Report on interoperability of ICT products and services in agriculture and agro-environment

Deliverable D5.2

Iver Thysen

31 March 2014

ICT-AGRI

Coordination of European Research on ICT and Robotics in Agriculture and Related Environmental Issues

Contents

1 Introduction

Data compatibility is the ability to exchange data automatically. Data compatibility is a prerequisite for interoperability of two or more systems, where interoperability is understood as the ability to be used together automatically. Without data compatibility, the use of data outside the system used to collect and store the data is impossible or demands manual reformatting and transfer.

Data compatibility is closely connected to the willingness to share data. If there is no willingness to share data, interoperability is not possible and there is no reason to care about compatibility.

A lack of interoperability within a business domain will therefore increase costs due to duplicated development of systems and decrease benefits due to sub-optimal utilisation of data.

Agriculture is an example of a business domain suffering from a low level of data compatibility and interoperability. This was identified in ICT-AGRI's Strategic Research Agenda and led to a recommendation of "Investing in compatible systems to harness the full potential of the technology". In ICT-AGRI-2, improvements of compatibility in ICT and robotics for agriculture is defined as a major goal.

The purpose of this report is to identify possible actions concerning compatibility of agricultural ICT and robotics, which can be taken by ICT-AGRI within the framework of an ERA-NET.

In Chapter 2 the agricultural ICT are characterised with respect to types and numbers. Chapter 3 seeks to identify the driving factors for investing in data compatibility (or deliberate avoidance of data compatibility). In Chapter 4 the current research and development concerning data compatibility is reviewed. In Chapter 5, the options for actions by ICT-AGRI are discussed.

2 Agricultural ICT providers

Type	ICT range	Bundled products	Market	Number
ICT companies	General Sector Specific		Multinational Country	10
Farmer owned advisory services	General Sector	Advice CAP support	Country Regional	15 50
Public extension services	General Sector	Advice CAP support	Country Regional	15 50
Large machine manufacturers	Sector	Machines	Multinational	10
Farmer cooperatives	Sector	Food	Regional	200
Small/medium manufacturers	Product related	Machines	Multinational Country	100
Farm input suppliers	Product related	Input goods	Multinational Country	20 50
Farm output buyers	Product related	Food/biomass Advice	Multinational Country	20 50
CAP/regulation authorities	General	Subsidies Regulation	Country Regional	15 50
Mini size software companies	Single product		Country Regional	?

Table 1 Overview of agricultural ICT providers in EU + associated countries

The purpose of Table 1 is to illustrate the diversity of providers of ICT to farmers. The content of the table is based on general knowledge of the agricultural sector and it is not based empirical studies.

In the ICT range column, 'general' means all farm business areas; 'sector' means arable, wine, dairy, pigs, etc.; 'specific' means crop, plant protection, etc.; and 'product related' means that ICT is delivered as support to the physical product.

Multinational can be from two countries to global.

The numbers of providers are guesstimated from general knowledge about, for example, multinational companies. Many of the numbers are simply guesstimated from the number of countries and regions in Europe. According to Eurostat there are 97 major socio-economic regions in EU-27.

Despite the uncertainty on the number of providers, the table clearly illustrates that there are many different agricultural ICT providers with strongly varying products and business objectives. This is obviously of significant importance for support actions concerning the improvement of data compatibility and system interoperability.

3 Data compatibility within agricultural ICT providers

3.1 Business policy for or against data compatibility

ICT providers may have an intentional policy concerning compatibility of their ICT products. There is, however, not much confirmed information regarding compatibility and data sharing policies in companies and organisation providing ICT to agriculture.

3.1.1 Business policy for data compatibility

A company may have expectations of business advantages from producing compatible products. Such advantages can arise from added benefits of the company's products when these are combined with products from other companies.

Advantages from interoperability and data sharing are often the case for small and medium size companies with a narrow product range and limited capacities to add support facilities to their products. In agricultural ICT, it will be smaller machine manufacturers, who can add sensors and processors to their machines with an open data interface for access for other companies' software.

3.1.2 Business policy against data compatibility

A company may have expectations of business advantages from producing non-compatible products. The intention is to promote consumer loyalty by offering consumers advantages by continued purchases from the company and by incurring extra costs from purchases from competing companies.

With respect to agricultural ICT, this is suspected in multinational agricultural machinery manufacturers offering software together with the primary products. Intentional non-compatibility and no data sharing polices may also exist in large ICT providers, who consider a monopoly concerning key data to be an essential competitive advantage.

3.1.3 No business policy concerning data compatibility

Many companies may not have an explicit business policy concerning data compatibility and data sharing. It is very likely that compatibility was not an issue in many of the first years of present day's companies and therefore never considered. The focus on software development was to create efficient systems fast and with low costs. This may be a main reason for the existence of numerous incompatible ICT systems.

This attitude may now have changed to a more positive view on data compatibility and data sharing as the shortcomings of the present situation are becoming clear. So, companies may desire compatibility and data sharing for their own benefits, but are facing difficulties in opening their own systems for reasons described in the following.

3.2 Demands from customers and business partners

The main trends in European primary agriculture as well as associated supply and demand industries are increasing business size, automation and reliance on ICT. The demands for

interoperability are therefore increasing. There is evidence for a positive effect on data compatibility and data sharing motivated by demands from customer and business partners.

Business to business data exchange exists between farmers and breeding organizations such as milk recording agencies, artificial insemination cooperatives and herd books. Within the farming enterprise, the increasing use of automatic devices on farm such as automatic feeders, automatic milking systems (AMS), results in an increasing demand for communication between devices and on farm management information system. Within the farm system, especially in dairy operations, there is a demand to integrate data from different systems: feeding, milk performance, milk composition (quality), reproductive performance, health, heifer rearing (again, feeding, performance, reproduction).

In arable farming, precision agriculture (PA) is one of the driving forces for data exchange and issues related to data formats and interface standardisation. Currently, new automation, ICT and GIS technologies provide solutions for steering and controlling site-specific production systems to fulfil requirements of safe, efficient, environment friendly and traceable production. There are therefore increasing potential benefits to be gained from compatibility between different systems needed for performing PA and farm management information systems. However, this has not yet lead to many attempts to introduce data compatibility and interoperability.

There is a striking difference between the introductions of compatibility in dairy sector and the arable sector. The dairy sector has a long tradition for collecting data from farms for breeding purposes (mainframe computers were used to calculate breeding indexes from the total population of dairy cows already in the 1960'es), and it was therefore compulsory for milk robot producers to be able to export/import data from the breeding databases. Precision agriculture has been a theoretical possibility for more than 20 years, but the benefits for the farmers may not have been sufficiently high or obvious to create strong demands for interoperability.

3.3 Knowledge about how to apply data compatibility

It is in general difficult to find concrete information about standards and which standards to use in a given situation. Standardisation documents are usually large technical documents requiring expertise to read and apply. Some standards (e.g., ISO standards have a cost for download).

Below is some information about relevant standards extracted from reports from the *agriXchange*, *SmartAgriFood* and *FISPACE* projects:

Data integration standardisation (data exchange) focuses on the format of messages and data definitions. XML has succeeded EDI as the leading standard for message specification. It is applied both at intra- and inter-enterprise level. Examples of data definition standards at enterprise level are identification standards of GS1 (formerly EAN/UCC) and the international standard for the exchange of product data. At inter-enterprise level, standardisation focuses on one level of information exchange. EDI-based standards are widely implemented, e.g. EDIFACT (UN/CEFACT, 2009) and ANSIX12 (ASC X12, 2009), but now ebXML (e-business XML) is emerging as its successor. EbXML provides a catalogue of information elements in XML format ('core components') that have to be exchanged in eBusiness processes. It consists of several sub standards, including ebXML

Messaging Services (ebMS), aligned with SOA, BPSS (Business ProcessSpecification Schema), ebXML Collaboration Protocol Profile and Agreement (CPPA) and ebXML Registry

For the livestock sector, different standards exist (ISO, government agencies, UN/CEFACT, national and international EDI associations), but maintenance, harmonization and coordination of these standards are limited which are maintained by different bodies at different levels.

Currently, information exchange between farm and other actors (e.g. advisors, government, processors) is also not sufficiently organized. Data exchange between machines at field level and management systems at farm level is supported by ISO standards (e.g. ISOBUS/ISO11873), however practical adoption by farmers is low.

3.4 Financial and human resources to develop and implement data compatibility

Implementation of data compatibility and data sharing require human skills and extended development time. This is in particular the case when an established standard is implemented. Interoperability is therefore often agreed on a bilateral basis or within a business cluster using propriety and ad hoc data definitions. There is a risk that this behaviour results in data definitions, which are difficult to generalise and which are poorly documented.

It is most likely that the majority of agricultural ICT providers do not have sufficient financial resources to acquire the required human capacities and work load for implementing data compatibility in a sustainable solution.

3.5 Dependencies on existing data structures

Many agricultural ICT providers can be assumed to have built their systems on successive extensions of an existing data structure, which is not suited for enabling data compatibility and data sharing. Such dependencies will increase the costs of enabling compatibility dramatically.

4 Solutions for data compatibility and interoperability

Due to the nature of the majority of agricultural ICT providers and the considerable costs of enabling sustainable compatible systems, the transformation to more compatible systems will not happen without support ting the providers with efficient tools to carry out such transformations at costs, which match the expected benefits.

The development of solutions for feasible adaption to compatible systems has been targeted by several projects. One of these is the German project *iGreen,* in which public and industrial partners have developed a "ubiquitous dynamic network to enable manufacturer independent data exchange in future precision farming". These results are followed up by another German project, *PAM (Pesticide Application Manager)*, which integrates Decision Support System data available online from different private and public sources with a special focus on mobile technologies. A web service is developed that creates machine-readable application maps using the non-proprietary ISO-XML format.

Two FP7 EU projects in the theme "Nanotechnologies, Materials and new Production Technologies" within the call "Automation and robotics for sustainable crop and forestry

management", namely *Crops* and *RHEA,* are carrying out research and development that may also be of value for data compatibility.

In the animal sector, three FP7 projects are concerned with automation, namely *EU-PLF*, *ALL-SMART-PIGS* and *Bio-Business*.

A very new (started November 2013) FP7 project, *CLAFIS - Crop, Livestock and Forests Integrated System for Intelligent Automation, Processing and Control*, will develop and demonstrate a pre-commercial intelligent integrated solution prototype based on a cross platform OPC unified architecture (OPC UA) specification entitling standards and related technologies for communication between automation systems and IT systems in farms and forest related process.

FI-PPP (Future Internet Public-Private Partnership) is a large EU funded initiative for improving European competitiveness within the rapidly growing market for Internet based applications of all kinds. A large number of major European ICT companies have joined the partnership and contributed to the development of technologies for making it easier for companies (in particular SMEs) to develop advanced Internet applications.

In the first two phases of FI-PPP, the core technology has been developed. In addition specific technology has been developed and tested for several business areas, including agriculture. In one of these projects a platform is developed with much of the functionality required for an easy implementation of data compatibility and interoperability.

The third FI-PPP phase includes 16 so-called accelerator projects, each having about €4 million for calls for implementation projects by SMEs and web developers. Four of these are targeting agriculture.

5 Conclusions concerning ICT-AGRI actions

5.1 Exchange information with agricultural ICT providers
On the one hand, the empirical knowledge about agricultural ICT providers is vague. The numbers of providers of various types, their attitudes concerning data sharing, their actual implementations of data sharing, etc., are not sufficiently known.

On the other hand, it is reasonable to assume that many of the small ICT providers, in particular those who only use ICT for their main business, have limited knowledge about potential benefits and opportunities from data sharing.

ICT-AGRI can establish, through its national partners, a two-way information channel, which at the same time fulfils both requirements.

ICT-AGRI may also enable and encourage communication among ICT providers and thereby foster community agreements on standardisation.

5.2 Support the supply of solutions for data compatibility and interoperability
Data compatibility and interoperability will be slowly implemented if the ICT providers do not have cost efficient solutions available. Sustainable data compatibility is, as opposed to bilateral ad hoc

solutions, technically demanding. Experts, who can embed the technology in user-friendly solutions, should do the technical part of the implementation.

ICT-AGRI can use the transnational call instrument to support development and propagation of technical solutions for data compatibility and interoperability with a clear view on the European scale. Examples are to liaise with FI-PPP accelerator projects for propagation of the FI-PPP solutions, to include topics for standardisation issues in calls, and to require compatibility in ICT products being developed in ICT-AGRI funded projects.

5.3 Support development of demands for data compatibility and interoperability

Data compatibility and interoperability is obviously mostly enabled when there is a strong demand for data sharing. Demands are probably in general not sufficiently strong to generate widespread implementation of compatibility. From a theoretical point of view, it is clear that interoperability can reduce costs and increase quality in agricultural ICT and robotics, and there is reasonable evidence for societal and environmental benefits from ICT and robotics through precision agriculture. This is, however, not sufficient seen from a farm business point of view.

Demands from farmers, those who must invest in precision farming technologies, may be stimulated through coupling with the agricultural subsidy and regulation systems. For example, by allowing documentation of regulated farm operations (e.g., fertilisation and plant protection) to be performed by transfer of data from smart agricultural machines. A further step could be a smart regulation based on GIS steered variable application of chemicals in a win-win arrangement, where susceptible areas are protected while less susceptible areas are subjected to more intensification.

ICT-AGRI may collect information from the participating countries concerning plans and initiatives for smart regulation, intensification of agricultural production and environmental protection, and perhaps foster a transnational discussion and exchange of ideas. Further actions may arise on this basis.

6 Sources

ICT-AGRI Strategic Research Agenda: http://db-ictagri.eu/ict-agri/content/SRA.php

Eurostat:http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_CLS_DLD&StrNom=NUTS_33&StrLanguageCode=EN

agriXchange: http://agrixchange.org/

SmartAgriFood: http://www.smartagrifood.eu/

FISPACE: http://www.fispace.eu/Pages/FIspace.aspx

iGreen: http://www.igreen-projekt.de/iGreen/index.php?id=47&L=3

RHEA: http://www.rhea-project.eu/

Crops: http://crops-robots.eu/

EU-PLF: http://www.eu-plf.eu/

ALL-SMART-PIGS: http://www.allsmartpigs.com/

Bio-Business: http://www.bio-business.eu/

CLAFIS: http://www.clafis-project.eu/

Future Internet Public Private Partnership: https://www.fi-ppp.eu/