first analyze user needs by selecting people involved in using the Zero Waste Shop web application as a team, called Scrum Team. The team members who participate in developing the application are assigned certain roles: three project administrators, two programmers and 15 testers (selected specifically from committee of the Ban Khlong Sam Praek community). Their main roles are to jointly determine the system operation guidelines, system design and testing. The researchers then study the process of developing a system introduced by Agile (Uriawan, et al., 2024; Srisura, Wayalun, Salee, and Sinjungreed, 2022), conduct a study of the general context regarding the purchase and sale of waste (Wongpanit International Co., L., 2024), and study methods for evaluating the quality of research and development of information systems for managing waste data that promote income generation for communities, including efficiency evaluation, including satisfaction assessment and evaluation of technology acceptance (Srisura, Wayalun, Salee, and Sinjungreed, 2022; Cheawpanich, 2020). Next, the group discussion between teams to gather needs is organized, divide work into parts, sequence work, and create work-related details according to user needs or User Stories of each work, defining success from this Zero Waste Shop web application development. That is, web applications must be usable at the end of the system development cycle and must be tested by the designated user and the user must accept the results of working with the system.

2.2 Preparing the Product Backlog

First, the researchers organized a group discussion among the team to design the functionality of the Zero Waste Shop web application by using the User Stories of each work for designing the Product Backlog. There are eight Product Backlogs: 1) System for registering and managing users in the system; 2) Wallet system; 3) Points system; 4) System for purchasing waste and managing promotional information; 5) Waste warehouse system, waste separation and waste transfer; 6) System for exchanging members' points for cash or consumer products; 7) Waste sales system; and 8) System for closing the balance and sending money to the community's central store. Then, the researchers arrange the sequence of work for Product Backlog using Stack Ranking method, which is the order of the most important tasks that must be performed first to the least important tasks that can be done later (Skooldio, 2023).

2.3 Setting Sprint Planning

Define Sprint Planning is organized by specifying the duration of web application development or Sprint according to the tester's (Community Committee) convenient time. Each Sprint will last between three and five weeks, and there are daily meetings between project executives and programmers to follow up on work. This research had a total system development cycle of seven Sprints, totaling 28 weeks of system development time until the system development ended, The conceptual framework for developing the Zero Waste Shop web application to shown in Figure 2.

2.4 Developing Web application

To develop Zero Waste Shop web, the researchers focus on a web application that can display work results through display devices including smart phones, tablets, notebooks, and desktop computers. It works through browsers such as Chrome and Microsoft Edge, etc., with PHP V.8 and other languages, such as JavaScript, Ajax, jQuery, and HTML5. The command set of Laravel Framework 10 with MVC writing techniques is also included. This makes writing web applications much easier, creating a user interface with Bootstrap 5.0 and using the database management program phpMyAdmin to manage the MySQL database running on the Nginx web server system. At this stage, the researchers begin

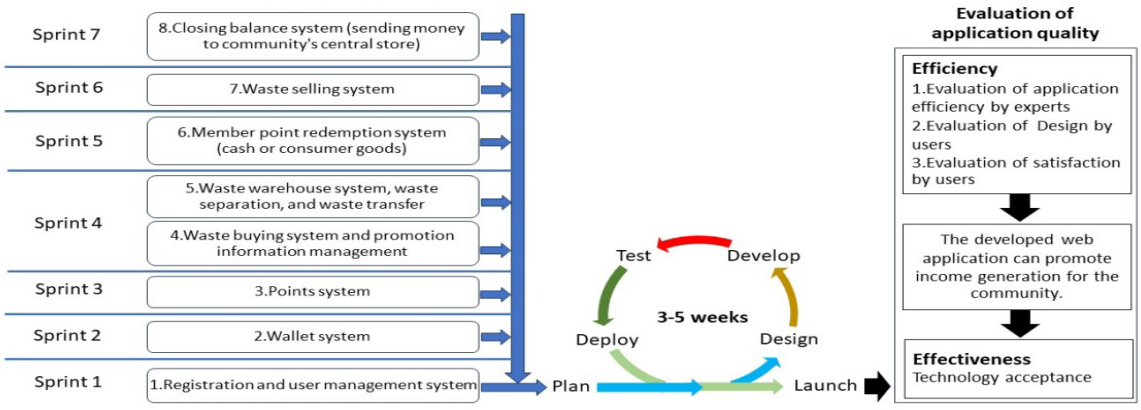

Figure 2. Conceptual framework for developing the Zero Waste Shop web application (Adapted from Srisura, R., et al., 2022: 69)

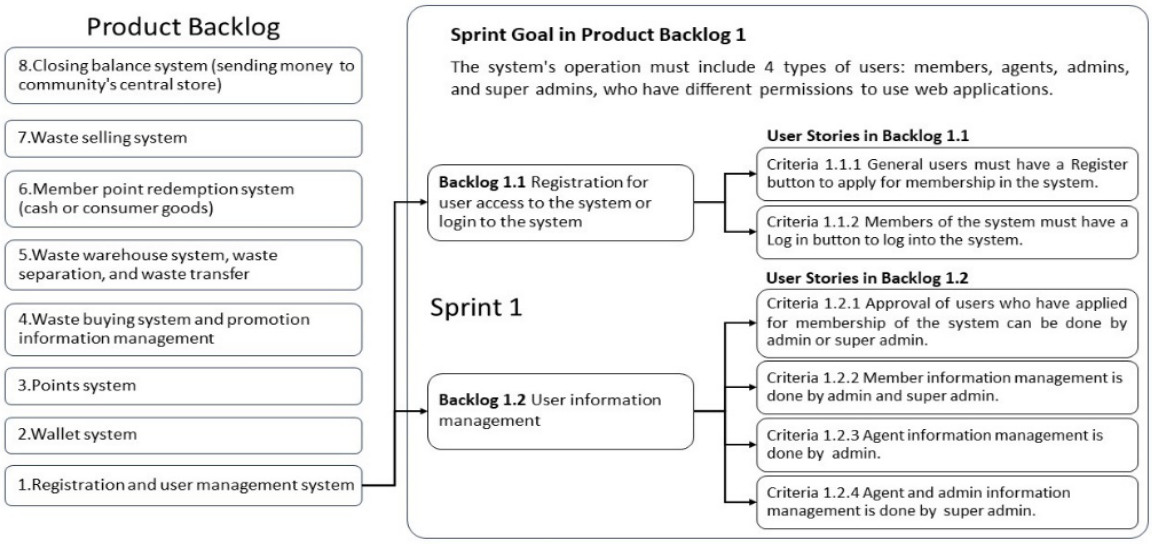

Figure 3. Sprint Backlog design of Product Back 1 Registration and user management system

to develop the system each of Product Backlog at a time according to the defined Sprint cycle, so that users can see the web application in action and understand how web applications work part by part until it can be used quickly. For instance, a Zero Waste Shop web application in Product Backlog 1 is user registration and management system in the system. As shown in Figure 3, when ranking the Product Backlog using the Stack Ranking method, the team can see that it is important and will let this system occur first.

Figure 3 illustrates an example of developing a Zero Waste Shop web application after analyzing User Stories and prioritizing tasks with a total of eight Product Backlogs. Therefore, researchers have begun to develop the system by selecting Product Backlog 1, system for registering and managing users as a priority. Then set Sprint Goal for Product Backlog 1, which is the operation of the system which must include four types of users: Members, Agents, Administrators, and Super Administrators who have different rights to use web applications. Next, design a Sprint Backlog divided into 2 sub-tasks: Backlog 1.1, user registration to use the system or login to the system, and Backlog 1.2, user information management, specifying that each Backlog of Product Backlog 1 must denote the Acceptance Criteria of User Stories for each Backlog. The acceptance criteria include Backlog 1.1, User registration to use the system or login to the system such as conditions 1.1.1. General users must have a Register button to apply to become a member of the system and conditions 1.1.2. Members

of the system must have a Log button in to be able to log into the system. After that, set Acceptance Criteria for Backlog 1.2. User data management is condition 1.2.1, approval of users who apply to become members of the system which can be done by administrators or super administrators. Condition 1.2.2, member data management can be done by administrators and super administrators. Condition 1.2.3, agent data management can be done by System administration, while conditions 1.2.4, agent and system administrator information is managed by the ultimate system administrator. Acceptance Criteria are defined to ensure that the Product Backlog 1, system registers and manages users in the system various details have been taken to develop a system that can actually be used according to Sprint Goal in Product Backlog 1, which is analyzed from the User Stories specified. After the web application development is complete, it is evaluated by experts and users, where the researchers upload the Zero Waste Shop web application developed at https://waste.ddl coding.com/.

2.5 Evaluating the quality of web applications

The researchers assure the quality of the Zero Waste Shop web application based on the evaluation of performance of web applications by experts and start testing the functionality of web applications by users. Web application performance is evaluated by experts and through testing of web application functionality by users, including evaluation of web application design by users. User satisfaction and technology acceptance assessments are analyzed with statistics, mean, and standard deviations, including interpretation of the evaluation results by experts according to the Likert 5-rating scale (Prachayagringkai, Siriangkulvanich, and Horma, 2024). The average of 4.51-5.00 is at the highest level, 3.51-4.50 a high level, 2.51-3.50 a moderate level, 1.51-2.50 a low level, and 1.00-1.50 the lowest level. The results of website quality assessment for all applications are presented as follows:

2.5.1 Evaluation of web application performance by experts was carried out using the Zero Waste Shop web application performance evaluation form, consisting of 91 questions, a 5-level rating scale. The questions are divided into four areas: 1) Function Test, 2) Usability Test, 3) Result Test, and 4) Security Test. After that, the researchers determine the quality of the tools using the IOC values of five experts in research, measurement and evaluation. The value is between 0.60-1.00. It can be concluded that the performance evaluation form developed can be used to evaluate the performance of web applications effectively. Then, the developed evaluation form is applied to evaluate the performance of web applications by five experts in computer and information technology and information systems. Two experts have doctoral degrees in computers and information technology, and one of them has an academic position at the level of Assistant Professor of Information Systems and is an expert in monitoring program performance. The other two are experts in community waste separation management whose area of expertise is in checking the efficiency of content related to waste separation in the program.

2.5.2 In relation to testing the functionality of the web application by users (Sprint Review), the researchers assign users to test the functionality of the Zero Waste Shop web application by going to use it at https://waste.ddlcoding.com/(Figure 4.) The researchers provide training in using the Zero Waste Shop web application to users in each Sprint, so that users can use the website. Thus, this application is effective. User then test and evaluate their use (Sprint Retrospective). Next, the researchers collect results from users to improve the functionality of the web application to make it work better as shown in Figure 4.

The functionality evaluation of the Zero Waste Shop web application was performed by 65 users, divided into two groups: a community committee of 15 people selected by the purposive selection method from the entire committee, who are responsible for overseeing the community waste management project. They provide the researchers with qualitative data at every

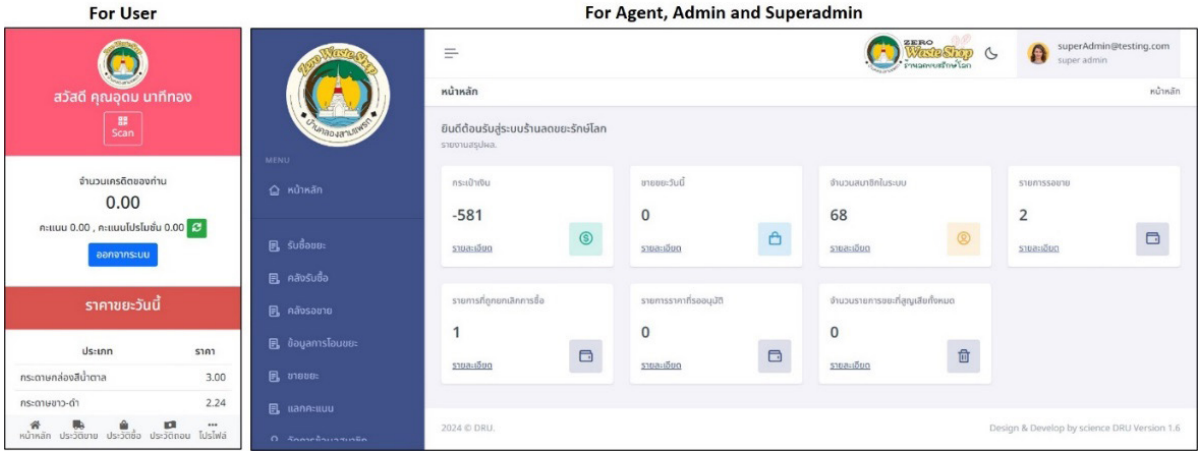

Figure 4. Working screen of the Zero Waste Shop web application for users to test and evaluate usage

stage of program development, and they are functional testers who evaluate the design of web applications. They also evaluate functionality and user satisfaction of web applications, including technology acceptance to draw a conclusion that the web application developed is of quality consistent with the needs for actual use set by the community committee group. For the group of 50 residents or people in the community, the researcher used a purposive selection method to provide quantitative information. They test functionality and assess satisfaction with the web application, leading to the conclusion that standards and quality of the web application developed are consistent with the needs of people in the community. The details can be explained as follows.

1) Functional testing and evaluation of web application designs by users is done by the Zero Waste Shop web application design evaluation form by users, totaling 37 questions. This was a 5-level estimation scale. The questions of the evaluation are divided into three areas: 1) content, 2) web application design, and 3) designing the data management section within the web application. The quality of research tools are determined by IOC values evaluated by five experts in research and measurement and evaluation, consisting of a value between 0.80-1.00. In conclusion, the design evaluation form developed can be used to effectively evaluate the design of web applications developed by users. The researcher, then use the prepared evaluation form to evaluate the web application design by 15 users, namely the Ban Khlong Sam Praek Community Committee. The testing and evaluation of the design is done immediately after training, and the results are used to improve the web application.

2) Functional testing and evaluation of user satisfaction of the web application is carried out with a satisfaction assessment form for users of the Zero Waste Shop web application. Set 1 is for the president, committee, and community representatives, totaling 114 questions, and Set 2 is for groups of residents or people in the community, totaling 33 questions, using 5-rating scale. Both questionnaires were divided into three designed questions: 1) the ability to work according to the application system, 2) the design of the system's functionality, and 3) the satisfaction with using the system. The researchers determine the quality of the research tools by using the IOC values for the first and second evaluation sets by five experts in research and measurement and evaluation. The values are between 0.60-1.00 and 0.80-1.00, respectively. It can be concluded that the satisfaction assessment developed can be used to effectively evaluate applications developed by users. The researchers then take both sets of evaluation forms to evaluate the satisfaction of users in the Ban Khlong Sam Praek community. It was divided into Set 1 for 15 people selected by purposive sampling,

and Set 2 for 50 people selected by purposive sampling. Testing and evaluating the satisfaction of both groups of users was done performed immediately after starting the trial for 7-15 days in order to use the results to further improve the web application.

3) Technology acceptance assessment is carried out using a technology acceptance questionnaire based on the TAM model (Thamman and Asanok, 2018; Srisura, Wayalun, Salee, and Sinjungreed, 2022). It consists of ten items with a 5-level estimation scale: 5 most accepted, 4 very much accepted, 3 moderate, 2 little, and 1 least accepted. The questions of the evaluation focused on two areas: 1) the perceived benefits received from use, and 2) the perceived ease of use. Next, the researchers determine the quality of the instrument using the IOC value evaluated by five research, measurement, and evaluation experts. All items are equal to 1.00, making it possible to conclude that the technology acceptance questionnaire developed could be used effectively. The researchers then organize a user group discussion meeting at Ban Khlong Sam Phraek Community, totaling 15 people to follow up on the use of the Zero Waste Shop web application after it has been used for 30 days. Evaluation of the acceptance of the technology is also administered, including the lessons learned from using the Zero Waste Shop web application both before use and after use for their reflections and suggestions for future improvements.

3. Findings and discussion

3.1 Findings

3.1.1 Based on the results of Sprint Backlog development from user evaluation, the designs of system architecture and the database used in the Zero Waste Shop web application can be presented as follows:

1) The result of the architectural design of the Zero Waste Shop web application consists of a diagram This shows the overall functioning of the web application User Case Diagram, a diagram of the process of buying and selling community waste through the web application principles used as a guideline for developing the system and details of the web application in Product Backlog 1, in which the system for registering and managing users in the system can be described as follows:

1.1) Diagram showing an overview of the operation of the Zero Waste Shop web application and all those involved with the system From Figure 5, general users will be able to see information on the price of pur-

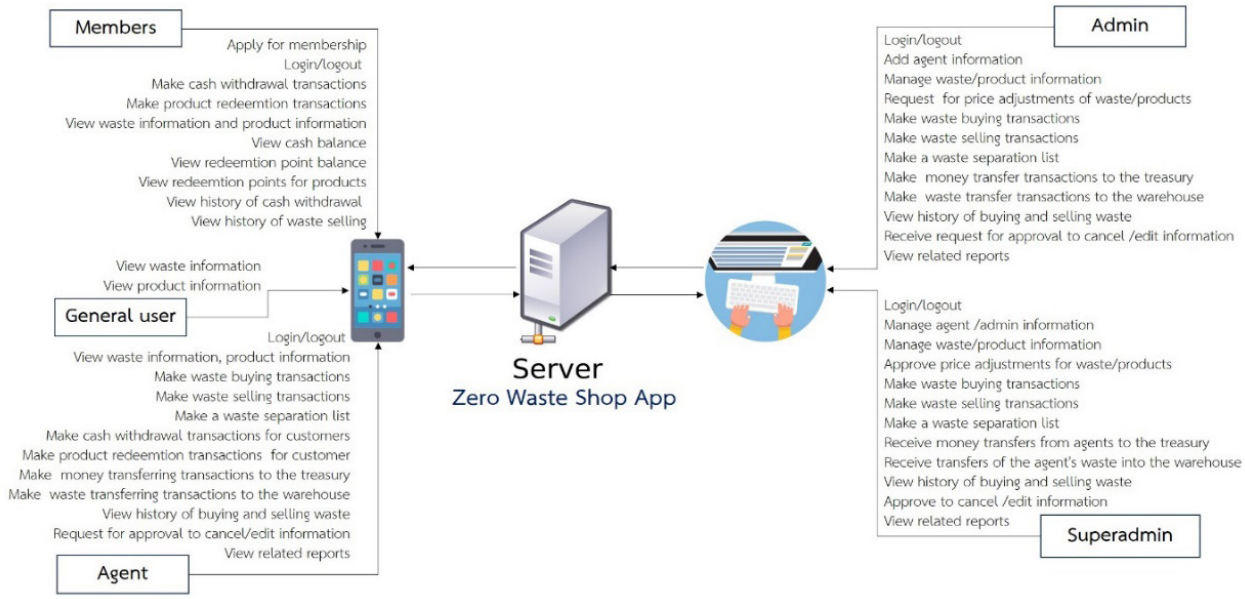

Figure 5. Diagram showing an overview of the Zero Waste Shop web application and all the people involved in the system

chasing garbage and can only view product prices from the web application because the Zero Waste Shop web application has been developed for all 4 types of users involved: Members, Agents, Administrators and Super Administrators. Users who are members of each web application group will have different access to the system such as agent, administrator, and super administrator. They will be able to conduct transaction to buy waste from their members. After completing the waste purchase transaction, points were transferred to the member's wallet. Members will be able to check the points received on the application web page immediately. Another example is that the system administrator will be able to request permission to adjust the price of garbage/products. But the web application will be able to adjust the price of garbage/products. Top Administrator must be the person who approves the price adjustment of garbage/products before being able to adjust the selling price, etc. In addition, the results of system development in Product Backlog 1 are the system for registering and managing users in the system. If you want to manage agent and system administrator information (add / edit / delete / reset passwords), this can only be done by the highest administrator.

1.2) User Case Diagram of the Zero Waste Shop web application This shows the relationship of users' work processes in the system by viewing the work process which provides information from Ban Khlong Sam Praek Community Committee. There are 4 types of users involved: Members, Agents, Administrators, and Super Administrators by dividing the work of the system in which each group of users works together. The User Case Diagram of the Zero Waste Shop Part 1 of web application demonstrates the interaction of users between the superadmin and admin (Figure 6). The User Case Diagram of the Zero Waste Shop Part 2 of the web application shows the user interaction between the superadmin, admin, and agent (Figure 7). The User Case Diagram of the Zero Waste Shop Part 3 of the web application shows the user interaction between the superadmin, admin, agents, and members (Figure 8). The User Case Diagram of the Zero Waste Shop Part 4 of the web application shows the user interaction between members, general users and admin (Figure 9).

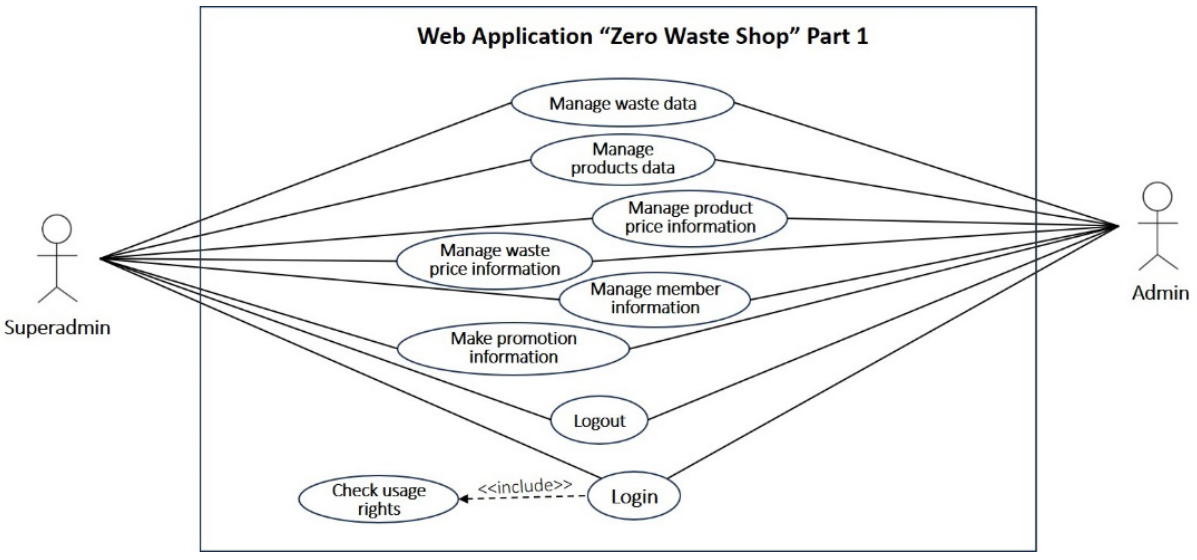

Figure 6. Use Case Diagram shows the relationship between superadmin and admin.

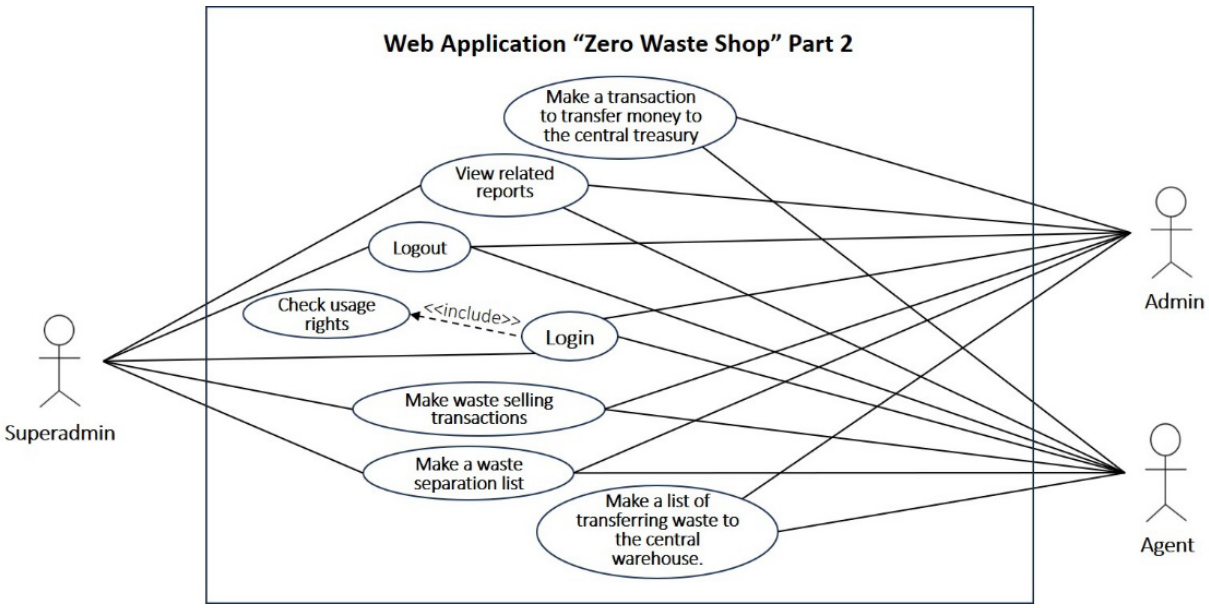

Figure 7. Use Case Diagram shows the relationship between superadmin, admin, and agent.

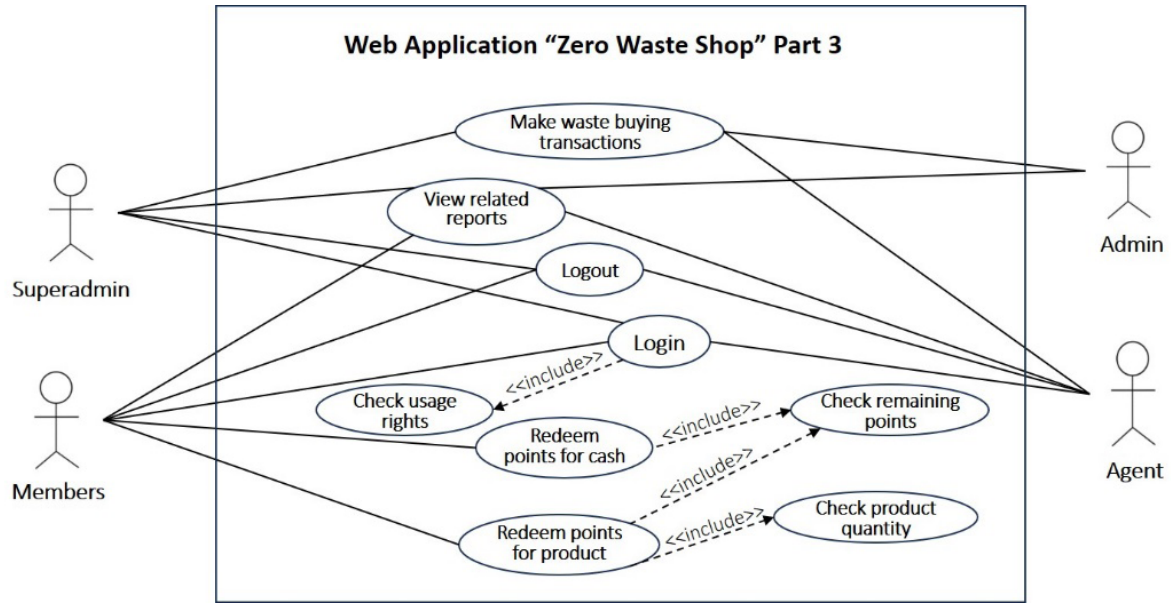

Figure 8. Use Case Diagram shows the relationship between superadmin, admin, agent, and members.

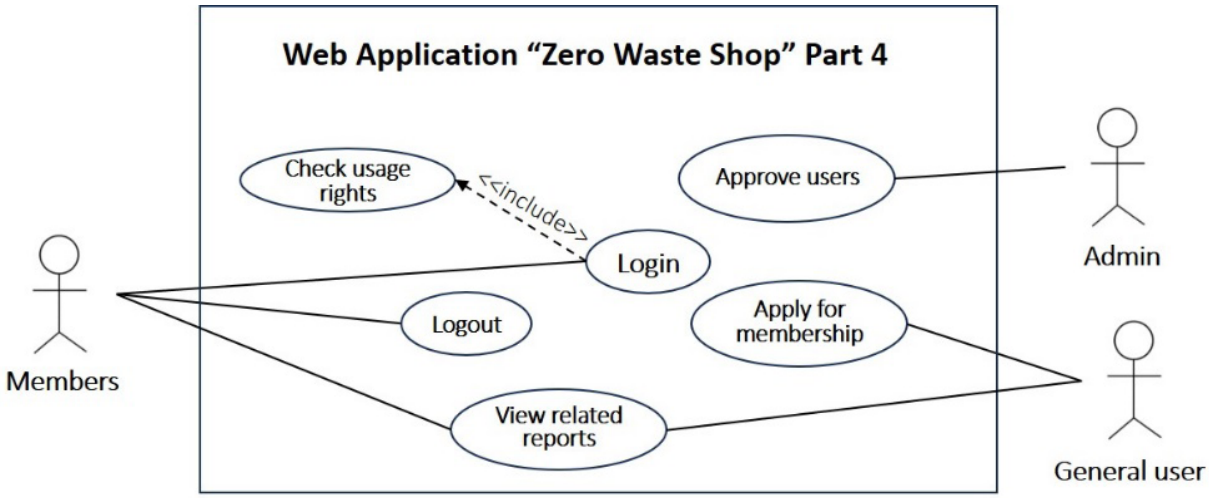

Figure 9. Use Case Diagram shows the relationship between members, general user and admin.

1.3) Diagram of the process of buying and selling garbage of people in the community with the Zero Waste Shop web application It begins when the representative of the community purchases garbage (user rights in the web app include Agent, Administrator and Super Administrator), from people in the community who are members via QR-Code with the Zero Waste Shop web application on smart phones or computer. After completing the waste purchase transaction, the community waste purchaser issues a waste purchase slip to the members as evidence of the waste purchase. In the event that members do not have a Smartphone, they can keep it as evidence. However, if members have a Smartphone, they can view their waste sales history through the Zero Waste Shop web application. After that, the purchased waste is stored in the purchasing warehouse (Database1) and sorted. Waste is separated or transferred by the community waste buyer's representative to the warehouse to keep for sale, (Database 2) which will be ready for representatives of community waste buyers to sell to waste factory operators or waste purchasing centers. After that, the community waste buyer representative will calculate the income from selling waste to waste factory operators or waste purchasing centers and calculate expenses from purchasing waste from community members. This is accounted for in a report of profit and loss separately on a monthly basis and in the following year. The process of buying and selling waste is illustrated in Figure 10 below.

1.4) Principles used as guidelines for designing and developing the Zero Waste Shop web application This time includes MVC writing techniques (Codinggun, 2024; Fowler, et al., 2002) that will help write command code that supports changes better. As shown in Figure 11, MVC methods use the data security encryption technique of JWT authentication (Thongjor, 2017; Akanksha & A. Chaturvedi, 2022). It is used for the point redemption process of Zero Waste Shop web application and Object Relational Mapping (ORM) technique is used, (Onmobile, 2023) which is a model of Laravel Framework that helps map data between Relational Database and OOP programming language without using SQL commands, thus reducing redundancy in interacting with the database.

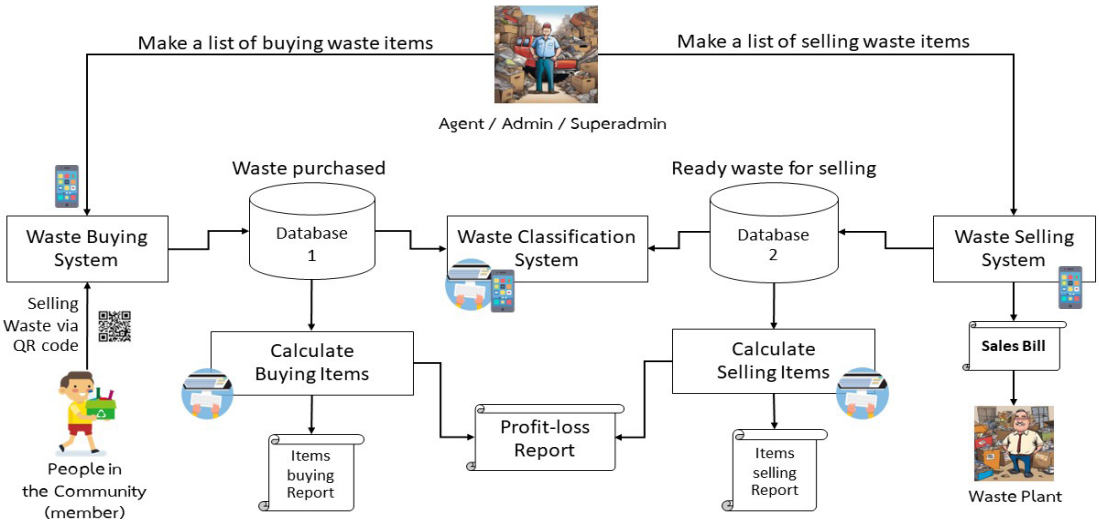

Figure 10. Diagram of the process of buying and selling community waste with the Zero Waste Shop web application

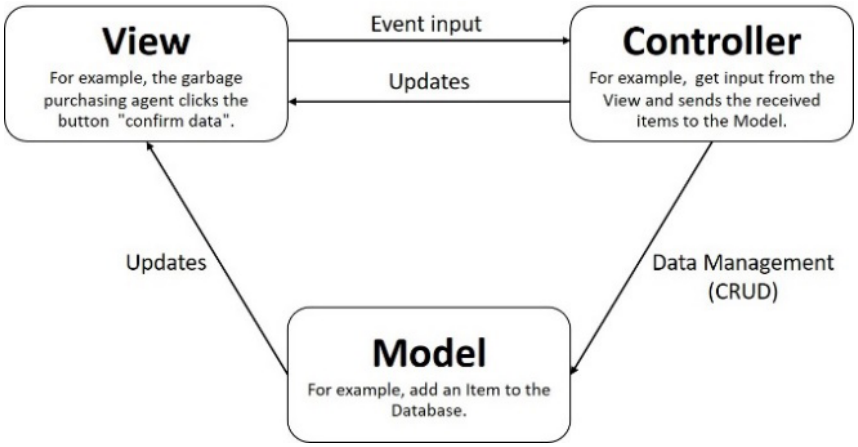

Figure 11. MVC methodology used to program the Zero Waste Shop web application (Adapted from Codinggun, 2024; Fowler, et al., 2002)

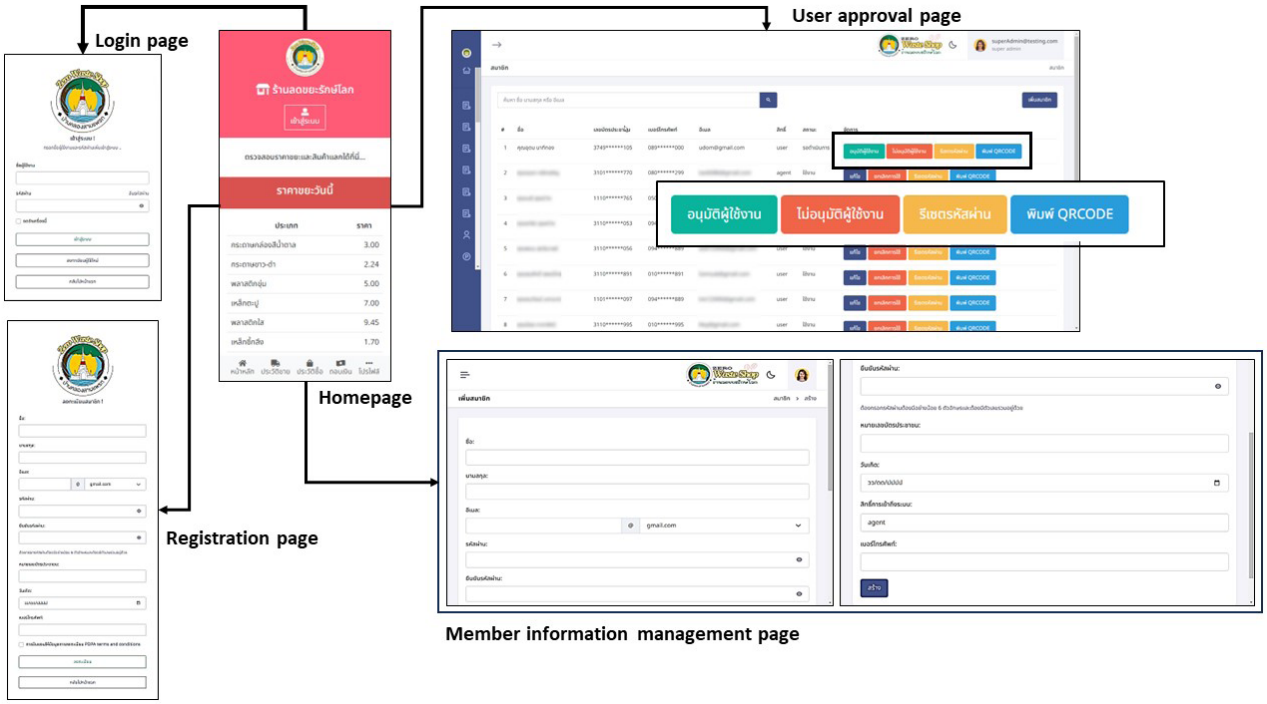

Figure 12. Details of information design in Product Back 1, registration and user management system

1.5) Details of the design of the Zero Waste Shop web application in Product Backlog 1, user registration and management system in the system It can be illustrated in Figure 12 below.

2) Results of designing the database working structure with a diagram showing data relationships (ER Diagram) in the form of Crow's foot model of the Zero Waste Shop web application There are a total of 29 entities, with each entity having 32 relationships with each other. The relationships show interconnected relationships between the entities, as shown in Figure 13.

3.1.2 The results of developing the Zero Waste Shop web application can be accessed at https://waste.ddlcoding.com/. The functionality of the web application divides users into four categories: members, agents, administrators, and ultimate administrators.

1) Members will have to fill out the Zero Waste Shop web application, user ID and password before they can log in, as shown in Figure 14. – 19.

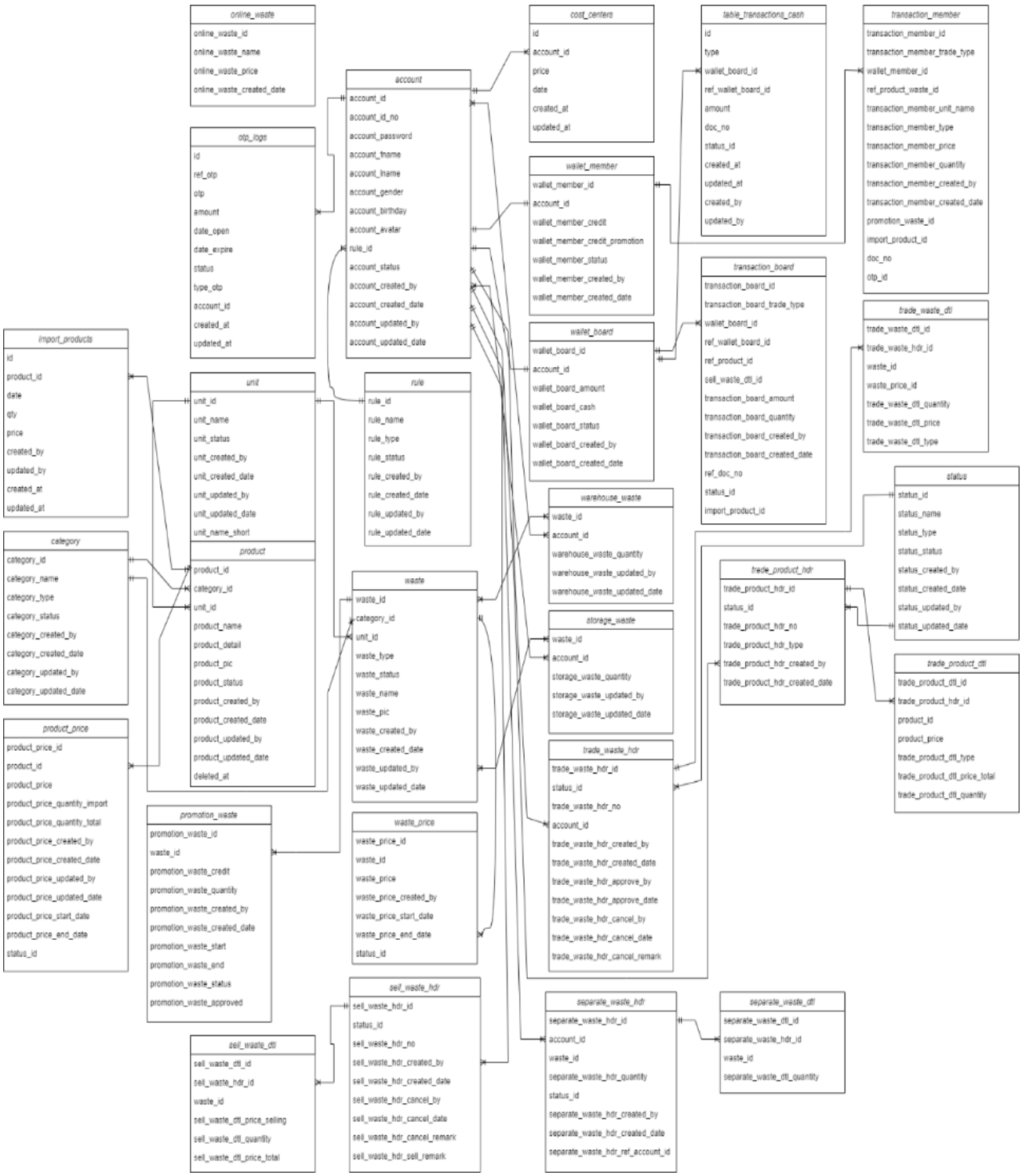

Figure 13. ER Diagram Zero Waste Shop web application

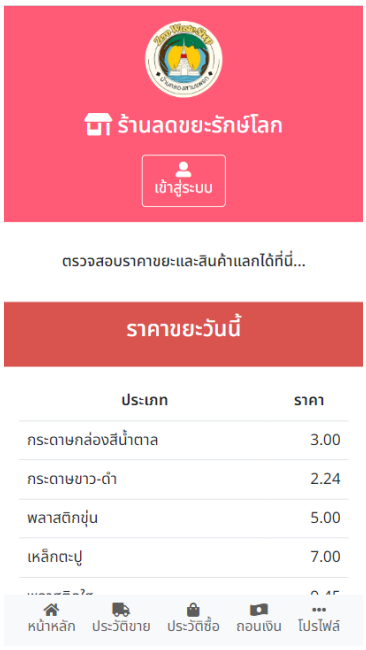

Figure 14. Home page

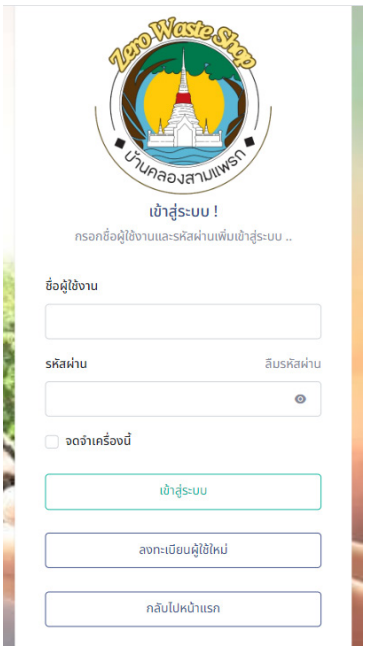

Figure 15. Login page

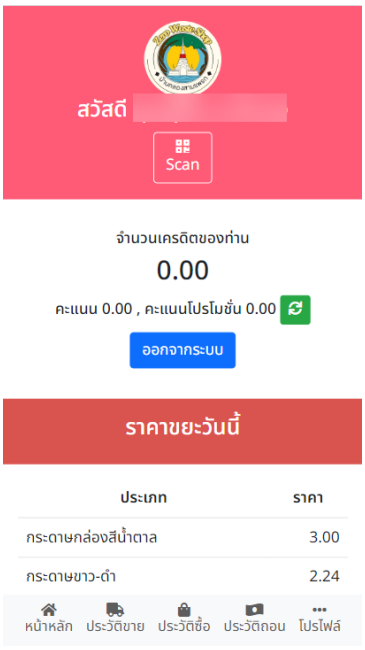

Figure 16. Member home page

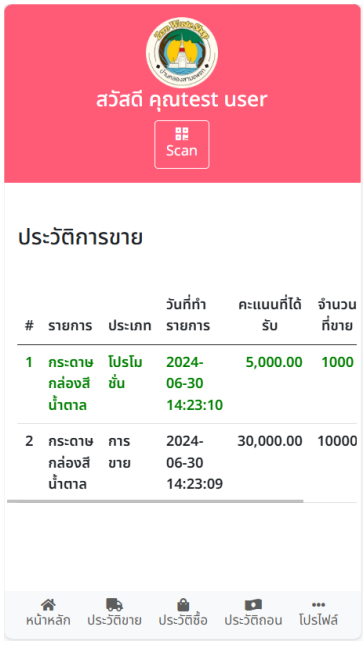

Figure 17. History of selling waste

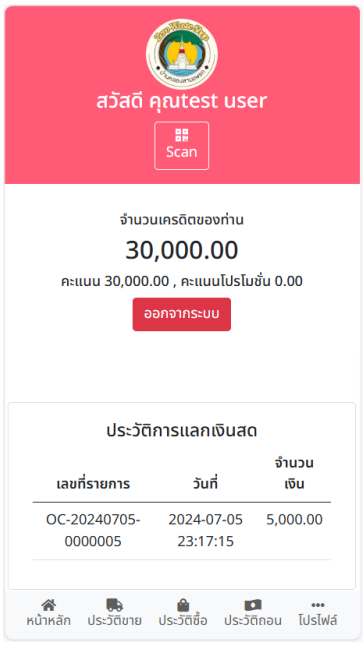

Figure 18. Cash withdrawal history

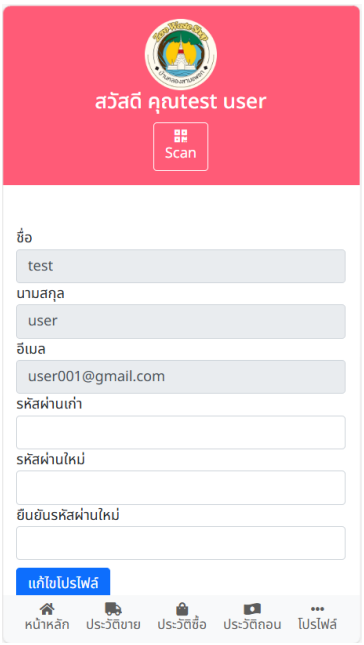

Figure 19. Profile of member

2) The agent will access the Zero Waste Shop web application and must fill out User ID and password before they can access. After logging into the system, they will be able to perform operations with the system, including purchasing waste, transferring waste, separating waste, selling waste, exchanging points for cash for members, and others. Examples of some of Agent's works are shown in Figure 20. – 22 below.

3) The administrator can operate the system in the same way as agent and has additional functions than Agent, including being able to exchange points for products. They can manage promotional information and be applied to adjustments to garbage prices and product prices. If there are changes in price, the system is designed to start using the new prices the next day. Examples of administrative work are shown in Figure 23. – 24.

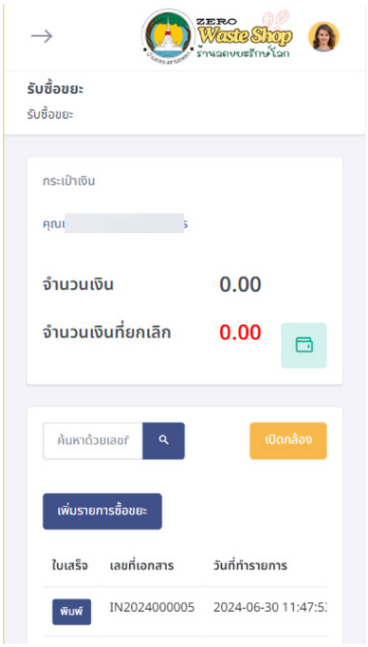

Figure 20. Waste purchase page

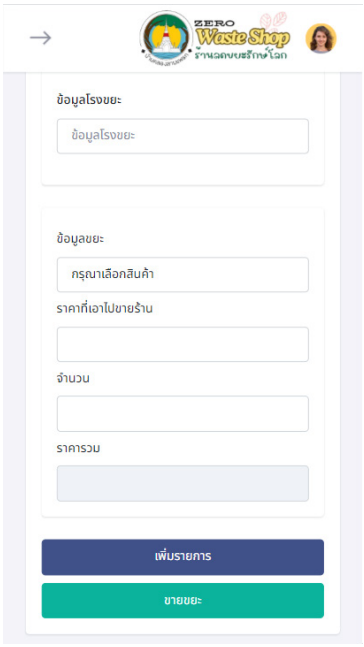

Figure 21. Waste selling page

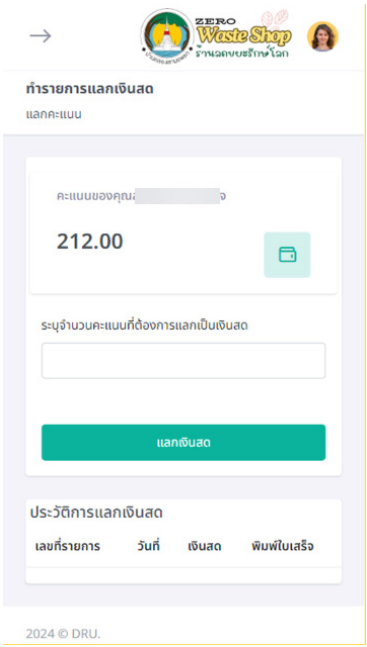

Figure 22. Points redeem for cash

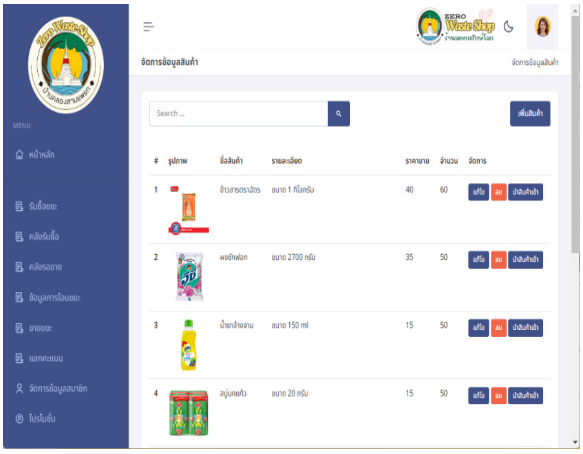

Figure 23. Product data management page

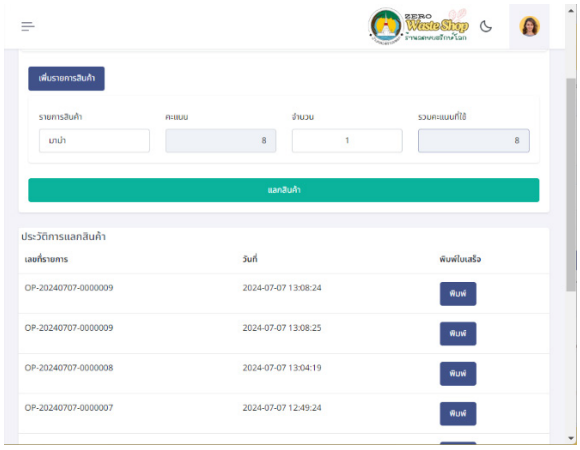

Figure 24. Points redeem for product

4) The super administrator can operate the system in the same way as agent and administrator and has additional functions, such as managing the transfer of agents and administrators into the central treasury, viewing income-expense reports, annual profit and loss, etc. Examples of some Super Administrator work can be illustrated in Figure 25. –27.

3.1.3 Results of evaluating the efficiency of the web application by five experts using the efficiency evaluation form It is found that the Zero Waste Shop web application has the highest level of efficiency (4.66±0.21) as shown in Table 1.

3.1.4 Results of testing the functionality of the web application by users (Sprint Review) to develop the Zero Waste Shop web application, the researchers evaluate the results by taking the results of each Sprint, summarize them as a whole, and presenting them in three phases of evaluation as follows.

1) With regards to results of web application design evaluation with the evaluation form by users who are a community committee of 15 people, the researchers evaluate it immediately after training the users on its use, and it reveals that The Zero Waste Shop web application has the highest level of design results (4.35±0.49) as shown in Table 2.

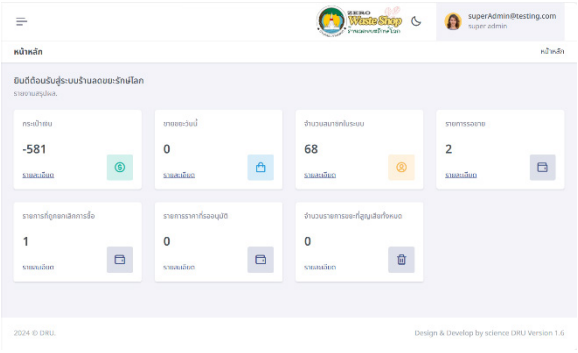

Figure 25. Dashboard Page for Super administrator

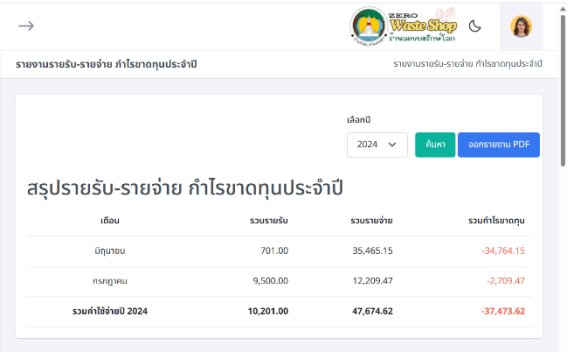

Figure 26. Income-expense report, annual profit and loss year 2024

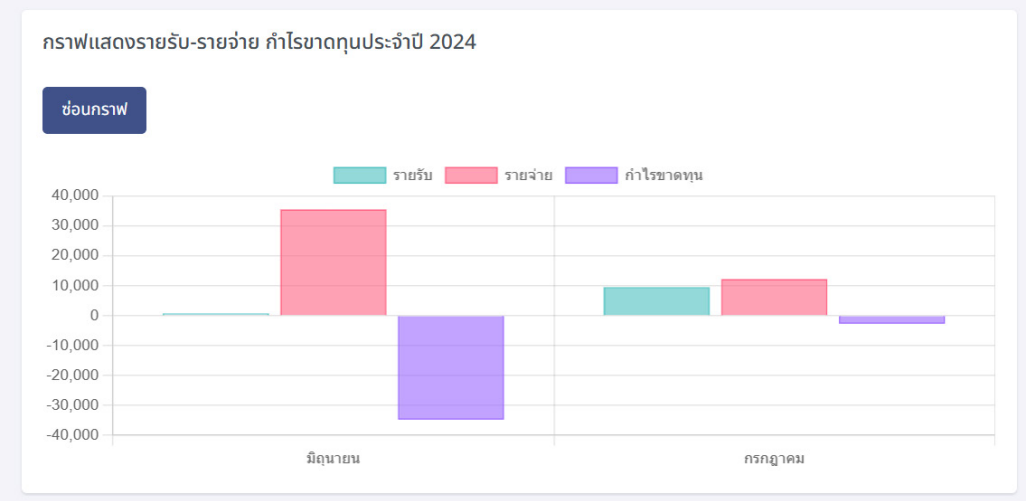

Figure 27. Graph showing income-expense summary results, profit and loss for the year 2024 obtained from the Zero Waste Shop web application

Table 1. Results of web application performance evaluation by experts (n=5)

Performance evaluation items	$\overline{X}$	S.D.	Level of performance
Function Test	4.67	0.25	Highest
Usability Test	4.52	0.22	Highest
Result Test	4.74	0.20	Highest
Security Test	4.70	0.19	Highest
Mean avg	**4.66**	**0.21**	**Highest**

Table 2. Results of web application design evaluation by users (n=15)

Design evaluation list	$\overline{X}$	S.D.	Level of Satisfaction
Content	4.38	0.50	High
Application design	4.33	0.49	High
Design of data management sections within web applications	4.33	0.48	High
Mean avg	**4.35**	**0.49**	**High**

Table 3. Results of user evaluation of web application design.

Satisfaction assessment list	$\overline{X}$	S.D.	Level of Satisfaction
Group 1 Community committee (n=15)	4.27	0.51	High
1. Ability to work according to the application system	4.24	0.50	High
Super administrator	4.23	0.52	High
Administrator	4.25	0.51	High
Agent	4.25	0.47	High
2. System work design	4.32	0.52	High
3. Satisfaction of system use	4.33	0.51	High
Group 2 Community members (n=50)	4.35	0.63	High
1. Ability to work according to the application system	4.39	0.63	High
2. System work design	4.33	0.64	High
3. Satisfaction of system use	4.32	0.62	High

Table 4. Technology acceptance results for the Zero Waste Shop web application (n=15)

Technology acceptance assessment items	$\overline{X}$	S.D.	Level of acceptance
Perceived Ease of Use	**4.64**	**0.49**	**Highest**
1. There is a user manual for each group of users.	4.67	0.49	Highest
2. There are easy and flexible steps to use.	4.73	0.46	Highest
3. The screen elements are arranged appropriately and are easy to understand.	4.67	0.49	Highest
4. There is speed in using or accessing information.	4.47	0.52	High
5. The system can be used anywhere and can be used on computer devices, Smartphones, and tablets	4.67	0.49	Highest
Perceived Usefulness	**4.48**	**0.51**	**High**
1. The system has complete information related to each user group.	4.53	0.52	Highest
2. The system has complete functionality related to waste management.	4.53	0.52	Highest
3. The system links information efficiently.	4.40	0.51	High
4. The system has correct processing.	4.47	0.52	High
5. The system has reliable security.	4.47	0.52	High
Mean avg	**4.56**	**0.50**	**Highest**

2) The results of the satisfaction assessment by users applying the user satisfaction assessment form are divided into two groups. Group 1 is a community committee of 15 people and Group 2 includes users who are members in a community of 50 people. The researchers conduct a satisfaction evaluation after users have tried using the web application for 7-15 days. It was found that users were satisfied at a high level in both the groups. The results of the overall

satisfaction evaluation are at a mean of 4.27 and 4.35 and an S.D. of 0.51 and 0.63, respectively, as shown in Table 3.

3) For results of technology acceptance assessment using technology acceptance questionnaire to a community committee of 15 people, the researchers proceed after users have tried using the entire web application system for 30 days. It is found that users have accepted the Zero Waste shop web application technology at the most acceptable level (4.56±0.50) as shown in Table 4. The results of lessons learned from using the Zero Waste Shop web application both before use and after use are shown in Table 5.

Table 5. and results of lessons learned from using the Zero Waste Shop web application

Web performance	Before use	After use
1. The process of managing waste purchases and sales within the community.	There is buying and selling of community waste. But there is no accounting of income-expenses, making it impossible to check the list of garbage purchases and garbage sales. There is no inventory of products that members can exchange waste for.	The application makes it possible to check the history of buying and selling garbage. There is a systematic list of product information for members who exchange garbage. There is information on waste that has been sorted for sale to waste purchasing sources. It enables the users to look at the history of buying and selling garbage and business operation history, with a summary of income - expenses and profit and loss in order to evaluate the business operation situation.
2. The process of encouraging people in the community to manage waste	People in the community are encouraged to join in exchanging waste for consumer goods with well-organized promotions.	The application makes it possible to plan promotions for members who sell their waste in exchange for cash or products. It also enables users to plan promotions in advance.
3. The process of community participation process in waste management	There is very little community participation in selling waste because the small amount of money received from selling waste which does not provide an incentive for participation.	Electronic wallet technology is used in the application so that members can save money in the application first. When there are a certain number of points, they can be withdrawn for cash or exchanged for products.
4. Results of the community committee from organizing the waste management project	No concrete summary of the results of the community waste management project has been prepared.	The application provides a report summarizing business results, income - expenses, and profit and loss which is separated into monthly and yearly sections. These support the efficient implementation of community waste management projects, and allow the community to plan how to use the profits gained as a guideline for welfare provision for the people of the community in the future.

3.2 Discussion

According to the development of the Zero Waste Shop web application in the research project to develop an information system for managing waste data that promotes income generation for the community, the web application has the best performance (4.66±0.21). This is consistent with the work of (Uriawan, and others, 2024) where Agile concepts were used to develop technology to help manage the lunch program with Nourishify, a tool that was used to help manage and disseminate school nutrition information efficiently, including developing a web application using the Laravel Framework and creating a user interface with Bootstrap. As a result, users are satisfied at a high level (4.27±0.51 and 4.35±0.63, respectively). Similarly, Sinaga and Samsudin (2021) illustrated the use of the Laravel Framework command set and MySQL database to develop web applications for providing services in restaurants. The developed web applications could function efficiently. Likewise, in the study by Damyati, F., et al. (2024) applied Laravel Framework command set to develop a web application that provides community services in the village office. This helps optimize village services. In addition, web application development with Laravel Framework using MVC architecture helps to manage waste purchases, waste sales, and other transactions of web applications more easily which is in consistence with the previous study (Valenty, Kosasi, Gat, David, and Kuway, 2024). As a result, users are very satisfied with the use of the web application that has been created. In addition, the results of the evaluation of the efficiency of the web application by experts indicate in terms of Result Test is the most effective (4.74±0.20). This may be because the process of developing the system piecemeal according to the Agile approach and evaluating results to improve the constantly evolving web application makes the results obtained from the Zero Waste Shop web application effective. When community members try using the Zero Waste Shop web application, it is found that community members are most satisfied with the web application's functionality (4.39±0.63). This may be because the web application is designed for the user to be easy, simple, and less complex. In addition, the community committee is satisfied with using the system the most (4.33±0.51), probably because their existing community work is too complicated, but with the method of developing the system using Scrum process in the concept of Agile makes their job become easier. This allows the researchers to develop a web application that is fully functional and meets the needs of the community committee. Moreover, after users in the community have been using the Zero Waste Shop web application for some time, it has been found that the technology has been accepted at the highest level and perceived ease of use at the highest level (4.64±0.49). However, since it has been in operation for a short period of time, the perceived benefits of the developed Zero Waste Shop web application may be less but still at a high level (4.48±0.51). Therefore, when lessons are taken from the use of the Zero Waste Shop web application both before use and after use shared between the researchers and the community committee, the researchers expect that it can help promote income generation for the community. In addition, it will provide the community with enough information to be used to plan business operations until they become profitable as well as the profits obtained can be used as a guideline for providing welfare to the people of the community in the future.

4. Conclusion and suggestions

The present study aims at developing the information system for waste data management to promote income generation for the community of Ban Khlong Sam Phraek Nai Khlong, Bang Pla Kot Subdistrict, Phra Samut Chedi District, Samut Prakan Province. Then evaluate the quality of the information system developed to create the Zero Waste Shop web application. The valuation of web application is carried out with a total of five related evaluation questionnaires. The questionnaire quality assessment based on IOC values evaluated by experts, ranges between 0.60 - 1.00. Results are analyzed with the average and standard deviation by choosing the Scrum system development method, which is one of the system development processes introduced by Agile concepts. Thus, the system devel-

opment involves five important steps: 1) Analyze User Stories, 2) Create Product Backlog, 3) Set Sprint Planning, 4) Develop web applications, and 5) Evaluate the quality of web applications. The web application has functionality, which can be divided into eight sub-tasks of Product Backlog: 1) system for registering and managing users in the system; 2) wallet system; 3) points system; 4) system for purchasing waste and managing promotional information; 5) system for waste warehouse, sorting Waste separation and waste transfer; 6) system for exchanging members' points for cash or consumer products; 7) waste sales system; and 8) system for closing the amount of money sent to the community's central store. Work is arranged using Stack Ranking method, and Sprint Planning is set for a total of seven Sprints, with each Sprint is being operated between 3-5 weeks, in which the total development time lasts for 28 weeks. There are four types of users involved in the Zero Waste web application are 4 types: Members, Agents, Administrators, and Super Administrators, with each is having different eligibility to use web applications. Most importantly, web applications are developed with PHP V.8, JavaScript, Ajax, jQuery and HTML5, including the command set of Laravel Framework 10, and Bootstrap 5.0 uses the MySQL database of the Nginx web server system. The database structure within the web application consists of 29 Entities and 32 Relationships and uses JWT techniques to encrypt data security. The findings can be concluded in 4 subcategories based on each result of evaluation. First, the results of the efficiency evaluation by five experts are in consensus that the Zero Waste Shop web application has the overall efficiency at the highest level (4.66±0.21). Second, the results of web application design evaluation in which the community committee of 15 people agree that the overall web application design are at the highest level (4.35±0.49). Third, the results of the satisfaction assessment by 2 groups of users, wherein Group 1 is a community committee of 15 people, and Group 2 is users who are community members, that 50 people are overall satisfied at a high level (4.27±0.51 and 4.35±0.63, respectively). Fourth, the results of the technology acceptance assessment by a community committee of 15 people, after using the system for 30 days, users accepted the Zero Waste Shop web application technology at the highest level of acceptance (4.56±0.50), including learning lessons learned between the researchers and the community committee. This allows the researchers to know how the user group is aware of how to use the application and to accept the use of technology that the researchers have created. In addition, there is the expectation that the business will be able to gain the profits obtained as a guideline for welfare provision for the people of the community in the future.

Using IOT technology to help in the waste separation process that can be connected to a web application, it will help reduce the process of working with the Zero Waste Shop web application that may be complicated in the waste sorting process. In addition, linking the web application with the banking system, it may help make the process and conversion of points into cash for group members more convenient and faster.

5. Acknowledgement

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