doi: 10.17221/26/2016-AGRICECON

On-line Agricultural Products Navigation System on the Google Earth

Christina Ling-hsing CHANG[1]*, Weng-yi-lang HSIAO[2]

[1]*Department of Information Management, National Pintung University, Kaohsiung, China*
[2]*Department of Information Management, National Pintung University, Taipei, China*

*Corresponding author: cchangmis@gmail.com

Chang C.L., Hsiao W. (2017): **On-line Agricultural Products Navigation System on the Google Earth.** Agric. Econ. – Czech, 63: 400–410.

Abstract: In the agricultural industry, many brokers exploit the benefits between farmers and customers and decrease the farmers' income. As the technology has developed, the internet has become the best advertising medium for many industries. In light of this, this study based on the Google Earth has designed an on-line Agricultural Products Navigation System operated by mobile devices which can easily exclude brokers, and build the bridge between farmers and customers in order to increase the farmers income and customer benefits. Moreover, based on the IS success model of DeLone and McLean, by using the qualitative methodology, it is expected that this model will be able to provide system developers with the knowledge to improve the success of their systems.

Keywords: agricultural products, electronic commerce, geographic information systems, IS success model

The managerial tasks in agriculture are currently shifting to a new paradigm, requiring more attention to the interaction with surroundings, namely the environmental impact, the terms of delivery, and the documentation of quality and growing conditions (Dalgaard et al. 2006). The increasing use of computers and the dramatic increase in the use of the Internet have improved and eased the task of handling and processing the internal information as well as the acquisition of the external information which may be produced from many sources and may be located over many sites (Sørensena et al. 2010). The potential of using these data will reach its full extent when suitable information systems are developed to achieve beneficial management practices (Fountas et al. 2006). For this reason, designing an information system should emphasize what the farmers do and how they act. Although the computer adoption on farms has been studied by many researchers (Inan et al. 2010; Jakku and Thorburn 2010; Louhichi et al. 2010; Aker 2011; Klerkx et al. 2012; Besser and Mann 2015; Liu et al. 2015) the current studies do not present rigorous analyses of the farm management information system (FMIS) success factors combined with the geographic information systems and the Google Earth.

In addition, most farmers do not yet sell their agricultural products using the technology and concept of the Internet marketing. Many benefits are therefore exploited by the brokers in the market. Therefore, this study focuses on the actual needs of the farmers and customers, combining the geographic information systems (GIS) (Bansal and Pal 2009), Google Earth (2012), the Internet and databases in order to design an on-line Agricultural Products Navigation System, which provides a means of managing information between farmers and customers (Wu and Lin 2010). This not only helps the farmers to lower the primary cost and to improve efficiency in management, but also to provide a simple surfing platform for customers. The customers will be able to order and pick up the product easily through the handheld devices (e.g., tablet computer, smart phones, PDA etc.) while choosing the freshest and most reasonable item at the nearest location.

However, improving the system for the successful use by farmers and customers is also a critical issue. In the light of this, this study is based on the updated IS success model of DeLone and McLean (2003) using a qualitative research method to explore how to improve the on-line Agricultural Products Navigation System and to implement it successfully.

doi: 10.17221/26/2016-AGRICECON

In fact, DeLone and Mclean (2004) found that the success of the on-line book stores and electronics e-commerce needs different kinds of characteristics in the system and use an approach between these two kinds of industries. In the light of this, we can infer that the on-line Agricultural Products Navigation System needs different characteristics to achieve success. Therefore, in order to design a successful on-line Agricultural Products Navigation System which can operate by mobile devices, this study expects to resolve two research questions: (1) What kinds of characteristics should be included in this system? (2) How can farmers and customers use this system and what characteristics are required for the success of the system?

LITERATURE REVIEW AND PROPOSITION DEVELOPMENT

Information systems in agricultural

Advances in the precision agriculture, such as positioning systems and sensors for the yield and machinery performance monitoring allow farmers to acquire a vast amount of site-specific data which can ultimately be used to enhance the decision-making (Pedersen et al. 2004; Fountas et al. 2006; Reichardt and Juergens 2009). The cost of time spent managing the data in many cases outweighs the economic benefits of using the data and it seems that the future use of the wireless communication is gaining much interest (Jensen et al. 2007). Hence, a refined and integrated solution to analyse and transform the acquired data is needed to improve the decision-making in the future (Fountas et al. 2006). It is clear that the software developers need to understand the farmers and to work more closely with them and that the systems should be adaptable to suit a range of farmer characteristics.

The FMIS have steadily increased their level of sophistication as they have included new technologies, with the Internet connectivity being the latest addition (Nikkilä et al. 2010). The requirements were defined by the precision agriculture on the FMIS and a modern Web-based approach to the implementation of the FMIS was evaluated that fulfilled the farmers' requirements (Nikkilä et al. 2010). Strong relationships exist between the adoption of each technology, the sophistication of the farm management and the complexity of the farm business (Gloya and Akridgeb 2000). Therefore, after controlling for the computer adoption, the results suggest that there remain several factors limiting the Internet adoption and success (Gloya and Akridgeb 2000). In addition, the computer is a key element of the managerial information system (MIS) on most farms, and the Internet has indeed influenced the adoption and success of the FMIS (Gloya and Akridgeb 2000). Therefore, the next step in the evolution of the FMIS system is the Internet use (Lewis 1998).

In fact, the Internet has emerged as an information technology that has many potential benefits and applications for both the U.S. and the EU farmers (Gloya and Akridgeb 2000). In the light of this, the Internet not only allows the farmer to acquire and analyse external data and information, but it also provides farmers with a convenient environment in which to communicate and transact business with the buyers, suppliers, specialists, and other farmers (Gloya and Akridgeb 2000). Moreover, information gathering is one of the Internet most useful features, therefore, the probability of the Internet use indicates that the increase in the intensity of farm planning increases the likelihood of the Internet use (Gloya and Akridgeb 2000).

Due to it, the farmers not only want to sell their products as soon as possible to increase the turnover, but they also can keep the products and sell them to a higher price; meanwhile, the customers need a reasonable price, the freshest, organic products, and fulfilment of the ecological concerns to avoid eating amounts of the pesticide/toxic elements used in the production of fruits and vegetables. For this reason, buying foods through Internet is a good way to achieve both the farmers and the customers goals. A 1999 National Agricultural Statistics Service (NASS) report stated that 68% of the U.S. farms with the annual sales over $100 000 had the computer access and 43% had the Internet adoption (NASS 1999). The Internet adoption in the general U.S. population is estimated to reach 60 to 100 million households using the Internet (Lake 1999). In addition, the total agricultural area within the EU-27 is about 183 million hectares. About 85% of the farm holdings have an area below 20 ha (Danish Agriculture 2007). The future and even the current European farmers are experiencing managerial tasks for the arable farming shifting to a new paradigm, requiring the increased attention to economic viability and the interaction with the surroundings (Sørensena et al. 2010).

doi: 10.17221/26/2016-AGRICECON

To this end, an integration of information systems is needed to advise managers of the formal instructions, recommended guidelines and documentation requirements for various decision- making processes (Sørensena et al. 2010). For instance, in the EU funded project FutureFarm, a new model and prototype of a new FMIS which meets these changing requirements will be developed (Sørensena et al. 2010). The FMIS effectively meets the farmers' changing needs, and used three indicators to evaluate the system (Sørensena et al. 2010): **(1)** ***the quality of system, information and service:*** the data collected and analysed efficacy; for obtaining the data (input), transforming and used efficiency; **(2)** ***users' use, satisfaction and benefits:*** improving the users' decision effectiveness. These indicators are consistent with the updated IS success model of DeLone and McLean (2003) to analyse the success of the FMIS.

Unfortunately, the FMIS was not designed using the GIS and Google Earth platform, or for the operation by the mobile devices. In the light of this, the updated IS success model of DeLone and McLean (2003) is a suitable theory by which to analyse an on-line Agricultural Products Navigation System in this study.

DeLone and McLean (D&M) IS Success Model

The DeLone and McLean (D&M) IS Success Model, though published in 1992, was based on the theoretical and empirical IS research conducted by a number of researchers in the 1970s and 1980s. The role of the IS has changed and progressed during the last 2 decades. Similarly, the academic inquiry into the measurement of the IS effectiveness has progressed over the same period. The primary purpose of the original DeLone and McLean paper (1992) was to synthesize the previous research involving the IS success into a more coherent body of knowledge and to provide guidance to future researchers.

Based on the communications research of Shannon and Weaver (1949) and the information "influence" theory of Mason (1978), as well as the empirical management information systems (MIS) research studies from 1981–1987, a comprehensive, multidimensional model of the IS success was postulated. Shannon and Weaver defined the *technical* level of communications as the accuracy and efficiency of the communication system that produces information. The *semantic* level is the success of the information in conveying the intended meaning. The *effectiveness* level is the effect of the information on the receiver. In the D&M IS Success Model, "systems quality" measures technical success; "information quality" measures semantic success; and "use, user satisfaction, individual impacts" and "organizational impacts" measure effectiveness success.

Information technology in general and the Internet in particular, are having a dramatic impact on business operations. Companies are making large investments into the e-commerce applications, but they are hard-pressed to evaluate the success of their e-commerce systems. The IS researchers have turned their attention to developing, testing, and applying the e-commerce success measures (Liu and Arnett 2000; D'Ambra and Rice 2001; Molla and Licker 2001; Teo and Choo 2001; Palmer 2002). Molla and Licker (2001) proposed an e-commerce success model based on the D&M IS Success Model. It demonstrates how the updated D&M IS Success Model can be adapted to the measurement challenges of the new e-commerce world.

For this reason, DeLone and McLean (2003) modified the IS Success Model (Figure 1) in the light of the dramatic changes in the IS practice, especially the advent and explosive growth of the e-commerce.

Therefore, the updated D&M IS Success Model and its six success dimensions are as follows:

(1) System quality: In the Internet environment, it measures the desired characteristics of an e-commerce system. The system quality includes (Hsieh et al. 2010): **(*A*)** ***Accessibility:*** access speed and system availability (Chen 2010). **(*B*)** ***Usability:*** visually appealing and consistent information which arouses curiosity. **(*C*)** ***Connectivity:*** the outbound links. **(*D*)** ***Interactivity:*** providing an interface for two-way communication and timely response (Palmer 2002; Ahn et al. 2007). **(*E*)** ***Authority:*** the authority of the VC (Hsieh et al. 2010; Hu 2015). Those characteristics are valued by the users of an e-commerce system.

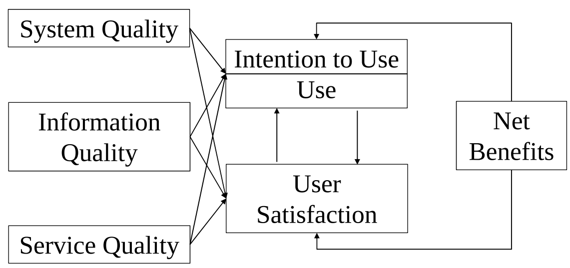

Figure 1. Updated D&M IS Success Model (DeLone& McLean 2003)

doi: 10.17221/26/2016-AGRICECON

(2) Information quality: It captures the e-commerce content issue. The web content should be personalized, complete, relevant, easy to understand, and secure if we expect the prospective buyers or suppliers to initiate transactions via the Internet and return to our site on a regular basis. It should have the following characteristics (Nelson et al. 2005; Hsieh et al. 2010): **(*A*)** ***Understandability:*** easy to understand. **(*B*)** ***Reliability:*** current, accurate and credible information. **(*C*)** ***Scope:*** complete and sufficient details. **(*D*)** ***Usefulness:*** applicable to a related value.

(3) Service quality: The overall support delivered by the service provider applies regardless of whether this support is delivered by the IS department, a new organizational unit, or outsourced to an Internet service provider (ISP). Its importance is most likely greater than previously since the users are now our customers and a poor user support will translate into lost customers and lost sales. Therefore, the assurance, empathy and responsiveness are critical elements in this dimension. Therefore, the service quality includes (Pitt et al. 1995): **(*A*)** ***Tangibility:*** physical facilities, equipment, and personnel appearance. **(*B*)** ***Reliability:*** able to perform the promised service dependably and accurately. **(*C*)** ***Responsiveness:*** willingness to help customers and provide prompt services. **(*D*)** ***Assurance:*** being able to gain trust and confidence; being knowledgeable and courteous. **(*E*)** ***Empathy:*** being caring and giving personal attention as the service provider to the customers. Service quality is founded on the comparison between what the customer thinks he/she should be offered and what is actually provided; the fact whether the service fulfils the users' expectation has a strong effect on the overall satisfaction (Pitt et al. 1995; Lwoga 2013).

(4) Usage: It measures everything from the visit to a Web site (number of site visits), to the navigation within the site (navigation patterns), to the information retrieval (nature of use), to the execution of a transaction (number of transactions executed).

(5) User satisfaction: It remains an important means of measuring our customers' opinions of our e-commerce system and should cover the entire customer experience cycle from the information retrieval through the purchase, payment, receipt, and service. Therefore, repeated purchases, repeated visits and the user surveys are critical elements in this dimension.

(6) Net benefits: They are the most important success measures as they capture the balance of positive and negative impacts of the e-commerce on our customers, suppliers, employees, organizations, markets, industries, economies, and even our societies. Therefore, cost savings, expanded markets, incremental additional sales, reduced search costs and time savings are critical elements in this dimension.

Moreover, according to the study of DeLone and Mclean (2004), they believe that different kinds of industries will have different characteristics to use and make the system a success. Therefore, the on-line Agricultural Products Navigation System should include different kinds of characteristics to make it successful, especially that it can be operated by the mobile devices. In the light of this, based on the updated D&M IS success model (2003), this study proposes the following two propositions:

P_1: In the on-line Agricultural Products Navigation System, information and service quality should include some characteristics which will improve the system success.

P_2: To compare with other industries, the usage of the on-line Agricultural Products Navigation System will differ according to the users (farmers and customers) to ensure the success of the system.

RESEARCH METHOD

In order to resolve the two questions of this study, this study presents a design for an on-line Agricultural Products Navigation System in the first stage, then adopts a qualitative research approach to interview the farmers and customers who have used the system in the second stage.

First Stage: Design an on-line agricultural products navigation system

This study uses Dream Weaver (2012), SQL Server 2005(2012), Google Earth (2012) and Google Map API (2012) as the developing tools: **(1)** ***Dream Weaver:*** Overall professional tool sets, used to set up and subordinate the Internet and the Internet application programs. It provides an integrated encoding environment and powerful standard WYSIWYG design platform; for the main program language used by the system, all program designers need to know how to design the modularization, windows and Object-Oriented Programming to work in different divisions (Chiang 2006; Laboratory of Ming-Wei Shih 2008; Studio of Ruei Deh 2007; Tsai 2006). **(2)** ***Microsoft***

doi: 10.17221/26/2016-AGRICECON

SQL Server 2005 (2012)**:** A well functioned database platform, using the integrated business intellectual (BI) tools to provide the data management function for business. In addition, the SQL Server 2005 database also provides a safer, more stable storage environment for the relational and structural data, in which the team members may set and manage a more useful and efficient application for company. **(3)** ***Google Earth*** (2012)**:** The visual tellurium software of the Google Company sets all satellite photos, aviation photos and Earth information system on the Google Earth Model. **(4)** ***Google Map API*** (2012)**:** Tools to produce, to view and edit 2D diagrams; it is simple and has various functions to work easily and efficiently (Chiang and Gong 2008).

The platform of each function is also designed according to the needs of the users, so that the users encounter fewer problems while working with the system. The system constantly interacts with the farmers and potential customers during the analysis and designing process, it receives suggestions from different sides, it continuously edits and renews its functions in order to achieve satisfaction for the users.

Second stage: Qualitative research approach

There is an absence of an extant literature on building an on-line Agricultural Products Navigation System used by the farmers (to have the government certification of agricultural products) and customers, but also organizational employees. Therefore, the next two questions are critical for this study: (1) What kinds of characteristics should be included in this system? (2) How will farmers and customers use this system and what characteristics are needed to achieve a successful system? In order to resolve the above two research questions, it is impossible to analyse the interactive relationship using the Cross-Section Positivism, since the user feedback of farmers and customers is a process (Pettigrew 1985). For this reason, the study adopted a case study approach to collect and analyse data (Paré 2004; Strauss and Corbin 1990). This paper adopts a multiple case study approach, collecting qualitative data from the farmers and customers who have used the on-line Agricultural Products Navigation System, then analysing the data based on the Updated D&M IS Success Model (DeLone and McLean 2003) (Strauss and Corbin 1990; Yin 1994; Paré 2004). In the light of this, this study was driven by the Eisenhardt's (1989) suggested eight steps of the theory (model) testing (building), consisting of: get started, selecting the cases, crafting the instruments and protocols, entering the field, analysing data, shaping propositions, enfolding the literature, and reaching a closure.

Firstly, two farmers have used the on-line Agricultural Products Navigation System to sell their agricultural products. Case # 1 is a pineapple farmer, and Case # 2 is a mango farmer. All of them believe that their agricultural products sales will be increased through this system. Secondly, five customers have bought agricultural products with this system. They also believe that the success of this system will be different from other systems. In the light of this, for collecting the qualitative data, the primary data sources were the semi-structured interviews (Myers 1997). The interview teams consisted of two of the four authors. The interview protocols were developed and refined several times. The interviews were taped, with the agreement from the participants. The semi-structured interviews lasted in average 2 hours. The taped interviews were transcribed verbatim into text files. To understand the systems success factors, the following represent a sample of the questions that guided the interview process (the follow-up questions in parentheses):

– What kinds of "system quality" will influence you to be willing to use this system? Does it affect your satisfaction for this system? Why or why not?
– What kinds of "information quality" will influence you to be willing to use this system? Does it affect your satisfaction with this system? Why or why not?
– What kinds of "service quality" will influence you be willing to use this system? Does it affect your satisfaction with this system? Why or why not?
– In what way will you use this system? Why or why not?
– Do you think the use (intention to use) and user satisfaction will impact each other? Why or why not?
– Do you think the use (intention to use), user satisfaction will be perceived as a net benefit? Why or why not?
– Do you think the net benefits will as a feedback influence the use (intention to use) and user satisfaction? Why or why not?

We also observed the users' physical environments to be certain that their user approach matches the interviewees' description. Based on the key constructs of the updated D&M IS success model (2003), we developed an initial list of coding categories. This

doi: 10.17221/26/2016-AGRICECON

list was refined after the first interviews, and refined again after the interviews were completed to reflect both the information gained from the interviews and the additional information of the published research (Strauss and Corbin 1990; Paré 2004). Once the research team agreed on the list of categories, each member separately coded the same interview file. We compared the results and discussed the differences until an agreement was reached on the categories, meanings, and future coding procedures (Paré 2004). One researcher then coded the interview files using the revised coding scheme, which provided not only the structure but also the flexibility for coding the new or unexpected findings (Strauss and Corbin 1990).

Table 1. Steps for developing propositions (adapted from Eisenhardt 1989)

Steps	Activity	Reason	This paper
1. Get started	(1)Definition of research question (2) Definition of a priori constructs	(1)Focuses efforts (2) Provides better grounding of construct measures	(1) What kinds of characteristics should be included in this system? (2) How will farmers and customers use this system and what characteristics can be found to achieve the system success?
2. Case selection	Theoretical, not random, sampling	Retains theoretical flexibility. Constrains extraneous variation and sharpens external validity	Cases that adopted and used the on-line Agricultural Products Navigation System
3. Craft data collection protocols	(1)Employ multiple data-collection methods (2)Qualitative and quantitative data	(1) Strengthens grounding of theory by triangulation of evidence (2)Synergistic view of evidence	(1) Interviews and observation are used to strengthen the grounding of theory through the triangulation of evidence. This enhances the internal validity (2)Synergistic view of the evidence
4. Entering the field	(1) Overlapping of data collection and analysis (2) Flexible and opportunistic data-collection methods	(1) Speeds analyses and reveals helpful adjustments to data collection (2) Allows investigators to take advantage of emergent themes and unique case features	(1) Iterative process is used to speed analysis and to reveal helpful adjustments to data collection (2) Emergent themes and particular case features are exploited by investigator
5. Data analysis	(1) Within-case analysis (2) Cross-case pattern search using divergent techniques	(1) Gains familiarity with data and preliminary theory generation (2) Forces investigators to look beyond the initial impressions and see evidence through multiple lenses	(1) Clarification of cases needed in the on-line Agricultural Products Navigation System (2) Comparison of the similarities and differences among all cases is made, enhancing the probability that the researchers will capture relationships which may exist in their data but not in the data of the prior studies
6. Shape propositions	(1) Iterative tabulation of evidence for each construct (2) Replication, not sampling, logic across cases (3) Searching evidence for "why" behind the relationships	(1) Sharpens the construct definition, validity, and measurability (2)Confirms, extends, and sharpens theory (3)Builds internal validity	(1) Verification of the propositions of the stakeholders' role and how they influence the outcome of the on-line Agricultural Products Navigation System (2) Development of the IS success dimensions relationships (3) Integration of categories to test theoretical propositions. All forms of coding enhance internal validity
7. Enfold the Literature	(1) Comparisons with conflicting frameworks (2) Comparison with similar frameworks.	(1) Builds internal validity, raises theoretical level, and sharpens construct definitions (2) Sharpens generalizability, improves construct definition, and raises theoretical level	(1) Comparison of established relationships of this study with prior published studies (2) Confirmation or falsification of the perspective of DeLone and McLean (2003) for the on-line Agricultural Products Navigation System in the second stage of this study
8.Reach Closure	Theoretical saturation	Ends the process when marginal improvement becomes small	No new information gained after the case interviews

doi: 10.17221/26/2016-AGRICECON

After these files were coded, further discussions were held until the coders achieved a complete agreement on the content categories and descriptors within the categories. An agreement was achieved through the open discussion. Each case was then recoded.

RESULTS

On-line Agricultural Products Navigation System

The database of this system is based on the attribute and spatial information of the agricultural products, it is, therefore, necessary to map out an extra method to produce and establish the graphic format which is supported by the Google Earth. This study uses the Google Earth as a tool to demonstrate the agricultural products as the actual map on the Google Earth and to combine the products' graphic with the farmers' address. In this way, it is possible to search for the agricultural products, places and relative information of the farmers (Figure S1 in electronic supplementary materiál (EMS); for the supplementary materiál see the electronic version). the relative information of the products can also be renewed or deleted if needed.

The On-line Agricultural Products Navigation System includes three management systems and eleven sub-systems (Figure 2). They are described as follows:

(1) Google Earth management system: (*A*) ***display graphic system:*** combines all display information graphic systems in Google Earth*;* (***B***) ***area selecting system:*** a system to combine the cartographic data of the Google Earth and displays the information from different areas.

(2) Farmers management system: (*A*) ***farmers data processing system:*** to manage the information of the farmers; (***B***) ***agricultural products data processing system:*** to manage the renewed and edited information of the agricultural products; (***C***) ***Delivering processing system:*** to manage the delivery of the farmers; (***D***) ***Transaction feedback processing system:*** to manage the customer's feedback (e.g., after the customer has completed the payment).

(3) Membership management system*:* (*A*) ***Tradable agricultural products analysis system:*** to search for the analysis information of tradable agricultural products and areas; (***B***) ***Membership data processing system:*** to manage the members' information; (***C***) ***Agricultural products order processing system:*** to deal with the orders of agricultural products; (***D***) ***Transaction data processing system:*** according to the situation of the member orders, it reports immediately the information of the trade; (***E***) ***Payment processing system:*** to manage the payment information from the members.

All the sub-systems mentioned above are written with the Dream Weaver (2012), the Microsoft SQL Server 2005 (2012) and the Google Earth into the guiding forms as an online trading platform. It combines the function of an item searching from the Google Earth and builds an on-line Agricultural Products Navigation System on the Google Earth (Figures S2–S4

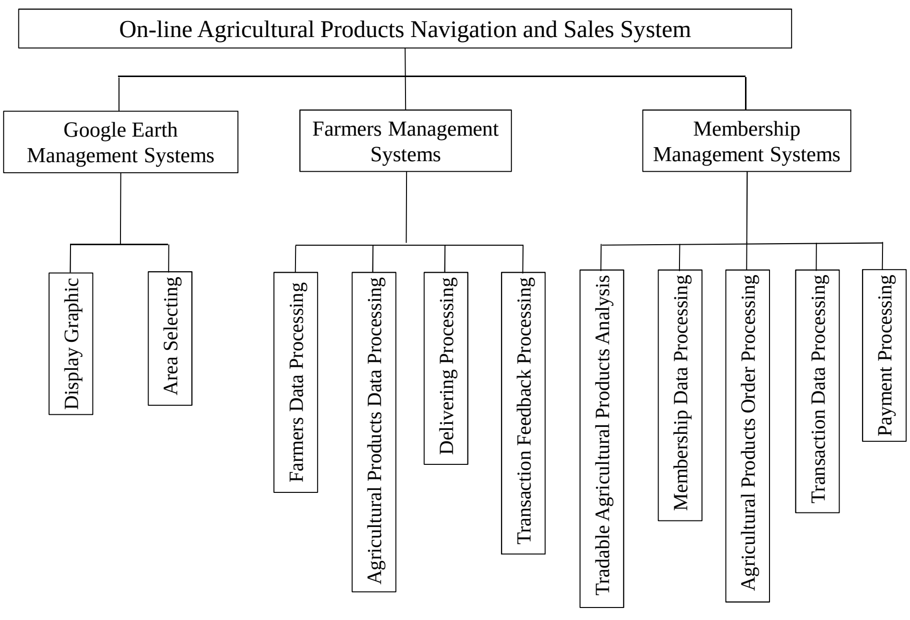

Figure 2. System structure

doi: 10.17221/26/2016-AGRICECON

in EMS). This not only provides the customers with a convenient and efficient online platform, avoids the previous complicated process, such as the personal consultations for agricultural product trade, but it also avoids the exploitation by brokers. Whether for the clients or farmers, this system creates a low-cost access for the greatest benefit and efficiency.

The system provides several ways for searching: **(1)** ***Single condition search:*** According to the name of the agricultural products (Figure S5 in EMS), areas (Figure S6 in EMS), customers (Figure S7 in EMS) and search for the needed products individually. **(2)** ***Multiple conditions search:*** Chooses several areas and products (Figure S8 in EMS); choose a combination of multiple areas and products at the same time for searching products (Figure S9 in EMS).

After the customers have chosen their area and agricultural products and farmers according to their needs, they will confirm it on the front page of the system, enter their member information (Figure S10 in EMS), and order the products at the relative subsystem for members (Figure S11 in EMS). The system has the advantage that it can be operated through the handheld devices (e.g., tablet computer, smart phones, PDA etc.) in order to order the products online at any time (Figures S12–S13 in ESM).

Result of qualitative data

(1) System quality: The updated D&M IS success model (2003) suggests that the desired characteristics of an e-commerce system should be measured in the Internet environment. These are: usability, availability, reliability, adaptability, and response time (e.g., download time), which are the examples of qualities that are valued by the users of an e-commerce system. However, so that farmers can sell their agricultural products through the on-line Agricultural Products Navigation System in this study, there is necessary an inter-exchange system data with the distributors' system at the same time. For this reason, the P_1 cannot satisfy the data of this study, therefore, we extend P_1 and revise it to the following proposition:

New_$P_{1\text{-}1}$: The system should provide an inter-exchange data function with the distributors' system to improve the system quality.

(2) Information quality: The updated D&M IS success model (2003) suggests that for capturing the e-commerce content issue, the web content should be personalized, complete, relevant, easy to understand, and secure if we expect the prospective buyers or suppliers to initiate transactions via the Internet and to return to our site on a regular basis.

(3) Service quality: The updated D&M IS success model (2003) believes that the overall support delivered by the service provider applies regardless of whether this support is delivered by the IS department, a new organizational unit, or outsourced to an Internet service provider (ISP). Its importance is the most likely greater than previously since the users are now our customers and a poor user support will translate into lost customers and lost sales. Therefore, the assurance, empathy and responsiveness are critical elements in this dimension. But, due to the fact that most of farmers who have adopted the on-line Agricultural Products Navigation System do not have the ability to resolve the system's problems, a 24-hours service of the system maintenance will be necessary. In the light of this, P_1 was extended and revised to the following proposition:

New_$P_{1\text{-}2}$: The system should provide the 24 hours service to improve the service quality.

(4) Usage: The updated D&M IS success model (2003) believes that everything from the visit to a Web site (number of site visits), to the navigation within the site (navigation patterns), to the information retrieval (nature of use), to the execution of a transaction (number of transactions executed) should be measured.

(5) User satisfaction: The updated D&M IS success model (2003) provides an important means of measuring our customers' opinions of our e-commerce system and should cover the entire customer experience cycle from the information retrieval through the purchase, payment, receipt, and service. Therefore, repeated purchases, repeated visits and user surveys are the critical elements in this dimension. However, the users' satisfaction will be produced after they have used (intention to use) the on-line Agricultural Products Navigation System. For this reason, this study extends P_2 and revises it to the following proposition:

New_$P_{2\text{-}1}$: Farmers will check the users request frequencies, but customers will query all kinds of agricultural products which they need.

New_$P_{2\text{-}2}$: Use (Intention to use) the system will influence user satisfaction.

(6) Net benefits: The updated D&M IS success model (2003) believes that it is the most important to balance the positive and negative impacts of the e-commerce on customers, suppliers, employees, organizations, markets, industries, economies, and

doi: 10.17221/26/2016-AGRICECON

even our societies. Therefore, cost savings, expanded markets, incremental additional sales, reduced search costs and time savings are the critical elements in this dimension.

In sum, the "on-line Agricultural Products Navigation System" has characteristics which could differ from other information systems. For this reason, this study has extended the updated D&M IS success model (2003) with four modified new propositions.

RESEARCH CONTRIBUTIONS

Academic contributions

Although the system has a number of advantages as described above, however, the Google Earth could not access the remote map data on the Android platform and this is the first contribution of this study. Therefore, we have resolved this by the following method: (1) transferring the database data to the KML format, which can R/W by the Google Earth on the Android platform; (2) although a default is declared with the UTF-8 code format in the file, it still needs to declare the UTF-8 in the program, before saving data to the KML to resolve the Chinese Mojibake problem; (3) addition of the exhibit figure KML function and helping the users to download the KML to exhibit the agricultural products figures problem with the Android platform; and (4) to change the users' connection to the outside IP address of server to capture and exhibit the figures on the Android platform. In the light of this, all the Android platform smart phone users can now perform the transaction of agricultural products through their smart phones at any time or place very easily.

This study found that the "on-line Agricultural Products Navigation System" indeed needs some system, information and service quality different from other industries' systems; and the users (farmers and customers) also have different kinds of use. Therefore, this study proposed $\boldsymbol{New\_P_{1\text{-}1}}$, $\boldsymbol{New\_P_{1\text{-}2}}$, $\boldsymbol{New\_P_{2\text{-}1}}$ and $\boldsymbol{New\_P_{2\text{-}2}}$ to revise and extend the perspective of DeLone and Mclean (2004) for adapting it for the agricultural system.

Contributions for practice

The system provides both farmers and customers with a powerful dynamic map, which facilitates the trade of agricultural products. First of all, the farmers can easily use the system to manage their agricultural products and to display them on the Internet in the Google Earth platform. Secondly, the consumers can easily use computers or handheld devices (e.g., tablet computer, smart phones, PDA etc.) to search for both the spatial and attribute information of the nearest farmers and products on this platform and to order the agricultural products they want. After the consumers complete the purchase, they can view their orders online at any time. The farmers can meanwhile obtain the basic information about the consumers and their orders, to manage and sell products accordingly in a more convenient and efficient way, to sell products and to create profits later on. Not only can the farmers promote products without using any commercials (due to the free APP it is easy to download it through handheld devices), the users can also save their search time and consume agricultural products from the nearest distance and at the lowest-cost, but also by the most convenient method, facilitating the pick-up procedure and saving the transport cost. It reduces the carbon footprint and accomplishes the purpose of energy saving and carbon reduction. It also reduces the time and spatial problems of both sides during trading and avoids the exploitation by brokers.

CONCLUSION

The system provides both farmers and customers with a powerful dynamic map, which facilitates the trade in between and achieve the goals below: the first step is to upload the pictures on the Internet. Users can search the spatial information simply through a computer's browser or Android smart phones and enlarge or reduce the size of pictures. Then, when the users are surfing the website of the system, they can collect the relative information and the geographic location of the farmers. Not only the farmers can promote their products without using any commercials, the users can also save their time of searching and consume the wanted products from the nearest distance and with the lowest-cost but in the most convenient way, which saves energy and reduces the carbon footprint. Moreover, besides viewing the location and the farmers' information, the system also provides farmers and customers with an online platform for the agricultural products trade. It reduces the time and spatial troubles of both sides during the trades and avoids the exploitation by the

doi: 10.17221/26/2016-AGRICECON

brokers. Lastly, the system also provides the farmers with the effective product management functions and an efficient searching platform for the relative information on agricultural products.

REFERENCES

Ahn T., Ry S., Han I. (2007): The impact of web quality and playfulness on user acceptance of online retailing. Information & Management, 44: 263–275.

Aker J.C. (2011): Dial "A" for agriculture a review of information and communication technologies for agricultural extension in developing countries. Agricultural Economics, 42: 631–647.

Bansal V.K., Pal M. (2009): Construction schedule review in GIS with a navigable 3D animation of project activities. International Journal of Project Management, 27: 532–542.

Besser T., Mann S. (2015): Which farm characteristics influence work satisfaction? An analysis of two agricultural systems. Agricultural Systems, 141: 107–112.

Chen C.W. (2010): Impact of quality antecedents on taxpayer satisfaction with online tax-filing systems – An empirical study. Information & Management, 47: 308–315.

Chiang K.J. (2006): Personal Book of Dream Weaver 8. Tpi Publishing, Taipei.

Chiang K., Gong S.P. (2008): Google API Development Resolution: Google Map and Google Earth Double Stalwarts. TPi Publishing, Taipei.

Dalgaard R., Halberg N., Kristensen I.S., Larsen I. (2006): Modelling representative and coherent Danish farm types based on farm accountancy data for use in environmental assessments. Agriculture, Ecosystems and Environment, 117: 223–237.

D'Ambra J., Rice R.E. (2001): Emerging factors in user evaluation of the World Wide Web. Information & Management, 38: 373–384.

Danish Agriculture (2007): Danish agriculture in numbers. Land Economic Outlook.

DeLone W.H. (1992): McLean ER Information systems success: The quest for the dependent variable. Information Systems Research, 3: 60–95.

DeLone W.H., McLean E.R. (2003): The DeLone and McLean model of information systems success: A ten-year update. Journal of Management Information Systems, 19: 9–30.

Delone W.H., Mclean E.R. (2004): Measuring e-commerce success: Applying the DeLone & McLean information systems success model. International Journal of Electronic Commerce, 9: 31–47.

Eisenhardt K.M. (1989): Building theories from case study research. The Academy of Management Review, 14: 532–550.

Fountas S., Wulfsohn D., Blackmore B.S., Jacobsen H.L., Pedersen S.M. (2006): A model of decision-making and information flows for information-intensive agriculture. Agricultural Systems, 87: 192–210.

Gloya B.A., Akridgeb J.T. (2000): Computer and internet adoption on large U.S. farms. International Food and Agribusiness Management Review, 3: 323–338.

Google Earth (2012): Available online at http://code.google.com/intl/zh-TW/apis/earth/

Google Map API (2012): Available online at http://code.google.com/intl/zh-TW/apis/maps/

Hsieh C.C., Kuo P.L., Yang S.C., Lin S.H. (2010): Assessing blog-user satisfaction using the expectation and disconfirmation approach. Computers in Human Behavior, 26: 1434–1444.

Hu X. (2015): Effectiveness of information technology in reducing corruption in China: A validation of the DeLone and McLean information systems success model. The Electronic Library, 33: 52–64.

Inan H.I., Sagris V., Devos W., Milenov P., van Oosterom P., Zevenbergen J. (2010): Data model for the collaboration between land administration systems and agricultural land parcel identification systems. Journal of Environmental Management, 91: 2440–2454.

Jakku E., Thorburn P.J. (2010): A conceptual framework for guiding the participatory development of agricultural decision support systems. Agricultural Systems, 103: 675–682.

Jensen L.A., Sorensen C.G., Jorgensen R.N. (2007): Real-time internet-based traceability unit for mobile payload vehicles. In: Proceedings of the XXXII COSTA-CIGR Conference Advances in Labour and Machinery Management for a Profitable Agriculture and Forestry, Nitra, Sep 17–19, 2016: 368–374.

Klerkx L., van Mierlo B., Leeuwis C. (2012): Evolution of systems approaches to agricultural innovation: concepts, analysis and interventions (Chapter 20). In: Darnhofer I., Gibbon D., Dedieu B. (eds): Farming Systems Research into the 21st Century: The New Dynamic. Springer Science, Dordrecht: 457–483.

Laboratory of Shih M.W. (2008): The Sixteen Courses of Correct Learning Dream Weaver CS3. Flag Publishing, Taipei.

Lake D. (1999): Spotlight: how big is the U.S. net population? The Industry Standard, Nov 29, 1999. Available at http://www.thestandard.com/metrics/display/0,2149,1071,00.html

Lewis T. (1998): Evolution of farm management information systems. Computers and Electronics in Agriculture, 19: 233–248.

doi: 10.17221/26/2016-AGRICECON

Liu C., Arnett K.P. (2000): Exploring the factors associated with Web site success in the context of electronic commerce. Information & Management, 38: 23–33.

Liu S., Zhang P., He X., Li J. (2015): Efficiency change in North-East China agricultural sector: A DEA approach. Agricultural Economics – Czech, 61: 522–532.

Louhichi K., Kanellopoulos A., Janssen S., Flichman G., Blanco M., Hengsdijk H., Heckelei T., Berentsen P., Oude Lansink A., van Ittersum M. (2010): FSSIM, a bio-economic farm model for simulating the response of EU farming systems to agricultural and environmental policies. Agricultural Systems, 103: 585–597.

Lwoga E.T. (2013): Measuring the success of library 2.0 technologies in the African context: The suitability of the DeLone and McLean's model. Campus-Wide Information Systems, 30: 288–307.

Mason R.O. (1978): Measuring information output: A communication systems approach. Information & Management, 1: 219–234.

Microsoft SQL Server (2012): The Evolution of Microsoft SQL Server, 1989 to 2005.

Molla A., Licker P.S. (2001): E-commerce systems success: An attempt to extend and respecify the DeLone and McLean model of IS success. Journal of Electronic Commerce Success, 2: 1–11.

Myers M.D. (1997): Qualitative research in information systems MIS Quarterly Discovery. Available at http://www.qual.auckland.ac.nz/

National Agricultural Statistics Service (NASS) (1999): Farm Computer Usage and Ownership. Agricultural Statistics Board, USDA.

Nelson R.R., Todd P.A., Wixom B.H. (2005): Antecedents of information and system quality: An empirical examination within the context of data warehousing. Journal of Management Information Systems, 21: 199–235.

Nikkilä E., Seilonen I., Koskinen K. (2010): Software architecture for farm management information systems in precision agriculture. Computers and Electronics in Agriculture, 70: 328–336.

Palmer J.W. (2002): Web site usability, design and performance metrics. Information Systems Research, 13: 151–167.

Paré G. (2004): Investigating information systems with positivist case study research. Communications of the Association for Information Systems, 13: 233–264.

Pedersen S.M., Fountas S., Blackmore B.S., Gylling M., Pedersen J.L. (2004): Adoption and perspective of precision farming in Denmark. Acta Agriculturae Scandinavica, Section B, Soil and Plant Science, 54: 2–6.

Pettigrew A.M. (1985): Contextualist research and the study of organizational change processes. In: Mumford E., Hirshheim R., Fitzgerald G., Harper T.W. (eds): Research Methods Information Systems. North-Hollan: 53–72.

Pitt F.L., Watson R.T., Kavan C.B. (1995): Service quality: a measure of information systems effectiveness. MIS Quarterly, 19: 173–187.

Reichardt M., Juergens C. (2009): Adoption and future perspective of precision farming in Germany: results of several surveys among different agricultural target groups. Precision Agriculture, 10: 73–94.

Shannon C.E., Weaver W. (1949): The Mathematical Theory of Communication. University of Illinois Press, Urbana.

Sørensena G.C., Fountasb S., Nashf E., Pesonend L., Bochtisa D., Pedersene S.M. (2010): Conceptual model of a future farm management information system. Computers and Electronics in Agriculture, 72: 37–47.

Strauss A., Corbin J. (1990): Basics of Qualitative Research: Grounded Theory, Procedures and Techniques. Sage Publications, Newbury Park.

Studio of Ruei D. (2007): Dream Weaver & ASP.NET web database design practices. TPi Publishing, Taipei.

Tsai Z.M. (2006): Dream Weaver 8 for Dynamic Web database design practices. TPi Publishing, Taipei.

Teo T.S.H., Choo W.Y. (2001): Assessing the impact of using the Internet for competitive intelligence. Information & Management, 39: 67–83.

Wu R.H., Lin H.H. (2010): Information System Analysis and Design. Tze-Sung Publication.

Yin R.K. (1994): Case Study Research: Design and Methods. 2nd ed. Sage Publication.

Received January 20, 2016
Accepted May 25, 2016
Published online June 1, 2017