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Short Paper

A Design of Cloud-Based Billing and Monitoring System for an Electric Company

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Abstract

Purpose – This descriptive study developed a cloud-based billing and monitoring system for an electric company named Quezelco1. The developed system was implemented in a web-based environment using a third party cloud infrastructure. After the development, the study gathered feedback from both end-users and technical experts to evaluate the proposed system in terms of content, functionality, reliability, maintainability, and features. Their comments and suggestions on the proposed system were also gathered.

Method – Interviews with the head of Consumer Area Department (CAD) head, IT personnel and Area Manager who fully understand the transactions and processes in electric billing of the company revealed that there was a need for an electric billing and monitoring system. After the software was developed, a questionnaire was utilized to necessary information on developing a system, and surveys to gather comments and suggestions from the respondents. The developed software was evaluated by the end-users; while the administrator page was assessed by the technical experts.

Results – All items of software criteria had at least acceptable ratings (Content: End-users, M = 4.42, Technical Expert, M = 4.42 = 4.32; Functionality: End-users, M = 4.42 = 4.47, Technical Expert, M = 4.42 = 4.49; Reliability: End-users, M = 4.42 = 4.40, Technical Expert, M = 4.42 = 4.42; Maintainability: End-users, M = 4.42 = 4.46, Technical Expert, M = 4.42 = 4.47; Features: End-users, M = 4.42 = 4.57, Technical Expert, M = 4.42 = 4.58). Test of difference between means revealed that there are no significant differences on the ratings of end-users and technical experts.

Conclusion/Recommendations – They both viewed the software acceptable. It was recommended that mobile payments (e.g., PayPal and credit cards) be included in future researches. There was also a need to enhance the customer experience online; promote other better support channel aside from phone calls, regular snail mails, and SMS. This study had shown that that cloud-based framework can be utilized as a tool for improving basic services in terms billing and monitoring.

Practical Implication – This study can be replicated in other basic services (e.g., water services) or in other fields of business (e.g., education or bank).

Keywords – billing system, cloud system, expert evaluation, end-user evaluation

INTRODUCTION

On June 19, 1960, Republic Act 2717 created the Electrification Administration (EA) to take charge of implementing the electrification program of the government aimed at improving the agricultural and industrial life of the people. Nine years after, on August 4, 1969, the EA was abolished by virtue of Republic Act 6038 and the National Electrification Administration (NEA) was created in its place. The government's policy for total electrification of the countryside on an area coverage basis was established.

By virtue of R.A 6038 and later through the promulgation of PD 269 the National Electrification Administration (NEA) was created with a mandate set for total electrification of the countryside. Under the supervision of NEA, the Provincial Electric Cooperative Team (PECT) was formed and tasked to promote and assist the organization and development of Rural Electric Cooperative (RECs).

It was in the summer of April 24, 1972 when Quezon I Electric Cooperative, Inc. (QUEZELCO I) was incorporated as the 22nd electric cooperative in the country with only six original member towns in the Bondoc Peninsula under its franchise represented by the following incorporators of the cooperative: Padre Burgos, Agdangan, Unisan, Pitogo, Macalelon, and Gen. Luna.

After a year, six more municipalities were included in the coop franchise that raised the number to 12 member-municipalities. A year later, eleven more towns joined the system bringing in a total of 23 member towns. In 1978, Mauban and Sampaloc in Quezon's first district clamored for inclusion in the coop franchise which brought its total member towns to 25. The last two towns were acquired by MERACO on September 10, 1983. To date, it has 23 covered municipalities represented by 13 district directors each representing up to three towns depending on the proximity and density of the town's membership. This 13-man board, headed by the President is the policy making body of the cooperative.

Quezelco1 already has a system for generating billing statements. It is very difficult to navigate because the system was created in Command Line Interface (CLI) which is also known as command prompt in D.O.S. and it was a stand-alone system that is not connected to any other computers. Therefore, only one computer did all the processes of billing and printing the billing statements of all the towns resulting to a slow turn-around of these processes. The problems that the company encountered are the following: 1) inconsistency of bill payment records, 2) difficulty of retrieving consumer records, and 3) slow turnaround time of distribution of bills due to distant locations of the sub-offices.

Cloud computing systems assist applications by offering virtualized resources that can be provisioned on demand basis. Computing resources are delivered by Virtual Machines (VMs). Traditional development models have many limitations such as cost and delay. Platform as services is an effective solution for most problems on traditional development application model that are faced by programmers as Platform as a Service provides them the same traditional features with a faster speed, reducing the cost and increasing collaboration among users. The aim of this paper is to develop cloud based framework based on Platform as a Services to assist in developing, testing, and deploying application without the need to purchase hardware, operating systems, and tools that are obtainable as services via the Internet (Yousif, Farouk & Bashir, 2015).

According to Scheier (2012), by using the Cloud open-source framework along with other open-source software, OpenCredo eliminated "heavy lifting" such as configuring virtual machines and adjusting the size of storage volumes. The framework allowed developers to write code locally, share it with the client, and automate the integration, testing, and deployment of application components. Because of the way it works with other open-source software, new features can be added in minutes rather than hours. Scheier also said that, even with all those benefits, open-source cloud frameworks like Cloud are a work in progress. Many manage only physical servers or stand-alone applications, leading customers who need more sophisticated capabilities to create their own frameworks. However, they offer compelling value because they mask the complexity of cloud computing setups, and the open-source model is an attractive way to do that.

Providing Quezelco1 a computerized system is a way of generating information more quickly but this is not enough. Because of the dispersed geographical location of the sub-offices, information dissemination to them was delayed because of manual distribution of the bills. So, by offering a web service available in the cloud, the system will be connected to the different sub-offices and pertinent information such as statements of account or bills may be easily accessed in real time. The researcher therefore came up with the proposal “A Cloud-based Billing and Monitoring System for an Electric Company.”

Conceptual Framework

The conceptual framework indicates the inputs, processes and outputs of the study. Figure 1's input frame shows the information/knowledge requirement are consumer information, company business rules/policies and processes. Hardware requirements are computers (at least Pentium 4) or modern devices (smart phones or tablets) for screens, printer for hardcopy of billing statement and other reports, networking cable for connectivity, and broadband Internet connection. Software requirements are as follows: PHP, the programming language to be used in developing the system and Laravel for extensions; MySQL for database in storing data; HTML5, JavaScript, CSS3 for interactive user interface; Adobe Fireworks for designing logos and pictures, and a third-party cloud infrastructure to host the web site. A survey form for testing and evaluating the system was designed beforehand in order to set its performance requirements.

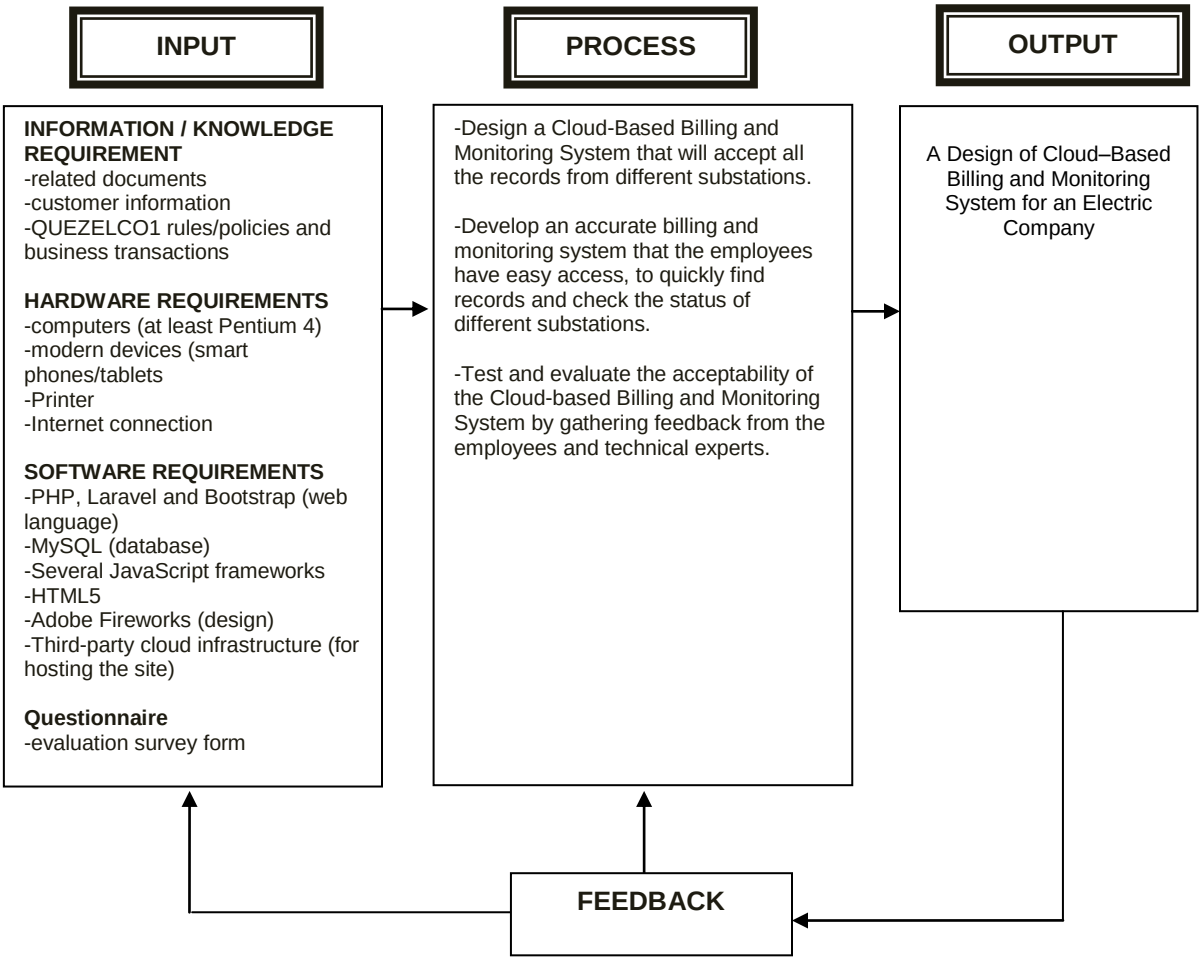

Figure 1. Conceptual Framework

The processes shown in the study reflected in the process frame are the following: Design and development of the billing and monitoring system for Quezelco1, and conduct

of the evaluation survey to measure the performance of the system based on the indicators identified in the evaluation questionnaire. The final output of the study shown in the frame is the evaluated Cloud-based Billing and Monitoring System developed for Quezelco1.

Statement of the Problem

This study aimed to develop a Cloud-Based Billing and Monitoring System for an Electric Company that would be implemented in a network, a web-based environment using a third party cloud infrastructure. The problems that the company was responding to are: 1) inconsistency of bill payment records; 2) difficulty of retrieving consumer records; and 3) slow turnaround time of distribution of bills due to distant locations.

Specifically, the study answered the following questions: (1) How do the end-users and technical experts evaluate the proposed system "A Cloud-Based Billing and Monitoring System for an Electric Company" in terms of content, functionality, reliability, and maintainability. (2) Is there any significant difference between the evaluation of the end-users and technical experts of the proposed system? (3) What are the comments and suggestions of the end-users and technical experts upon evaluation of the proposed system?

LITERATURE REVIEW

Review of Related Systems

In-house developed Software for Canteens' Canteen Billing System (BISMAC, 2010), is a user-friendly software which generates automatic display of Menu Listing per concessionaire (Figure 2). Flexible design for cashless transaction with ID swiping validation, yet also accepts payment for non-employees/students. The researcher used this as basis for creating or developing a more and improved user-friendly environment for the proposed system.

The researcher also took note of the following procedures in Meralco E-bill (Wire, 2003). The consumers have to go to the website of Meralco and follow the procedures to log in to their accounts.

Source Therapy Billing™ combined with Therapy Source Software, offers the most innovative and affordable turnkey solution in the industry. Their therapy scheduling, documentation and billing software solution is integrated with their billing services to provide the customer with 100% visibility into their billing operations productivity and performance. If one should ever decide to take it back in house, it is guaranteed that smooth transition with no loss of business continuity, disruption of clinical operations and no complicated data migration issues (Source Medical Solutions, Inc., 2012).

Figure 2. Canteen Billing System

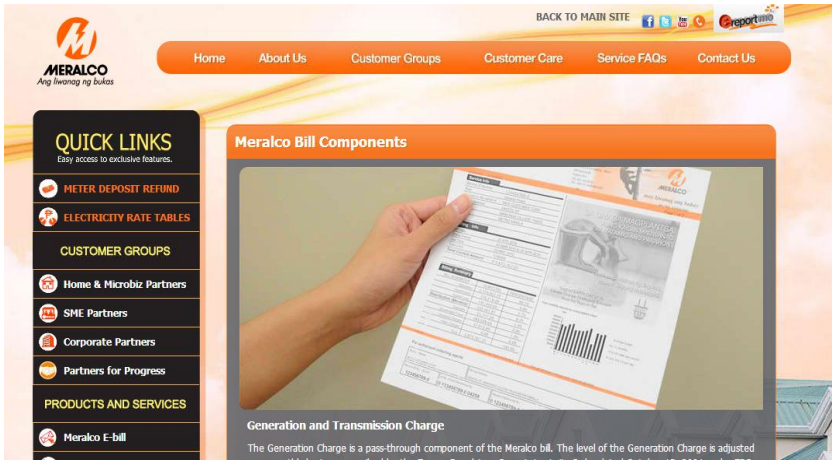

Figure 3. Meralco Website

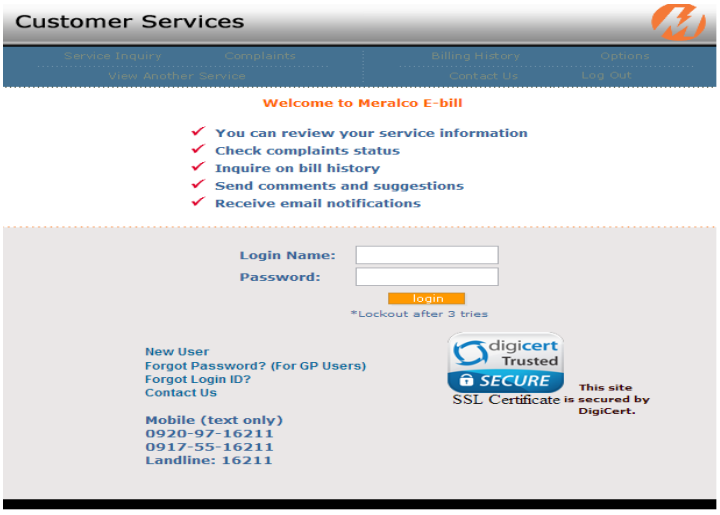

Figure 4. Meralco Log in Page

This billing system was created for the medical industry. The researcher used this as a reference to show relation in terms of billing process and monitoring of the patient. It also gives patients' information so that it could be monitored well which allowed the system to generate different reports and billing statements to financial reports. The result of this study gave opportunities for the hospital and to be more competitive.

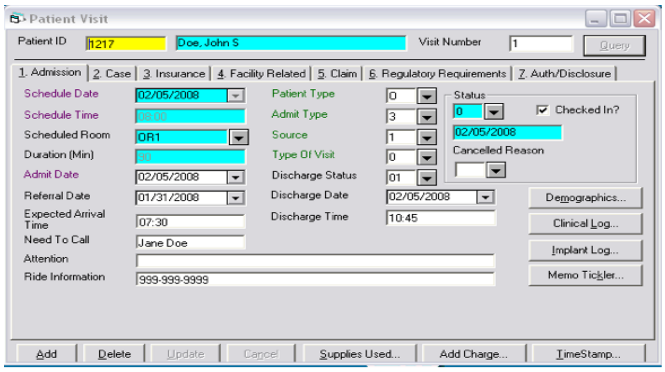

Figure 5. Patient Screen

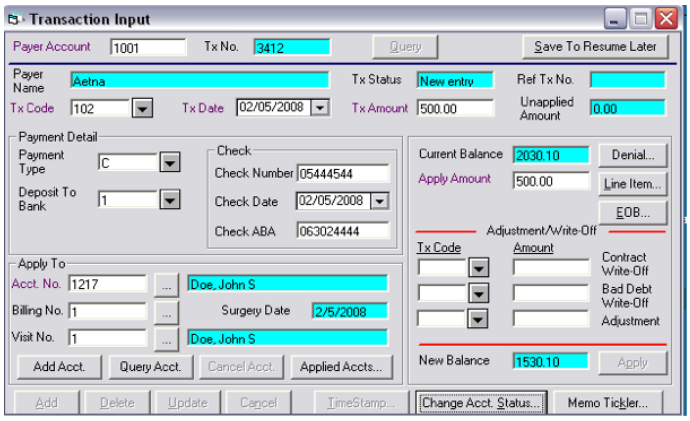

Figure 6. Transaction Screen

Figures 5 and 6 present the screenshots of the patient and transaction screen of the system used by the hospital. El Dorado Utility Billing software is a unique design that makes available metered and flat rate water bills for a variety of purposes. The researcher found it more adaptable to support both residential and business customers in single or multi-user billing environments. This study is very flexible, the billing rate structures for water industry allowed bills to be customized depending on the nature of the business (Creative Technologies, 2012).

Gravel Software is a legal practice management software. The researcher found this very helpful especially its features that served as basis for the development and enhancement of the proposed system. The following features are as follows: Client Record and Case Management System, Document Management System, Companion Website, Automatic Billing, Reminder, Multi User Environment, Secure System, and

Reports provided guidance to the researcher to develop a better system (Gavel Software Informer, 2012).

UBS Inventory & Billing (Informer Technologies, Inc., 2018) made inventory management easy by putting the control back into the user's hands. It provides the user with the flexibility to handle all types of inventory transactions and have instant updates and inventory status in their fingertips. It also has an invoicing system. It serves as a quick start to new users in getting started with the system. It provides a step-by-step guide for the user to setup necessary masters in the system. It reduces the hassle of going thru different menu paths in order to get all the setup required in place. The study also used FIFO (First In, First Out) method.

Another study by Olufunke, Olusegun, and Ayodele (2009) presented and aimed to develop a multi-user electronic bill presentation and payment system. It uses XHTML (Extensible Hypertext Mark-up Language) which has the capability of consolidating billing reports from various sources. Results showed that the modified EBPP consolidation model enhances quick notification of bills to the customer for the previously rendered goods and services, and users could pay for multiple services rendered by companies.

Hornbuckle's (1997) study focused on how to monitor the use of computer software. "Remote control of the use of computer data is described in a system for renting computer software which derives use and billing information, prevents unauthorized use, maintains integrity of the software and controls related inter-computer communications. A user at a target computer 'downloads' programs or data, via a telephone line and remote control modules from a host computer. Usage of the programs or data by the target computer or other accounting data are recorded and stored; at predetermined time, the host computer 'uploads' the usage data for processing. Other features include: (1) software and usage security for rental programs; (2) a polynomial generator/checker for generating block check characters for assuring integrity of data transmitted and received; (3) a voice-data switch for switching between data communication and normal telephone communication; and (4) an audio amplifier and speaker for monitoring of activity on the communication line during data transfers."

The Exceptional Performance team at "Yahoo!" has provided 35 best practices for speeding up website. Some of the practices relied onto optimizing the front-end user interface, consisting of HTML, JavaScript and CSS and minimizing HTTP requests. Usage of content delivery network (CDN) is also discussed ("Best Practices for Speeding Up Your Web Site"). Gube (2014) encouraged web developers to use any free CDNs available such provided by Microsoft, Google, jsDelivr, jQuery CDN, and others.

Such studies complimented with modern times with the article of Vuong (2014), on which he said that people hate slow loading websites as compared to the hate on waiting lines. Akamai Technologies, Inc.'s (2006) white paper , "Retail Web Site

Performance" highlighted a link between website performance and site abandonment, on which he quoted Jupiter that an outage due to slow performance may cause some of online customers to abandon it.

To maintain performance and scalability on the end of the employees as well as the subscribers while utilizing the system, cloud computing is a viable option, on which applications are hosted through highly-optimized IT data centers(Sarga, L. , 2012) of service providers (Singh, Vasantha, & Hemalatha, 2012). Enterprises can then utilize the cloud without much of the software license hassle as most of the companies perceived that it is disproportionate to the value it creates (Linthicum, 2010).

Šedivá (2013) stated that enterprise information systems are being challenged as it needs to deploy mobile applications, regardless of location. Mobile enterprise web applications, according to Bal (2013) are "key enablers to help customers reduce operational costs, improve customer service, and achieve a faster information processing by providing real time visibility and monitoring into their operational processes with better data granularity".

The researcher found it important since the proposed study is also an online system. The project or study was conducted to have a fast and accurate monitoring of reservation and billing system. With this project, it determined the problems and the manipulation of the business flow process. The descriptive method of research used interviews, surveys and observations as main instrument in gathering needed data.

The outcome of the project revealed that the manual system required more efforts for the employees to list the guest's reservations and in computing for the billing transactions. It was also found to be more prone to human errors, and inaccurate.

The proposed billing and monitoring system would fulfill the beneficiaries' needs. For updating items, management of users, and a tight security for protected access of transactions and items. Between the old billing and proposed billing and monitoring system, the latter was best so far. So, rapid billing has come out with this online billing and monitoring system. As compared to the manual billing, online billing and monitoring was quite easy to manage and a solution to mentioned problems. It was the best billing for all small and midsized business. Online billing software can simplify the user's billing process and save time and money. There was no need to employ an accountant to operate online billing software. It can be installed online and immediately increase productivity and expand the business' billing management capacity.

Synthesis of the Reviewed Literature and Studies

The inclusion of foreign and local literature and studies presented a wealth of information on the integration of customer experience, billing and monitoring systems; cloud computing, mobility and website performance. These elements, being the

instruments to the development of the system, presented a challenge to bring the best experience to the customers and the business owners by utilizing cloud computing technologies.

Experiences of the customers and business owners refer to the perceived usage of the developed system that would start from loading the login page to viewing their billing transactions letting them have decisions based on how they utilize the viewable information to let it be an instrument for the improvement of their lives. Center to the experience is the accuracy and efficiency of the system, on which it presents a challenge that it should minimize or eliminate processes, or provide an entirely new process which would change how Quezelco1 runs.

METHODOLOGY

Method of Research

This study used the descriptive method of research, to describe the nature of the procedures used and problems that exist in the Quezelco1 with regards to its billing and monitoring system. Descriptive research was also used to evaluate the proposed system in terms of content, functionality, reliability, maintainability and features.

Population, Sample Size and Sampling Technique

To be able to compare the responses of 2 groups of evaluators, the researcher administered the survey questionnaire to 38 out of the 42 employees of the Quezelco1 Main office under the following different departments: Consumer's Area Department (CAD), Member's Service Department (MSD) and Finance for Technical Experts; while, 130 out of 193 consumers for End-Users. Specifically, 11 CAD, 1 area manager, 5 department heads, 5 cashiers, 3 collectors, and 13 other technical experts.

The researcher used convenient sampling method because of the availability of the respondents during the software presentation. The employees of the required departments participated in the survey and served as technical experts. The combination of consumers and employees of Emerson served as end-users who were selected due to their availability, experience, and familiarization with the nature of the proposed system.

The researcher employed the Sloven's formula for the computation of the sample size to identify the number of technical experts that should be included in the study as respondents. A sample of 38 technical experts (N = 42) and a sample of 130 end-users (N = 193) were computed using the Sloven's formula (e = 0.05).

The technical expert respondents are the employees of Quezelco1, coming from CAD and MSD departments. Employees from the said department like the department head, teller/cashier, IT, collectors, auditor, accounting staff, accounting clerk, BAPA

officer, Admin Clerk, Area Manager, Purchase Officer, fifty consumers, and 10 faculty members also served as end-users in the study

Research Instruments

Various interviews were conducted with people from the organization so as to find out what requirements are to be included in the gathering stage prior to the development of the system. Formal interview was conducted with Mrs. Norma Osana, the manager of Consumer Accounts Department to determine the requirements of the system.

A questionnaire for the gathering of data needed in determining and solving the problems met by Quezelco1 was administered. The questionnaire was used to establish the profile of the respondents. It was also used as instrument in the formal interviews conducted and observations made. The same questionnaire was administered to obtain the respondents' perceptions about the differences between the current system and the proposed system. The items of the questionnaire could be answered using a 5-point Likert Scale (Table 1.).

Table 1. 5-Point Liker Scale, Mean Range and its Descriptive Equivalent

Numerical Rating	Rating	Descriptive Equivalent
5	4.51 – 5.00	Highly Acceptable
4	3.51 – 4.50	Acceptable
3	2.51 – 3.50	Moderately Acceptable
2	1.51 – 2.50	Slightly Acceptable
1	1.00 – 1.50	Not Acceptable

The researcher conducted an observation on the company's billing process and observed the actual process of entering the meter reading to compute kilowatts consumed by the consumers.

Data Gathering Procedure

Questionnaires were immediately distributed so as to obtain the much needed data. A formal questionnaire was given to the department head of CAD. Once accomplished, the questionnaire was immediately retrieved for analysis, and interpretation.

After the administration of the questionnaires, an interview was conducted to obtain information on the policies, procedures and rules of the company regarding the

system. In this manner, the researcher was enlightened on how things should be done in developing the proposed system, taking note of the improvements needed.

Survey forms were given to the respondents to give their suggestions and comments as they were asked to evaluate the acceptability of the proposed system, the Cloud-Based Billing and Monitoring System for an Electric Company. In this last part of data gathering procedure, the researcher identified the needed improvements of the proposed system.

Statistical Treatment of Data

Frequency, percent distribution, and mean were utilized to describe the data. Test of difference between means (independent sample) were used to solve if there is a significant difference between the end-users and technical experts' assessment.

Proposed System Framework

The study was limited to the development and evaluation of a Cloud-Based Billing and Monitoring System for an electric company (which was QUEZELCO1- Quezon Electric Cooperative 1).

The functions and features of the proposed system are billing of electric consumption, monitoring of payment records, and notifications via SMS. Only the department head of the Consumer Accounts Department, area managers, cashier/teller, collectors and consumers have access to the system (Figure 7). However, there would be different levels of accessibility and restriction according to their position. For the testing of the system, only the main office serves as the testing location because of good Internet connection.

The proposed system was hosted via a third party cloud infrastructure so that the sub-offices can have access to the system. Through the use of Internet, payment records would be automatically forwarded to the main office from the sub-offices. In addition, the department head in the main office could check the records of the different sub-offices by accessing their accounts. All payment transactions in all sub-offices would be automatically-recorded in the database.

The developed proposed system is only a prototype and may not be accredited by the Bureau of Internal Revenue unless pursued by Quezelco1. The system would only rely on manually-entered data coming from a metering device. Furthermore, the system would only be tested in screens like desktop, laptop, tablets and smart phones.

The system lies on the connection of web services to and from other services in the Internet. The researcher subscribed to a cloud service provider, Digital Ocean, on which the web app and the database are hosted. It was chosen by the researcher because

its services matched the system requirements of the proposed system. The web app directly connects to Twilio SMS as its service provider for its short messaging service notification system to all clients. Content delivery networks such as Google Hosted Libraries and Bootstrap CDN are the hosts for some libraries being used in the web app. Finally, the modern computer devices such as desktop, laptop, tablet and smart phones were used and generated content through the billing and monitoring system.

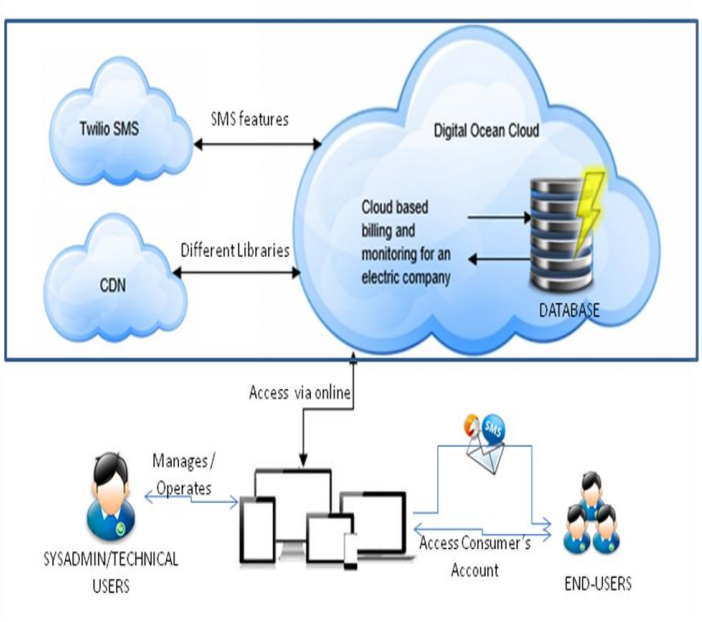

Figure 7. Proposed System

The web app was constructed using Laravel framework for PHP for model-view-controller design pattern as the web service, HTML5, Javascript, and CSS3 for interactivity and imperative design that powered the PHP web service. MySQL deployed in the cloud was used as the database platform. Native mobile app for Android, iOS, Windows Phone and other mobile platforms were not used as it is faster to construct a mobile-first web application using these tools.

RESULTS

Evaluation of the Software

Table 2 displays the evaluation of items on the content of the software. It shows that the evaluation of end-users obtained an overall mean of 4.47 verbally interpreted as 'acceptable'. On the other hand, the technical experts gave an overall mean rating of 4.64, which is interpreted as 'highly acceptable'. It can be deduced from the findings that the software is acceptable to all the evaluators.

The evaluation of the items in terms of the functionality of software is shown in Table 3. It can be observed from the table that the evaluation of end-users gained an

overall mean of 4.47, interpreted as 'Acceptable'; while, the technical experts acquired an overall mean rating of 4.53, interpreted as 'Highly Acceptable'. This means that the software is acceptable to all the evaluators.

Table 2. Evaluation of the Software Criteria in Terms of Content

	END-USERS	
CONTENT	**MEAN**	**DESCRIPTIVE EQUIVALENT**
1. Accuracy or content presentation	4.48	Acceptable
2. Updatedness of content	4.47	Acceptable
3. Informative	4.45	Acceptable
Overall Mean	4.47	Acceptable
	TECHNICAL EXPERTS	
CONTENT	**MEAN**	**DESCRIPTIVE EQUIVALENT**
1. Accuracy or content presentation	4.66	Highly Acceptable
2. Updatedness of content	4.53	Highly Acceptable
3. Informative	4.74	Highly Acceptable
Overall Mean	4.64	Highly Acceptable

The system was designed and programmed with user convenience in mind; giving the users the least number of operations they can do to get information. Of all the items defined in functionality, the provision for comfort and convenience stood out having a highly-acceptable rating of 4.71 for technical experts.

Table 3. Evaluation of the Software Criteria in Terms of Functionality

	END-USERS	
FUNCTIONALITY	**MEAN**	**DESCRIPTIVE EQUIVALENT**
1. Ease of operations	4.51	Highly Acceptable
2. Provision for comfort and convenience	4.49	Acceptable
3. User friendliness	4.41	Acceptable
4. Operability	4.47	Acceptable
Overall Mean	4.47	Acceptable
	TECHNICAL EXPERTS	
FUNCTIONALITY	**MEAN**	**DESCRIPTIVE EQUIVALENT**
1. Ease of operations	4.47	Acceptable
2. Provision for comfort and convenience	4.71	Highly Acceptable
3. User friendliness	4.45	Acceptable
4. Operability	4.50	Acceptable
Overall Mean	4.53	Highly Acceptable

Table 4 exhibits the evaluation of the software criteria in terms of reliability. It can be gleaned from the table that 'acceptable' or a mean of 4.42 was rated by the end-users and a mean of 4.27 for the technical experts. However, in item 3 (Absence of Failure), the evaluation of the technical experts presents the lowest given mean weight of 4.05. It can be denoted based on the findings that the proposed system is acceptable in terms of reliability.

Table 4. Evaluation of the Software Criteria in Terms of Reliability

	END-USERS	
RELIABILITY	**MEAN**	**DESCRIPTIVE EQUIVALENT**
1. Conformance to desired results	4.55	Highly Acceptable
2. Accuracy of performance	4.42	Acceptable
3. Absence of failure	4.38	Acceptable
4. Recoverability	4.34	Acceptable
Overall Mean	4.42	Acceptable
	TECHNICAL EXPERTS	
RELIABILITY	**MEAN**	**DESCRIPTIVE EQUIVALENT**
1. Conformance to desired results	4.42	Acceptable
2. Accuracy of performance	4.45	Acceptable
3. Absence of failure	4.05	Acceptable
4. Recoverability	4.16	Acceptable
Overall Mean	4.27	Acceptable

Table 5 shows the evaluation on the items of maintainability. It presents an overall mean of 4.48, which is interpreted as 'acceptable' the end-users, and 4.32 for technical experts. It can be seen from the table that in item 3 (Provision for diagnostic tools and procedures) both end-users and technical experts gave the lowest mean of 4.38 and 4.21 respectively, but is still interpreted as 'acceptable'; while, 'testability' attained the highest mean of 4.56 (Highly Acceptable) for the end-users and 'Ease of Maintenance" with 4.45 (Acceptable) for the technical users. The data revealed that the proposed system is deemed acceptable.

Evaluation of the features was easy for the end-users and technical experts as the items are mostly based on the generation of outputs from the system (Table 6). Item 1 "Generates different kinds of reports" got a mean weight of 4.47 from end-users and 4.66 from technical experts. Both were verbally interpreted as 'Highly Acceptable'. Item 2 "Real time connection with other offices, meaning connection through the offices and the users' personal devices using a broadband or cellular connection" obtained a mean weight of 4.57, a highly-acceptable rating for end-users and 4.50, which is also a highly-acceptable rating from technical experts, giving them an option to bring their work and make decisions anywhere. Item 3 "Notifications through the interface" attained a mean of 4.58 and 4.71, which means highly acceptable ratings from both the end users and the technical experts respectively. Item 4 "SMS" likewise acquired a highly-acceptable rating

of 4.56 and 4.74 respectively from the end-users and the technical experts. Item 5, stated as "Web application adopts the size of the screen, be it a desktop, laptop, tablet or smart phone greatly increasing its accessibility" received a 4.73 mean for end-users, and a 4.37 mean for technical experts.

Table 5. Evaluation of the Software Criteria in Terms of Maintainability

	END-USERS	
MAINTAINABILITY	**MEAN**	**DESCRIPTIVE EQUIVALENT**
1. Testability	4.56	Highly Acceptable
2. Ease of maintenance	4.55	Highly Acceptable
3. Provision for diagnostic tools and procedures	4.38	Acceptable
4. Provision for enhancements and modifications	4.42	Acceptable
Overall Mean	4.48	Acceptable
	TECHNICAL EXPERTS	
MAINTAINABILITY	**MEAN**	**DESCRIPTIVE EQUIVALENT**
1. Testability	4.37	Acceptable
2. Ease of maintenance	4.45	Acceptable
3. Provision for diagnostic tools and procedures	4.21	Acceptable
4. Provision for enhancements and modifications	4.26	Acceptable
Overall Mean	4.32	Acceptable

Table 6. Evaluation of Software Criteria in Terms of Features

	END-USERS	
FEATURES	**MEAN**	**DESCRIPTIVE EQUIVALENT**
1. Generates different kinds of Reports	4.47	Acceptable
2. Real time connection with other offices	4.57	Highly Acceptable
3. Produce Notifications	4.58	Highly Acceptable
4. Produce SMS	4.56	Highly Acceptable
5. Accessible to other devices	4.73	Highly Acceptable
Overall Mean	4.58	Highly Acceptable
	TECHNICAL EXPERTS	
FEATURES	**MEAN**	**DESCRIPTIVE EQUIVALENT**
1. Generates different kinds of Reports	4.66	Highly Acceptable
2. Real time connection with other offices	4.50	Acceptable
3. Produce Notifications	4.71	Highly Acceptable
4. Produce SMS	4.74	Highly Acceptable
5. Accessible to other devices	4.37	Acceptable
Overall Mean	4.59	Highly Acceptable

Significant Difference between the Evaluation of the End-Users and Technical Experts for the Proposed System

As shown in Table 7, there is a significant difference of 0.10 between the mean ratings of the end-users and technical experts in terms of the content of the software. However, the computed *t*-value of 0.845 does not exceed the tabulated *t*-value of 2 at 0.05 level of significance with df = 74. This was also the case on Functionality ($t(74) = 0.978 < t_{tabulated} = 2$, d = -0.002), Reliability ($t(74) = 0.849 < t_{tabulated} = 2$, d = -0.015), Maintainability ($t(74) = 0.899 < t_{tabulated} = 2$, d = -0.009), and Features ($t(74) = 0.847 < t_{tabulated} = 2$, d = -0.015).

Table 7. Significant Difference between Mean Ratings of End-Users and Technical Experts on the Different Software Criteria

Software Criteria	End-Users	Technical Expert	D	Computed t-value	Tabulated t-value	df	Significant at (α) = 0.05
Content	4.42	4.32	-0.076	0.845	2	74	Not Significant
Functionality	4.47	4.49	-0.002	0.978	2	74	Not Significant
Reliability	4.40	4.42	-0.015	0.849	2	74	Not Significant
Maintainability	4.46	4.47	-0.009	0.899	2	74	Not Significant
Features	4.57	4.58	-0.015	0.847	2	74	Not Significant

The data revealed that there were no significant differences between the evaluation of end-users and the technical experts, based on the results of the evaluation of the system with the software criteria of Content, Functionality, Reliability, Maintainability and Features.

Comments and Suggestions on the Cloud-Based Billing and Monitoring System upon the Evaluation of the End-Users and Technical Experts

The comments and suggestions gathered from end-users are: "There are textboxes that seem like drop-down list boxes"; "Highly responsive even when one views it on a tablet"; and "Nice and cool system." These comments and suggestions prompted the researcher to modify some features that acknowledged the given insights of the respondents for the improvement of the proposed system. A very encouraging comment from the technical expert is: "The design is accepted; needs for us to study so that we will use it in the future." Overall, the system was well-received and accepted by the respondents. This would require extensive collaboration between the developer and the business owners for further enhancements.

CONCLUSIONS AND RECOMMENDATIONS

This study aimed to develop and design a cloud-based billing and monitoring system for an electric company that will be implemented in a network, a web-based environment using a third party cloud infrastructure. Specifically, the study answered questions having to do with how do the end-users and technical experts evaluate the proposed systems in terms of content, functionality, reliability, maintainability, and features; the significant difference between the evaluation of the end-users and technical experts for the proposed system; and the end-users and technical experts' comments and suggestions on the proposed system.

The system was deemed acceptable by both end-users and technical experts. The first statement of the problem showed that the proposed system is acceptable for both end-users and technical experts in all software criteria (content, functionality, reliability, maintainability and features). The proposed system could be a good and acceptable solution to the problems of the company on their billing and monitoring activities.

There was no significant difference on the evaluation of the users and the technical experts. It may be concluded that different criteria were highly-visible to the users, making them more able to act on their payment notifications to maintain their electricity consumption in Quezelco1 through the proposed system.

The end-users and technical experts commented that the system was highly responsive in tablets, smart phones, laptops and desktops. One commented that 'there are textboxes that seem like drop-down list boxes' and 'a nice and cool system'. These comments referred to the functionality criteria which demonstrated the usage of Bootstrap making people appreciate its user-friendliness.

No system is ever perfect and complete. All IT systems are continuously upgraded, refined and optimized, but the study could open more opportunities for other researchers to improve the system. Therefore, an extensive effort on integrating mobile payments, PayPal and credit-card based payments is a good possibility. It is also recommended so as to enhance customer online experience, and to promote a better support channel aside from phone calls, snail mails, and SMS, be enhanced.

The result of the evaluation indicated acceptability of the proposed system as very encouraging. Hence, future researchers may come up with another study on the effectiveness of the proposed system or other related topics. Some aspects of customer relationship management could also be integrated into the system so as to provide ways on how the marketing and sales people of an electric company perform their tasks online. With these recommendations to be implemented in future studies, , this work could serve as reference for industry solution and for online utility billing systems.

REFERENCES

Akamai Technologies, Inc. (2006). *Retail web site performance: Consumer reaction to poor online shopping experience.* Retrieved from https://www.akamai.com/us/en/multimedia/documents/report/akamai-site-abandonment-final-report.pdf

Bal, S. N. (2013). Mobile web - enterprise application advantages. *International Journal of Computer Science and Mobile Computing*, 2(2), 36-40.

BISMAC. (2010). Canteens' billing system. Retrieved from http://www.bismac.com.ph/software-solutions/id/canteen_billing_system

Creative Technologies. (2012). *El Dorado utility billing software*. Retrieved from http://www.waterbill.com/Solutions/El_Dorado8_System_Overview.pdf

Gavel Software Informer. (2012). *Gavel*. Retrieved from http://gavel.software.informer.com/

Gube, J. (2014). A *list of free public CDNS for web developers*. Retrieved from http://sixrevisions.com/resources/free-public-cdns/

Hornbuckle, G. (1997). *Method and apparatus for remotely controlling and monitoring the use of computer software*. U.S. Patent No. 5,649,187 United States of America.

Informer Technologies, Inc. (2018). *UBS inventory and billing education*. Retrieved from http://ubs-inventory-and-billing-education.software.informer.com/9.3/

Linthicum, D. (2010). *The value of cloud computing*. Retrieved from https://timreview.ca/article/339

Olufunke, V., Olusegun, F., & Ayodele, A. (2009). On consolidation model in e-bill presentment and payment. *Information Management & Computer Security*, *17*(3), 234-247.

Sarga, L. (2012). Cloud computing: An overview. *Journal of Systems Integration*, *3*(4), 3-14.

Scheier, R. (2012). *Open-source cloud frameworks: A work in progress*. Retrieved from https://www.computerworld.com/article/2503804/cloud-computing/open-source-cloud-frameworks-a-work-in-progress.amp.html

Šedivá, Z. (2013). Mobile applications in enterprise information system. *Systémová Integrace*, *20*(4), 49-59.

Singh, A., Vasantha, V., & Hemalatha, M. (2012). A brief survey on architecture, challenges and security benefit in cloud computing. *International Journal of Information and Communication Technology Research*, 2(2), 102-111.

Source Medical Solutions, Inc. (2012). *SurgiSource billing*. Retrieved from http://surgisource-billing.software.informer.com

Vuong, W. (2014). *The business impacts of website speed - and ways to accelerate*. Retrieved from http://apmdigest.com/the-business-impacts-of-website-speed-and-ways-to-accelerate

Wire, A. A. (2003). *Meralco starts new billing system minus PPA charge*. Retrieved September 26, 2012, from http://www.meralco.com: http://www.accessmylibrary.com/coms2/summary

Yousif, A., Farouk, M., & Bashir, M. (2015). A Cloud Based Framework for Platform as a Service. *2015 International Conference on Cloud Computing (ICCC)* (pp. 1-5). IEEE.