

Blue Sentinels: An IT Project Management Tool towards Productive Projects

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Abstract: This study explored the development and the implementation of a web-based, mobile-responsive project management tool using Platform as a Service (PaaS) cloud technology. The said software can be used to monitor the progress of a project, its project timeline, deliverables and the assigned project team members, and other pertinent project information.

The said software was evaluated by the IT project managers, developers and senior managers of a local bank in the Philippines in terms of functionality, usability and interactivity. Based on the results, they were satisfied with the software, receiving a mean of 3.0, 3.58 and 3.44, respectively. Thus, the authors concluded that the developed system can be used by the project managers and stakeholders with no cost involved.

Key words: Cloud computing, mobile-responsive, project management.

1. Introduction

In the era of rapidly-evolving technologies, companies nowadays must adapt in order to survive the very cut-throat world of business. They take on projects to enhance and to provide the best service they could offer to beat the competition. Most of these are called *projects* because of the complexity entailed by the upgrade. According to the Project Management Institute (PMI), a project is a temporary endeavor that has a defined start and end date which will produce a product or service. Project Management, on the other hand, “is the application of the knowledge, skills and techniques to execute projects effectively and efficiently” [1]. In order to maximize the business’ return of investment, it is crucial that these projects are delivered as scheduled and within or under the prescribed budget. To do this, project managers use a project management information system to monitor the progress of the project.

Innotas, a Cloud portfolio management provider, conducted a survey in 2013. The study revealed that 50% of projects failed in that year. Innotas subsequently performed another study: 126 IT professionals were surveyed between January and March 2015, wherein 55% admitted that their projects failed. This was a 32% increase from 2014 [2]. Because of the alarming increase of project failure, there is a greater need for projects to be completed on time and within budget. Thus, one of the purposes of this study is to address the alarming project failure rate in the project management profession. In an article published in Gartner last 2015, a study revealed that the key to solving the project failure rate is not through adding more project governance, improving project stakeholder engagement or adding more reporting, but through addressing project complexity. Dr. Daryl Carlton, research director at Gartner, explained that by simplifying business processes, corporate bureaucracy, and project requirements, there is a higher chance for project success [3]. Furthermore, most IT professionals, whether a project manager, client or member of the development team, make use of a Project Management Information System to identify the work needed to be done and monitor its progress. According to a study conducted by Pellerin, *et al.*, the performance of the project is directly related to the amount of time spent in

using the project management information system. It revealed that the more time spent on using the said Project Management Information System, the better the Cost Performing Index (CPI) of the project [4]. Additionally, Alami's study revealed that small-scaled IT projects are less prone to project failure than larger-scaled IT projects – a possible basis for scaling is the project budget, If the project budget is larger than \$350,000 it is considered large-scale project; otherwise a project with a budget of less than \$350,000 is considered small-scale project [5].

In custom software development, the emerging Agile Methodology is used prevalently in the industry [6]; however, not all practitioners employ it. Some still adhere to the traditional methodology also known as the waterfall methodology. Thus, there are several published studies that were conducted to study existing project management methodologies. According to Spundak, it is possible to infuse Agile with traditional project management principles [7]. He added that the project methodology selection should be according to the project characteristics. He also stressed that the project methodology should adapt to the project and not the other way around. The said mixed methodology is especially applicable for custom software development. On the other hand, Binder, Aillaud and Schili commissioned a study to combine the Agile Methodology with the ISO 21500 model, coined the "The Project Management Cocktail Model" [8]. They used the ISO 21500 to group the 39 processes based from the waterfall model into 10 ISO subject groups (ISOSG) and five ISO process groups (ISOPG) then combined it to the Agile Principles. The Cocktail Model was proposed to get the "best of both worlds" from the ISO 21500 and the emerging Agile Methodology. Meanwhile, another project management practice study commissioned in Russia by Polkovnikov and Ilina revealed that out of the 140 respondents analyzed, 40% use PMBOK, 14% use Agile/Lean, 16% use Russian standard NTK, 1% use P2M, 20% use a combined methodology, and 9% do not use any project management methodology [9].

Over the years, the world saw the continuous advent of the web, smartphones and cloud technologies. The Internet's popularity, accelerated by the dot-com bubble from 1997 to 2000, paved the way for websites and web-based systems [10]. Currently, web-based systems development is the new trend because of the available tools and the possibility of a richer design and experience it could give to its users. A few years after this, smartphones took the world by storm. With the rising popularity of smartphones, Pitichat's study proved that smartphones can be used in the workplace. He elaborated that using smartphones in work encourages autonomy and knowledge-sharing, and improves relationships among its users [11]. Furthermore, since the early 2000, cloud computing started to take off as the next generation of data storage. Because of the lesser need for physical servers, cloud storage is the next thing for data storage next to virtualization [12]. Mobile applications even use cloud storage to store the data so that users can access and/or use their applications from virtually anywhere. Almuddara and Qureshi developed ShaMoCloud Service, a mobile-cloud based content and media management system. When integrated with the concepts of Agile, it reduced the cost in terms of development time [13]. This, in turn, reduces costs in the programmer's man hours and remuneration, thereby enabling businesses to launch a new product or service in the market faster. This has the potential to result in a bigger revenue for businesses.

With project members or stakeholders coming from different backgrounds, the variation of emerging cultures in the workplace can be a factor in project success. According to Ozguler, other factors that can affect project success are teamwork, teambuilding, and stakeholder management. The authors' solution is to build a Multi-Cultural Project Management Process to address the cultural differences of the project working team and the executive committees. He further explained that having such will improve the interpersonal sensitivity of project members and stakeholders towards one another [14]. Moreover, in practicing project management, it is advisable to use a Project Management Information System. However, it is not advisable to just purchase the most known PMIS in the market because choosing the appropriate tool relies on the complexity of the projects that will be undertaken and the features needed to manage those projects. [15]. Additionally, Small Medium Enterprises also partake projects and not all can afford to purchase a project management software. There are free project management software available in the market but not as featured-packed as paid software.

Thus, the main objective of this study was to develop a web-based Project Management Information System

that notifies project stakeholders on impending deadlines. Specifically, it aimed to address the following sub-problems: (1) What are the available project management tools currently utilized by the company?, (2) What are the issues encountered in using the current tool?, (3) What is the level of satisfaction of the respondents in the developed system in terms of: Functionality, Usability and Interactivity.

2. Methods

2.1. Methods of Research

In order to meet the objectives of this study, the researchers opted to use a combination of descriptive and developmental research. The researchers gathered information relevant to the study, such as familiarization with project management concepts, integration of ideas espoused by the Project Management Body of Knowledge, project management best practices, related software, studies and literature. Pertinent information on possible system features were also gathered, such as the required features of a project management information system and the functionalities of existing project management information systems available in the market. After analyzing and comparing the aforementioned, the proposed featured of Blue Sentinels were drafted in order to gain an edge in the market and to allow it to be differentiated from the others.

The researchers then began to design the Graphical User Interface (GUI) and finalize the list of features of the software. The researchers also worked on finalizing the flowchart of the software as well as the screen wireframes.

After these procedures, the researchers surveyed the participants of the study from a local bank in the Philippines, composed of ten IT project managers, twenty IT developers, and six IT senior managers. They were asked to evaluate the software functionality, usability and interactivity in terms of their level of satisfaction with a Likert Scale employed in the survey, as adapted and modified from Hao, et al. [16]. The Likert scale and corresponding interpretation are presented as follows:

Table 1. Likert Scale and Ranking

Scale	Range	Verbal Interpretation
4	3.51-4.00	Highly Satisfied
3	2.51-3.50	Satisfied
2	1.51-2.50	Somewhat Satisfied
1	1.00-1.50	Dissatisfied

2.2. Statistical Treatment

The statistical tools below were used for the study:

Frequency Distribution. This tool shows the occurrence of an interval as a relative frequency (RF, in percent) in a set instead of showing the actual number. The formula $RF = (f/N) * 100\%$ was used, where f is the frequency, and N is the total number of respondents

Arithmetic Mean. The mean is the sum of all the scores divided by the number of sources. The formula $\mu = (\sum X)/n$ was used, where μ is the mean, n is the number of sources, and X is the number of occurrence.

3. The Developed Blue Sentinels System

3.1. Framework of the Study

Fig. 1 below presents the graphical representation of the framework of the study.

The study began when the researchers observed the current project management processes of the company – the project management tool used and how project data were stored. After the initial observations, the researchers were able to list the issues encountered in using their current processes. With these in mind, the researchers checked the project management information systems available in the market to determine the

features of a project management software available. As a result, the researchers were able to list the common features of existing project management information systems and note areas of improvement which were then incorporated with Blue Sentinels. Afterwards, the developers began to design the wireframes and color schemes for the Blue Sentinels. The wireframe would dictate the information and actions of all pages in the system while the color scheme pulled together the overall look and feel of the system. After which, the developers finalized Blue Sentinels' features and graphical user interface. Using the chosen company's project data, the Blue Sentinels prototype, and ISO/IEC 9120 to evaluate the quality of the software and elicit feedback from the respondents for this study, a survey was conducted. The outputs of the system are the project status reports and delayed projects report. Using statistical tools such as frequency distribution and arithmetic mean, the researchers were able to interpret the results of the survey and list the recommendations of the respondents.

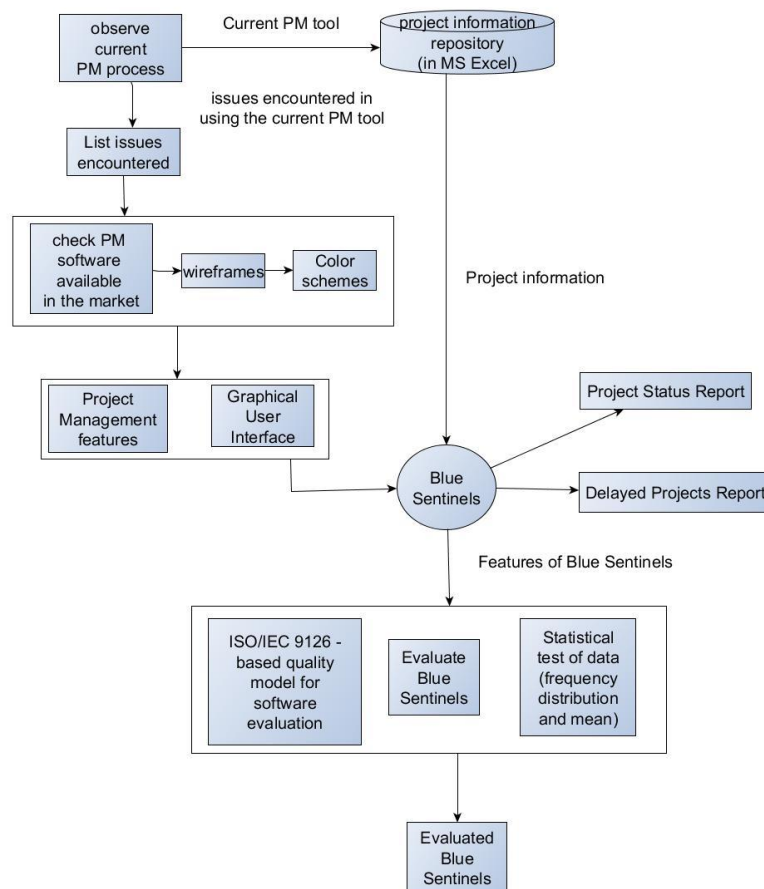


Fig. 1. Blue sentinels' framework of the study.

3.2. System Features

In developing Blue Sentinels, the developers ensured to set the scope of the project in accordance with the focus of the study. Blue Sentinels consists of eleven major functionalities namely: (1) User Management, (2) User Profile Management, (3) Project and Phase Management, (4) Features Management, (5) Issues Management, (6) Document Management, (7) Notification Management, (8) System Parameter Management, (9) Reports Generation, (10) Mobile adaptability, and lastly (11) Cloud Integration.

3.2.1. User management

Like any system, a module for user management is included and will enable the administrator to add, edit, view and delete user IDs. The key fields for User ID creation are the standard last name, first name, middle name,

user ID, password, email address and user profile. Password is required to be composed of alphanumeric characters, containing at least one upper case letter, at least one special character, and a minimum of 6 characters. Passwords will be encrypted using SHA-512 to protect the credentials of the users. If the user forgets his password, the system also has capability to enable the user to key in another password of his choosing.

3.2.2. User profile management

An added feature of this system is the User Profile Management wherein the user profiles can be added and defined by the Administrator. The profile of the user will determine the modules that can be accessed. The default user profile is the Administrator profile that allows complete access to the pages in this system.

3.2.3. Project and phase management

Project and Phase Management is the heart of the system. The Project Management feature will allow users to detail project information to give readers a high-level overview of the entire project. Meanwhile, Phase Management will allow the project managers to break the scope of work into phases. This feature also gives readers an idea of the scope of work needed for that particular phase of the project. Collectively, this will allow project managers to effectively manage the project and available resources with respect to the timeline agreed upon with the clients.

3.2.4. Features management

Features management will allow the members of the project working team to view the proposed and agreed upon functions of a phase. In this function, selected users will have the ability to update the status of a feature from 0% to 100%. The status of a feature in a phase will be computed to display the completion rate of a phase and over-all project progress.

3.2.5. Issues management

Issues Management will allow users to keep track of the issues encountered during User Acceptance testing of a specific feature. This will not only allow the project working team to put descriptions in the issue raised to provide an opportunity for the tester to fully explain the details of a particular issue, but also bring transparency as issues are open to project stakeholders. Furthermore, open issues in a feature affect the computation of the project progress computation: a feature with open issue(s) cannot be updated with 100% status. The issue must be closed first before the feature in question can be considered done. The same way, phases and projects cannot be considered done when there is still an open feature.

3.2.6. Document management

The system's document management function will allow for all relevant project documents to be stored in a centralized repository. This promotes transparency among the project working team as they will have access to the documents for that project.

3.2.7. Notification management

The system's notification management will alert the project working team of impending deadlines assigned to them. This function can personalize the notification settings per user. The user can set the notification alert to an email address of his choosing and the number of days before the deadline to send the notification alert.

3.2.8. System parameters management

The system's parameter management module will allow its administrators to readily adjust any configurations easily. Some of these include number of days before password expiration, user access profiles, profile names, and others. For security purposes, only administrator profiles will have access to this module.

3.2.9. Reports management

One of the essential functions of any system is the ability to generate reports for monitoring and reporting purposes. The system can generate a high-level progress report of the projects under a specific project manager. It can also generate reports a list of delayed projects under a specific project manager.

3.2.10. Mobile adaptability

With the rise in popularity of smartphone in today's society, it plays a huge role in everyone's life – even in

one's professional life. Smartphones are now used to access work email and even certain critical systems. Thus it is imperative that the system be mobile-responsive. Regardless of the size, the system adjusts to the device's screen size and orientation.

3.2.11. Cloud integration

In order to take advantage of the mobility and cost-efficiency of the cloud technology, the system is developed using Platform as a Service (PaaS) and is housed on a cloud server. Thereby, making Blue Sentinels available as Software as a Service (SaaS) to its users.

4. Results and Discussion

After administering the survey to the intended respondents, the researchers used the formula for arithmetic mean and frequency distribution. Afterwards, the Likert Scale was used to gauge the respondents' level of satisfaction. The following sections show the results of the survey and discuss the respondents' satisfaction to Blue Sentinels.

According to the respondents who used Microsoft Excel, they simply log the project information, target dates and latest project updates in the said spreadsheet software. The dissemination of the project updates is done by emailing the MS Excel file to the proper recipients. Since the act of entering the project details in Microsoft Excel is only technically logging, the actual monitoring lies in the developers and project managers remembering their target dates so they will not miss their deadlines.

Table 2. Project Management Solution Used

PM Software	Number of Responses	Frequency Distribution
Redmine	0	0.00%
Jira	0	0.00%
MS Project	7	19.44%
BaseCamp	0	0.00%
OrangeScrum	0	0.00%
Others (MS Excel)	29	80.56%

Respondents who chose Microsoft Project encountered different issues that may vary according to their job function or experiences. A total of 8.33% of the respondents answered they experienced missing project documents which could be attributed to the fact that Microsoft Project does not have an integrated Document Management feature built-in. If needed, Microsoft has a separate Document Management Software called Microsoft SharePoint but this requires a separate license. The results revealed 13.89% of the respondents encountered source code version control, this could be attributed to the poor project portfolio planning. When two simultaneous projects requires to change the source code of the same program, there will bound to be version control issues. 2.78% of the respondents experienced missing deadlines and/or project milestones when they are using Microsoft Project. Since Microsoft Project already has a feature wherein the user can tag a task as a milestone, this could be attributed to the lack of notification to the concerned user that the deadline was fast approaching. 5.56% encountered problems in generating project status report. This could be credited to the fact that Microsoft Project has sets of predefined reports but it is still not customizable that can fit to the needs of the company.

Respondents who indicated they used Microsoft Excel as a project management tool also encountered a number of problems. These issues can be attributed to the fact that Microsoft Excel is a spreadsheet software not a project management tool. Nevertheless, respondents who used the either Microsoft Project or Microsoft Excel experienced the same issues.

From the results from Table 4, the respondents were highly satisfied with the Cloud Integration feature of the software, with a mean value of 3.47. Mobile Adaptability and User Profile Management closely followed with a mean of 3.31. System Parameter Management received a 3.28 mean. The User Management feature gained a mean of 3.11. The system's Notification Management secured a satisfactory rating with a mean of 3.08. The

Project and Phase management feature followed closely with a mean of 3.06. Issue Management managed to secure a satisfactory mean of 2.72. Documentation Management received a 2.67 mean. The feature that scored the lowest is the Reports Generation feature with a mean of 2.39.

Table 3. Issues When Using the Chosen Project Management Solution

PM Software	Issues	Number of Responses	Frequency Distribution
MS Project	Missing project documents	3	8.33%
	Source code version control	5	13.89%
	Missing deadlines and/or milestones	1	2.78%
	Over project budget	4	11.11%
	Status report generation	2	5.56%
	Others	0	0.00%
	Missing project documents	6	16.67%
Others (MS Excel)	Source code version control	3	8.33%
	Missing deadlines and/or milestones	5	13.89%
	Over project budget	3	8.33%
	Status report generation	4	11.11%
	Others	0	0.00%

Table 4. Level of Satisfaction in Terms of Functionality

Features	Mean	Interpretation
User Management	3.11	Satisfied
User Profile Management	3.31	Satisfied
Project and Phase Management	3.06	Satisfied
Features management	2.61	Satisfied
Issue Management	2.72	Satisfied
Documentation management	2.67	Satisfied
Notification Management	3.08	Satisfied
System Parameter Management	3.28	Satisfied
Reports Generation	2.39	Somewhat satisfied
Cloud Integration	3.47	Satisfied
Mobile Adaptability	3.31	Satisfied
Overall mean	3.00	Satisfied

The overall mean for the respondents' level of satisfaction to the features of Blue Sentinels is 3.00. Reports Generation garnered the lowest mean with 2.39, interpreted as somewhat satisfied. This can be attributed to Blue Sentinels' report generation which only contains two reports: Project Status Report and Delayed Projects Report. Project management reports are tools for users to be given a view of the project progress. These tools will help determine if a change in the project execution is needed.

The respondents gave their verdict to the Blue Sentinels' usability qualities. Overall, results were highly satisfactory as three out of four qualities revealed that the respondents were highly satisfied. Topping the usability is Accuracy with a mean of 3.72. The Learnability followed closely with a mean of 3.69. Efficiency gained a mean of 3.61. Aesthetics got the lowest with the mean of 3.31. Collectively, Blue Sentinels' usability garnered an overall mean of 3.58, interpreted as highly satisfied.

Out of the four usability elements, Aesthetics received the lowest marks with a mean of 3.31 interpreted as satisfied; one of the recommendations endorsed by the respondents was to overhaul the website design.

The respondents gave their inputs on the interactivity qualities of Blue Sentinels. Operability topped the interactivity qualities with a mean of 3.78. The Reliability quality followed with the mean of 3.69. The Blue Sentinels' Robustness garnered a mean of 3.28 and Readability only gathered a mean of an even 3.00. Collectively, Blue Sentinels' interactivity garnered an overall mean of 3.44 interpreted as satisfied.

Table 5. Level of Satisfaction in Terms of Usability

Quality	Mean	Interpretation
Accuracy	3.72	Highly Satisfied
Aesthetics	3.31	Satisfied
Efficiency	3.61	Highly Satisfied
Learnability	3.69	Highly Satisfied
Overall mean	3.00	Highly Satisfied

Table 6. Level of Satisfaction in Terms of Interactivity

Quality	Mean	Interpretation
Operability	3.78	Highly Satisfied
Readability	3.00	Satisfied
Reliability	3.69	Highly Satisfied
Robustness	3.28	Satisfied
Overall mean	3.44	Satisfied

Out of the four interactivity elements, Operability received the highest marks with a mean of 3.78. The respondents were highly satisfied on the reliability of the system residing in the cloud environment since the system was able to produce the same desired output over time.

5. Conclusion and Future Works

Based on the results of the study, the respondents were generally satisfied with the developed Blue Sentinels. In the future, the developers will extend their work by providing a capability to browse the developed software using Android and iOS mobile phones. In addition, they will integrate with the Blue Sentinels some pertinent reports such as Gantt charts, Critical path, Earned Value Analysis as well as milestone tagging in the project and Active Directory for better complete edged and project performance monitoring.

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