Web-based Project Tracking and Critical Path Evaluating System

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Abstract

The contral objective of this study was to study users' problems and requirements, develop, and study the satisfaction of users toward Web-based Project Tracking and Critical Path Evaluating System. The data were collected from 4 specialists in the area of project management and software development. Most of them could not achieve as planned due to lack of tracking tool. Therefore, Critical Path Method was applied to Web-based Project Tracking and Critical Path Evaluating System at planning stage for setting up timeframe of the project. The experimental stage was tested by 10 other specialists by using interviews and satisfactory surveys. The satisfaction of users was evaluated by averages ($\overline{X}$) and standard deviation (S.D.) of scores including the in-depth interviews of users. The research findings showed that the satisfaction of user toward the system on Function Requirement Test was ($\overline{X}$ = 4.22, S.D. = 0.85), Function Test was ($\overline{X}$ = 4.25, S.D. = 0.84), Usability Test was ($\overline{X}$ = 4.38, S.D. = 0.76) and Security Test ($\overline{X}$ = 4.37, S.D. = 0.88), all of which were at very satisfied. The result showed that the system was able to respond to the needs of users and to meet the requirements of the study.

Keywords: Project Tracking System; Critical Path Method; Evaluate Project

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Introduction

Today, information technology has been playing a major role in several organizations, both in private and public sectors, dealing with important reports needed to be communicated on a real time basis. The necessity of informational technology, for example, includes preparing seminars, designing mega projects in buildings, expanding factories to increase productivity, or developing new computer software. The aforementioned examples can be categorized as projects (Jiradamkerng, W., 2009). Project management, in general, includes several components. Moreover, each job is complicatedly interrelated, with limitations in resources and time, thereby leading to such problems as lack of well-planned project management and predicted feasibility. This, in turn, causes the lack of project monitoring, thus failing to gain information on the status and viable problems in the project. With these shortcomings, it is difficult to prevent problems in due cause, thereby causing the delay of the project.

Project management is part of administration that all organizations need to consider in order to plan processes and activities involving the consumption of resources. There is need to have personnel and units that are responsible for administration so that the project can be achieved as planned, in due cause, and with efficient outcomes. Some units use programs for project management. Nowadays, there are a variety of such programs, both free and paid ones, including programs that can be accessed through the internet. The capabilities of each program vary depending on the functions provided by the programs. One of the most famous programs in the field is "Microsoft Project", which provides comprehensive functions. However, the program has some disadvantages. First, it is quite difficult to use. Second, the program is not provided on the website. Third, users need to pay for the program.

Literature is evident that the research by Panjaisri, P. and Khemawoot, P. (Panjaisri, P. and Khemawoot, P., 2004), "The evaluation and monitoring on work procedures of employees using the project management on the internet", focus on the following-up of progress on the project without interest in the process on time-controlling. In the meantime, researches by Dong Eun Lee, J.J. Shi (Dong Eun Lee, J.J. Shi, 2004), the research by Marasovic, J. and Marasovic, T. (Marasovic and Marasovic, 2006), as well as the research by Sappakitkamjorn, J. (Sappakitkamjorn, J., 2006), in her article "The usage of Excel in project management with PERT/CPM", do not include the following up progress of the project.

Project management is a temporary task, so it can cause complication for the planning and control of the project. More instruments used for project management deal with the project by linking each task under a proper procedure of the project. A well-known instrument is the so-call "Critical Path Method". This method is suitable for projects with predictable timeframe (Varaphakdi, M., 2003).

The researcher, therefore, develops the Web-based Project Tracking and Critical Path Evaluating System. The system is expected to manage the project in the way that can identify and assign the job, with the capacity to follow up the progress of each job, to be provided on the internet in order that users can follow up progress and problems of the project on a real-time basis. In order to achieve this, the researcher will use the "Critical Path Method" to assist the planning of the project, defining each phrase of the project, including starting, operating and ending of the project. The instrument focuses on the analysis of the critical path in the network of the project. "Critical Path" means the longest timeframe of the task in the project, which can be predicted for the ending of the project (Mishra, R.C., 2011). The Web-based Project Tracking and Critical Path Evaluating System will give importance to the collection of data on "requirements" from specialists directly responsible for the development of computer software, which can be applied other projects.

Research Objectives

1. To investigate problems and requirements concerning the planning and following up of projects provided on websites by users.

2. To develop a system for planning and following-up on projects on the internet.

3. To study satisfaction of users on the system for planning and following-up for projects on the internet.

Materials and Methods

In order to collect and analyze requirements of the users for designing the limitation of the development, research procedures were as follows.

Users

10 people: 4 specialists in project management and software development before the development of the system, and 6 specialists in project management and software development from software development companies.

Research Tools

1. Questionnaires to gain requirements of the users in such areas as planning and monitoring of the system, problems during the project, as well as requirements for a system for planning and monitoring project on the internet.

2. A developed system for planning and monitoring project on the internet.

3. Forms for interviews and satisfactory survey of using the system for planning and monitoring project on the internet in such areas as the correctness of the system pertaining to the needs of the users, the convenience of the system, the attractiveness of the system, the categorization of the system, the safety for data on the system, as well as problems and recommendations for improvements of the system.

Data Collection

The data collected from in-depth interviews with 4 specialists showed that the project could not be achieved as planned. Most of the programs could not predict that last date of the project because Thailand has several public holidays, which are not the same as the international holidays. Moreover, a responsible person of the project did not have a clear assignment due to lack of continuous communication system and the working status of each person could not be monitored. The whole picture of the project was also unclear because of too many tasks and too many people responsible made it difficult to inform progress and problems in time.

Data Analysis

The data input were analyzed in order to know requirements of the users, and to be used as guidelines for developing the Web-based Project Tracking and Critical Path Evaluating System. The data led to developing the system to operate on the internet, access control for different users, and creating access control for the user. In addition, project managers should be able to design the limitations of members in the program, to design each task and responsible person, and to follow up the status of each task of the project. Members of the project should be able to report the status of the task under their responsibility to project managers and team members, and the system should allow users to design the calendar as per their requirements. Finally, the "Critical Path Method" should also be used at planning stage for setting up timeframe of the project.

Procedures for Developing the Web-based Project Tracking and Critical Path Evaluating System

After collecting and analyzing data, the researcher started developing the system using C#.Net as a tool for developing the program, and using SQL Server as a database, with the following procedures.

　　　　1. Analyze the system architecture of the Web-based Project Tracking and Critical Path Evaluating System, and design the structure that can operate on the internet so that the system can run on the internet without the need to install the program, and can be accessed at any time and place in an easy and convenient manner.

　　　　2. Conduct functional analysis in order to ensure that the system for planning and monitoring the projects possess two aspects of the following functions.

　　　　Functional requirements for the system administrator, project manager, and members of the project with details below.

　　　　- Administrators can allow the project manager who requests to use the system for planning and monitoring the project.

　　　　- Project managers can design the structure of the project, increase members and tasks.

　　　　- Members can revise details of assigned tasks under their responsibility, such as informing the status of the task, uploading documents relating to the task.

　　　　Non-functional requirement derives from requirements of users of the program in order to develop the program that can meet the satisfaction of the users as details below.

　　　　- Subscribing for membership of the program
　　　　- Giving and quitting access to the system
　　　　- Logging in and logging out the system
　　　　- Designing the pattern of the calendar
　　　　- Increasing, deleting, and amending the project
　　　　- Increasing, deleting, and amending members
　　　　- Increasing, deleting, and amending tasks
　　　　- Changing passwords

　　　　3. Design a model that represents the operation of the system, or presents the functions of the system, including the structure and components by using case diagram, which shows the interactions of the subsystem or the use case and the user or the actor.
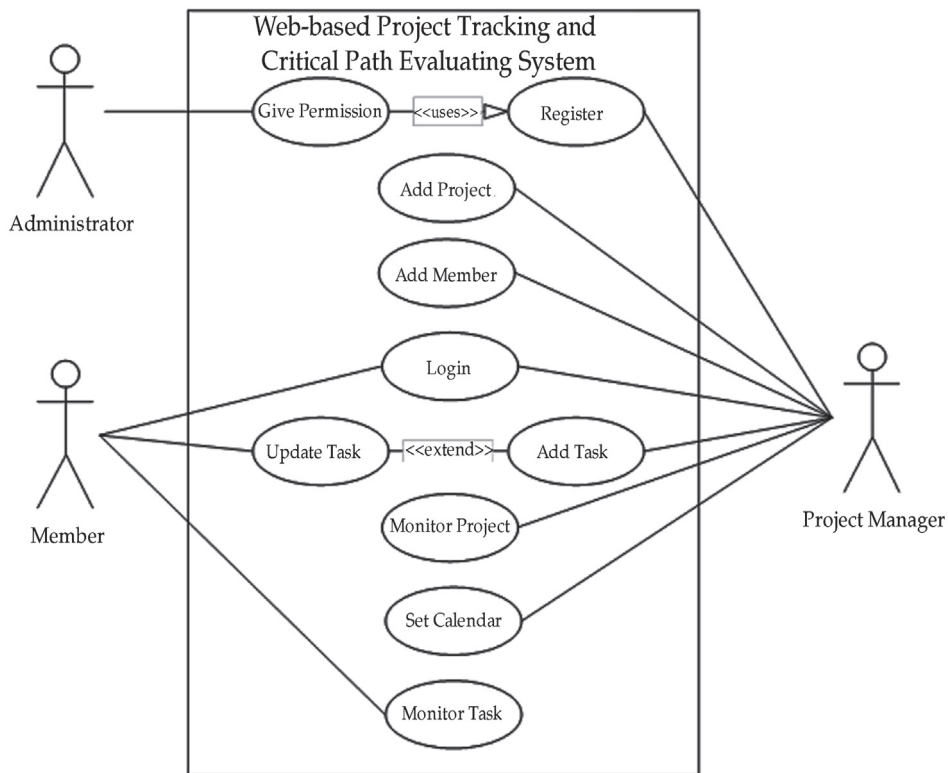
Figure 1   Use Case Diagram of the Web-based Project Tracking and Critical Path Evaluating System

According to Figure 1, the components of the Web-based Project Tracking and Critical Path Evaluating System, the system for planning and monitoring on the internet are as follows.

The administrator is the person who gives permission for accessing the system. The administrator has the duty to investigate information of the users, giving and quitting access to users of the Web-based Project Tracking and Critical Path Evaluating System.

The project manager manages the Web-based Project Tracking and Critical Path Evaluating System as follows:
- Subscribe to the system to use the program.
- Add projects to the program.
- Add members to the system.
- Log in by using user ID and password.
- Add tasks to the project.
- Monitor the overall picture and the tasks of the project.
- Set up the pattern of the calendar for the project.

Members can use the system with the following functions.

- Update tasks to the system, such as the status of the task, details of the job, as well as uploading relevant documents.

- Log in using user ID and password.

- Monitor the tasks with the capacity to see the overall picture and the tasks of the project.

4. Design content architecture or the so-called "Site Map" in order to design the structure for presenting content on the website.

5. Develop the system for planning and monitoring the project on the internet according to the design and the structure of the website.

6. Investigate errors of the system for planning and monitoring the project on the internet and then fix the problems.

7. Ask 10 specialists to test the system for planning and monitoring the project on the internet and to provide feedbacks for the system through the forms for interview and satisfactory surveys.

8. Evaluate the data collected from the specialists and summarize such data, with the criteria for converting the scores of response (Chrzan, K. and Michaud, J., 2004) as follows.

The scores 4.50 – 5.00	Completely Satisfied
The scores 3.50 – 4.49	Very Satisfied
The scores 2.50 – 3.49	Somewhat Satisfied
The scores 1.50 – 2.49	Slightly Satisfied
The scores 1.00 – 1.49	Not at All Satisfied

Results

The results from in-depth interview with 4 specialists displayed that the system could be accessed easily online and the users could access the system all the time and everywhere and also record progress and problems of the project. The system allowed the users to design the calendar, plan the project, and follow up progress and status of the job of each responsible person in the project. Furthermore, the system designed an effective work procedure. For example, the system indicated the interrelation among each task. The whole picture of the project as well as the status of the tasks was also exhibited.

In addition, the researcher developed Web-based Project Tracking and Critical Path Evaluating System and asked 10 specialists to test the system through the forms for interview and satisfactory surveys resulting as follows:

Part 1 : Research outcome of the qualitative analysis

This is the results from the analysis of the satisfactory surveys of 10 specialists in project management and software development. The analysis was categorized into 4 aspects.

1. The results of analysis in function requirement test

This analysis aimed at investigating the correctness and the quality of the system according to requirements of the users.

Table 1   The average and the standard deviation in function requirement test

Descriptions	$\overline{X}$	S.D.	Satisfactory level
1. The capacity of the system in terms of access	4.30	0.82	Very Satisfied
2. The capacity of the system in terms of data management	4.20	0.79	Very Satisfied
3. The capacity of the system in terms of reporting data	4.20	0.92	Very Satisfied
4. The capacity of the system in terms of searching for data	4.10	0.88	Very Satisfied
5. The capacity of the overall system	4.30	0.82	Very Satisfied
Overall	4.22	0.85	Very Satisfied

Table 1 indicates that, overall, the level of satisfactory for the Web-based Project Tracking and Critical Path Evaluating System is very satisfied ($\overline{X}$ = 4.22). This is as a result of the fact that the researcher investigated the problems and requirements of users before the development of the system. Therefore, the developed system was appropriate and had the quality that met requirements of the users. This, in turn, impacts the levels of satisfaction in the areas of the capacity of the system in terms of access, and the capacity of the overall system was at the level of very satisfied ($\overline{X}$ = 4.30), with the level for satisfaction of the capacity of the system in terms of data management, and the capacity of the system in terms of reporting data being very satisfied ($\overline{X}$ = 4.20). However, the level of satisfaction on the capacity of the system in terms of searching for data, albeit very satisfied, was lower ($\overline{X}$ = 4.10). This might be because the system could not support the searching for data in the form of graph.

2. The results of data analysis in function test

This analysis aimed at providing the information on the correctness and the quality of the system concerning capacities of the function.

Table 2   The average and standard deviation in function test

Descriptions	$\overline{X}$	S.D.	Satisfactory level
Administrators			
1. Giving and quitting access to users	4.40	0.84	Very Satisfied
2. Administrating information of those request to use the system	4.30	0.67	Very Satisfied
Project Manager			
1. Creating a new project	4.40	0.84	Very Satisfied
2. Increasing new members in the project	4.50	0.71	Completely Satisfied
3. Adding tasks to the system	4.30	0.82	Very Satisfied
4. Planning the project with CPM	4.20	0.92	Very Satisfied
5. Monitoring the project	4.20	0.92	Very Satisfied
Members of the website			
1. Following up the status of the project	4.10	0.88	Very Satisfied
2. Informing progress of the project	4.10	0.88	Very Satisfied
3. Uploading relevant documents	4.00	0.94	Very Satisfied
Overall	4.25	0.84	Very Satisfied

According to Table 2, the satisfactory level for using of the Web-based Project Tracking and Critical Path Evaluating System is very satisfied ($\overline{X}$ = 4.25). This might be because the researcher, before the development of the project, studied the problems and requirements of users for the system for planning and monitoring the project on the internet. The researcher also investigated relevant researches in order to apply in this research. The developed system therefore is correct and qualified pertaining to the functions in the system. The explanation of the satisfactory level in this category can be explained as follows:

For administrators of the system, the satisfactory level concerning giving and quitting access to users was very satisfied ($\overline{X}$ = 4.40), with the satisfactory level for administrating information of those request to use the system also being very satisfied ($\overline{X}$ = 4.30).

The level of satisfaction for project managers in the item of increasing new members in the project was completely satisfied ($\overline{X}$ = 4.50). This is conformity with the research by Panjaisri, P. and Khemawoot, P. (Panjaisri, P. and Khemawoot, P., 2004), "The development of information technology for the evaluation and monitoring work

procedures of employees". The satisfactory level for creating a new project was very satisfied ($\overline{X}$ = 4.40), the satisfactory level for other categories was also very satisfied, with ($\overline{X}$ = 4.30) for adding tasks to the system, and ($\overline{X}$ = 4.20) for planning the project with CPM and monitoring the project. This is in agreement with the research by Dong Eun Lee, J.J. Shi (Dong Eun Lee, J.J. Shi, 2004), who proposed a model for the administration of time-management for the project. The model predict the opportunity of achievement of project under a set timeframe, by comparing the results from the setting of schedules using the CPM. The results also in line with research project entitled "The development of supporting system for the project with CPM and PERT on the internet" by Liangpanit, S. (Liangpanit, S., 2003).

As for members of the team, the satisfactory level in the area of following up progress of the project was very satisfied ($\overline{X}$ = 4.10). This is compatible with the research by Panjaisri, P. and Khemawoot, P. (Panjaisri, P. and Khemawoot, P., 2004), "The evaluation and monitoring on work procedures of employees using the project management on the internet". The level of satisfaction for uploading relevant documents was also very satisfied ($\overline{X}$ = 4.00). The researcher is of the opinion that sharing documents is important for jobs that are interrelated.

3. The results of data analysis in usability test

This is the analysis that intended to investigate the convenience of the developed program, as well as the attractiveness, and the appropriate pattern of the screen for presenting information.

Table 3   The average and standard deviation in usability test

Descriptions	$\overline{X}$	S.D.	Satisfactory level
1. The speed for data processing of the system	4.40	0.70	Very Satisfied
2. The precision of data shown on screen	4.20	0.79	Very Satisfied
3. The appropriate font size on screen	4.50	0.71	Completely Satisfied
4. The appropriate use of font color and background	4.40	0.70	Very Satisfied
5. The appropriate use of font pattern	4.40	0.70	Very Satisfied

Table 3   The average and standard deviation in usability test (Cont.)

Descriptions	$\overline{X}$	S.D.	Satisfactory level
6. The appropriate use of language and communication	4.30	0.82	Very Satisfied
7. The appropriate location for boxes that are used to fill in data	4.40	0.84	Very Satisfied
8. The system is easy to use	4.40	0.84	Very Satisfied
Overall	4.38	0.76	Very Satisfied

Table 3 shows that the satisfactory level of the Web-based Project Tracking and Critical Path Evaluating System in the area of usability test, the overall was very satisfied ($\overline{X}$ = 4.38). This is because the developed program was designed with the emphasis on its convenience, attractiveness, and the appropriateness of the screen, thereby leading high levels of satisfaction in the items of the appropriate font size on screen with the highest score ($\overline{X}$ = 4.50). The speed for data processing of the system, the appropriate use of font color and background, the appropriate use of font pattern, the appropriate location for boxes that were used to fill in data, as well as the fact that the system was easy all reached the level of very satisfied ($\overline{X}$ = 4.40). The appropriate use of language and communication also achieved the level of very satisfied ($\overline{X}$ = 4.30), with very satisfied level ($\overline{X}$ = 4.20) for the precision of data shown on screen.

4. The results of data analysis in security test

This analysis aimed at testing whether the system is developed in the way that is appropriately categorized based on its users and how far it takes into account in terms of data safety.

Table 4   The average and standard deviation in security test

Descriptions	$\overline{X}$	S.D.	Satisfactory level
1. There is security control to protect users' data	4.40	0.84	Very Satisfied
2. Names and access rights for users shown on the website are correct	4.40	0.84	Very Satisfied
3. There is a warning system for the error of the program	4.30	0.95	Very Satisfied
Overall	4.37	0.88	Very Satisfied

Table 4 reveals that the satisfactory level for the Web-based Project Tracking and Critical Path Evaluating System was very satisfied ($\overline{X}$ = 4.37). This is because there was a variety of target group for the program, each with different requirements. An appropriate management of users according to their requirements facilitated the maintenance of data safety, thus leading a high level of satisfaction in the item of safety control for data and the correct information of the users and their rights for access control. In the two categories, the score was at very satisfied ($\overline{X}$ = 4.40). The warning system was also at the level of very satisfied ($\overline{X}$ = 4.30).

Part 2 :   The results of data analysis from the interview

After having interviewed 10 specialists in project management and software development from software development companies, the researcher wants to elaborate the results and discussions into 7 points as follows.

1. The researcher found that users know some programs "Microsoft Project", "Microsoft Office Outlook", "Microsoft Office Excel", "Redmine" and "Zoho Projects".

2. The reasons why users chose such programs were different. Some users chose "Microsoft Project" because the company they work for purchased such a program. Others use such programs as "Microsoft Office Outlook" and "Microsoft Office Excel" as these programs are provided with Microsoft office. Those who used "Redmine" and "Zoho Projects" gave the reason that the programs were easily downloaded and installed.

3. When considering the strength and weakness of such programs, the research found that each program has some strength and weakness, depending on different functions of the programs. The users need to consider the one that most satisfied their needs. The strength and weakness of each program can be described as follows:

The strength of "Microsoft Project" is that the program has several tools, enough to manage a project. The program also has a variety of look that can be used to oversee the overall picture of the project. Also, the users can get the report from the program. The weakness of the program is that it cannot be used through websites and users need to pay for the program.

The strength of the calendar in "Microsoft Office Outlook" is that the program can send a signal to e-mail. Moreover, both "Microsoft Office Outlook" and "Microsoft Office Excel" are easy to use. And the programs are good for collecting data. The weakness is that the program cannot be used for planning the project, and that the users cannot see the whole picture of the project from these programs.

"Redmine" has a lot of strengths. First, it can be used for project planning. Second, users can see the whole picture of the project; therefore, it is easy for the project manager to allocate resources. Besides, the program can be accessed through the

internet, and it is free of charge. However, the program is not well-known. If users face problems using the program, they might take a long time finding solutions as not many people know how to use it.

The strength for "Zoho Projects" is that the program can be used for project management. The project manager can see the whole picture of the project by using this program so it is easy for the project manager to manage resources. Also, the program can be used on the website. The weakness of this program is that one need to pay for the program.

4. When considering how and why the Web-based Project Tracking and Critical Path Evaluating System can meet the requirements of users, the researcher found that the system can meet the requirements of the users. This is because the researcher investigated the problems and requirements for the system for planning and monitoring project on the internet before starting to develop the system. The system is designed to follow-up the status of tasks and to reduce possible risks. Also, the system is provided on the internet. However, the system still cannot achieve the functions on resources management, some follow-up functions, and report.

5. Whether "Critical Path Method" in the Web-based Project Tracking and Critical Path Evaluating System is useful for project management, and why is another question the researcher is looking at. The answer is that the "Critical Path Method" is useful and can be used in real situations. The tool helps the project management to investigate the critical path and tasks that require the longest time in the project. Thanks to this tool, the project manager can find out which task is in critical path and know the exact date of the ending of the project. Therefore, this can help the project manager to plan and prepare solutions for upcoming problems.

6. Considering the type of project management that the manager can apply the Web-based Project Tracking and Critical Path Evaluating System, the researcher found out that the system is suitable for the project which is not too big nor too complicated, and the project that gives importance to the ending date of the project. The system is suitable for a temporary project, which has a small amount of time for the project. It can also be good for the project that has many people involved as all members can update the status of their tasks on the internet, and in the meantime, can follow up tasks of other members.

7. As for recommendations for further development of the system, the interviewees provided some advice as follows. First, there should be a further development of the system. Second, the view of the whole project should be presented in the form of graph. Third, there should be alert system to users' email or SMS. Also,

the program should provide more details in the form of hours, or seconds. Besides, resources management should be considered. Finally, there should be a report from the system that users can print out.

Discussions

After developing the Web-based Project Tracking and Critical Path Evaluating System, the researcher found that there were some areas that are worth studying to further develop the system.

1. The development of the system for planning and monitoring that allow users to have a view of the overall project in the form of graph.

2. The development of the system for planning and monitoring that add a function that includes alert e-mail and SMS to inform users to start their tasks.

3. The development of the system for planning and monitoring that include the report forms that can be printed out.

4. The development of the system for planning and monitoring that facilitate resources management in such areas as costs and equipment.

Conclusion

The study of system for planning and monitoring the projects, using in-depth interview of 4 specialists, the researcher found that the project could not be achieved as planned. The researcher gathered the problems and requirements of users in order to develop the Web-based Project Tracking and Critical Path Evaluating System. The system was easy to access at any time and any places, especially provided on the internet and allowed users to record progress and problems from the project. Moreover, the project manager could set up a calendar as per requirements. The system facilitates priority setting and shows the whole picture of the project by using "Critical Path Method", or the path that requires the longest time to achieve, that will show which tasks are in critical path. The system predict the ending date of the project is also helpful in that the users, knowing which tasks have an impact on the project, can plan and solve problems in due cause. The system allows users to carry out risk analysis and help users to take special care of the tasks at risk. The experimental stage was tested by 10 other specialists by using interviews and satisfactory surveys. The satisfaction of users was evaluated by the average ($\overline{X}$) and standard deviation (S.D.) of scores including the in-depth interviews

of users. The research findings were that the satisfaction of user toward the system on Function Requirement Test ($\overline{X}$ = 4.22, S.D. = 0.85), Function Test ($\overline{X}$ = 4.25, S.D. = 0.84), Usability Test ($\overline{X}$ = 4.38, S.D. = 0.76) and Security Test ($\overline{X}$ = 4.37, S.D. = 0.88), all of which were at very satisfied. The result showed that the system was able to respond to the needs of users and to meet the requirements of the study.

Acknowledgements

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