Multi-Platform Decision Support System for High Value Crops using a Posteriori Algorithm

Remie-Bie Donato Andres, Maria Visitacion N. Gumabay, Jesus B. Pizarro

Abstract--- Information systems, particularly of decision support systems are becoming increasingly important in the agriculture sector. Access to vital, timely information can help stakeholders involved in agriculture and agribusiness such as farmers, traders, government personnel make better decisions about crop production and trade. This study aimed to develop a web-based integrated information system within a mobile application on digital marketing as an enabler to enhance better access of information for buyers and farmers. It specifically it aimed to identify the challenges encountered by agency participants within the existing system with regard to accessing relevant information on HVCs, to identify the system to be developed to address the identified challenges, to determine the extent of compliance of the developed system with the ISO 25010:2011 Software Quality Assurance Standard, and to determine whether or not there is a significant difference between the assessment of the users and IT experts with regard to compliance with the aforementioned ISO standard. The Research and Development (R&D) and the V-Model methodologies were selected by this researcher as study and software development methodologies respectively. These participants were chosen on the basis of their involvement in the growing and marketing of high value crops in the province. Questionnaires were the main instrument for gathering data from the participants. Standard statistical methods such as frequency counts and percentage, weighted mean, hypothesis means, and analysis of variance were used as tools in analyzing and interpreting the data gathered. Level of significance was set at.05. For data visualization and knowledge extraction, the educational edition of the RapidMiner application was utilized to summarize the knowledge generated by the system that can be used to support decision-making. The results show that the developed system conformed with industry-compliant software quality standards and thus satisfactorily met all of the requirements of its users. It was concluded that the developed system is a suitable replacement for the existing system and its deployment recommended.

Keywords: high value crops, ISO 25010, Isabela, web-based, mobile application, decision support system, information systems

I. INTRODUCTION

The profound impact by the rise of the Internet on a highly diverse range of fields as distinct as say aerospace technology, agriculture, information technology and manufacturing was once unimaginable in the past. One field in particular stands out: Agriculture. One of man's oldest economic undertakings; agriculture is a vital means of food production as well as a means of supplying materials for clothing and industrial uses. Technological evolution has historically had a large impact on agriculture. The information age has heralded significant changes on how agriculture is conducted. According to Tomas, et al (2014), the Internet can enhance agricultural production in areas of inefficiency and at the same time can be also be threat to pre Internet-era conventional agricultural enterprises.

The province of Isabela is one the Philippines major food producing areas. It accounts for significant portions of the country's vital staple crops: rice and corn. Isabela is also noted for its production of high value crops (HVC) such as tobacco, bananas, mangoes, coffee and mung beans. The province's agricultural output supplies the needs of many areas of the country and is considered to be a bulwark against scarcity. In addition, commercial food animal production and is also an important and fast growing industry.

According to Firdhous, et al (2013), the adoption of Information and communication technologies (ICTs) in the agricultural sector can drive the empowerment of the farmers and viable agriculture. There are however, obstacles that hamper the full integration of ICT into agricultural practice and business. These obstacles are:

- Lack of knowledge about the potential uses of ICT in agricultural production by the farmers.
- Perceived high cost of ICT in rural areas due to the instability of electrical services and lack of technical expertise.

The research questions presented based on the primary objective of this study is to support farmers with better information flow and availability. The outcome of the research is expected to provide solutions to the identified challenges. The study will also set delimitations in order to focus the research on the core issues considering the available time and resources.

This is for the reason why the researcher aims to develop a multi-platform system in "Multi-Platform Decision Support System for High Value Crops using a Posteriori Algorithm". The uptake of decision support system by farmers, traders and agricultural sector has been slow and various issues said to be contributing to this include fear of using computers, tablets, mobilephones, time constraints, poor marketing, complexity, lack of local relevance, lack of end-user involvement, and mismatched objectives between developers and users.

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II. REVIEW OF RELATED LITERATURE AND STUDIES

A. Technical Background

The rapid adoption of smartphones, particularly in the Philippines unfortunately does not automatically translate into information integration with the agriculture sector. This means that the farmers do not fully realize the benefits of mobile and information technologies in regard to the trade of crops and other agricultural products. According to Paper (2013), frameworks do not yet exist that would create a platform that integrates and seamlessly connects farmers with their customer base. The wide availability and increased affordability of smartphones provides an opportunity for farmers to leverage the power of ICT in general and mobile technologies in particular to reach a wider customer base. The same technologies can also help farmers gain timely access to vital information and technical know-how from experts such as the government's agricultural officers. This undeterred access information can ultimately reduce the costs of doing business and improve efficiency and drive better decision-making processes among farmers. The lack of access to information and value-added services has been identified as a major obstacle for farmers in improving their livelihoods.

B. Related Literature and Studies

The preceding literatures provided insights on the value of information and mobile technologies to the agriculture sector. Agriculture is one area that could reap immense benefits by taking advantage of the capabilities of information technology to manage the acquisition and distribution of knowledge. The implementation of custom-developed information systems, particularly that of Decision Support Systems can provide the impetus for boosting agricultural productivity and marketability of crops. This would ultimately lead to the lifting of the economic standards of farmers. Cases have been made about the improvements in the sustainability of agricultural business, not just in the profitability and efficiency, but also in the livelihood of individual farmers. Finally, this study benefited greatly from distilled information and knowledge contributed by the literature. Armed with these, the researcher developed her own ideas on what original study to pursue and how to go about it.

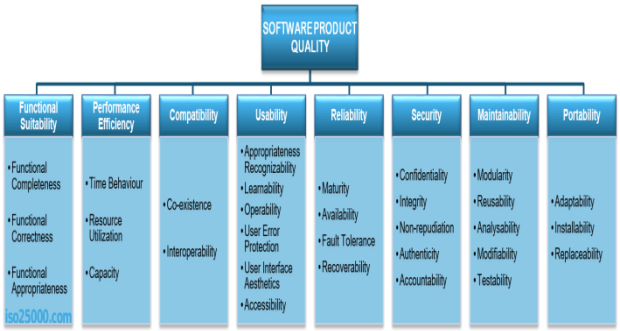
The selection of agribusiness-related websites presented shows the viability and utility of implementing such information-based systems to aid farming businesses and farmers in particular. Information and knowledge are made more accessible to those who need them most, which results in greater efficiency, profitability, reduced environmental impact, and sustainability. Governments can step up their support for farmers by providing much-needed expertise, technical support, and ICT resources that would enable the stakeholders help themselves and boost their livelihoods. Farmers can be educated on the importance and profitability of high value crops as opposed to traditional crops to provide them with an alternative and better source of income. These agribusiness websites provided the seeds of new ideas that this researcher could use in her study, particularly with the development of a web-based information decision support system.

C. Decision Support System

The role of farmers in the practice of sustainable agriculture is not just of being the producer, but also as the decision-maker. Farmers have to make decisions on the crops they produce that strongly influences agricultural sustainability. Such decisions do not occur in a vacuum; they are done in a domain of multiple multifaceted, sometimes conflicting interests. The ability to make good decisions depends heavily on the availability and timeliness of information. A form of decision support system, the Agricultural Decision Support System (AgriDSS) that focuses on agriculture can provide this information that will form the basis of good decisions by farmers. Such systems, in concert with the decision makers, are projected to be a key player in the attainment of a sustainable agriculture sector with a reduce environmental footprint. Contemporary DSSs that are available for use to the agriculture industry stakeholders are not yet maximized; thus the benefits of using such systems are not fully realized. This is because in many cases, these systems do not truly meet the needs of farmers in a relevant way; thus resulting in low acceptance. Many of these DSSs are designed without input from farmers, making them unsuitable and unfriendly to the intended audience. Modern user-centered software development practice requires the full participation of the intended users during the entire process of software production. Adoption of the User Centered Design software development philosophy is expected to help remedy the identified issues with conventional DSSs and at the same time make the software more accessible. The scientific personnel and developers who respectively commission and develop the systems must avoid falling into the trap where they think they know better than what the farmers actually require of a DSS. A fully developed AgriDSS that meets the needs of all the stakeholders in agribusiness can result in improvements in the decision-making processes, communication, and accessibility of information.

D. Conceptual Framework

Figure 1. ISO/IEC 25010:2011 System and Software Quality Requirements and Evaluation (SquaRE) products model



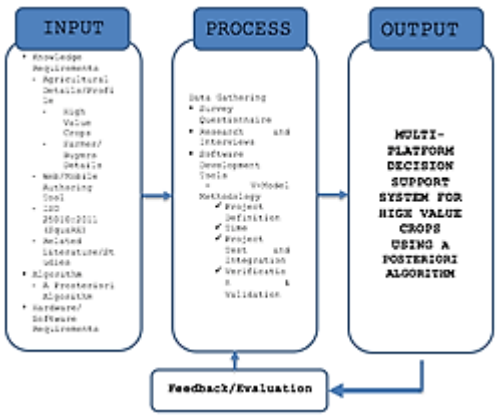
The ISO/IEC 25010:2011 System and Software Quality Requirements and Evaluation (SquaRE) products model shown in Figure 1 employed by this researcher as the

standard by which the proposes system assessed. The SquaRE model defines eight characteristics that can be used to evaluate the quality of a software product based on the outcomes of being used in a specific context. This model is highly suited to assessing human-computer systems, which includes the computer systems and the software products that run on it. The model provides a consistent set of terminology, characteristics and sub characteristics for quantifying and measuring, and comparing software product quality and product completeness. While this product quality model is intended for software and computer systems, many of the defined characteristics can be applied to many other types of systems and even services.

E. Conceptual Framework

Figure 2 illustrates the Input-Process-Output Model, served as the research paradigm of the study. The Input stage is where all the extensive knowledge requirements, algorithmic requirements, as well as the hardware, and software requirements for the study are gathered. The knowledge requirements include the relevant agriculture details such as the information about high value crops, as well as the details about the farmers and buyers, the selected algorithm to be used, namely the Unsupervised Algorithm, and the detailed system requirements needed to deploy the developed system.

Figure 2. Conceptual Framework of the Study



Once this is done, the researcher proceeds to the study proper which is the Process phase. In this phase the gathers data via the defined survey questionnaire instruments and performs research systematically. Research and interviews are conducted in order to supplement the information obtained via surveys and questionnaires. An information system platform is then developed to solve the identified problems using the prescribed V-Model software development methodology. This includes the software project definition, time frame, project testing and integration, and verification and validation. The outcome of this process is the completed research and information system which is then evaluated by the intended users following the prescribed ISO software quality standard. The feedback of the users is then used to continually improve the system until it is deemed ready for production use.

III. OBJECTIVES OF THE STUDY

This study aims to develop a web-based integrated within a mobile application on digital marketing as an enabler to enhance better access of information for buyers and farmers.

Specifically, it sought to:

1. Determine the challenges encountered by the agency participants in the existing system with regard to access to relevant information on high value crops.
2. Identify what system can be developed to meet the identified challenges.
3. Determine in what extent does the developed system comply with the ISO 25010 Software Quality Assurance Standards in terms of: Functional Suitability; Performance Efficiency; Compatibility; Usability; Reliability; Security; Maintainability; and Portability.
4. Determine if there is a significant difference on the assessment of IT Expert and Users on the extent of compliance to ISO 25010 Software Quality Standards of the developed system?

A. Scope and Limitation of the Study

This research is intended to contribute to the improvement of the agricultural sector and the promotion of sustainable agriculture in Isabela province. The main stakeholders and motivation have been identified, while the various obstacles that hamper the free flow of information have been scrutinized to provide comprehension on the difficulties of information dissemination between the stakeholders. At the end of this scientific research, the primary outcome is the development of a trustworthy, web-based and mobile application to solve the problems identified in the research.

B. Significance of the Study

This study is significant and be beneficial to the society in general, and to the Province of Isabela. Specifically; Agricultural Sector. The agriculture sector as a whole benefited from the resulting optimized production, thus contributing to its sustainability; Community. The community would benefit greatly from the outcomes of sustainable agriculture and the resulting reduced environmental footprint; Researcher. The researcher would benefit from this research by honing her research and software development skills and learn significantly about agribusiness by her exposure to it; and Future Researchers. Future researchers can use this research as a reference and source of knowledge with the aim of creating their own, unique studies that would contribute new knowledge for the benefit of mankind.

IV. METHODOLOGY

With the main goal of developing an information system, the primary concentration of the research methodology is to generate a suitable system development-focused framework that sustain the design and deployment of the information system being developed. The methodology is the basis of the research processes conducted in the study.

A. Research Design

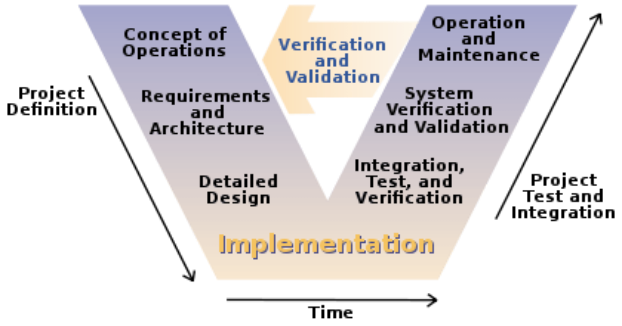
The Research and Development (R&D) method was selected by this researcher as the appropriate methodology for this study. Research and Development uses existing knowledge, research, methods and practices to solve practical problems and generate new knowledge (David and Grebmer, 2017). Broadly speaking, research and development is essentially a systematically conducted creative activity based on scientific principles whose ultimate purpose is to utilize the existing stock of collective knowledge to develop useful new techniques, processes, systems, machines, and solutions to real-world problems as well as to to grow the collective knowledge of mankind.

Data must be gathered from research participants in order to help find answers to the research questions of the study. There are two methods of gathering data, namely the Qualitative and Quantitative Method. One of the most useful qualitative techniques is the interview. It is also a challenging method because the interviewer has to be mindful of his possible biases during the interview so that the data gathered will not be tainted and therefore lose its objectivity (Boeree, 2005). This means, for example, an interview must be conscious of asking leading questions that produce answers that the interviewer has preference for.

B. Software Development Methodology

This researcher selected the V-Model of software development as the development methodology as illustrated in Figure 3. This method was deemed by the researcher to be suitable for this study because it involves the end users in all aspects of the system design and is also highly recommended for moderate to complex software development requirements.

Figure 3. V-Model Methodology



The V-shape of the V-Model method represents the various stages that passed through during the software development life cycle as shown in Figure 2. Beginning at the top-left stage and working, over time, toward the top-right tip, the stages represent a linear progression of development similar to the waterfall model.

Much like the traditional waterfall model, the V-Model specifies a series of linear stages that should occur across the life cycle, one at a time, until the project is complete. For this reason, V-Model is not considered an agile development method, and due to the sheer volume of stages and their integration, understanding the model in detail can be challenging for everyone on the team, let alone clients or users. The end result is that the developed system tends to be better tested and accepted by its intended users.

C. Research Instruments

The data gathering instruments employed by this researcher included the questionnaires, observation checklist, interview guides, and document analysis/records review.

Observation. this data gathering approach in order to better understand and personally experience the study environment. Information derived from observation was used to complement the data gathered via traditional means such as from questionnaires and interviews.

Interview/Focus Group Discussion. Face to face interviews were also used to collect vital information that would be useful for this study. Interviews were conducted on site with the farmers, traders and agricultural officers in order to engage in personal communication with the experts and obtain a better understanding of the facts. The preferred language of the research participants was used in order to assure full comprehension. The researcher followed all necessary protocols and obtained the permission of the interviewees before proceeding.

Questionnaires. Validated questionnaires were constructed to serve as the instrument for evaluating the developed system. Based on the Industry Standards Organization (ISO 25010:2011) System and Software Quality Requirements and Evaluation (SquaRE) products model, the questionnaires were designed to elicit information from the research participants who would evaluate the software based on a standard, pre-determined set of criteria.

Document Analysis/Records Review. The researcher also perused and studied relevant documents and records with the permission of the owners in order to gain more insights on the problem at hand.

D. Study Participants

The main participants of this study were the agriculture officers and the business sectors (farmers, traders, farmer/trader) who were primarily involved in the system process. The IT experts were also selected as participants because of their valuable input to the development of the developed system.

E. Data Gathering Procedures

Guided by ethical research practice, the researcher first obtains the permission of all the research participants. The research participants informed first about the research subject and then formally invited to participate. Protocol and procedure observed, particularly when dealing with the provincial agriculture office. Data collected using the previously identified instruments and methods such as interviews, questionnaires and checklists. Analysis on documents, particularly from the agriculture office performed to obtain additional information.

F. Data Analysis

This research begins with an examination of the findings from existing relevant applications and systems development projects. A model of the roles to be played by the system actors were illustrated. The results of interviews from face to face interactions with participants were discussed to form part of the basis for the system design or model as well as the eventual deployment of the completed system prototype. The system design was depicting the users and their interactions with various components of the system.

G. Ethical Review Document

In compliance with the Ethical Clearance requirements of the Commission on Higher Education (CHED)for all higher education institutions starting 2015, Saint Paul University Philippines has required all research proposals that involve human subjects to undergo ethical review and secure clearance before proceeding. The purpose of this ethical review and clearance is to protect the welfare of the research participants or subjects.

This researcher has duly complied with the requirement by applying for ethical clearance at the Saint Paul University Research Ethics Board. The requisite documents were submitted and scrutinized by the board. The researchers however, still gave assurance that he conducted his study while adhering the highest ethical standards and ensured the safety of human participants.

V. RESULTS AND DISCUSSION

I. Challenges encountered by the agency participants in the existing system with regards to the access to a relevant information on high value crops.

The challenges were encountered by the agency participants in utilizing the existing system with regards to the access to a relevant information on high value crops such that the farmers access to high-value market after harvesting products that could give them profit; consistency in terms of supplying products to the formal market given by the department of agriculture by disseminating information; more could be done to ensure actual happening in the farmers, traders or agriculture sector when it comes to the availability of high value crops in Isabela province; improve competitiveness by becoming an important link in the agricultural sector; and a transaction costs be minimized to enable smallholder farmers to participate successfully in the agricultural sector.

II. System to be developed to meet the identified challenges

A System to be developed to meet the identified challenges. The researcher developed an information system that would provide a solution to the identified challenges. It would provide the desired functionality based on industry standard software development tools, data science techniques, and the A Prosteriori algorithm. The identified algorithm would provide the raw "intelligence" to generate the desired knowledge outcome by the presentations of patterns/graphs. On the data analysis and data modeling of significant attributes to discover relevant knowledge comprising the decision-support functions utilized the methods of clustering, decisions trees, cross validation and A prosteriori algorithm to extract knowledge from the generated data set given by the developed system.

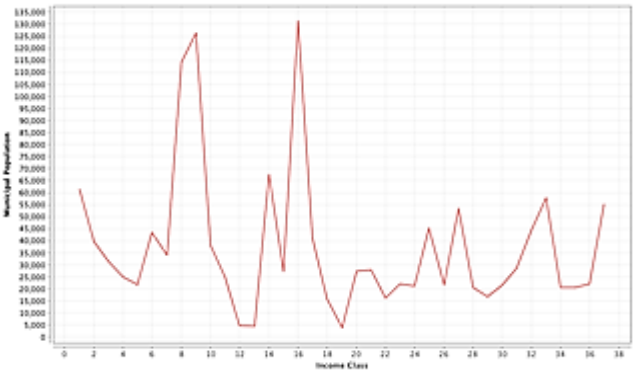
A. Data Analysis and Data Modeling of Significant Attributes to Discover Relevant Knowledge

The data sets supplied by the provincial agricultural office of Isabela is utilized for data analysis tasks. Formatted in the form of tables, the data itself is defined with a high level of precision, while the meta data is the source of the significant attributes and patterns. According to Chapman, et al, (2000), these patterns are mined and visualized into human-readable charts; which is considered to be data modeling in descriptive format. These patterns provide the knowledge needed for accurate and timely decision making for agriculture. Chen et al (2006) also stated that significant knowledge can be extracted via the judicious application of algorithmic techniques.

a.1 Data Modeling

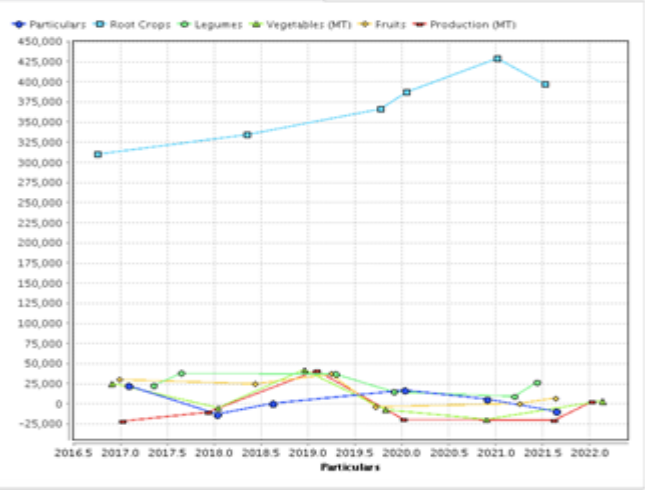
Isabela is politically subdivided into thirty-four (34) municipalities, two (2) component cities and one (1) independent component city. The province is represented in the Philippine House of Representatives with four (4) legislative districts. The province has ten (10) first class municipalities, two (2) second class cities and one (1) first class independent component city. Ilagan City, which became a city thirteen years after its failed cityhood proposal in 1998, it is now Luzon's largest and the country's fourth biggest city after Davao City, Puerto Princesa and Zamboanga City by land area.

Figure 4. Isabela's Administrative Divisions



The series multiple charts shown in Figure 4 indicating the income class as the x-axis and municipal population the y-axis. These pattern shows the fluctuating population when it terms of the income class of each municipality in Isabela Region. Anent to this, its demonstrating that based on the class provided by the municipality it reflects on the given population, it is for the reason why cities in each municipality has the most number of population merely because of the given opportunities by the people in their everyday life.

Figure 5. Isabela's Production of Alternative Staples 2017-2012



This historical record of production manifests the capability of the province to sustain and improve the volume needed in the country shown in Figure 5.

On the context of food staple sufficiency, the commodities covered the root crops, legumes, vegetables and fruits. These crops are indigenous in the province. Aside from being nutritious, they are grown under minimal technology and labor yet are profitable to farmers. Besides, these crops are climate change tailored and are buffer foods especially during adversities.

a.2 Production Profile and Situational Analysis

The Province of Isabela being known for its dominance in grain crops is also a producer of other staples. These staples are sources of protein, minerals and vitamins in the case of legumes and vegetables and carbohydrates in the case of root crops. These crops are mostly grown in areas near rivers, broad plains and foot slopes having light soils and with good surface and internal drainage.

Aside from ready source of food, it also serves as cash crops for almost all families. Most of these crops are planted in small areas of their backyard or patches in their farm yards. Enterprising farmers now grow the crops in commercial scale supplying big markets in and outside of the province where return is relatively higher than grain staples.

With the land resource of the province and the changing weather pattern prevailing, the expansion and clustering of production in strategic locations in the province shall be an advantage. The production cluster can become sources of supply in calamity stricken areas while opportunity for income to farmer producers.

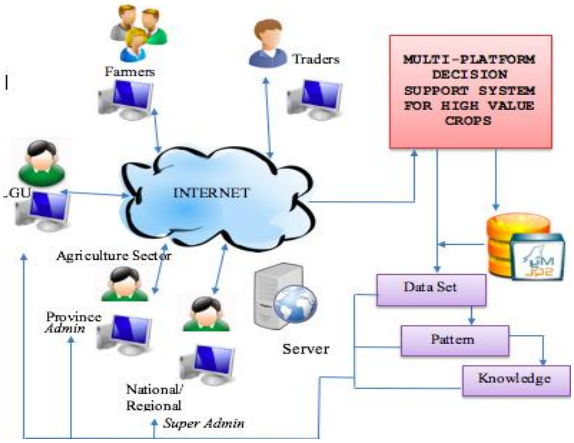
a.3 Project/System Conceptualization

The researcher conducted an interview with the Provincial Department of Agriculture about how the farmers sell their agricultural products and who are the traders and the needs of agricultural sector for decision-making about the high value crops of Isabela Province. The participants said that the farmers go to the market and there they sell their agricultural products, the traders personally contacted farmers for their own profit and the agricultural sector manually collected data from the different farmers and traders to summarized high value crops in the province.

This study promoted easy and faster way of selling agricultural products using multi-platform interactive agri-knowledge in Isabela Agriculture. Also the system provides knowledge on the different products, traders in the province. The system digitizes the process of selling high value crops by uploading a photo of the products using the developed system. The system can also monitor who are the different traders in the province and the different crops that produced. The agricultural sector highly be benefited in the developed system as to use on their decision-making and analyze the output given by the system.

The system provides information about the agricultural products to the traders specifically on the high value crops provided by the province. This offers easier and faster transaction for the traders between farmers, traders and agricultural sector.

Figure 6. Logical Design



The Logical Design of the developed system is shown in Figure 6. It portrays the overall view and relationship among the components of the system. The above figure shows that the propose system provide different users (super admin, admin the users of the system). The output of the developed system then be vital as decision-making in the part of the agriculture sector.

Figure 7. Information Flow Architecture of the System

The Figure 7. shows the information flow architecture of the developed system. The key stakeholder such as the

Agricultural officer/sector responsible for responding the queries from farmers and buyers. Also the officer/sector verify the authenticity of the information uploaded by each party. Furthermore, the officer shares the information about the status of various markets, including the trending price of the crops by uploading them to the system.

At the center, the interactive agri-knowledge system is displayed which will act as a platform to support both stakeholders to obtain information such as price of crops, location of the crops and general market information. The system will register both users and store their information into the local cloud storage provided by department of agriculture in Isabela province. The information accessed locally through the Wi-Fi hotspot installed department or part of the project of the province.

At the right upper corner, the farmers will upload the picture of the crops into the system through the developed prototype mobile application. The picture will contain pre-defined metadata such as the location of the crops, name of the crop and quantity of the crop. Also, the farmer able to access market information from the system through the phone to assist him/her in knowing the trending price as well as the type of crop which is highly demanded in the market.

At the right bottom is the trader/buyer who will issue the crop order from the system. The buyer will use the developed system to select the type of crop uploaded by farmers, then the system will direct the trader/buyer to the location where he/she can negotiate the price with the farmer.

At the end of the information flow, the agriculture sector is then the last hand in all the input of both farmer and traders. In here, they can easily monitor the different farmers and traders who are having transaction without the appearances of the concerned unit in the department of agriculture.

By using the developed system, the agriculture sector is then easily retrieving records when it comes to the different crops, farmer's information, trader's location and support decision-making in administering different reports needed by the national government.

a.4 User Interface

The user interface is a space in which humans and the computer system interact. The goal of user interface design is to produce a user interface which makes it easy (self-explanatory), efficient, and enjoyable (user-friendly) to operate a machine in the way which produces desired output. The developed system has the following design and forms along with list of categories, buttons and navigation tools.

Figure 8. User Interface of the System

Web Interface

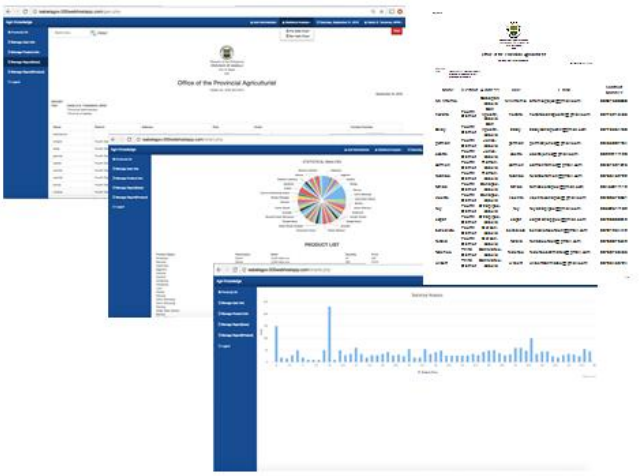
Mobile Interface

a.5 Process of the developed software

Technological evolution has historically had a large impact on agriculture. The information age has heralded significant changes on how agriculture is conducted. According to Tomas, et al (2014), the Internet can enhance agricultural production in areas of inefficiency and at the same time can be also be threat to pre Internet-era conventional agricultural enterprises.

The developed software intended to monitor and evaluate transactions between the seller and the buyer of each municipality in the province.

a.6 Statistical Analysis applying A Posteriori Algorithm



III. Extent of Compliance of the developed system to ISO 25010 System and Software Quality Assurance Standard.

The evaluation of the developed system in compliance with the ISO 25010:2011 System and Software Quality Requirements and Evaluation (SquaRE) products model. The system was evaluated this equates to an overall

descriptive evaluation of "Very Great Extent". Viewed as a whole, this means that the developed system is highly compliant with the prescribed ISO 25010:2011 standard. The evaluation of the developed system as evaluated by the participants. The results of the evaluation of the developed system by the participants show that the developed system is compliant with the software quality standards prescribed by the ISO 25010:2011 System and Software Quality Requirements and Evaluation (SquaRE) products model. The evaluation of the developed system as evaluated by the users and experts. It was observed that the performance criteria evaluated both on the Users and IT Experts which all fell under the descriptive interpretation of "Accepted Unconditionally". The evaluation of the developed system as assessed by the users and IT experts is descriptively interpreted as "Accepted Unconditionally". This means that both the users and experts found to be usable and met their needs.

IV. There is a significant difference on the assessment of IT experts and Users on the extent of compliance to ISO 25010 Software Quality Standards of the developed system.

a.7 Data Integrity

In this study, the developed system accommodates the third party who will act as verifier to validate the goods and services offered by system.

VI. CONCLUSION

The developed system is ready for full implementation use by its intended users as shown by its very high level of compliance with the ISO 25010:2011 System and Software Quality Requirements and Evaluation (SquaRE) products model. The developed system is ready for full implementation as evidenced by its high overall performance rating as evaluated by the participants against the ISO 25010:2011 System and Software Quality Requirements and Evaluation (SquaRE) products model. This corroborates the previous conclusion. Based on the overall rating and descriptive evaluation of "Accepted Unconditionally", there is a very high level of acceptance of the developed system by the experts with regard to the given evaluation criteria. In other words, this is an endorsement of the quality of the system by experts in the discipline.

The developed system for decision support is fully compliant with the extent of the ISO standard and therefore ready for deployment and implementation. The full compliance with the accepted software quality standards means that the needs of the office of the provincial agriculture in the province of Isabela have been fully met.

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