Deploying an Observatory of Agricultural e-Markets

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Abstract

The emergent adoption of Information & Communication Technologies (ICT) has led an increasing number of agricultural professionals and enterprises that are demonstrating electronic commerce (e-commerce) activities. In most occasions, these activities include the use and/or deployment of electronic markets (e-markets). The growing number of e-markets that offer agricultural products and supplies and that are currently operating online, may create confusion to a typical Internet user that is searching for interesting e-markets online. To overcome this information overload, appropriate Internet-based services can be introduced. To this direction, this paper presents the design and prototype implementation of an online observatory of Greek agricultural e-markets. This observatory aims to help users that search for agricultural e-markets online, according to characteristics such as their products and services or their geographical coverage.

Key words: E-commerce, agricultural e-markets, UML, RUP, metadata.

1 Introduction

Electronic markets (e-markets), which are also referred to as e-marketplaces or electronic trade systems (Fritz et al., 2005), can be defined as information systems that intend to provide their users with online services that will facilitate information exchange and transactions. E-markets are characterized by the very low-cost flow of information between market participants (e.g. producers and consumers), and they have been long expected to create economic value for buyers, sellers, market intermediaries, and for society as a whole (Grieger, 2003). In the agricultural sector, a plethora of e-markets have already started their operation (Manouselis et al., 2005). These e-markets mainly provide products, supplies and services to the stakeholders of the agricultural sector and can be generally termed as agricultural e-markets. They may serve as an additional trade and marketing channel for agricultural professionals and enterprises (e.g. producers, processors, retailers, agribusinesses, wholesalers, brokers), also providing them the opportunity to extend the chain of their suppliers. In general, agricultural e-markets may play an important role for agricultural professionals and enterprises, providing them an alternative communication medium with their market participants, and allowing them to further develop to extend their consumer base online through the World Wide Web.

Agricultural e-markets can be distinguished in three major categories (Wilson, 2001; Manouselis et al., 2005): (a) e-markets for the outputs of farms, which are usually operated by producers or retailers, and which sell agricultural products to consumers; (b) e-markets for the production factors and inputs of farms, which are usually operated by agribusinesses and sell products (e.g. machinery parts, seed, chemicals) to the producers; and (c) e-markets of services by third parties, which offer specialised support services to producers such as logistic, transport, banking, insurance and legal services. It is important to note that agricultural e-markets demonstrate different degrees of e-commerce adoption. For instance, there are e-markets that provide only product catalogue information, e-markets that also provide transaction settlement, and more sophisticated e-markets that support online negotiations as well.
However, from the online user’s perspective (being it a consumer interested in agricultural products or a producer looking for farm supplies), tasks such as searching, locating, comparing and selecting an appropriate agricultural e-market can be difficult and time-consuming. The large amount of information from the variety of existing agricultural e-markets, as well as the complicated transactions offered by advanced e-markets, can become complex for a typical Internet user. To overcome such problems, Internet-based services may be introduced to help users find agricultural e-markets according to their specific needs and preferences. In this direction, this paper proposes the design and implementation of an online observatory of agricultural e-markets. Such a system can support Internet users that search for agricultural e-markets according to characteristics such as their product types or their geographical coverage. The paper describes the development process of such a system according to the Unified Modelling Language (UML)-based Rational Unified Process (RUP) lifecycle approach. It also presents a prototype implementation of the suggested system. To facilitate structured description and classification of agricultural e-markets in its database system, the proposed observatory is built upon a metadata schema for the description of e-markets, the Dublin Core for E-Markets (DC-EM) (Manouselis et al., 2005; Manouselis & Costopoulou, 2006) specialized for particular characteristics of the agricultural e-markets. Thus, the system is briefly called the AgreMaM (Agricultural e-Markets Metadata) observatory.

2 Background

2.1 Metadata

Metadata is made up of data items that can be added to or attached to an information resource. Such data items can be (i) machine-readable, giving software applications the data they need to interpret the information held on a resource, or (ii) designed for human interaction, listing the creator, subject, title, and other data needed to find and manage the resource. These data items are better known as metadata elements. To use and benefit from metadata on the Internet, we need a common format for expressing it that should be designed for machines rather than humans. Metadata schemas (or metadata models) are sets of metadata elements designed for a specific purpose, such as describing a particular type of resource (NISO, 2004). Metadata specifications are well-defined and widely agreed metadata schemas that are expected to be adopted by the majority of implementers in a particular domain or industry. When a specification is widely recognized and adopted by some standardization organization (such as ISO), it then becomes a metadata standard. There is no one all-encompassing metadata standard to be used in all applications. Rather, there are various metadata standards or specifications that can be adapted or ‘profiled’ to meet community context-specific needs. This conclusion has lead to the emergence of the ‘application profile’ concept. An application profile is an assemblage of metadata elements selected from one or more metadata schemas. The purpose of an application profile is to adapt or combine existing standards or specifications into a package that is tailored to the functional requirements of a particular application, while retaining interoperability with the original base schemas (Duval et al., 2002).

In AgreMaM, an application profile of the DC-EM schema has been developed. More specifically, the DC-EM schema (Manouselis & Costopoulou, 2006) is a specialised metadata schema for describing e-markets based on the generic Dublin Core metadata standard (http://www.dublincore.org). It stores e-market characteristics in a systematic, interoperable and reusable manner, and allows for the description and classification of e-markets, facilitating online services (e.g. search engines, e-market catalogues) that might be deployed to support Internet users. In AgreMaM, the DC-EM elements have been specialised to reflect particular characteristics of the agricultural e-markets such as the geographical coverage of the e-market (where the ability to refer to geographical regions apart from countries has been included), the classification of the e-market in relation to the particular agricultural segment it is operating in (using the AGROVOC vocabulary of FAO, http://www.fao.org/aims/), and the main targeted audience of the e-market (distinguishing different agricultural stakeholders such as producers, processors, traders, etc.).

2.2 RUP design

Software development involves a number of steps to be carried out, so that a software system is properly modelled, analysed, designed, specified and implemented. To design and develop the prototype version of AgreMaM, the RUP has been followed (Boggs & Boggs, 2002). RUP is an iterative software development process that is especially well suited to UML (http://www.uml.org), which is the de-facto software industry standard modelling language for visualizing, specifying, constructing and documenting
the elements of systems in general, and software systems in particular. It provides a rich set of graphical artifacts to help in the elicitation and top-down refinement of software systems from requirements capture to the deployment of software components. In UML, a system is described using different levels of abstraction and considering various views (i.e. Business view, Use Case view, Design and Process view, Implementation view). Each view is realized using different UML modelling tools (diagrams), such as Use Case Diagrams, Activity Diagrams, Sequence Diagrams, Collaboration Diagrams, Statechart Diagrams, Class Diagrams, Component Diagrams, and Deployment Diagrams. UML is largely process-independent, meaning that it can be used with a number of software development processes. RUP is an iterative software development process that is especially well suited to UML. The RUP development starts with four process workflows (business modelling, requirements or system use case modelling, analysis and design, and implementation) that adopt the various UML views, and continues with five more process workflows (test, deployment, configuration management, project management and environment). For AgreMaM, we have gone through the four initial workflows, until the prototype system was developed.

3 AgreMaM: an Agricultural e-Markets Metadata observatory

The scope of building a Web-based access point (namely, an observatory) of agricultural e-markets is to provide an online environment that allows users to search, locate and select appropriate e-markets with agricultural products and supplies. The proposed AgreMaM observatory allows for searching of e-markets characteristics, as they are stored in the elements of the DC-EM model. It is built upon a database of metadata descriptions, termed as a metadata repository. This section provides an overview of the RUP workflows that led to the implementation of the AgreMaM prototype.

3.1 Business Modelling

Business modelling concentrates on the business activities that will be generally supported by the system (referred to here as the AgreMaM business), while the rest of process workflows focus on the system that will be built. It concerns the identification of business actors (anyone or anything that is external to the AgreMaM business but interacts with it), business workers (roles within the AgreMaM business), and business use cases (a group of related workflows within the AgreMaM business that provide value to the business actors). A Business Use Case Diagram illustrates business use cases, business actors, and business workers for business activities, as well as the interactions between them. Activity Diagrams can also be used to model the workflow through a particular business use case.

The AgreMaM business is the observatory that aims to facilitate online users when searching for agricultural e-markets that match their needs. We have identified two main business actors that will take advantage of the AgreMaM business, which are the following:

- **Consumer**, who is interested in finding agricultural e-markets to buy products or services (including all types of agricultural stakeholders that will perform as consumers/buyers).
- **Producer**, who is interested in finding agricultural e-markets to sell products or services, as well as making available his own e-market through AgreMaM (including all types of agricultural stakeholders that will perform as producers/sellers).

For simplicity reasons, we can accept that these two roles are interested in buying or selling products and/or services, they can be both considered as Customers of AgreMaM (Fig. 1). Furthermore, the business workers of AgreMaM are the following:

- **E-market researcher**, who is an actor internally concerned with searching, locating, and describing e-markets for AgreMaM.
- **Quality inspector**, who is an actor internally concerned with reviewing and approving the publication and modification of services (e.g. users’ registration) and content (e.g. description of e-markets) in AgreMaM.

Figure 1 presents the Business Use Case Diagram for AgreMaM. The workflow of each business use case can be furthermore analyzed using Activity Diagrams.

3.2 Requirements

Use cases and actors define the scope of the system built (Boggs & Boggs, 2002). Use cases include anything that is inside the system. Actors include anything that is external, interacting with the system.
Reconsidering the AgreMaM business actors, we identified the following AgreMaM actors, from the system’s perspective:

- **Customer**, a consumer or producer (referring to agricultural professionals or enterprises) that uses AgreMaM to find an appropriate e-market.
- **Author**, a producer describing his own e-market or an AgreMaM e-market researcher.
- **Reviewer**, the quality inspector responsible for approving the publication or modification of e-market descriptions in the repository of AgreMaM.
- **System administrator**, the quality inspector responsible for the proper functioning of the AgreMaM system and for the creation/approval of user registrations in AgreMaM.

The above actors are engaged in a number of AgreMaM system use cases, which are:

- **Make User Profile**, concerns submitting a registration request to the AgreMaM system so that a user profile is created.
- **Approve User Profile**, concerns checking and approving (or not) a user registration request.
- **Login**, concerns the logging into AgreMaM. It aims to allow only registered users to perform certain operations in the system.
- **Contribute EM**, concerns the description of an e-market according to the DC-EM model, and the submission of this description to AgreMaM for publication.
- **Approve EM**, concerns checking and approval (or not) of a submitted description of an e-market.
- **Modify EM**, concerns the modification of some elements of an e-market description and the submission of the modifications to AgreMaM for publication.
- **Evaluate EM**, concerns the submission of an evaluation (assessment of users’ satisfaction) of an e-market whose description is in AgreMaM.
- **Delete EM**, concerns the request for deletion of an e-market description from AgreMaM.
- **Approve EM Modification**, concerns checking and approval (or not) of a modification or deletion of an e-market description.
- **Simple Search**, concerns the initiation of a simple keyword-based search for e-markets in AgreMaM and viewing a list of matching results
- **Advanced Search**, concerns the initiation of a search of combined keywords and viewing results.
- **Browse**, concerns browsing descriptions according to e-market characteristics and viewing results.
- **Recommend**, concerns the request for a recommendation of an appropriate e-market description, according to the stored e-market evaluations, and viewing a list of recommended results.
- **View EM**, concerns viewing the description and characteristics of an e-market as stored in AgreMaM’s metadata repository.

Figure 2 illustrates the AgreMaM Use Case Diagram that provides an overview of the identified actors and use cases, as well as the associations between them.
Fig. 2 Use Case Diagram for AgreMaM

Fig. 3 Deployment Diagram for AgreMaM

Fig. 4 Screenshot of AgreMaM prototype
3.3 Analysis & Design

In the AgreMaM system, use cases are supported by a set of corresponding sub-systems. The following AgreMaM sub-systems have been identified:

- **Interface sub-system**, responsible for the interaction with the users, passing information to and from the users to AgreMaM.
- **Search sub-system**, responsible for transforming user search interactions to queries that are understandable from AgreMaM, as well as for returning the results to the interface sub-system.
- **Repository sub-system**, responsible for storing the descriptions of e-markets, providing data to the AgreMaM interface according to the users’ requests.

During the AgreMaM analysis, the interactions between the involved actors and the AgreMaM sub-systems are illustrated using a variety of other UML diagrams, such as Sequence Diagrams. This analysis is not presented in this paper due to space restrictions. The final result of the AgreMaM design is the Deployment Diagram. A Deployment Diagram is concerned with the physical deployment of the system, including issues such as the network layout and the location of components in the network. It illustrates all nodes of the system network, the connections between them, and the processes that will run on each one. Figure 3 presents the Deployment Diagram of AgreMaM.

3.4 Implementation

The implementation process workflow has led to the initial version of the system. More specifically, following the results of the previous workflows, a first version of the AgreMaM service has been implemented. Figure 4 presents a characteristic screenshot of the AgreMaM prototype: the interface for viewing an e-market description.

4 Conclusions

This paper describes the design and prototype implementation of AgreMaM, an online observatory for Greek agricultural e-markets. AgreMaM can support users who are searching for agricultural e-markets, based on characteristics such as their product types or their geographical coverage. In the paper, the analysis and design of AgreMaM took place using the RUP software development process, based on a series of appropriate UML diagrams. The prototype version of AgreMaM is currently populated with descriptions of e-markets, and will be soon be released for public use. In addition, an evaluation experiment with human users who will access and use AgreMaM in order to discover agricultural e-markets will be implemented, aiming at evaluating the system and providing useful feedback for its further improvement.

5 References

Boggs W., Boggs M. (2002), Mastering UML with Rational Rose. SYBEX Inc.


