Proposed Utilities Billing Information Management System using Google Workspace Platform for a Property Management Services Company

Francis Lourdan M. Miña
School of Industrial Engineering and Engineering Management
Mapúa University
Manila, Philippines
lourdzmina@gmail.com, flmina@mymail.mapua.edu.ph

Grace Lorraine D. Intal
School of Industrial Engineering and Engineering Management
School of Information Technology
Mapúa University
Manila, Philippines
gldintal@mapua.edu.ph

Abstract

Cloud computing's popularity has been dominant in the IT industry over the past year. One of the widely-used cloud platforms among the business organization is the Google Workspace (formerly G Suite), an integrated cloud-based service that offers real-time document collaboration and increased cloud storage capacity. In this paper, the cloud platform was utilized to create an online computer-based information system (CBIS) for utilities data management and processing to eliminate work handoffs and prevent human error throughout the utilities billing information processing for a property management services company. The proposed CBIS, called UBIS (Utilities Billing Information System), also aims to automate the traditional manual generation of forms and reports required in the utilities data processing. The first three phases of the SDLC Waterfall Model were used as a guide in developing the proposed online CBIS - systems planning, systems analysis, and systems design. In the system review, five manual processes are identified that can be automated, and four out of these five processes are also considered unnecessary work handoffs. The use case diagram, system flowchart, and dataflow diagram (DFD) were used in the system design. The four work handoffs were eliminated in the system testing, and the five manual processes were automated successfully through the UBIS using Google Workspace. The criteria analysis using a scoring model is used to evaluate the proposed UBIS and the traditional system. Results show that the UBIS is the better system overall by scoring higher in 6 out of 8 criteria based on the company's business model.

Keywords
Google Workspace, information system, cloud computing, process automation, utilities billing

1. Introduction
According to the National Institute of Standards and Technology (NIST), cloud computing is defined as a ubiquitous model for convenient and on-demand access to a shared network of computing resources (e.g., servers, networks, data storage, tools & applications) that can be quickly provided and serviced with minimal management involvement of the service provider (Mell and Grance 2011). Under this definition, a computing capacity will qualify as a cloud service if the cloud model has the five essential characteristics - on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service (Satyanarayana 2012). There are three service models of cloud computing, as listed as well in NIST definition of cloud computing, which are the software as a service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) (Rani and Ranjan 2014).

Furthermore, there are four deployment models available for cloud services, namely private cloud, community cloud, public cloud, and hybrid cloud. In a private cloud, the cloud infrastructure is operated solely for an organization that is managed by a third party or the organization itself and may exist on-premise or off-premise. On the other hand, the public cloud is made available to the general public or a large industry group wherein the infrastructure is owned by an organization selling cloud services (Mel and Grance 2011) such as Google, Amazon, and Microsoft (Mather et al. 2009). The community cloud falls between the public type and private type, wherein the cloud infrastructure is exclusive to two or more organizations with common privacy, security, and regulatory considerations rather than a single organization. Lastly, hybrid cloud has two or more distinct cloud infrastructures (private, public, and community) that remain unique entities but are bound together by standardized or proprietary technology that enables application and data portability among them (Goyal 2014).

2. Literature Review

The use of cloud computing, an IT resource as a service rather than as a product, has been gaining popularity with big organizations due to its benefits. Some of the key benefits include minimal upfront investment, flexibility, scalability, speed of deployment, and access to quality software (Oredo et al. 2019). With its variety of business applications, it has been an encouraging information systems (IS) technology opportunity, especially among SMEs (Dedi Rianto and Mifta 2012); accounting IS to manage all customer accounts online through the software-as-a-service (SaaS) platform (Christauskas and Miseviciene 2012); data management for e-health care system (Nur and Moon 2012); optimizing financial service operations for banking services (Ghule et al. 2014); and automate business processes and documents into workflow management systems (Cristani et al. 2018).

One of the widely-used cloud platforms among business organizations is the Google Workspace, formerly G Suite (Google Workspace 2022), due to its capabilities of enhanced speed, accessibility, effective collaboration, and reliable storage. It is an integrated cloud-based service that offers real-time document collaboration and increased cloud storage capacity (Mahapatra et al. 2017). It has been recommended for improving administrative services to the community by utilizing Google Docs, Google Form and Google Drive in Serang City, Indonesia (Hanafiah and Gunadi 2021); hospital management system with an accessible application through Google SQL and Google App Engine (Malladi and Vadivel 2012); automation of data collection and analysis of hand hygiene compliance monitoring in healthcare facilities by utilizing Google Form and Google Sheets (Wiemken et al. 2018); automated management of embargo records of the scholarly works in Skidmore College using various Google Workspace applications (Luo 2018); and managing mortgage information using Google Sheets (Arnold 2017).

3. Situational and Problem Analysis

3.1 Opportunities for Computer Based Information System

One of the significant roles of the property management service company is to manage the billing of utilities consumption of its buildings' tenants. The electric and water consumptions by each of the units in the buildings are collected monthly and billed accordingly by the property management office (PMO). The utilities data are collected and managed into the Masterfile by the PMO's engineering team, then processed into an application (app) of the accounting team to generate the billing statements. However, delay in app uploading of the Masterfile is a recurring problem in the company affecting the overall team performance and resulting in extra man-hours of the employees and even causing delays in the generation of billing statements to the tenants.

This current problem in desktop-based utilities data processing is an opportunity to design a computer-based information system (CBIS). The proposed CBIS will primarily involve a transaction processing system (TPS) type of information systems that will be useful in the operational level of business.

3.2 Root-Cause Analysis

Using Why-Why analysis and Root Cause Analysis (RCA), a modified root-cause tree diagram is created, as shown in Figure 1, to determine the factors contributing to the problem of delays in utilities data processing for billing. Four primary and four secondary causes are identified. Among the four secondary causes, work handoffs and human error in encoding have been associated with two primary causes. Furthermore, five tertiary causes were determined, which are the root causes of the problem. Three root causes (C2, C3, and C5) are associated with a lack of automation. The other two causes (C1 and C4) are related to the unutilized cloud platform.

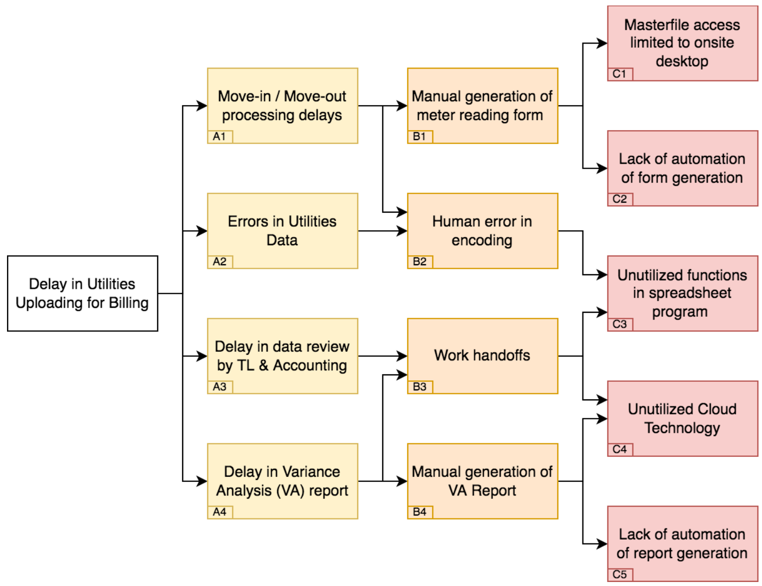

Figure 1. Root-cause tree diagram

3.3 Problem Statement and Objectives

Some manual methods performed in the generation of billing are already obsolete. While there are IT resources and employees' capabilities, there is no initiative to improve the process nor automate some manual methods. This prototype project initiative aims to create an online computer-based information system (CBIS) for utilities data management and processing using the Google Workspace platform to eliminate work handoffs and prevent human error, thereby preventing delays in the utilities information app uploading. Also, the project aims to automate the generation of forms and reports required in the utilities data processing and integrate these automated functions into the online CBIS.

4. System Analysis

To develop the proposed online CBIS, the first three phases of the SDLC (systems development life cycle) Waterfall Model are used as a guide – systems planning, systems analysis, and systems design. With situational and problem analysis, the system requirement and the whole process of monthly utilities information app uploading are then reviewed and analyzed.

4.1 System Requirement

As shown in Table 1, there are five categories of system requirements involved in the proposed online CBIS: output (Out), input (In), process (Pr), performance (Per), and control (Ctl) requirements. Also, the system must use the Google Workplace as the primary cloud computing and collaboration platform being used by the company. Lastly, the three main functions must be integrated into one website.

The first function is the meter reading request. The admin requires the meter reading for the transfer of the billing account, such as from unit owner to tenant (move-in) and vice versa (move-out) or from old tenant to new tenant. All meter readings are collected in move-in / move-out (MIMO) processing by the admin, an independent pre-requisite process to the utilities app uploading. Meter reading request is also a service offered by the PMO to the residents who wish to check the readings of their water and electric meters.

The second function is the generation of variance analysis (VA) report. The VA is done to the newly encoded utilities reading in Masterfile. This process aims to identify the utilities reading that generates the current consumptions far from the mean consumption of utilities per unit and, thus, identify possible errors in the utilities reading.

The last function is creating an XLSX file which will be uploaded into the accounting team's app to generate the billing statements. The file includes the meter identification number and the meter readings of the billing month.

Table 1. System requirement

Meter reading request	
Out	The system must create a meter reading form into an online shared folder with the admin assistants and engineering team. The form can also be send to the requestors (internal and external) directly through email should they prefer.
In	The request details, electric and water meter readings must be collected into a spreadsheet accessible online for the monthly move-in / move-out review by admin.
Per	The system must be available online and support all the PMO team members (engineers, team leader, admin) simultaneously.
Ctl	The system must require password to access the function.
Variance Analysis Report	
Out	The system must create a VA report into an online shared folder with the accounting team and engineering team.
Pr	The system must calculate the utilities data variation real-time.
Per	The system must be available online and support all the engineering team and accounting team members simultaneously.
Ctl	The system must require password to access the function.
Utilities Information App Uploading	
Out	The system must create a XLSX file, ready for utilities uploading, into an online shared folder with the engineering team
Per	The system must be available online and support all the engineering team members simultaneously.
Ctl	The system must require password to access the function.

4.2 Review of Current System Processes

The process of utilities data app uploading mainly involves the engineers, team leader, and accounting team members, as shown in Figure 2. It starts with the engineering team's reading of the electric and water meter and encoding them to the Masterfile in the local shared desktops of engineers. Four unnecessary work handoffs are identified, as shown in Figure 2 with red highlight, which the CBIS aims to eliminate.

The first work handoff is sending the Masterfile from the engineering team to the team leader to review readings that generate negative consumption and extremely low or high consumption. Should there be no corrections, it will be sent to the accounting team, which is the second handoff, to generate the VA report manually through MS Excel. The third work handoff is sending the VA report to the engineering team, who will verify if the meter readings of the listed units in the VA report are accurate. If there are readings subject to change in the listed units, the engineering team updates the correct reading into the Masterfile. The fourth work handoff is sending the updated Masterfile and the engineer's remarks on the VA report from the engineering team to the team leader for another review. Furthermore, these four work handoffs and the manual process of creating of XLSX file for app uploading, as highlighted with a red box in Figure 2, are the five manual processes identified that can be automated by the proposed CBIS.

5. System Design

After analyzing the current processes involved, various models are created to satisfy the requirements in the proposed CBIS. These include the use case diagram, process flowchart of the new system, dataflow diagram (DFD), and the user interface. The proposed system shall be called as Utilities Billing Information System (UBIS).

5.1 Use Case Diagram

The use case diagram for the proposed UBIS is shown in Figure 3, representing users' interaction (PMO - engineer, admin, and team leader; and accounting team) with the system. The engineering team is involved in all use cases.

Team leaders are only limited to use cases “Create meter reading form” and “Access Masterfile” only, while the accounting team to “Access Masterfile” and “Create VA report” only.

The system will collect the details input in the meter reading request through “Create meter reading form,” which updates the backend spreadsheet for the admin's MIMO processing through “Update summary sheet.” Furthermore, the meter reading form can be automatically sent directly to the requestor upon creating the form or manually shared to the requestor by the admin assistants through “Send meter reading.”

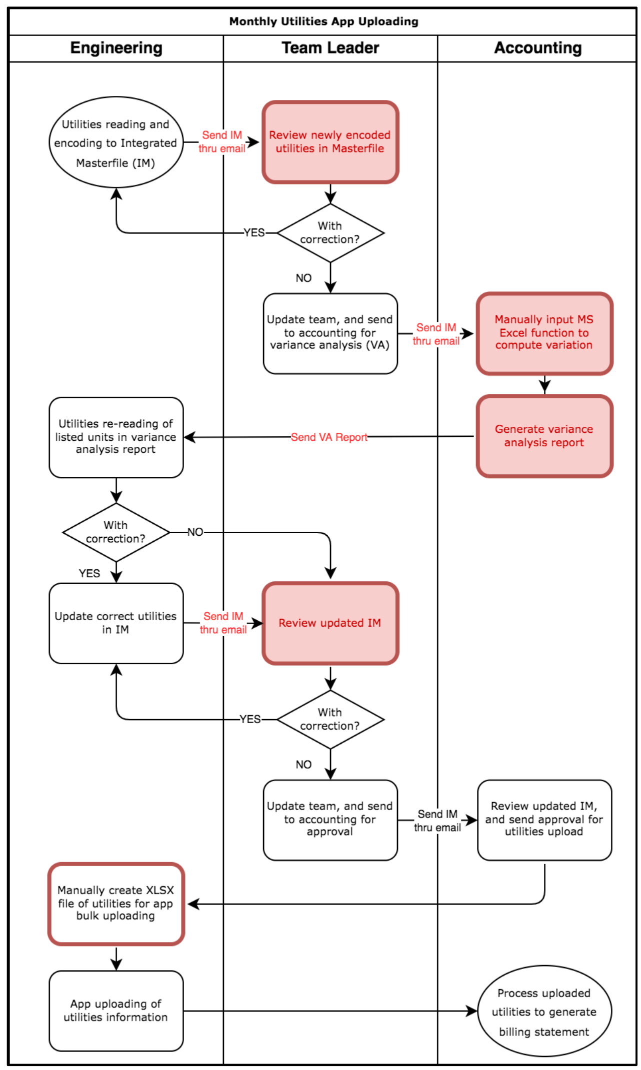

Figure 2. Process flowchart of monthly utilities app uploading

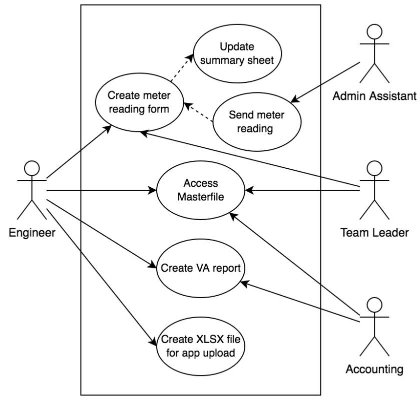

Figure 3. Use case diagram of the proposed CBIS

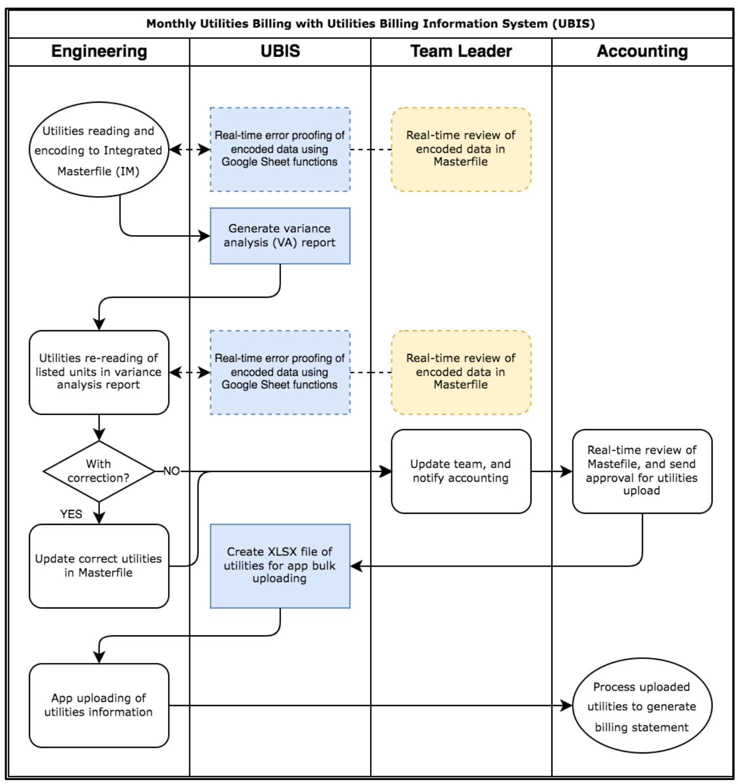

Figure 4. Use case diagram of the proposed CBIS

5.2 Proposed System Flowchart

With the proposed UBIS, the new system flowchart is shown in Figure 4, wherein work handoffs were eliminated using cloud computing through the system's automated functions (represented by the blue background box) and with real-time error-proofing and team review capabilities (represented by dash-line blue box). Generating the VA report and creating an XLSX file for app uploading were also automated in the UBIS (represented by a solid-line blue box).

5.3 Dataflow Diagram

The data processing flow is modeled using the dataflow diagram (DFD), as shown in Figure 5. The system has two data stores: the “Utilities Masterfile,” housing the unit information and monthly reading, and the “Request backend sheet,” where the meter reading submissions are collected for MIMO processing.

Process 1.1 “Request meter reading” receives utilities reading data flow from the engineering team (engineer and team leader). Process 1.1 produces meter reading submission details to the request backend sheet, which are then used to process 1.2 to create the meter reading form. The meter reading form is saved into the shared folder managed and accessible to the entire PMO.

The Utilities Masterfile provides the unit information for the meter reading form generation, the utilities reading for the XLSX file for the app upload, and the VA details for the VA report.

Process 1.3 involves sending the meter reading form from process 1.2, which requires the requestor's email address from the engineering team. The output of this process is the email to the requester with the form attached.

The processes 2.0 and 3.0 are activated by data flows which are the file request and report request, respectively, wherein the sources are the engineers for process 2.0 and the engineers or the accounting team for process 3.0. The said entities are also the sink of the XLSX file for app upload from process 2.0 and the VA report from process 3.0, respectively.

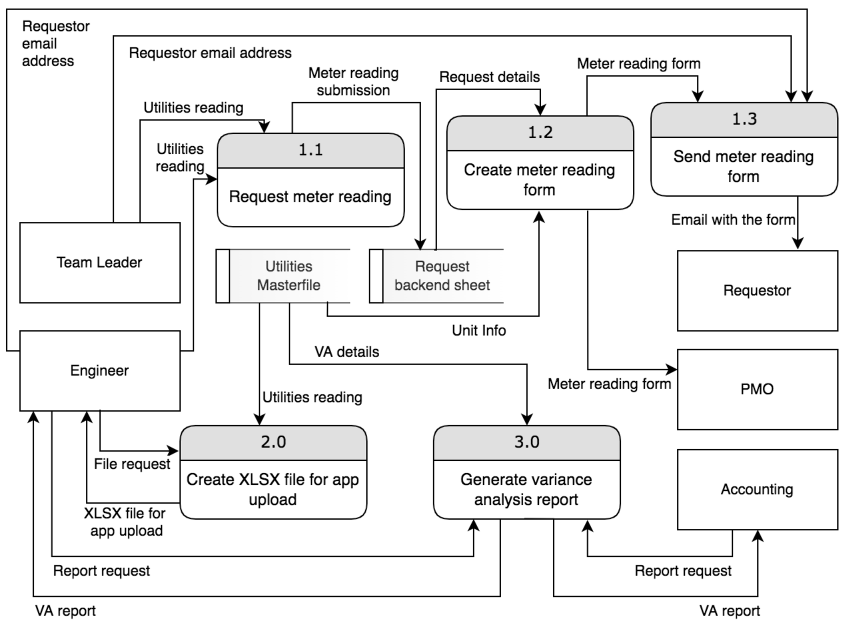

Figure 5. Use case diagram of the proposed CBIS

5.4 System Interface

The Google Form application of the Google Workspace platform is utilized for the input implementation methods. To customize the user interface (UI) of the website, the FormFacade extension app is used with built-in graphical user interface (GUI) components such as text boxes, checkboxes, drown down lists, hyperlinks, buttons, and data validation functions for numbers, date, and email address, as shown in Figure 6 and Figure 7. Data validation functions are used in text boxes such as valid numbers for meter readings and valid email addresses in requestor details.

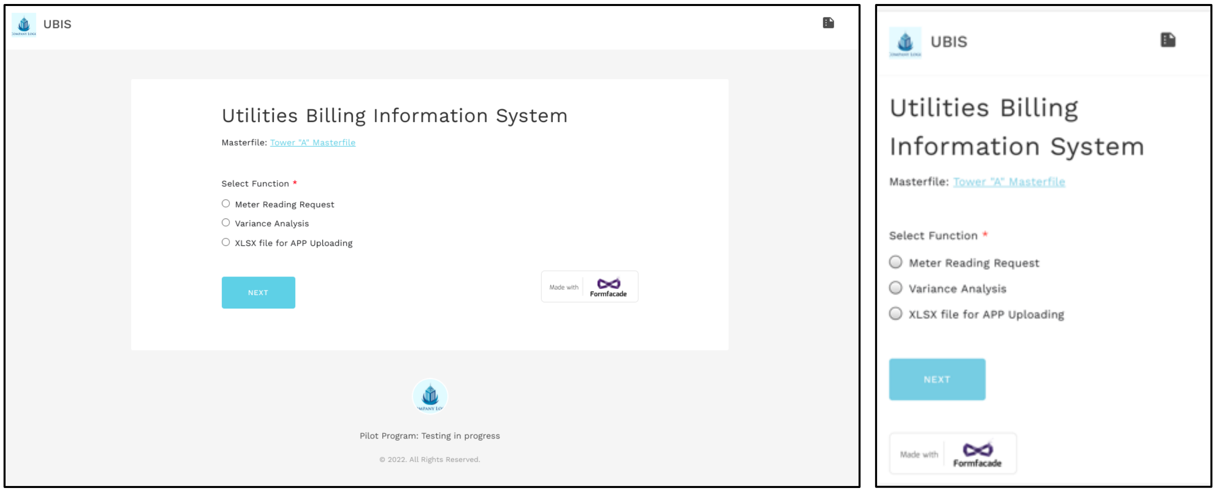

Figure 6. Proposed sample UI of the UBIS home page in 16:9 desktop display (left), and in 5.8 inches display size smart phone (right)

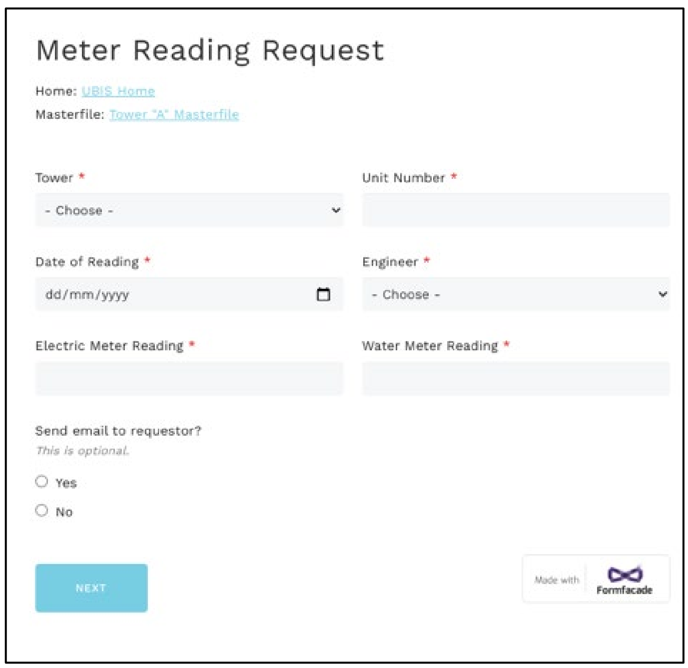

Figure 7. Proposed sample UI of the meter reading request page showing different GUI

6. System Evaluation

6.1 System Testing

System testing was done through a pilot UBIS with a mock-up dataset in the Masterfile. The test results met the system requirements listed in Table 1 using the Google Workspace. Five manual processes identified in Figure 2 were successfully automated, and the four work handoffs were eliminated accordingly. The system's sample meter reading form output is shown in Figure 8, wherein the meter details are automatically exported from the Masterfile to the form template.

COMPANY LOGO

Managed by: Property Management Services Company

METER READING

DATE: 1/1/2022

UNIT NUMBER: TA-3421

KWHR METER

SERIAL NUMBER	READING	BRAND TYPE	PHASE
0123456789	*9,876.54 kWh*	*DM Metering*	*3 ø*

WATER METER

SERIAL NUMBER	READING	BRAND TYPE	SIZE
12341234	*321 m^3*	*E series*	*25 mm*

Prepared by:

Lourd Miña

Figure 8. Sample output of the meter reading request

6.2 Criteria Analysis

The criteria analysis using a scoring model is used to evaluate the proposed UBIS compared to the traditional system. There are eight criteria identified grouped into two review aspects as shown in Table 2 with a rating scale from 1 as the lowest to 5 as the highest. The eight criteria with varying weight, as shown in Table 3, are based on the company's business model.

For the business operation review, the results show that UBIS is the better system with corresponding weighted scores of 1.25, 0.60, 0.50, and 0.40 for Customer Service, Process Efficiency, Team Performance, and Ease of Use, respectively. This is compared to the old system with corresponding weighted scores of 0.75, 0.30, 0.30, and 0.30, respectively. This is due to the huge potential increase in customer satisfaction with automated and faster meter reading requests and prevent, if not completely eliminated, the delays in the billing statement generation. Moreover, with the UBIS, work handoffs were significantly reduced, increasing the whole process efficiency. Also, the automated functions of the UBIS made the new system easier to use. These reasons, including remote access capabilities, real-time collaboration, Masterfile error-proofing, and increased utilization of the paid cloud platform, will surely significantly improve the overall team performance.

Table 2. Scoring matrix for eight criteria

Criteria	Rating				
	1	2	3	4	5
Business Operation Review					
Customer Service	Poor	Average	Good	Very Good	Excellent
Process Efficiency	Not Efficient	Low Efficiency	Average	High Efficiency	Very High
Team Performance	Poor	Average	Good	Very Good	Excellent
Ease of Use	Very Difficult	Difficult	Average	Easy	Very Easy
Assets and Resources Review					
Stronger Control	Poor	Average	Good	Very Good	Excellent
Labor & Utility Cost	Very High	High	Average	Low	Very Low
Ease of Maintenance	Very Complex	Complex	Average	Easy	Very Easy
Obsolescence Risk	Very High	High	Average	Low	Very Low

Table 3. Criteria analysis using scoring model

Weight	Criteria	OLD SYSTEM	UBIS

		Score	Weighted Score	Score	Weighted Score
60%	**Business Operation Review**				
25%	Customer Service	3	0.75	**5**	**1.25**
15%	Process Efficiency	2	0.30	**4**	**0.60**
10%	Team Performance	3	0.30	**5**	**0.50**
10%	Ease of Use	3	0.30	**4**	**0.40**
40%	**Assets and Resources Review**				
15%	Stronger Control	**4**	**0.60**	3	0.45
10%	Labor & Utility Cost	3	0.30	**4**	**0.40**
10%	Ease of Maintenance	**4**	**0.40**	3	0.30
5%	Obsolescence	2	0.10	**4**	**0.20**
100%	Total Score:	3.05		**4.10**	

For the assets and resources review, cloud computing in general poses challenges in data security (Oredo et al. 2019). Since Google Workspace is a SaaS type of cloud computing, the control of the platform is less. However, Google is known for its reliable security and is committed to continuous improvements of this critical aspect (Zurier 2022). Hence, for the Stronger Control, the old system has a weighted score of 0.60, which is higher than 0.45 of UBIS. Also, although the updates and maintenance of the cloud platform are part of the paid services, the UBIS requires more comprehensive management of the cloud folders and customization in applications, compared to the old system that is easier to maintain. Hence, the old system still has a higher weighted score of 0.40 in Ease of Maintenance compared to 0.30 of the UBIS.

Nevertheless, the UBIS is still clearly more advantageous in terms of less labor & utility cost and less risk to obsolescence with a weighted score of 0.40 and 0.20, compared to the old system with a weighted score of 0.30 and 0.10, respectively. The higher score in labor & utility cost of UBIS is due to the reduction of man-hours with faster processes brought by the automation and work handoffs elimination, which consequently reduces the utility needs such as the office facilities and computer use. Lastly, the higher score of UBIS in terms of the Obsolescence Risk is obviously due to the continuously growing cloud computing and increasingly automating of business processes, while the old system has been obsolete by itself already.

7. Conclusions and Recommendations

While the use of Google Workspace in creating the proposed UBIS was successful, more functions in the cloud platform can be used and integrated to improve business processes. Other cloud platforms can also be used with their wide variety of business applications (King 2013) and solutions to information infrastructure and cross-system communication challenges among the service industry (Ratnam et al. 2014), educational institutes (Ruangvanich & Piriyasurawong 2019), and in transport logistic industry (Benotmane et al. 2017).

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Biographies

Francis Lourdan M. Miña is a licensed mechanical engineer and master plumber in the Philippines, currently working as a Senior Building Engineer in Metro Manila. He holds a degree in Bachelor of Science in Mechanical Engineering from Mapúa University with best undergraduate thesis award in 2018. At present, he is pursuing a degree in Master of Engineering Program in Industrial Engineering in the same university. He is also a Certified Lean Six Sigma Yellow Belt accredited by the Council for Six Sigma Certification (CSSC) and a qualified safety officer with DOLE-OSHC accreditation.

Grace Lorraine Intal is a full-time faculty member in Mapua University. She is teaching Information Systems core courses in the School of Information Technology and Information Systems course in the School of Industrial Engineering. She obtained a BS degree in Management and Industrial Engineering from Mapua University, master's in business administration from Pamantasan ng Lungsod ng Maynila and Master in Information Systems from Asia Pacific College respectively. At present, she is pursuing a Doctorate degree in Information Technology at the University of the Cordilleras. She is also an independent Management Consultant.