

QSUMeMarket: a decision support system framework for smes to process customer orders

Winston G. Domingo¹, Jennifer A. Gamay², Viridi C. Gonzales², Selino S. Malunao¹

¹College of Teachers Education, Quirino State University-Maddela Campus, Dipintin, Philippines

²IMIS Department, Southern Isabela Medical Center, Rosario, Santiago City, Philippines

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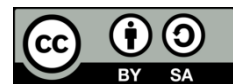
Point of sale

SMEs

ABSTRACT

With the progression of big data analytics (BDA), point of sale (PoS) could be amalgamated with an inventory management (IM) system. The problem of SMEs is to generate a financial report only using simple calculations based on income and expenses. To develop a web-based computerized system to solve the problems encountered and ease the marketing office's operations. The used of a descriptive research design and software development life cycle (SDLC) methodology. The ISO/EIC 25010:2011 software quality standard was chosen as one of the most comprehensive software-quality evaluation models. The software performs exceptionally well in several key areas, including performance efficiency (4.00), usability (3.94), portability (3.89), compatibility (3.83), security (3.80), maintainability (3.70), and reliability (3.67). These ratings highlight its strengths in speed, security, and overall user experience. However, with the lowest score being 3.44, there is still potential for improvement to better align the software with user needs and business objectives. While it meets industry standards and is suitable for practical use, ongoing enhancements are essential to sustain and elevate its quality.

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Corresponding Author:

Winston G. Domingo

College of Teachers Education, Quirino State University-Maddela Campus

Dipintin, Maddela, Quirino, 3404, Philippines

Email: winston.domingo@qsu.edu.ph

1. INTRODUCTION

As big data analytics (BDA) advances, point of sale (PoS) and inventory management (IM) systems can be combined to help retailers provide an inventory overview and even forecast when restocking is required [1]. Small and medium-sized enterprises (SMEs) inability to create financial statements using basic computations based on income and expenses. For years, this practice has made it difficult to get the comprehensive financial data required by financial institutions and for the advancement of businesses. To help SMEs who are unable to produce financial reports, accounting software should be integrated into e-marketplaces [2].

A major obstacle to SME development is the use of the newest technology, such as websites, e-commerce, high-speed internet, and point of sale (POS). This important sector can be achieved with the right use of technology [3]. Better decision-making through insight analysis will be possible with the use of suitable point-of-sale systems with business intelligence capabilities. To make better business decisions, SMEs must effectively handle and evaluate vast amounts of data. Making wise decisions will provide SMEs a competitive edge. This is the point at which business intelligence (BI) emerges to offer perceptive data to support the process of making business decisions [4].

In an effort to identify flaws or mistakes early, the analytics and business intelligence industry adopted the approach of continuous integration, which was created by software engineers. Every retail location has a point-of-sale system. Payroll software is used by every business with staff, and sales reports are practically always available [5].

Even though SMEs have some planning and control systems in place, identifying the difficulties they face during inquiry management and demonstrating the necessity of an efficient decision support system (DSS) is essential [6]. This company's business operations include ordering and buying products from vendors and selling them to clients [7].

In a very competitive worldwide market, the research presented here describes order processing, particularly with regard to deadline limitations during the customer inquiry stage. It draws attention to issues that (SMEs) confront in a make-to-order setting, specifically with regard to delivery speed and quality at this crucial point. For SMEs, commercial tools like manufacturing resource planning and enterprise resource planning can be employed at this inquiry stage, but their high maintenance costs may make them prohibitive. Even if SMEs have some planning and control systems in place, it is important to acknowledge the difficulties they face during inquiry management and to demonstrate the need for an efficient DSS [8]. This company's business operations include ordering and buying products from vendors and selling them to clients [9]. The operational efficiency, accuracy, and scalability of SMEs that rely on manual ordering and calculation processes are hampered by a number of issues. These manual systems result in inefficiencies and possible errors since they require human participation in duties like order recording, computations, invoicing, and inventory tracking.

The goal of this paper is to develop and implement a DSS for Quirino's SMEs in order to provide a market analysis solution. The primary goal of this study is to address the issues that SMEs face with regard to product inventories, sales collection reporting, sales summaries, sales summaries for each supplier or distributor, and office credit accounts. The proposed study aimed to create a web-based computerized system to address issues and streamline operations. Describe a system feature that will be utilized to make decisions. How we use the tools, resources, and marketing tactics at our disposal to enhance business practices has become a hot topic in both academic and professional domains from both a technology and business standpoint. In order to increase productivity, accuracy, and business expansion, SMEs must switch from manual processing to automated solutions. SMEs may improve customer service, save expenses, and streamline operations by putting digital solutions into place.

2. METHOD

This study was used a descriptive research design and software development life cycle (SDLC) methodology. The descriptive research design method was used to determine the present status and condition of the manual process.

Figure 1 is industrial businesses can benefit effectively from the agile iterative model, which is an adaptation of agile methodology over the conventional software development life cycle approach. Agile and iterative approaches to software development will be compared in this paper. The practical usefulness of both iterative and agile techniques to software development in a variety of businesses or organizations is demonstrated by numerous surveys [10]. Aligning machine learning production with conventional software development procedures frequently presents challenges for software development teams. The intrinsic difficulties of data preparation and collecting, model entanglement, and machine learning's technological debt required iterative testing.

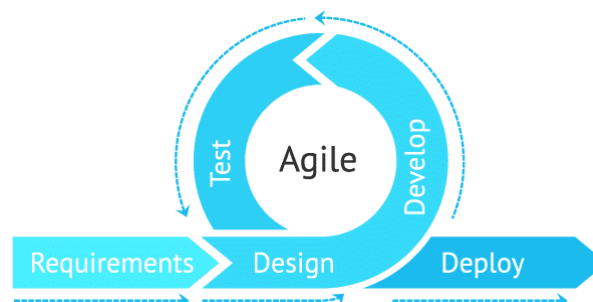


Figure 1. Agile iterative model

2.1. Requirement

On this process, the researcher attended with a series of interviews with the staff/clerk of the target SMEs who typically administered and supervised the whole process and actions. The researcher conducted observation in the manual process and observed their practices. Collected sample reports and conducted interviews to assess what are the problems in the manual operations. All the gathered data, information and processes were studied by the researchers to come up with appropriate inputs in designing and developing the computerized QSUMeMarket: a decision support system framework for smes to process customer. The data and process were the basis for planning the design of the computerized system to adopt and integrate the practices and processes of the SMEs.

2.1.1. Design

The researcher regularly coordinated with the end-users on the features that were suitable for their needs. The researcher used a data flow diagram as part of the designing, data flow diagram to the design of the process and relation between entities. Also, part of the design was the entity relationship diagram. The design for the relationship of tables in the database. to identify the relationship between each data in the table. The researcher used a combination of normalizing and denormalizing database design.

The computerized system's development is based on a data flow diagram. The developer must go through a number of phases when creating an application. One of them is a data flow diagram (DFD), which describes the application's process from start to finish. Users would find it easier to utilize the application if all of its components were displayed, which would have an indirect impact on how convenient it is to use [11]. Tables' logical relationships are depicted in an entity relation diagram. The denormalization and normalization of the database are combined in the database design. How the data is kept in the database tables and how it is connected to the other tables. The instructional tool that is being offered aims to teach all disciplines how to comprehend their data, the links between the data, and how to express those relationships in a relational database. With entity relationship diagrams serving as the main visual design model, the tool offers a visual introduction to key database design ideas [12].

2.1.2. Develop

In order to make the produced system compatible, the researcher selected the right database, hardware, and programming software. The user interface's design and coding are the tasks at hand. A number of laboratory experiments were carried out in the various system modules during the development process. In order to match the users' requirements with the produced system, compatibility testing was conducted and ongoing communication with the users was maintained.

2.1.3. Test

The developed system was tested in parallel during this process. In order to modify and redesign the system, the researcher gathered feedback from the testing teams. to evaluate the computer's software compatibility with other operating systems, browsers, and hardware. The researcher employed parallel testing during the testing phase to ensure that the system was operating in accordance with the protocols. Both descriptive and inferential statistics were used to tabulate, analyze, interpret, and summarize the data. The average evaluation of the information technology (IT) experts regarding the application's compliance with the ISO25010 software quality standards that was created and applied in this study was analyzed using the mean score. Based on ISO 25010: 2011 standardization, assess the functional appropriateness level of ERP in the SME sector and generate high-quality systems as a result of the successful implementation of ERP systems in automating business operations and integrating data-across systems. Assessing the system quality of a software product is seen to be essential for developing a strategy for its development. Numerous models have been created to assess the quality of software [13].

2.1.4. Deploy

The system is put into practice by the researcher in the Quirino province's chosen SMEs. The system was set up and put to use. A number of training courses were created for the clear throughout the implementation stage. Users' expectations were calibrated and aligned with the established system. One of the key pillars of the organization's information system (IS) governance is IT resource management. This method enables a systematic analysis to be performed to certain structural matrices in order to assess how IT resources are deployed to accomplish business activities [14].

3. RESULTS AND DISCUSSION

The problems encountered using the manual operations: supply chain complexity, insufficient order management, inventory loss, and inaccuracy of data were the problems encountered using the manual operations of the Marketing office in terms of product inventory management and reporting.

Time-consuming and costly to produce reports, inconsistency in data entry, room for errors, reduction in sharing information and customer services, inconsistent tracking, inaccurate data, manual documentation, and overstocking were the problems encountered in using the manual operations of the marketing office in terms of inventory and sales reporting. SMEs that depend on manual order processing and computation face some problems that affect their efficiency, accuracy, and scalability. These challenges are: errors in data entry, miscalculations, and order processing errors can result in financial loss; written notes and spoken instructions can be misunderstood, which may lead to wrong deliveries or undelivered items; records may be lost or duplicated, which will reduce efficiency and easily cause confusion. Calculating prices, discounts, and taxes manually can slow down the invoicing and financial reporting process. Inefficiencies in manual processing for ordering and computation can impede the growth and profitability of SMEs. By embracing digital solutions like automated order management and accounting software, businesses can greatly enhance accuracy, efficiency, and customer satisfaction.

3.1. System design that will enhance the process and solve the problems encountered in manual operations

Figure 2 displays the sales record and sales details. This page is the recording of the sales transactions. Shows the ID/transaction no, date of transactions, time, tendered, total sales, change, status, total quantity, sales by, mode of payment (cash or credit), customer (for credit transactions), and remarks. The other table displays the products purchased/orders which include the product description, quantity, price, and amount. This page has a button for payment and transaction closing. When the status is closed. The system will remove the buttons for add, payment, and close transactions to ensure that the records will not be altered or modified. The user needs to create new for the next transactions.

Figure 3 This page displays the transactions for deliveries. The transactions list shows the date, supplier sales invoice (si), salesman/representative, product order number, terms, gross sales, total discount, total amount, status, and actions. The user/admin manages the different transactions and can add new/delete transactions. The user can delete the transaction when the status is still open but when the status is paid the system will remove the delete button. These features secure the records that were already closed/paid.

Sales Details

id	Date	Time	Tendered	Total sales	Change	Status	TotQty	Sales By	modepayment	Customer	remarks
00000000010	10/4/22	19:49:13	P0.00	P265.00	-P265.00	open	2	Administrator	Cash		

Product Description	Qty	Price	Amount
Ethyl Alcohol	1	P250.00	P250.00
Coke Sakto	1	P15.00	P15.00
Total: 2		Total: P265.00	

Figure 2. Sales records and sales details

Deliveries

id	date	supplier id	si no	salesman	terms	po no	gross sales	total discount	total amount	status	Action
2	9/16/22	VILLA PASCUA	21312	1	1	3,070	0	3,070	Paid		
3	10/4/22	VILLA PASCUA	213	ss	ss	ss	0	0	0	Open	Close

Figure 3. Deliveries transaction

Figure 4 collections report. This page is a printable report that displays the collections from cash transactions and other collections transactions (account receivables). Displays the credit transactions which display the customer/employee information, product description, quantity, price, and amount for the credit transactions.

Sales Report for Date: 2022-10-04-2022-10-04					
Cash Transactions					
Product Description	Qty	Price	Amount		
Coke Sakto	1	15.00	15.00		
Ethyl Alcohol	3	250.00	750.00		
Total Cash Collex					<u>765.00</u>
Credit Transactions/Account Recievable(s)					
Transaction Number: 00000000011 Customer Name: WINSTON DOMINGO					
Product Description	Qty	Price	Amount		
Ethyl Alcohol	2	250.00	500.00		
Total					<u>500.00</u>
Total Credit Amount/Account Recievables					<u>500.00</u>
Other Collections(Credit Collex)					
Credit Accounts			Debit Accounts		
Date Transaction	Accounts	Amount	Date of Payment	Paid By	Amount Paid
Total Other Collections(AR Collex)					<u>0.00</u>
Total Cash on Hand					<u>765.00</u>
Total Account Recievables					<u>500.00</u>

Figure 4. Collections report

3.2. The extent of compliance of the developed system as assessed by the IT experts

Table 1 shows the assessment of the extent of compliance of the developed application to ISO 25010 software quality standards concerning functional sustainability as assessed by the IT experts. The developed computerized system for the marketing office got 3.67 for the indicators of functional completeness with a descriptive rating of compliant to a very great extent, and the indicators of functional correctness and functional appropriateness got a descriptive rating of compliant to a great extent. With a category mean of 3.44 with a descriptive rating of compliant to a great extent. With these results implies with the IT expert's participations found out that the system functionality provides correct results, covers all the specified tasks and user objectives, and facilitates the accomplishment of specified tasks.

A software quality model based the ISO 25010 software standard was presented with an evaluation method in the ISO 25040 standard. The system's growth and complexity have generated systematic and specific approaches in evaluating the systems developed which have reduced focus but produce an efficient solution [15].

Table 1. Extent compliance of the developed application to ISO 25010 software quality standards concerning functional sustainability

Indicators	IT experts	Descriptive rating
Functional completeness	3.67	Compliant to a very great extent
Functional correctness	3.33	Compliant to a great extent
Functional appropriateness	3.33	Compliant to a great extent
Category mean	3.44	Compliant to a great extent

Table 2 shows the assessment of the extent of compliance of the developed application to ISO 25010 software quality standards concerning performance efficiency. All indicators of performance efficiency time-behavior, resource utilization, and capacity got the descriptive rating of compliant to a very great extent with a category mean of 4. The participants found out that the system performed efficiently the expected tasks within the set of parameters.

Table 2. Extent compliance of the developed application to ISO 25010 software quality standards concerning performance efficiency

Indicators	IT experts	Descriptive rating
Time-behavior	4	Compliant to a very great extent
Resource utilization	4	Compliant to a very great extent
Capacity	4	Compliant to a very great extent
Category mean	4	Compliant to a very great extent

It is necessary to conduct a performance assessment such as stress testing which includes the qualification of the system's ability to process information based on the sub-characteristics of a reliable capacity system, such as the number of requests and data concurrency. Performance efficiency characteristics are also a parameter of platform suitability that can be used by companies effectively with guaranteed quality, and the right system size [16].

Table 3 shows the assessment of the extent of compliance of the developed application to ISO 25010 software quality standards concerning compatibility. All indicators of compatibility co-existence and interoperability got the descriptive rating of compliant to a very great extent with a category mean of 3.83. The respondents found out that the system compatibility that can exchange information with other features, systems, or components, and/or perform its required functions while sharing the same hardware or software environment. Software quality standards were the fundamental today, particularly in software technology and systems in every organization. Evaluations were carried out to assess the service quality and product quality [17].

Table 3. Extent compliance of the developed application to ISO 25010 software quality standards concerning compatibility

Indicators	IT experts	Descriptive rating
1. Co-existence	3.67	Compliant to a very great extent
2. Interoperability	4	Compliant to a very great extent
Category mean	3.83	Compliant to a very great extent

Table 4 displays the participants' evaluation of the generated application's conformity with regard to its usability. The usability of the system received a category mean of 3.94, which is descriptively regarded as very compliant. Additionally, every indicator received a very high descriptive grade for conformance. This suggests that the participants discovered that, within a given context of use, the system's usability can be utilized by certain users to accomplish specific goals with efficacy, efficiency, and satisfaction.

When developing the information systems, it is crucial to consider the system's quality, which can be assessed by looking at how well it meets the needs and requirements of its users and how easy it is for them to use. The created system satisfies two requirements for information system quality: usability and functional suitability [18].

Table 4. Extent compliance of the developed application to ISO 25010 software quality standards concerning usability

Indicators	IT experts	Descriptive rating
Appropriateness recognizability	3.67	Compliant to the very great extent
Learnability	4.00	Compliant to the very great extent
Operability	4.00	Compliant to the very great extent
User error protection	4.00	Compliant to the very great extent
User interface aesthetics	4.00	Compliant to the very great extent
Accessibility	4.00	Compliant to the very great extent
Category mean	3.94	Compliant to the very great extent

Table 5 demonstrates the evaluation of the produced application's level of conformance with ISO 25010 software quality standards with regard to the reliability. The developed computerized system received a descriptive rating with extremely high complaint, a mean score of 3.67. The three indicators—recoverability, fault tolerance, and maturity—all received a very high descriptive rating of compliance, while the other indication, availability, also received a high descriptive grade. This demonstrates that the participants discovered that the system's dependability can carry out specific tasks for a given amount of time under specific situations.

Table 5. Extent compliance of the developed application to ISO 25010 software quality standards concerning reliability

Indicators	IT experts	Descriptive rating
Maturity	3.67	Compliant to a very great extent
Availability	3.00	Compliant to a great extent
Fault tolerance	4.00	Compliant to a very great extent
Recoverability	4.00	Compliant to a very great extent
Category mean	3.67	Compliant to a very great extent

Table 6 demonstrates how well the built application complies with ISO 25010 software quality standards for security. With a descriptive rating of “compliant” to a very high degree, the designed system received a category mean of 3.80. The indicators of authenticity, accountability, integrity, and confidentiality received a very high descriptive rating of compliance, whereas the other indicator, non-reputation, received a very high descriptive grade of compliance. The participants discovered that the systems are highly secure, protecting sales data, product information, and database data. They also discovered that some individuals have access to data that is suitable for their level of authorization. Information system designers are well aware of the necessity of a shared knowledge and consensus about both functional and non-functional criteria. Designing the correct system and attaining interoperability with other systems both require this [19].

Table 6. Extent compliance of the developed application to ISO 25010 software quality standards concerning security

Indicators	IT experts	Descriptive rating
Confidentiality	4.00	Compliant to a very great extent
Integrity	4.00	Compliant to a very great extent
Non-repudiation	3.00	Compliant to a great extent
Accountability	4.00	Compliant to a very great extent
Authenticity	4.00	Compliant to a very great extent
Category mean	3.80	Compliant to a very great extent

Table 7 displays the participants’ evaluation of the generated application’s compliance with maintainability standards. The maintainability of the system received a category mean of 3.70, which is descriptively regarded as highly compliant. To a large extent, all factors, including modularity, reusability, analyzeability, modifiability, and testability, received the same descriptive rating of compliant. The participants discovered that the system’s maintainability can be changed to make it better, fix it, or adjust it to the needs and changes in the environment.

Table 8 displays the participants’ evaluation of the produced application’s conformity with regard to portability. The portability of the system received a category mean of 3.89, which is descriptively regarded as very compliant. To a large extent, all sub-indicators, including adaptability, installability, and replaceability, received the same descriptive rating of compliant. Participants discovered that the system’s mobility allows it to be moved between different hardware, software, and other environments for use or operation.

Table 7. Extent compliance of the developed application to ISO 25010 software quality standards concerning maintainability

Indicators	IT experts	Descriptive rating
Modularity	3.67	Compliant to the very great extent
Reusability	3.50	Compliant to the very great extent
Analysability	3.67	Compliant to the very great extent
Modifiability	3.67	Compliant to the very great extent
Testability	4.00	Compliant to the very great extent
Category mean	3.70	Compliant to the very great extent

Table 8. Extent compliance of the developed application to ISO 25010 software quality standards concerning portability

Indicators	IT experts	Descriptive rating
Adaptability	3.67	Compliant to a very great extent
Installability	4.00	Compliant to a very great extent
Replaceability	4.00	Compliant to a very great extent
Category mean	3.89	Compliant to a very great extent

Table 9 demonstrates the outcome of the IT expert's assessment of the produced application's level of compliance with ISO 25010 software quality standards, which yielded a grand mean of 3.78 and a descriptive grade of "compliant to a very great extent." Functional sustainability received a descriptive rating of complaint to a large degree, while the indicators of ISO 25010 software quality standards—performance efficiency, compatibility, usability, reliability, security, maintainability, and portability—received a descriptive rating of compliant. Thus, it can be concluded that IT professionals gave the developed application great approval.

Although the standards offer useful viewpoints, it can be challenging to come up with a universal definition due to human factors like user sentiments and particular situations. It is emphasized how important requirements engineering and business analysis are to guaranteeing software quality. Stakeholder needs, business requirements, and the caliber of functional and non-functional requirements all become essential elements [20]. In supply chains, software quality is crucial because it guarantees that software solutions fulfill customer expectations and provide value by digitizing businesses. To effectively attain and evaluate software quality, organizations rely on defined standards and frameworks [21]. Implementing digitizing business processes can help SMEs overcome their technical backwardness and increase the effectiveness of their operational procedures [22].

The inventory management should be understood as a system of material flow [23]. Designing and developing a computer-based system to increase the efficiency and accuracy of business operations [24]. Some point-of-sale systems are even used by supplier management and sales management modules to handle customer sales. Only the ability to track sales and generate sales invoices is offered by the majority of point-of-sale systems. For companies that deal with consumer products transactions, an inventory management system is crucial to maintaining quality control. When registering the stock, an automated inventory management system reduces errors. Assist decision-makers such entrepreneur in forming their inventory management policies in the face of unknown raw material demands [25]. Implementing computer systems in small and medium-sized enterprises (SMEs) boosts productivity, minimizes errors, cuts costs, and enhances customer satisfaction. By investing in business management software, accounting tools, and automated order processing, SMEs can set themselves up for sustainable growth and a competitive edge.

Table 9. The extent of compliance of the developed application to ISO 25010 software quality standards

ISO 25010 software quality standards	IT experts	Descriptive rating
1) Functional suitability	3.44	Compliant to a great extent
2) Performance efficiency	4.00	Compliant to a very great extent
3) Compatibility	3.83	Compliant to a very great extent
4) Usability	3.94	Compliant to a very great extent
5) Reliability	3.67	Compliant to a very great extent
6) Security	3.80	Compliant to a very great extent
7) Maintainability	3.70	Compliant to a very great extent
8) Portability	3.89	Compliant to a very great extent
Grand mean	3.78	Compliant to a very great extent

4. CONCLUSION

From the above results and findings, the researchers therefore concluded that the existing system for the marketing office can be improved through the adoption of the developed system. The developed QSUMeMarket: a decision support system framework for SMEs to process customer orders was very highly compliant with ISO 25010 quality standards. The provided reports can be the basis for the decision support in maintaining and monitoring the products and accounts in the marketing office. The developed system will provide a report for actual product inventory, which can be daily or monthly basis reports. The user can also monitor and track the actual inventory based on the system records, and provide a report for sales reports, delivery reports, and adjustment products. And to address the problems in terms of Time-consuming, costly to produce reports, inconsistency in data entry, room for errors, reduction in sharing information and customer services. The software is very reliable, efficient, and secure, requiring only minor adjustments to boost its functional effectiveness. The software meets high-quality standards, but improvements in functional suitability and continued enhancements in security and reliability will further strengthen its effectiveness. To enhance the software's quality and usability, it's important to conduct further user testing and analyze requirements to boost feature completeness and user satisfaction. Implementing improved fault tolerance and recovery mechanisms will help maintain system stability. Regularly updating security protocols is essential to guard against new threats and ensure adherence to data protection standards.

A computerized system can really transform the way SMEs work. It helps them run more smoothly, cut down on expenses, and make decisions based on solid data. When SMEs embrace technology, they can boost their productivity, provide better customer service, and grow their business in a smart way. Integrating data analytics can really help SMEs work smarter, enhance customer experiences, and boost their profits. It takes all that raw data and turns it into useful insights, enabling businesses to spot trends, streamline their inventory, and increase their revenue.

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Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Winston G. Domingo	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	
Jennifer A. Gamay	✓				✓	✓		✓	✓	✓				
Virdi C. Gonzales	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓	
Selino S. Malunao		✓		✓		✓	✓			✓				✓

C : **C**onceptualization

M : **M**ethodology

So : **S**oftware

Va : **V**alidation

Fo : **F**ormal analysis

I : **I**nterpretation

R : **R**esources

D : **D**ata Curation

O : **O**riginal Draft

E : **E**diting

Vi : **V**isualization

Su : **S**upervision

P : **P**roject administration

Fu : **F**unding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

Data availability is not applicable to this paper as no new data were created or analyzed in this study.

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BIOGRAPHIES OF AUTHORS



Winston G. Domingo     is an assistant professor at the College of Teachers Education, Quirino State University-Maddela Campus, Quirino, Philippines. A freelance open-source web applications developer. Co-founder of XSOFT (CROSS-PLATFORM SOFTWARE) Solutions a group of open-source web-app developers in the region, that provides services through SaaS (software as a service) in SMEs. Former a system administrator and MIS of Cagayan Valley Computer and Information Technology College from 2018-2021. Developed a computerized grading system for the Senior High School Department. He holds a doctorate in information technology. I am the assistant secretary for membership of the Philippine Society of Information Technology Educator-Cagayan Valley. He can be contacted at email: winston.domingo@qsu.edu.ph.



Jennifer A. Gamay     is a programmer at Southern Isabela Medical Center, Santiago City, Isabela, Philippines. He holds a master's degree in information technology. Assist in planning, design, and development of new systems and enhancements to existing applications. She can be contacted at email: agustinjennifer.tutaan@gmail.com.



Virdi C. Gonzales     is a supervising health program officer at Southern Isabela Medical Center, Santiago City, Isabela, Philippines. Review and analyze the effectiveness and efficiency of existing systems and develop strategies for enhancements. He holds a doctorate in Information Technology. He can be contacted at email: virdigonzales@gmail.com.



Selino S. Malunao     is an instructor I handling elective and major subjects at the College of Teacher Education, Quirino State University–Maddela Campus. A freelance software developer. Provides support in the system testing and implementation on the campus and the other campus. He holds a Master's degree in information technology. He can be contacted at email: selino.malunao@qsu.edu.ph.