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Long Paper

Agricultural E-Commerce: A New Business Platform for Smallholders in Quirino Province

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Abstract

Purpose – ICTs play a vital role in achieving sustainable agricultural development when they are used to record both organic and conventional farming practices. The move to more sustainable agriculture techniques depends on smallholders. The province of Quirino has been recognized as one of the top food producers in the nation and worked hard to provide high-quality items that are shipped to neighboring provinces and areas. This study aims to develop a multi-vendor e-commerce platform where vendors can add their own products.

Method – This study utilized a descriptive and developmental research method. A set of questionnaires were given to the respondents based on the ISO 25010 software quality

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standards. Problems were reframed using the design thinking process and concepts were developed for prototyping and testing. The system was developed by utilizing the Scrum framework.

Results – The developed platform allows vendors to set up their own stores and add their own products. Transport services are also available but limited to flatrate shipping and local pickup. It also supports modes of payment, but they are limited to cash on delivery, DragonPay, Globe Gcash, and UnionPay. The IT experts assessed the extent of compliance of the developed system to ISO 25010 to a very great extent and therefore, ready for deployment and implementation.

Conclusion – The developed system can utilize product-search matching to connect the farmers with their intended customers and vice versa. The vendors can add more products in their module, set the price and can schedule discounts. Product inventories are also displayed in the vendors module.

Recommendations – The inclusion of data analytics, a mobile app for iOS and Android, as well as various business models can all be taken into consideration to further improve the system.

Practical Implications – Using the multi-vendor e-commerce platform, this research will benefit the buyers and sellers by allowing them to buy and sell their products.

Keywords – Agriculture, E-commerce, Smallholders, Scrum, ISO 25010

INTRODUCTION

There is a great need to adapt to and deal with the growth of modern technology when it becomes necessary, especially during pandemic. With these modern technologies, there shall be lots of changes that will surely benefit especially the small business owners. To manage the economic recovery following the Covid-19 outbreak, the Philippines continues to rely on e-commerce and the digital economy. During the pandemic, the Philippines' e-commerce sector has grown as lockdown measures have affected brick-and-mortar businesses. As a result, the Philippines recognizes the importance of the digital economy and e-commerce as major drivers of economic growth. According to data from the Philippine Department of Trade and Industry (DTI), e-commerce contributed 3.4%, or US$12 billion (PHP599 billion), to the country's GDP in 2020. The Philippines' current goal is to increase e-commerce revenue to US$17 billion (PHP850 billion), or 4.3% of GDP, by 2021, and to US$24 billion (PHP1.2 trillion), or 5.5% of GDP, by 2022 (Hani, 2021).

Farmers and consumers are connected through several middlemen in traditional agricultural value chains. At the farm gates, farmers typically sell their produce to middlemen. Then, before reaching the final consumer, produce is passed through numerous middlemen. Due to the profit margins that each link in the value chain makes, farmers only receive a small percentage of the price that the final user pays. The agriculture sector dominates the province of Quirino. People primarily survive by selling the crops they grow. Being one of the provinces in the Cagayan Valley region that has long been acknowledged as one of the top food producers in the country, has worked hard to offer high-quality goods that are transported to nearby provinces and regions.

During the pandemic, lack of transportation services was a serious problem resulting in overproduction and waste. Even though this has enabled a range of internet venues to advertise the items, one of the challenges is the lack of e-commerce platform to access these locally produced commodities in the province. The Philippines' small-scale farms are the target market of the developed system. The developed system contains two modules, purchasing module and selling module. This study discusses the development of purchasing module as part of Agriculture e-commerce system. Buyers and sellers will have their own section on the system. Purchasing module was developed intended for buyer of agriculture products offered. To prevent the buy and sell of commodities within the system, the system will only present the options for selling products if a user is registered as a farmer. But if a user is registered as a buyer, he is only entitled to the options to buy and not to sell. The system was developed using PHP as a scripting language and WordPress to interact with the server-side database to display the page.

Conceptual Framework

The researchers adopted the following frameworks in this study.

Dimensions of C2C Social Commerce Model

Figure 1 presents the dimensions of Customer to Customer (C2C) Social Commerce model. Incentive systems refer to devices including monetary or non-monetary rewards that could engage and stimulate the consumer's motivation. Information and Communication Technologies (ICT) refers to technologies that provide access to information through communications (Wijit et al., 2015). It includes any communication device, television, mobile technology, and computer; that helps individuals, businesses, and organizations get access to information. Using ICT, particularly mobile technology and digital technology has increased dramatically, and new technologies such as video chat, live chat, and mobile banking played a vital role to support C2C SC activities.

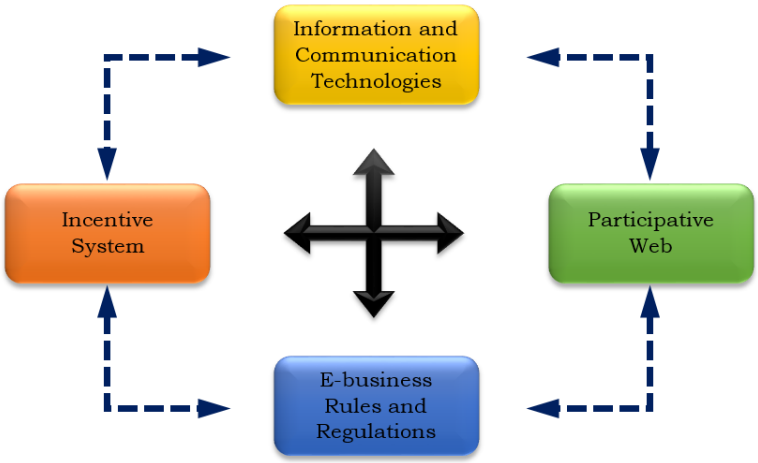

Figure 1. Dimensions of C2C Social Commerce Model, updated from the I-model (Wang & Zhang, 2012)

Participative Web concerns the implementation of new innovative web services that empower the users to express themselves through different channels and media such as user-created content (UCC) such as text, image, and multimedia shared across SNSs. E-business rules and regulations, including strategies, procedures, and policies that can assert business structure, ethical conduct, and control or guide consumer's behaviour (Wang & Zhang, 2012).

Customer to Customer (C2C) Model

Figure 2 shows the Customer to Customer (C2C) Model. C2C is a business model where customers can trade with each other, typically in an online environment. It represents a market environment where one customer purchases goods from another customer using a third-party business or platform to facilitate the transaction. C2C companies are a type of business model that emerged with e-commerce technology and the sharing economy. Customers benefit from the competition for products and often find items that are difficult to locate elsewhere. Also, margins can be higher than traditional pricing methods for sellers because there are minimal costs due to the absence of retailers or wholesalers. C2C sites are convenient because there is no need to visit a brick-and-mortar store. Sellers list their products online, and the buyers come to them (Ho & Chow, 2022).

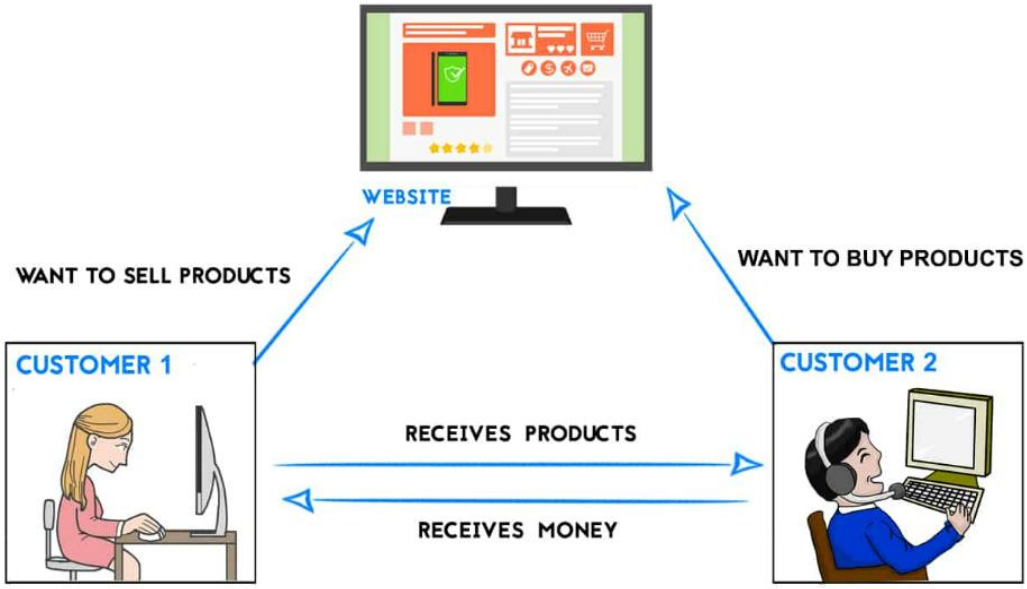

Figure 2. Customer to Customer (C2C) Model

Business Model Canvas of the Study

Figure 3 illustrates the business model canvass of the study. It is a visual representation of the business model, highlighting all key strategic factors (Kean, 2018). This tool assisted the researchers in developing a clear picture of their value proposition, operations, customers, and finances. It also assisted in the addressing the specific risks and learn more about competitors, costs, consumer groups, or a market niche. The gaps in planning stand out because the researchers used this tool, making it effective for them who are starting and running a business.

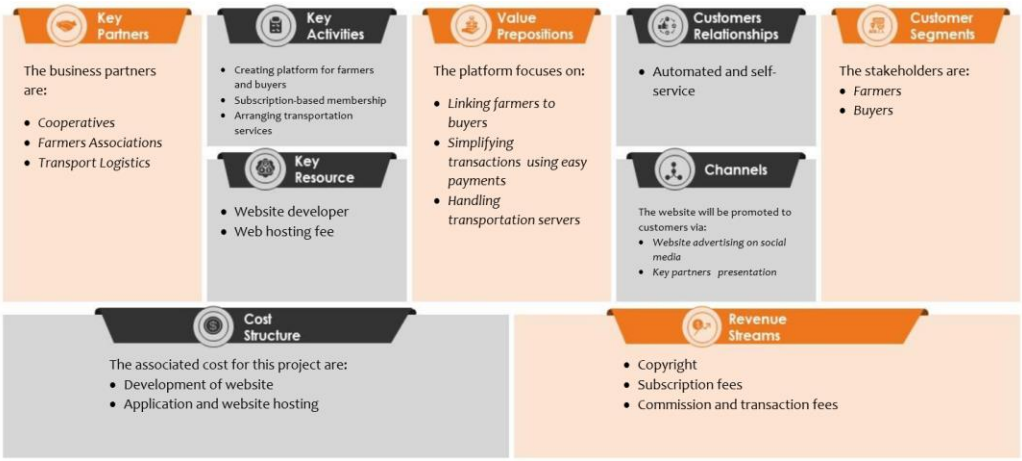

Figure 3. Business Model Canvas of the Study (Keane et al., 2018)

In this study, the researchers used this entrepreneurial tool, which gives them the ability to envision, create, and reinvent their own business concept. This will act as their conceptual and development framework for their e-commerce platform.

Conceptual Paradigm of the Study

Figure 4 displays the conceptual framework of the study. The Input-Process-Output (IPO) model, a commonly used method in system analysis and software engineering, was employed in the study's research paradigm to describe the structure of an information processing program or other processes. It shows the inputs, outputs, and necessary processing operations needed to convert inputs into outputs. The inputs represented the outside flow of information and materials into the operation. The processing step consisted of all the activities necessary to transform the inputs. ISO 25010 software quality standards aids in specifying, measuring, and evaluating the quality of the developed system. It safeguards the end-users from utilizing inferior and substandard software, thereby boosting their satisfaction. It also ensures that researchers check the system to make sure that it functions as planned. The information and materials that came out of the transformation process were the outputs that were displayed. In order to review and further improve the created system, feedback mechanisms are implemented to elicit comments and suggestions from end users and IT professionals. The IPO model provides an effective method for deciphering and recording the crucial elements of a transformation process.

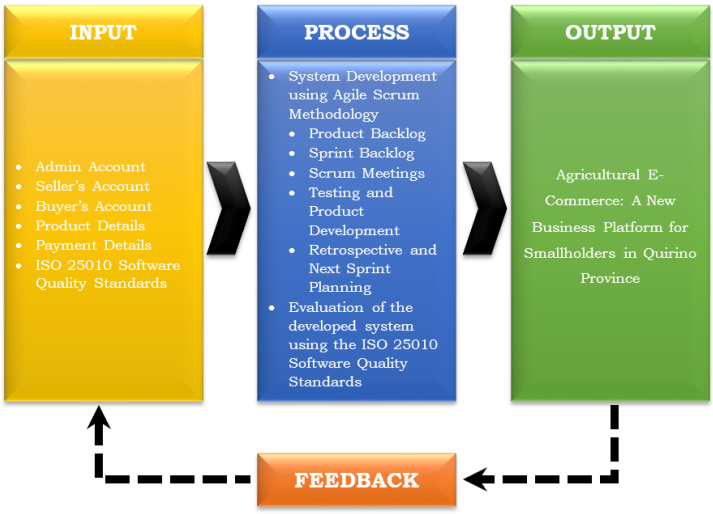

Figure 4. Conceptual Paradigm of the Study

Objectives of the Study

The main objective of this study was to develop a multi-vendor e-commerce platform where vendors can add their own products.

Specifically, it aimed to:

1. develop a module that would utilize product-search matching to connect the farmers with their intended customers and vice versa;
2. determine the extent of compliance of the developed application to ISO 25010 Software Quality Standards in terms of:
   2.1 Functional Suitability,
   2.2 Performance Efficiency,
   2.3 Compatibility,
   2.4 Usability,
   2.5 Reliability,
   2.6 Security,
   2.7 Maintainability, and
   2.8 Portability.
3. provide mode of payments that are easy to use, and
4. determine the enhancement that can be done to improve the developed system.

LITERATURE REVIEW

Agriculture E-commerce is known as a platform to buy and sell some agriculture products. It plays a significant role in supporting economic development and market expansion for farmers in particular and people in rural areas in general.

The Market for E-commerce Services in Agriculture

E-commerce refers to the use of the Internet to market, buy and sell goods and services, exchange information, and create and maintain web-based relationships between contributor entities. Based on its demonstrated impact in industrial retail markets, e-commerce is believed to have the potential to increase profitability in agricultural markets by increasing sales and decreasing search and transactions costs. The creation of electronic markets that are expected to be more transparent and competitive than physical markets may attract more consumers by increasing demand and improving the firm's strategic position with customers seeking specific position products or having geographical restrictions. However, due to the relatively new state of e-commerce in agriculture, its impact has not been widely measured and documented (Sambhudas et al., 2018).

E-Agriculture is a trending field that intersects between technological utilization and agricultural aspects. Such a feature is a type of e-Commerce that creates a portfolio of products and services to be able to sell them online for the consumers to buy. Although the use of apps in agriculture is overgrowing, its development and adoption are slower than the trends in other sectors (Xin et al., 2015).

As the world's population increases, so do agri-food demands, demanding a change away from traditional agricultural practices toward smart agriculture. Even though agriculture is regarded as one of the most important industries in sustaining food security, studies and software development that incorporate technology into agriculture are still few (Abbasi et al., 2022).

In the process of the establishment and development of the ecological circle, agricultural Internet finance will run through every process of agriculture, including the sale and purchase of agricultural materials, the whole process of agricultural production, the sale of agricultural products, and other links, to make comprehensive agricultural materials, e-commerce, and similar finance. The integration of service, on-line and off-line agrochemical service, has become the inevitable trend of the comprehensive development of modern agricultural industry (Xiaochun & Dan, 2020).

E-commerce Applications in Agriculture

E-commerce is developing rapidly and has penetrated almost all sectors. Agriculture is identified as being promising due to its high level of fragmentation (Zhang & Berghäll, 2021). The benefits of e-commerce are that it boosts the circulation of agricultural products and development (Cai et al., 2015), enables smoother communication and better experiences (Xiong et al., 2016), and promotes market transparency and price discovery. To sum up, e-commerce brings various benefits to the agricultural sector, which have been promisingly predicted for potential success in agricultural e-commerce (AE) field.

AE is an application of e-commerce in the agricultural industry. AE, in particular, uses the internet and mobile devices to provide information and bring together supply and demand in the agricultural industry. From a farmer's perspective, e-commerce is the selling and purchasing of agricultural products over the internet (Wang et al., 2016).

Agricultural e-commerce that utilizes advanced technologies can promote sustainable economic growth and gender equality and, therefore, helps achieve the Sustainable Development Goals. It also allows farmers access to new markets where they can bypass intermediaries, leading to higher income, less waste, and fresher produce for customers. The usefulness of using agricultural e-commerce depends on the efficiency of addressing the emerging challenges from merging perspectives of agricultural and e-commerce fields (Altarturi et al., 2023).

Development of an Integrated Agricultural Platform for Philippines

Filipino farmers have been ensnared in a vicious cycle of poverty for a very long time due to a variety of problems, such as a lack of necessary capital, high interest rates, climate change and natural disasters, uninsured crops and animals, and expensive input prices for agriculture. Even though ICT has made many advancements, including the availability of reliable markets, accurate weather information, and access to agricultural technology and equipment, almost all of them only address a single issue rather than

being concentrated in one place, making them unavailable to farmers when they need them most.

To solve the aforementioned problems, Docejo and Kim (2022) study proposed the development of Promdi farm, a one-stop agricultural platform. Based on the validation and approval of industry experts, the developed platform has shown that the platform will be very helpful to farmers and other stakeholders. Experts also noted that it should be further developed and commercially available. On the other hand, farmers have shown enthusiasm and interest in using this type of system. The platform was coded using Python (backend) and Flutter (frontend), and included direct links to e-commerce sites, insurance chat features, weather forecasts, crowd funding, and government e-learning/learning sites. The platform can be used by all stakeholders in the agricultural value chain, including but not limited to farm input sellers, producers or farmers, crowd funders, institutional buyers, retailers and consumers. Therefore, it is judged that the main interest of farmers was not individually, but as a whole, and it will contribute to increasing farmers' income and improving their quality of life.

METHODOLOGY

Research Design

In this study, a descriptive and developmental research method were used to gather relevant facts and information to achieve the objectives in a floated questionnaire. The Design Thinking Process was also used to understand users, challenge assumptions, redefine problems and create innovative solutions to prototype and test. To systematically design, create, and evaluate the software required in the new agricultural e-commerce platform to serve farmers in Quirino Province (vendors) and buyers inside or outside the province, development research was used. This shall be applied in order to satisfy the internal consistency and effectiveness requirements.

Following the ISO 25010 software quality requirements, the researchers designed and developed the system using the Scrum framework. The majority of the Scrum team in this study is made up of the representatives from the Departments of Trade and Industries (DTI) and Agriculture (DA), farmers, as well as vendors' association representatives, consumers, and IT experts.

Development Tools

The different tools and techniques used by the researchers in developing the system are as follows: PHP: Hypertext Preprocessor (PHP), Asynchronous JavaScript and XML (AJAX), Hypertext Mark-up Language (HTML), Astah Professional, and Cascading Style Sheets (CSS). These were utilized to better analyse the system needs.

Participants of the Study

There were six (6) groups of participants in this study: farmers, market vendors, consumers, IT professionals, and representatives from the Department of Trade and Industries and Department of Agriculture. This study was conducted from January to June, 2022.

Table 1. Frequency and Percentage Distribution of Participants

Participants	Frequency	Percentage
Farmers	120	32.00
Market Vendors	120	32.00
Consumers	120	32.00
IT Experts	13	3.46
Representative from DA	1	0.27
Representative from DTI	1	0.27
TOTAL	**375**	**100.00**

Table 1 shows the study participants' frequency and percentage distribution.

Instrumentation

The proponents compiled pertinent data. In addition to collecting and studying documents/forms as the foundation for developing the various forms and reports in the project, interviews were performed to acquire information. The system's design that was created was visualized using the Unified Modeling Language (UML). These tools were used to gather the information that the study required. A survey questionnaire based on the ISO 25010 software quality standards was used to systematize the quality aspects of the developed software. This was done to evaluate how the whole system's performance and overall characteristics met the requirements for ISO 25010 software quality.

In this study, functional suitability was used to determine how the developed e-commerce platform could provide features that met the criteria of functional completeness, correctness and appropriateness. For the level of development of the e-commerce platform and its components' ability to carry out specific tasks under specific circumstances, reliability test was performed. Performance efficiency was used to assess the effectivity of the developed e-commerce platform operates while given the number of resources that are utilized. Usability test was utilized to define how easily, effectively, and satisfactorily a designed e-commerce platform may be utilized to accomplish specific goals. To assess the degree to which the developed system protects data and information against security vulnerabilities, security test was also performed. Compatibility test was also done to determine how well the platform and its components can communicate and carry out their tasks while utilizing the same hardware or software environment. Maintainability test was performed to measure how well the created system can be modified to improve, correct, or adapt to changes in the environment as

well as its requirements. Finally, to test the ability of the designed system and its components to be installed across various platforms, portability test was also done.

Data Gathering Procedures

Data gathering was done using a descriptive methodology. A closed-ended Likert scale statement is part of the survey instrument used to assess how much the developed system complies with the overall characteristics and system performance requirements of ISO 25010 software quality standards. This tool was used to assess the produced system's quality attributes. Following the survey's completion, information acquired from the floated questionnaires was combined to support the survey's closed-ended questions. Based on the participants' frequency of item checking, the results were summed and tabulated for interpretation.

Data Analysis

After gathering of data, the following statistical tools were used to analyze the data.

Table 2. Likert Scale Rating

Points	Descriptive Interpretation
4	Very Great Extent
3	Great Extent
2	Low Extent
1	Very Low Extent

Frequency and Percentage were used in the survey for proposing an online agricultural e-commerce platform and Weighted Mean to determine the average responses of each item in the four options written in the questionnaire. The Likert Scale was used in analysing the result of the evaluation of the developed system. The four points that were used are shown in Table 2.

Table 3. Range of Weighted Mean and its Descriptive Interpretation

Mean Range	Descriptive Interpretation
3.25 – 4.00	Very Great Extent
2.50 – 3.25	Great Extent
1.75 – 2.50	Low Extent
1.00 – 1.75	Very Low Extent

In interpreting the survey questionnaire regarding the compliance of the developed software to ISO software quality standards, it made use of the interpretation as shown in Table 3.

RESULTS

The extent of compliance of the developed platform to ISO 25010 Software Quality Standards

Utilizing a four-point Likert scale, it was determined to what extent the developed system complied with ISO 25010 software quality criteria. It was applied to the process of analyzing the system's evaluation results. The mean assessment of the participants regarding the developed system's functional suitability is "great extent," based on the computed mean value of 3.04, and the mean assessment of the IT professionals regarding the developed system's performance efficiency, as determined by the computed mean value of 3.31, is also "very great extent," in accordance with ISO 25010. The developed system's compatibility with the mean value of 3.23 was rated by IT professionals as "great extent." The participants evaluated the developed system to be "very great extent" for usability, with a computed mean value of 3.47. With a mean value of 3.72, the reliability of the developed system was rated as "very great extent." The computed mean score of 3.80 indicates that the developed system's security is found to be "very great extent." The computed mean value of 3.26, which is described as a "very great extent" by the IT experts, proves that the developed system is maintainable, and the computed mean value of 3.15, which is described as "great extent" by the IT experts, reveals that the developed system is compliant with portability requirements.

Table 4 summarizes the assessment of the developed system's level of conformance with the ISO 25010 Software Quality Standards.

Table 4. Summary table on the assessment of IT experts on the extent of compliance of the developed system to ISO 25010 Software Quality Standards

Criteria	Weighted Mean	Descriptive Interpretation
Functional Suitability	3.04	Great Extent
Performance Efficiency	3.31	Very Great Extent
Compatibility	3.23	Great Extent
Usability	3.47	Very Great Extent
Reliability	3.72	Very Great Extent
Security	3.80	Very Great Extent
Maintainability	3.26	Very Great Extent
Portability	3.15	Great Extent
Overall Mean	**3.37**	**Very Great Extent**

The developed agricultural e-commerce platform was evaluated for compliance with the ISO 25010 Software Quality Standards in terms of functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability, with an overall mean of 3.37, which is characterized as "very great extent". This indicates that IT professionals found the system to be functional, working as intended, and satisfies

their needs. This is a significant contribution towards establishing the delivery performance of software processes and suggested improvements, as it is in agreement with the study by John Estdale and Elli Georgiadou (2018) entitled "Applying the ISO/IEC 25010 Quality Models to Software Product" that ISO 25010 provides the leading models for assessing software products.

DISCUSSION

Development of module that would utilize product-search matching to connect the farmers with their intended customers and vice versa

Figures 5 to 11 illustrate the primary user interfaces that users of the developed system shall utilize.

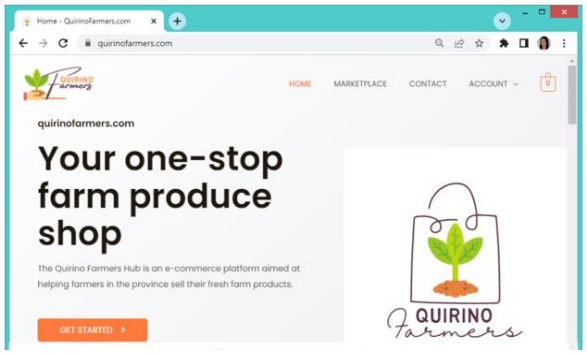

Figure 5. The Home Page

Figure 5 shows the home page which embodies the developed system as a whole. It includes the account tab which a user can sign in. It also shows vouchers if there are any.

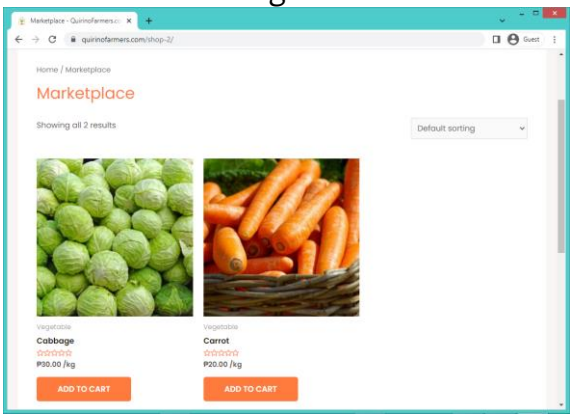

Figure 6. Marketplace Page

Figure 6 shows the marketplace which consists of the products that are available to sell and can be sorted by options.

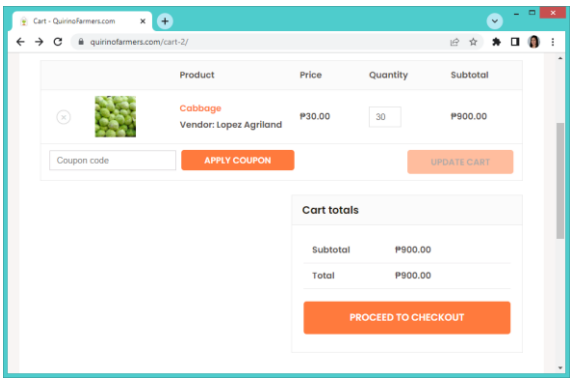

Figure 7. Cart Page

Figure 7 shows the cart page which displays the products that have been added from the products page.

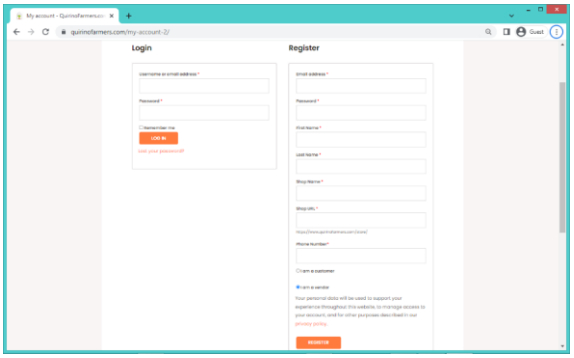

Figure 8. Vendor Registration Page

Figure 8 shows the vendor registration page which presents the log-in information and the registration details of vendors.

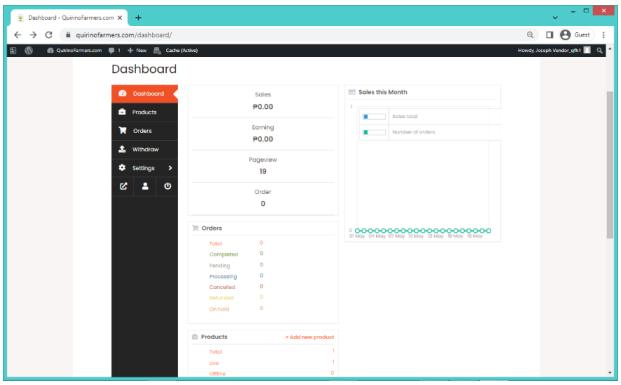

Figure 9. Vendor Dashboard – Sales

Figure 9 shows the vendor dashboard which displays the sales, earnings and page views. It also displays the orders of the costumers.

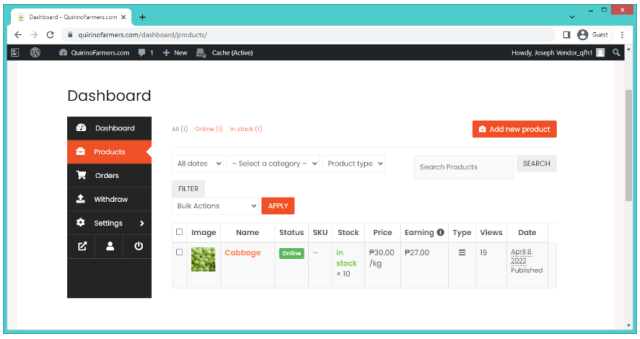

Figure 10. Vendor Dashboard - Products

Figure 10 shows the Vendor dashboard which displays the inventory of products available, unit price and the earnings. The dashboard is where the vendors can add new products to sell.

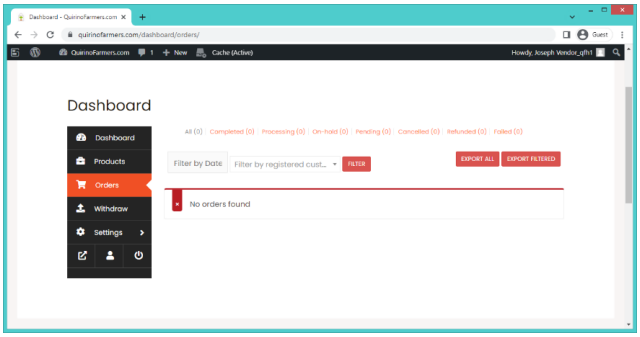

Figure 11. Vender Dashboard – Orders

Figure 11 shows the page where consumers' orders are displayed.

Mode of payments are Easy to Use

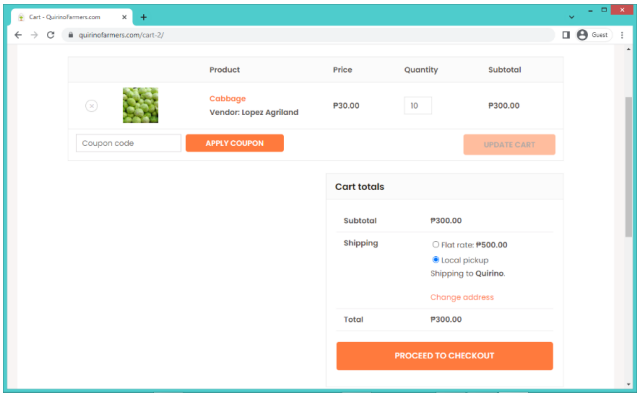

Figure 12. Cart Page

Figure 12 shows the add to cart page which displays the subtotal and the shipping rate according to the address of the customer. An option of local pickup is also included for the customers residing nearby the vendor. Add to cart button feature was added to allow customers to choose items even without payment.

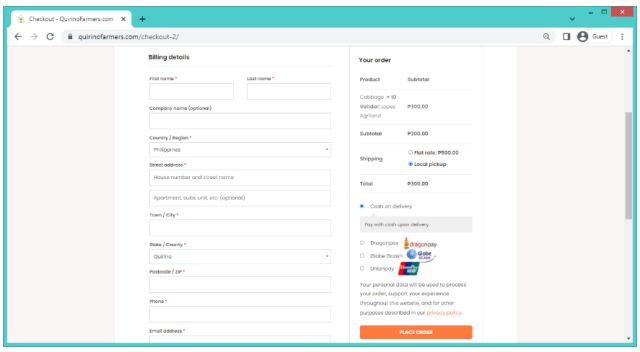

Figure 13. Checkout Page

Figure 13 shows the checkout page which has the options of the different modes of payment: cash on delivery, DragonPay, Globe Gcash, or UnionPay. These modes of payment allows the customer to utilize whatever mode of payment is available and convenient for them.

Enhancement that can be done to improve the developed system

The system is only constrained on the Customer to Customer (C2C) business model. This feature may be improved by incorporating the ideas of different business models, such as Business-to-Business (B2B), Business-to-Consumer (B2C), Consumer-to-Business (C2B), Business-to-Administration (B2A), and Consumer-to-Administration (C2A).

For the farmers to readily identify which specific months of the year a certain product is in demand on the market, the inclusion of data analytics may be considered. Although the system is built to work with many different web platforms, most customers use mobile apps to browse online stores. The creation of an app for the iOS and Android operating systems may be considered to enhance this feature.

CONCLUSIONS AND RECOMMENDATIONS

From the results, the product-search matching can be utilized in the developed system to connect the farmers with their intended customers and vice versa. The modules have separate sign in options for vendors and customers. Like other e-commerce platforms, the module has add to cart options for customers. The vendors can add more products in their module, set the price and can schedule discounts. Products inventories are also displayed in the vendors module.

The developed agricultural e-commerce platform was evaluated for compliance with the ISO 25010 Software Quality Standards in terms of functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability, with an overall mean of 3.37, which is characterized as a “very great extent”. Generally, the users found out that the developed e-commerce site is working as its intended use.

There are several modes of payment that each customer can use according to what is available and most convenient for them. The customers can choose cash on delivery, DragonPay, Globe Gcash, or UnionPay. These modes of payment are readily available in the checkout page of the customers which they can utilize.

The inclusion of data analytics, a mobile app for iOS and Android, as well as various business models like business-to-business, business-to-consumer, business-to-business, business-to-administration, and consumer-to-administration can all be taken into consideration to further improve the developed system.

IMPLICATIONS

In developing countries, agricultural-e-commerce is a growing opportunity. However, there is a wide range in the preparedness of emerging nations for agricultural e-commerce, particularly in the Philippines. Using the created multi-vendor e-commerce platform, this research serves in bringing together buyers and sellers in buying and selling their products directly using online electronic devices. This paper would also serve as a roadmap for future researchers who wish to develop a similar system for farmers.

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DECLARATIONS

Conflict of Interest

The authors declare that there is no conflict of interest.

Informed Consent

All participants of the study were informed of the purpose and data to be collected upon answering the survey questionnaire. The respondents' identities were not obtained during data gathering. The individuals' names were kept private by the researchers.

Ethics Approval

The Quirino State University Research and Development Office and the Research Ethics Review Committee accepted and approved the conduct of the study.

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APPENDIX A

Assessing the compliance of the developed system with respect to the ISO 25010 Quality Software Criteria

Please indicate the extent of compliance of the Agricultural E-Commerce: A New Business Platform for Smallholders in Quirino Province in terms of Functional Suitability, Performance Efficiency, Compatibility, Usability, Reliability, Security, Maintainability and Portability. Please put a tick in the appropriate answer using the following scale:

4 – Very Great Extent *3 – Great Extent* *2 – Low Extent* *1 – Very Low Extent*

QUALITY CRITERIA OF SOFTWARE BASED IN ISO 25010			LEVEL OF COMPLIANCE			
Characteristics	***Sub-Characteristics***	***Description***	***4***	***3***	***2***	***1***
Functional Suitability	Functional Completeness	The set of functions covers all the specified tasks and user objectives.				
	Functional Correctness	The functions provides the correct results with the needed degree of precision.				
	Functional Appropriateness	The functions facilitate the accomplishment of specified tasks and objectives.				
Performance Efficiency	Time-behavior	The response and processing times and throughput rates of a system, when performing its functions, meet requirements.				
	Resource Utilization	The amounts and types of resources used by a system, when performing its functions, meet requirements.				
	Capacity	The maximum limits of the product or system, parameter meet requirements.				
Compatibility	Co-existence	A system can perform its required functions efficiently while sharing a common environment and resources with other products, without detrimental impact on any other product.				
	Interoperability	Two or more systems can exchange information and use the information that has been exchanged.				
Usability	Appropriateness Recognisability	Users can recognize whether a system is appropriate for their needs.				
	Learnability	A system enables the user to learn how to use it with effectiveness, efficiency in emergency situations.				
	Operability	A system is easy to operate, control and appropriate to use.				
	User error protection	A system protects users against making errors.				
	User interface aesthetics	A user interface enables pleasing and satisfying interaction for the user.				
	Accessibility	A system can be used by people with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use.				
Reliability	Maturity	A system meets needs for reliability under normal operation.				
	Availability	A system is operational and accessible when required for use.				
	Fault tolerance	A system operates as intended despite the presence of hardware or software faults				
	Recoverability	In the event of an interruption or a failure, a system can recover the data directly affected and re-establish the desired state of the system.				
Security	Confidentiality	The prototype ensures that data are accessible only to those authorized to have access.				
	Integrity	A system prevents unauthorized access to, or modification of, computer programs or data.				
	Non-repudiation	Actions or events can be proven to have taken place, so that the events or actions cannot be repudiated				

		later.				
	Accountability	The actions of an entity can be traced uniquely to the entity.				
	Authenticity	The identity of a subject or resource can be proved to be the one claimed.				
Maintainability	Modularity	A system is composed of discrete components such that a change to one component has minimal impact on other components.				
	Reusability	An asset can be used in more than one system, or in building other assets.				
	Analyzability	Degree of effectiveness and efficiency with which it is possible to assess the impact on a system of an intended change to one or more of its parts, or to diagnose a product for deficiencies or causes of failures, or to identify parts to be modified.				
	Modifiability	A system can be effectively and efficiently modified without introducing defects or degrading existing product quality.				
	Testability	Degree of effectiveness and efficiency with which test criteria can be established for a system and tests can be performed to determine whether those criteria have been met.				
Portability	Adaptability	A system can effectively and efficiently be adapted for different or evolving hardware, software or other operational or usage environments.				
	Installability	Degree of effectiveness and efficiency in which a system can be successfully installed and/or uninstalled in a specified environment.				
	Replaceability	A system can replace another specified software product for the same purpose in the same environment.				

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