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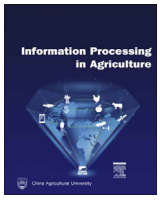
INFORMATION PROCESSING IN AGRICULTURE 2 (2015) 51–63

journal homepage: www.elsevier.com/locate/inpa



Management and control applications in Agriculture domain via a Future Internet Business-to-Business platform

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ARTICLE INFO

Article history:
Received 9 July 2014
Received in revised form
28 April 2015
Accepted 30 April 2015
Available online 14 May 2015

Keywords:
Future Internet
FI-WARE
Generic Enablers
B2B platform
Agriculture
Internet of Things

ABSTRACT

The Agriculture business domain, as a vital part of the overall supply chain, is expected to highly evolve in the upcoming years via the developments, which are taking place on the side of the Future Internet. This paper presents a novel Business-to-Business collaboration platform from the agri-food sector perspective, which aims to facilitate the collaboration of numerous stakeholders belonging to associated business domains, in an effective and flexible manner. The contemporary B2B collaboration schemes already place the requirements for swift deployment of cloud applications, capable of both integrating diverse legacy systems, as well as developing in a rapid way new services and systems, which will be able to instantly communicate and provide complete, "farm-to-fork" solutions for farmers, agri-food and logistics service providers, ICT companies, end-product producers, etc. To this end, this conceptual paper describes how these requirements are addressed via the FIspace B2B platform, focusing on the Greenhouse Management & Control scenarios.

1. Introduction

ICT and agriculture originate from disparate human needs, nevertheless, the first domain proves to be of upmost significance to the second in order to facilitate modern complex business processes related to agriculture. ICT application in agriculture has been an emerging field for some years, attempting to enhance the agricultural processes through sophisticated information and communication developments. Aspects of the agriculture industry such as crop cultivation management and control, quality management, transport of food products and food preservation may all be enhanced by taking into account their domain-specific requirements and translating them into the respective functional design, development and applications by ICT experts.

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Peer review under the responsibility of China Agricultural University.
http://dx.doi.org/10.1016/j.inpa.2015.04.002

Several efforts over the last years have attempted to integrate end-to-end ICT solutions into the agriculture business processes. Smart farming, precision agriculture, Farm Management Information Systems (FMIS), all are terms, which introduce the notion of sophisticated processes using advanced information and communication tools and systems into agriculture processes, previously unexploited. Analyses of potential developments in the precision agriculture domain have taken place taking into account spatial and temporal variations. Examples of existing site-specific precise farming approaches, using dynamic, real time, adjustable approaches as well as future directions for such developments have been described ([1,2]). With regard to existing solutions, a considerable amount of efforts is focusing on wireless sensor networks solutions for monitoring the condition of the crops during production, for product autoidentification, as well as for the transport of products condition monitoring ([3–5]). The main operations, which are in general dealt within the context of Precision Agriculture and Greenhouse Management are data monitoring, data processing, knowledge inference and finally knowledge transfer back to the farm or greenhouse and execution of the generated actions. In principle, a typical solution comprises a wireless sensor network residing inside the farm or greenhouse, while at the other end there is a database, as well as a processing component, such as an expert system, which is processing the available data and generates actions – often in an automated manner – for the farmer. Modern business processes related to agriculture and greenhouse management and control involve multiple stakeholders, enterprises, as well as external back-end systems. The complexity of those business processes is nowadays the most crucial challenge that needs to be coped with. Several sophisticated Farm Management Information Systems' solutions and architectures have been already described in the literature ([6–8]). However, most of the existing schemes limit their functionality to a very narrow aspect of the overall business process, isolating the business actors and thus, not being able to maximize the potential outcomes.

In [9] the authors describe a novel architecture, which takes advantage of the Future Internet Public–Private Partnership (FI-PPP) ([10]) capabilities in order to facilitate the interoperability among services and stakeholders. In the afore-mentioned work, it is aimed to demonstrate how the adoption of these general-purpose software modules provided by FI-PPP and their extension into farming specific ones may provide a cloud operating system that can integrate different services and applications. In [11], a detailed analysis of the FI-PPP software modules exploitation is provided according to the deployments in the context of the Smart Agri-Food (SAF) FI-PPP Phase 1 project ([12]). An operational example is used to demonstrate the interworking of the functional modules of the architecture, as well as corresponding business actors and events. In [13] the implementation of an innovative, open and flexible, cloud-based Farm Management System is provided, along with a framework that allows the interconnection among services developed by different service providers.

Another FI-PPP Phase 1 project related with the Smart Agri-Food project presented earlier, based on the FI technologies as well but focusing on the domains of transport and logistics is FInest ([15]). The aim of FInest was to define realistic business scenarios illustrating how transport business operations could be conducted and facilitated through the help of a FI-based collaboration platform. Different use case scenarios were used to demonstrate the capabilities of the FInest architecture in real-life: handling late booking cancellations, resource coordination, real-time event handling, e-planning, as well as automated shipment tracking.

Another significant perspective, in parallel to the actual developments and technology choices presented earlier, is ultimately being able to offer to the end-users (i.e., farmers, greenhouse managers, etc.) and/or domain business stakeholders the capability to search for and use specific services and applications according to own needs and requirements, from a centralized repository of services/apps, namely an "app store". An app store usually offers a variety of choices among apps, in a similar manner the famous Apple Store ([16]) or Google Play ([17]) offer. In the agriculture domain, AgWeb app store ([18]) offers a considerable number of agri-food chain-related apps specializing in different fields such as agronomy apps, farm business apps, machinery, weather, etc. What is actually missing, however, is a unified underlying infrastructure, which supports the execution of the offered apps, lacking this way in homogeneity, usability and user friendliness. Even in the case of Google Play or Apple Store, although there is a single platform to support the several apps (Android or iOS respectively), the apps are developed in a completely independent and separated way from one another, lacking any business collaboration model behind them to link their requirements, actual execution, or results and offer a complete end-to-end solution.

Although prior efforts do attempt to address some of the high challenges of the business processes either in the domain of the agriculture or the logistics exclusively, what is actually missing is a holistic, end-to-end solution, which is capable of bridging the diverse gaps between different – but directly associated – domains, such as the afore-mentioned ones. The increasing complexity through the agri-food supply chain processes, involving more and more business actors and stakeholders, as well as multiple and often complex interactions between them establish completely new needs – previously unseen. In all cases presented earlier, the proposed schemes attempt to partially enhance a narrow aspect of the overall supply chain picture, failing to provide a holistic solution, in which any stakeholder is able to take advantage of a specific business collaboration model, as well as select and deploy the desired means (apps, services) to accomplish it. Future systems cannot rely on existing infrastructure and require more sophisticated and smart frameworks in order to improve the effectiveness of business processes. Current trend is gradually heading toward the Internet capabilities in order to address several of the existing limitations. However, handling vast number of devices (i.e., Internet of Things domain), as well as realizing an efficient communication scheme between the involved stakeholders of the business chain still remain some of the most significant obstacles.

In this paper, an advanced architecture based on the Future Internet developments is presented, which aims to