ASIST Automated Water Billing System
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Abstract
Water billing system is important to provide consistent and accurate billing information to clients and service recipients. The study is aimed to develop an automated water billing system for the Abra State Institute of Sciences and Technology in Lagangilang, Abra, Philippines and to determine the usability of it in terms of Efficiency, Affect, Helpfulness, Control, and Learnability. The descriptive and applied types of research were employed in the study. Data were gathered through interview and feedback form. The respondents were from the 8 personnel of the accounting and cashiering offices. The Rapid Application Development model was used in the development of the system and the Software Usability Measurement Inventory questionnaire to test its usability. The gathered data were analyzed and interpreted using frequency count and mean. Findings of the study revealed that they need an automated billing system to improve their billing procedures since it is done manually. Using the Rapid Application Development model, reliable and feasible automated billing system from development until implementation was achieved. The developed system was found usable because it was designed to fit the needs of ASIST.

Keywords
Water billing system, Software Usability Management Inventory, Rapid Application Development Model, Billing procedures, Philippines.

I. Introduction
Computerized System and improved efficiency have been the focus of entrepreneurs. As with many business scenarios, getting rid of paper improves efficiency, reduces human error and allows information to flow to an infrastructure without a time-consuming data input process. There is also less chance of handwritten orders being misread and a higher customer turnaround as customers will be served faster.

Scott (2011) concludes that automation increases the accuracy of the data, as human error is less likely to occur. The completeness of the data is also improved as the automated systems will process all the data in an efficient manner.

Neumann (2010) states that water billing system is a necessary tool to assist small municipalities, utility providers, bookkeepers, operators, managers, and auditors in unifying their water billing services, in order to provide consistent and accurate billing information to clients and service recipients. It is essentially software that processes data and produces invoices in a given format, facilitating and unifying the billing process.

Dzikus (2011) the director of Water for Asian Cities Programme in India also adds that an efficient system of billing can only ensure timely serving of demand notice and collection of dues from customers, thereby enabling efficient cash recycling and serve the following objectives: 1.) Timely raising of bills for the water dues; 2.) Establishing clear - cut time schedules between the raising of bills, serving it to the consumers and payment by them; 3.) Collection from the consumers of the right amount and on due date; 4.) Make it easy for willing consumers to pay at convenient collection centers, most ideally at the door step; 5.) Accounting for daily collections and their remittances; 6.) Clear accounting of dues of consumers; 7.) Elimination of avoidable delays; and 8.) Minimizing the cost of collection.

According to Gokhale (2008), in Amaravati water supply scheme is the only urban water supply scheme in Maharashtra which has been getting the facility of computerized water billing system continuously since 1991. The operating of the system has been outsourced. The software development has not been in a year or two, but it has been in process years together and proudly contributed by generously from meter readers, counter clerks, fitters, plumbers, clerical staff in the office, and auditors and accountants, to the higher officers, engineers at all levels, and most of the consumers of the scheme. It has become most intelligent software in the country and now, it is not only utility software but it is management software. It is in use in number of cities in Vidarbha and shares the experience of managing more than 800,000 consumers in the Delhi, the Capital city of the Country, since 1995.

In the national setting, Orani Water District in Bataan, which started its operation in 1978 and now having 11 pump stations has been fully a computerized system in 2003. The system has helped them to have organized and faster transaction. Davao City Water District was created by virtue of Presidential Decree 198 in 1973 and now, the biggest water district in the Philippines having over 140,000 service connections and still growing. It also adopted automated water billing system to handle the massive volume of data of concessionaires. The City of Tampa Water District which has around 723 concessionaires also switched to an automated billing from the manual process.

One of the Income Generating Projects of the Abra State Institute of Sciences and Technology is the water system that supplies water to the cottages, buildings and dormitories of the school. ASIST water system charges only concessionaires from cottages and dormitories while water used from buildings are free since the system is owned by the school. As of June, 2014 there are only forty concessionaires who are obliged to pay their water consumption. ASIST water system is currently using the manual method in computing the amount of bill of the concessionaires. The accounting personnel manually prepare the monthly water bills, pre-addressed bill and post consumption and bill amount of the water bills. They manually accomplish the posting of the payment to concessionaires’ temporary ledger.

The personnel admitted that there were instances that they committed inaccurate computations. Regarding the posting of payments, there is a tendency that the input of date paid and debit-credit of a concessionaire may be compromised thus, duplicated collection of payment may happen.

In accordance to this, the researcher developed the automated water billing system. The system was developed specially to meet the needs of ASIST personnel to strengthen their billing procedures and to render good service to the concessionaires.
The main objective of this study was to develop ASIST Automated Water Billing System. Specifically, it aimed to achieve the following objectives:
1. Identify the billing procedures of ASIST water system;
2. Develop the ASIST Automated Water Billing System; and
3. Determine the usability of ASIST Automated Water Billing System in terms of:
   • Efficiency,
   • Affect,
   • Helpfulness,
   • Control, and
   • Learnability.

Conceptual Framework
This project study used the developmental research that deals on design, development and evaluation. In connection with this, the researcher used the RAD model which has four phases namely, requirement planning, user design, construction and cutover. The paradigm in Figure 1 shows the interaction of the Input–Process–Output (IPO) variables that were used in the development of the ASIST Automated Water Billing System. Information about billing procedures was the input and it was processed by way of documentary analysis coupled with a structured interview to the accounting and cashier personnel of the school as the end-users.

The result from the documentary analysis and interview were used in the system development premised on the Rapid Application Development Model. The developed system was validated in terms of usability to produce an efficient, helpful, controlled and reliable ASIST Automated Water Billing System.

The output is ASIST Automated Water Billing System. The feedbacks of the study were based from the results of the system being tested and evaluated by the users or respondents and this provides room.

Fig. 1: Research Paradigm

II. Methodology
Descriptive and developmental designs of research were used in this study.

Browneyes (2010) states that “descriptive” method of research is where the person doing the research presents it in a descriptive manner. Browneyes adds that the descriptive research designs enable researchers to describe or present the picture of a phenomenon or phenomena under investigation.

This study used the descriptive research design because the determination of billing procedures was determined through interview. The identification of the mentioned variable was used as basis for the development of ASIST Automated Billing System which eventually led the researcher to use developmental type of research design.

According to Richey and Klein (2007), developmental research is the systematic study of design, development and evaluation processes with the aim of establishing an empirical basis for the creation of instructional and non-instructional products and tools to new or enhanced models that govern their development. It focuses upon a given design, development, or evaluation model or process. They may involve constructing and validating unique design models and processes, as well as identifying those conditions that facilitate their successful use.

This project study used the developmental research that deals on design, development and evaluation. In connection with this, the researcher used the RAD model which has four phases namely, requirement planning, user design, construction and cutover.

For objective no. 1 to identify the billing procedures, interview was conducted to the personnel of accounting and cashier because they were the authorized persons who know the billing procedures. Documentary analysis was used to analyze the documents that were gathered such as statement of account, summary of bills, and official receipt.

For Objective no. 2, the development of ASIST Automated
Water Billing System, the researcher used the Rapid Application Development. As emphasized by Ravindran (2007) RAD is a software development process model that emphasizes an extremely short development cycle using a component based construction approach. If the requirements are well understood and defined, and the project scope is constraint, the RAD process enables a development team to create a fully functional system with in very short time period.

RAD has four (4) phases namely: requirements planning phase, user design phase, construction phase and cutover phase respectively, as shown in Figure 2.

![Figure 2: Rapid Application Development Model](image)

The development process is discussed below:

1. **Requirements planning phase**, the researcher identified specific information needed in order to develop an effective automated water billing system. This stage includes tasks such as determining the status of the existing ASIST water system that need to develop. She analysed the situation to know the processes that need to be automated. She identified the scope, constraint and system requirements of the system. Additionally, the researcher created a Use Case Diagram to determine the functional view of the system.

2. **User design phase**, it involves the complete design of the automated water billing system. This phase designs the database which specifies the content of records and files were included. In designing, the researcher considered the user interface and user friendliness of automated water billing system.

3. **Construction phase** focuses on program and application development task similar to the SDLC. In RAD, however, the researcher can continue and can still change or improve actual screens or reports that are developed. Its tasks were programming and application development, coding, unit-integration and system testing. The researcher used Visual Basic 2008 as programming language and MYSQL as the relational database in developing the automated water billing system.

4. **Cutover phase** resembles the final tasks in the SDLC implementation phase, including data conversion, testing, changeover to the new system, and user training. The system was delivered to the personnel of accounting and cashier as target users and user training was conducted in order for them to learn the flow of the system.

For objective no. 3, determine the usability of the ASIST Automated Billing System, the researcher used questionnaire based on the concept of Veenendaal (2002) known as Software Usability Measurement Inventory (SUMI). Since the instruments were already used by the previous researchers, and these were really used in evaluating systems in the ICT world, it is presumed to be valid and reliable and that no validation and reliability tests were already conducted.

**Respondents**
The study was conducted at Abra State Institute of Sciences and Technology. The accounting, and cashier personnel served as the respondents of the study. The distribution of the respondents is shown in Table 1.

A total enumeration of 8 personnel involved in the billing procedures were selected to identify the billing procedures and to evaluate the developed system in terms of its usability.

<table>
<thead>
<tr>
<th>Respondents</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounting Personnel</td>
<td>4</td>
</tr>
<tr>
<td>Cashier Personnel</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
</tr>
</tbody>
</table>

They were chosen because they could provide the needed information about the billing procedures and the evaluation of the ASIST Automated Water Billing System.

**Data Gathering Procedure**
Prior to the pilot test of the study, the system was presented for trial run and demonstration to the campus where the audience consisted of the Accounting personnel and Cashiering personnel. This included system testing of the integrated system to verify if the system meets the specified requirements.

An evaluation was conducted if the system satisfies the requirements outlined and to ensure that they are error-free. The ASIST Automated Water Billing System was pilot tested to the Accounting and Cashiering personnel. The researchers established close coordination with the heads of the Cashiering and Accounting Offices. The researchers floated the questionnaire after the live or actual demonstration on how to install and use the system. The researchers personally collected the questionnaire to ensure a one hundred percent (100%) retrieval.

**Data Analysis**
The data gathered from the respondents were analyzed and interpreted using statistical treatments such as frequency count and mean.

In the usability of the ASIST Automated Billing System, the data gathered were quantified by using the Likert’s scale with the corresponding descriptive ratings which are as follows;

<table>
<thead>
<tr>
<th>Point Scale</th>
<th>Mean Rating</th>
<th>Descriptive Rating (DER)</th>
<th>Descriptive Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4.20-5.00</td>
<td>Strongly Agree</td>
<td>Usable</td>
</tr>
<tr>
<td>4</td>
<td>3.40-4.19</td>
<td>Agree</td>
<td>Usable</td>
</tr>
<tr>
<td>3</td>
<td>2.60-3.39</td>
<td>Neutral</td>
<td>Usable</td>
</tr>
<tr>
<td>2</td>
<td>1.80-2.59</td>
<td>Disagree</td>
<td>Not Usable</td>
</tr>
<tr>
<td>1</td>
<td>1.00-1.79</td>
<td>Strongly Disagree</td>
<td>Not Usable</td>
</tr>
</tbody>
</table>

The variables with responses within the mean range of 2.60- 5.00 were interpreted as Usable while those variables with responses
within the mean range of 1.00 to 2.59 were considered as Not Usable.

III. Results and Discussion

Billing Procedures of ASIST Water System
From the interview conducted with the accounting and cashier personnel about billing policies, they said that the billing procedures start with: a) The meter reader reads the water meter of the concessionaire, then submits the meter reading list to the accounting personnel, b) The accounting personnel posts meter readings individually then computes the cubic meter consumed by every concessionaire and its charge in peso, c) After computation, the billing clerk prepares the notices of collection and a summary of bills, d) After billing, the Billing Clerk turns over the notices of collection to the accounting personnel., e) Concessionaires pay their water bills to the Cashier, and f) The Billing Clerk posts the paid bills based on the Cashier’s official receipt.

Development of the ASIST Automated Water Billing System

The use case diagram of the ASIST Automated Water Billing System which indicates the functional requirements and activities of the different users was made.

Functional Requirements
The use case diagram of the ASIST Automated Water Billing System represents the functionality of the system from a user’s point of view. It describes the features that the users expect the system to provide. Different users including the administrator, the accounting, and the cashier personnel interact with the automated billing system.

The Administrator has the total control over the system and users of the system. The Administrator’s roles and privileges includes adding and editing bills, accepting payments, printing notices of collection, resetting billing, viewing and printing summary of bills, viewing and posting posted bills, viewing and printing uncollected bills, viewing and printing collections, viewing disconnected or defective meter list, printing the meter reading form, updating the water rate per cubic meter, adding, editing, and deleting users, and logging in and out from the system. The billing clerk can only add, edit bill, print notices of collection, view and print summary of bills, view and post posted bills, view and print uncollected bills, view and print collections, view disconnected or defective meter list, print the meter reading form and log in and out from the system. On the other hand, the cashier can only accept payments, print notices of collection, view and print summary of bills, view and print posted bills, view and print uncollected bills, view and print collections, view disconnected or defective meter list, print the meter reading form, and log in and out from the system.

Non-Functional Requirements
The Automated Billing System and the following are needed for the implementation of the said project.

Hardware Requirements
In order for the software to meet its best performance, it should have the proper hardware required. For the implementation of ASIST Automated Water Billing System, the following computer hardwares are needed in server side: Intel Quad Core, 4 GB for physical memory, 500 GB for hard disk drive and 14 inches for monitor. For the client side: Dual Core, 2 GB for physical memory, 80 GB for hard disk drive and 14 inches for monitor.

Software requirements
The software requirements below should be installed for the successful installation of the system. For both server side and client side: Windows 7 for the operating system, MySQL Data Provider for data provider, and MySQL Server for database platform.

Network Plan
In this study, the star topology was used. There are three work stations to be used for the administrator, accounting personnel, and cashier respectively. These are connected to the database server via a network router and network wired media.

User Design
The ASIST Automated Water Billing System is supposed to replace the manual operations done. It has three users classified as administrator, accounting and cashier. The administrator has the overall control of the system. The accounting can only access the bill menu and report menu while cashier has only the privilege to access the payment menu and report menu.

In the ASIST Automated Water Billing System, billing and payment transactions are done electronically, not the usual way in which they will enter all the entries in the notices of collection, stubs and official receipts manually and repeatedly. These will be printed thereafter using a continuous form. The computation of bills and payments is also automated. There is no need to compute using the calculator which will have the possibility to yield inaccurate results. The due date and disconnection date are also automatically determined. Billing and payment are made easier and faster because it is easier to search for the record of a certain concessionaire.

Another function that the ASIST Automated Water Billing System offers is the electronic registration of new concessionaires. The data of a new concessionaire will be entered into the system by the Administrator. The new account will be automatically added and saved to the record of all concessionaires and can be updated. The ASIST Automated Water Billing System generates reports which enable the administrator, the accounting, and the cashier to get summary of bills, posted bills, uncollected bills, and collection.
In addition, the administrator can update the rate per cubic meter and meter reader, can also add, edit, delete users, and reset the billing process.

Construction
The researcher used Visual Basic 2008 as programming language and MySQL as the relational database in developing the automated water billing system.

Features and Activities of the ASIST Automated Water Billing System

1. Login Form
A log-in is a combination of information that authenticates user’s identity. A user must choose from the type of user combo box and input his or her user name and password to obtain access to the system. After clicking the Ok button, the Main form of the system will appear.

2. The Main Form of the ASIST Automated Water Billing System
The Main form allows the user to select tasks from the menu. The Accounting personnel can only access the Billing Menu, Set Billing Menu, Summary of Bills menu, and Posted Bills menu while the Cashier can only access the Payment Menu, Summary of Bills menu, and Posted Bills menu. Only the Administrator has a full access to all the tasks. After clicking a sub-menu, the sub-form will appear. If the user selects the Exit button, the system will be terminated.

3. The Concessionaire Form
The Account form allows adding and updating account information, viewing the concessionaires’ list, and number of concessionaires’ status.

4. Billing Form
The Billing Clerk and the Administrator have the control over this form. The Reading Date must be set first. The Billing Form lets the user enter the present reading of the concessionaire in the Present Reading Column. The cubic meter used is automatically computed, providing before due amount, ten percent penalty, and after due amount. The form also displays the due date and the disconnection date.

5. Payment Form
This form contains the fees to be paid by the concessionaire. The user needs to enter the account number in the Account Number textbox then click the Load button to display all the unpaid bills of a particular concessionaire. This form determines also if the bill to be paid by the concessionaire is overdue or not. Upon entering the cash amount, it will automatically compute the change. After clicking the Save button, the record will be saved.

6. Summary of Bills Form
All users can access this form. The user should enter the month and year into the textbox to display the summary of bills on the data grid for the particular date. The user can print the report.

7. Posted Bills Form
The Posted Bills form displays the history of payment of a certain concessionaire. The user will just enter the account number of the concessionaire in the Account Number text box. Clicking the Load button automatically displays the history of payment list on the data grid

8. Rate per Cubic Meter Form
The Administrator is the only authorized user to update the rate per cubic meter.

9. User Management Form
The Administrator is the only authorized user to add, edit, and delete users of the system.

Cutover
The system was delivered to the personnel of Cashier and Accounting as target users and user training was conducted in order for them to learn the flow of the system.

Summary of the Usability of the ASIST Automated Water Billing System

Table 2 : Summary table of the usability of the Automated Water Billing System

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Mean</th>
<th>Descriptive Equivalent Rating</th>
<th>Descriptive Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Efficiency</td>
<td>4.61</td>
<td>Strongly Agree</td>
<td>Usable</td>
</tr>
<tr>
<td>2. Effect</td>
<td>4.38</td>
<td>Strongly Agree</td>
<td>Usable</td>
</tr>
<tr>
<td>3. Helpfulness</td>
<td>4.54</td>
<td>Strongly Agree</td>
<td>Usable</td>
</tr>
<tr>
<td>4. Control</td>
<td>4.59</td>
<td>Strongly Agree</td>
<td>Usable</td>
</tr>
<tr>
<td>5. Learnability</td>
<td>4.76</td>
<td>Strongly Agree</td>
<td>Usable</td>
</tr>
<tr>
<td>Grand Mean</td>
<td>4.58</td>
<td>Strongly Agree</td>
<td>Usable</td>
</tr>
</tbody>
</table>

Table 2 shows the usability of the ASIST Automated Water Billing System. It is evident that the respondents agreed that the system is very usable with a grand mean rating of 4.58. The highest rating mean of 4.76 (strongly agree) was given to learnability which means that the users perceived that the automated billing system is easy to learn. The least rating mean of 4.38 described as strongly agree was given to effect which means that the developed system is effective for use. In terms of efficiency, the respondents agreed that the system is efficient to use while control and helpfulness were rated by the respondents as strongly agree.

It means that the system has a very effective way of control usability and easy to learn. According to an online article Computer System Validation - It’s More Than Just Testing, dynamic testing of the software is important to help ensure that software systems meet their intended requirements.

IV. Conclusion
Based from the findings, the following conclusions are deduced:
1. The billing procedures of ASIST Water System are done manually.
2. Using the Rapid Application Development Model, reliable and feasible automated billing system from development until
implementation was achieved.

3. The developed ASIST Automated Water Billing System is usable based on the users’ test.

V. Recommendations

In the light of the above conclusions, the following recommendations are forwarded:

1. An automated system can be developed based on the procedures of the ASIST Water System.
2. The Rapid Application Development model maybe used by researchers having the same study as automated billing system.
3. The ASIST Automated Water Billing System maybe implemented to offer a better service to their concessionaires.
4. End users are recommended to undergo appropriate training to equip them with the necessary skills needed to operate the system to the fullest.
5. For better results in the usage of the automated billing system, the end-users should follow the intended system requirements.

VI. Acknowledgement

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References


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