Computers and Electronics in Agriculture 114 (2015) 125–133

Contents lists available at ScienceDirect

Computers and Electronics in Agriculture

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

ERP in agriculture: Lessons learned from the Dutch horticulture

C.N. Verdouw [a,b,*], R.M. Robbemond [a], J. Wolfert [a,b]

[a] LEI Wageningen UR, P.O. Box 29703, 2502 LS The Hague, The Netherlands
[b] Logistics, Decision and Information Sciences, Wageningen University, P.O. Box 8130, 6700 EW Wageningen, The Netherlands

ARTICLE INFO

Article history:
Received 16 July 2014
Received in revised form 31 March 2015
Accepted 3 April 2015

Keywords:
Enterprise resource planning
Enterprise integration
Adoption
ICT
Farm management information systems
Food and agribusiness

ABSTRACT

Farming nowadays is a complex managerial task that imposes stringent requirements on farm management information systems. In other sectors, Enterprise Resource Planning (ERP) systems are widely implemented to meet such requirements. This paper assesses the applicability of ERP systems in the agri-food domain by investigating the experiences of agri-food companies that already have implemented an ERP system. More specifically, the research has analyzed the drivers and barriers for adoption of ERP in the Dutch horticultural sector. The results show that the alignment of ERP with the specific characteristics and requirements of a company is a crucial challenge in order to capitalize the benefits of ERP. The study also shows that it is possible to deal with this challenge. The majority of the respondents (62%) is positive about of the match of the specific ERP solution with the company's business processes during implementation. Most of these respondents have implemented a system that includes a sector-specific layer around a standard ERP solution. Moreover, it is concluded that a proper management of the orientation, selection and implementation processes is of crucial importance for a successful adoption.

1. Introduction

The industrialization of agriculture has expanded a lot in the previous decades. Farms are developing towards high-tech factories that are characterized by large scale production and intensive use of technology. Farms should not only be very efficient, but also have to meet high quality and environmental standards and should adapt flexibly to changing market conditions. In this complex and turbulent business environment, it is of great importance to keep business processes in control. This imposes high requirements on the managerial tasks in agri-food business and consequently on the supporting information systems, particularly regarding flexibility, integration and incorporation of intelligence for advanced decision making (Sørensen et al., 2010; Wolfert et al., 2010). It is widely argued that the current information systems in the agri-food sector do not sufficiently meet these requirements (Sørensen et al., 2010; Teye et al., 2012; Lehmann et al., 2012; Kruize et al., 2013; Verdouw et al., 2013). In other sectors, Enterprise Resource Planning (ERP) systems are widely implemented to mitigate for this. An ERP system is a standardized software package that combines functionality of multiple business functions into one integrated system (Davenport, 2000; Kumar and Hillegersberg, 2000). ERP helps to overcome fragmentation between organizational units (functional silos) and systems (island automation). As a result, ERP could potentially be an effective solution approach also for the agri-food sector.

Hence, this paper assesses the applicability of ERP systems in the agri-food sector by investigating the experiences of companies that already have implemented an ERP system in this sector. More specifically, the research aims to identify drivers and barriers for the adoption of ERP systems in the Dutch horticultural sector. This sector is chosen because of its expected front-running position concerning ERP adoption within the Dutch agri-food cluster. The trend towards complex managerial tasks and scale-enlargement is already in an advanced phase in Dutch horticulture (Berkhout et al., 2014). Production processes are highly industrialized and companies have developed into big international organizations. As a result, ERP systems are increasingly used in Dutch horticulture.

The paper is structured as follows. It first describes the research methodology and it provides some background of ERP and its application in agriculture. Next, it introduces the framework for analysis that is used to identify barriers and drivers in the adoption of ERP. The paper subsequently presents the results of the investigation of existing ERP implementations in the Dutch horticulture. Finally, it concludes with summarizing the main findings and discussing the main contributions to literature and practical implications.

* Corresponding author at: LEI Wageningen UR, P.O. Box 29703, 2502 LS The Hague, The Netherlands. Tel.: +31 317 4 84752.
E-mail address: Cor.Verdouw@wur.nl (C.N. Verdouw).

http://dx.doi.org/10.1016/j.compag.2015.04.002
0168-1699/

2. Methodology

2.1. Project context

The research has been carried out as part of the research and innovation programme of the Digital Greenport Holland. In this Public Private Partnership (PPP) businesses, knowledge institutes and the (national) government are working closely together towards a common vision and action plans on digital information management and standardization in the Dutch horticultural cluster (Verdouw et al., 2014a). The main business partners are three industry associations for chain information in the Dutch horticulture, i.e. Frug I Com (fruit and vegetables), Floricode (flowers and plants) and EDIbulb (flower bulbs). The members of these associations cover nearly all companies active in the Dutch horticulture, including producer organizations, auctions, traders, logistics service providers and information technology vendors. The activities of Greenport Digital Community focus on four key themes: e-Standards, e-Information Integration, e-Government and e-Competences. The research presented in this paper was part of the e-Information Integration theme.

2.2. Research design

The research is carried out in four phases: (i) Literature review; (ii) development of a theoretical framework for analysis; (iii) data gathering in in-depth structured interviews with industry experts; and (iv) data analysis and evaluation.

The research started with a literature review on farm management systems and ERP to define the problem context of the research. The second step was the development of a theoretical framework for analysis, i.e. a systematic classification of critical factors for the adoption of ERP systems. These factors can either be barriers that negatively influence adoption or drivers that positively influence it. The broadly accepted theory of Rogers (1995) about the adoption of innovations was selected as the basis of the framework. Next, the most important factors that influence ERP adoption were identified based on ERP literature.

The third research phase conducted interviews with experts of Dutch horticultural companies that implemented ERP. Based on the theoretical framework, a questionnaire for in-depth semi-structured interviews was developed. Next, a long list of ERP implementations in the Dutch horticulture was defined based on the input of the business experts of the Digital Greenport Holland. The long list identified 25 producers, 29 traders or auctions and 16 other companies like food processing companies, cooperatives and sector organizations. From the long list in total 13 companies were selected, aiming for a balance of the involved subsectors and the supply chain roles (see Table 1). The data were collected by conducting in-depth interviews with key experts of the selected companies, who have a good overview of the ERP selection and implementation process.

The size of the interviewed companies ranges from less than 20 FTE to over 200 employees (see Fig. 1). Only one company employs less than 20 FTEs, which illustrates that ERP is mostly implemented by companies that are relatively large for the agri-food domain. In total eight of the interviewed companies use Microsoft Navision, which has a large share in horticulture. The other implemented ERP systems are SAP (1), Freshng Advanced Software (1), PlantITware based on Infor LN, formerly Baan (1) and custom ERP solutions (2).

Table 1
Distribution of the interviews.

Horticultural subsector	Supply chain role			Total
	Growers/ farmers	Traders/ auctions	Both	
Fruit & vegetables	1	2	1	4
Plants	2	2		6
Flowers and flower bulbs	2	2	1	7
Total	5	6	2	13

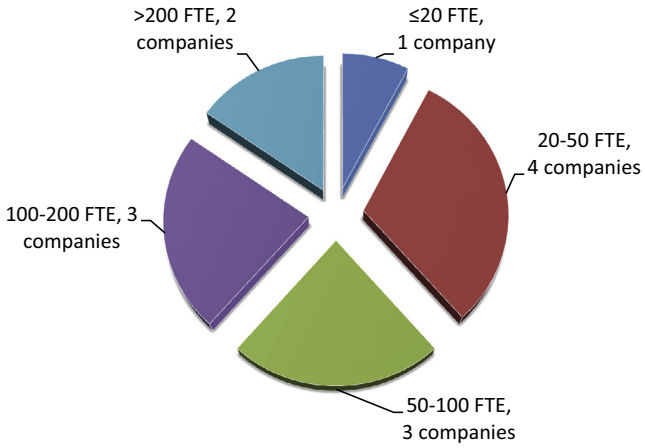

Fig. 1. Company size of the respondents in number of employees.

The fourth and final research phase was the analysis and evaluation of the interview results. The analysis has identified and prioritized the drivers and barriers by analyzing the frequency of the occurrence of each factor. The results were evaluated in a working group of six experts of the Digital Greenport Holland.

The remainder of the paper introduces the results following the research steps as described above.

3. Farm management information systems and ERP in agriculture

To ensure the effectiveness and efficiency of business processes, information must be continuously captured, edited and communicated. Enterprise Information Systems support the processing of information at different levels ranging from operational to strategic, i.e.: (i) mechanized cultivation and logistic systems, (ii) enterprise management systems and (iii) business intelligence applications. The present research focuses on the enterprise management layer, which provides basic capabilities to process transaction data and to support operational decision-making based on these data. This section introduces the current situation concerning these systems in the agricultural sector.

3.1. Farm management information systems

In agriculture, the adoption of ICT has generally been low, especially in comparison to other, more industrialized sectors (Teye et al., 2012). Applications have primarily come from technology developments in the field, greenhouse or animal house. Especially, the introduction of sophisticated sensing and monitoring technology has resulted in the trend of precision farming or -horticulture (Nikkilä et al., 2010). Other driving forces were the advancements in modelling biological processes which has led to a number of decision support systems (DSSs) e.g. for pests and diseases or nutrient management (Nikkilä et al., 2010).

Precision farming and related DSSs focus on specific aspects of farm management (Keating and McCown, 2001; Wolfert, 2002). Usually these systems require more general farm data e.g. on fields, implements, herd composition, etc. This has led to DSSs that also