



Sustainable Agriculture through ICT innovation

AgriXchange vision

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ABSTRACT

Within the knowledge-based bio-economy, information sharing is an important issue. In agri-food business, this is a complex issue because many aspects and dimensions play a role. An installed base of information systems lack standardisation, which hampers efficient exchange of information. The objective of this paper is to present a Strategic Research Agenda (SRA) of AgriXchange project, which reflects the business demands for utilisation of ICT and exchange of agriculture data, information and knowledge supported by current standardisation, but also by future research in ICT for agri-food industry. It reflects the needs of the agriculture business. The focus of the SRA is on identifying major ICT challenges related to the utilization of ICT and data, information, knowledge and standards in agriculture and agri-food industry sector. The agenda defines not only the necessary ICT standards, but also in a broader view the Research and Technology Development (RTD) areas which will be selected as key priorities in order to achieve the challenges identified.

Keywords: ICT, agriculture, standardization, Strategic Research Agenda.

1. INTRODUCTION

In our networked society, standards play an important role. That is especially the case in exchanging digital data. With “*Standards*” we refer to the protocols that describe how data (in so called ‘meta-data’) and the data-exchange are defined to make a digital exchange of data between two devices (often computers but also computer-machine interaction) possible. Such standards enable interoperability of data, information and knowledge between systems – they ensure compatibility. Standards can reduce choice but the big advantage is that they reduce transaction costs to share data and promote competition (users can easily change suppliers as they are not ‘locked in’ to complete systems). That means they can also support innovation, although the wide use of a standard can also block progress to something better.

2. Objectives

The agriculture sector is a unique sector due to its strategic importance for both European citizens (consumers) and the European economy (regional and global), which, ideally, should make the whole sector a network of interacting organisations. Rural areas are of particular importance with respect to the agri-food sector and should be specifically addressed within this scope. There is an increasing tension that has not been

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Sustainable Agriculture through ICT innovation

experienced in any other sector between the requirements to ensure full food safety as well as sustainability while keeping costs under control. Also it is necessary to ensure the long-term strategic interests of Europe and worldwide, also with regard to food security and global challenges. To solve the problems of future farming, we need to develop a new generation of knowledge management, which will help the agri-food sector to adopt to a changing world.

Three ways of the community contribution was used for updating the document:

- Publishing the draft agriXchange SRA on the project agriXchange platform for public discussion.
- In situ discussion about the draft agriXchange SRA on SmartAgriMatics 2012 conference in Paris;
- Virtual discussion about the draft agriXchange SRA on Linked-In network. The challenges and recommendations were discussed by international community. Number of comments and contributions came from social networks. In reality, it was the most valuable source of comments.

The definition of the SRA required a deep knowledge of problems of agriculture data, information and knowledge interoperability, previous activities, existing standardisation problems, state of the art in agri-food ICT area, but also consultations with representatives from industry, governments, agencies, operators, and agri-food authorities and stakeholders involved in rural development. The discussions with stakeholders during events such as the GeoFARMatics conference in Cologne in 2010 or the EFITA congress in Prague 2011 played an important role. The first version of the SRA was published in May 2012. The current document is presenting the final version of strategic lines that, after validation of the draft version (mainly provided based on the Smart AgriMatics conference and the LinkedIn social network), will support all domain stakeholders in the process of implementing a number of specific measures to achieve the stated objectives. This document is the final version, but it is still open for comments. The goal of this SAR is to stimulate future discussions. For this reason, the document is published under the Common Creative License to support its re-use and further exploitation of the collected ideas. The objective of the document is to stimulate discussion. ICT in agriculture is a very dynamic sector and it requires continuously updating ideas. On the other side, the analysis of previous activities demonstrates that there is a need for a long time sustainability of ICT for agri-food research (many previous SRAs and other strategic documents dispersed without any continuity and also accessibility of previous documents). The last update of the document was done on the basis of comments and discussions within the agriXchange team. The comments led to this final version of document.

For the future analysis of agriXchange, important are the first three terms data, information and knowledge, which define three levels related to the management of farms. The wisdom could be understood as part of decision processes.

It is clear that we have to look at the problem of agriculture standardization from different angles. It is evident that the focus on standardization only on data level is too

C0271

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"Sustainable Agriculture through ICT Innovation", Turin, Italy, 24-27 June 2013.

Sustainable Agriculture through ICT innovation

narrow and will not be able to cover the needs of the agri-food sector. In the future, the main effort has to be on the level of standardization of information and knowledge.

4. SRA Analysis

At the beginning SRA introduces basic problems of agriculture interoperability, the problems of management and interoperability of data, information and knowledge in agriculture. SRA gives a short overview of current standardisation initiatives, which are relevant to the problems of agriXchange. It also describes current agriXchange activities in the area of standardization. The agriXchange work was focused on two topics:

- The structure of the framework model serves information on sharing and harmonization development for data exchange, and
- The implementation of the practical model tool (aXTool) in the agriXchange platform to be user-friendly.

SRA gives an overview of previous activities. We analyzed only those projects and documents that were focused on a vision of future ICT for agri-food or eventually ICT for rural development. The analyses conclude that the progress in the deployment of ICT-infrastructure for (standardized) data exchange in Europe is changing very fast and changes from one year to the other. In principle, big part of population in Europe has possibility to access broadband or has permanent access to the Internet (bandwidth is usually lower for rural regions than for cities). This potential access to the Internet is not really used, real utilisation of Internet access is lower in rural regions and the uptake of new solutions into practice and also research in agri-food and rural applications is slower than the deployment of the general infrastructure. In many cases application priorities are the same as 10 years ago. The big problem is the data, information and knowledge exchange and interoperability.

- From the overview we come to the following conclusions, important for building of agriXchange SRA: The uptake of new ICT interoperable technologies in primary production, which will be accepted by farming sector
- The analysis of documents from the last decade demonstrates that there is low sustainability of ICT for agri-food research and low exchange of experiences among projects. There are often provided similar analyses with similar results, but the overall progress is low. To overcome this problem, it is necessary to support a long term suitability of ICT research and support for long time vision for RTD development in the agri-food sector.
- Better and faster implementation of RTD results of ICT into practice with appropriate business model thinking.
- Strong professional (international) organisation which will unify different efforts of different ICT research and development groups, but which will be also able to protect interests of communities. The candidate for such organisation could be European Federation for Information Technology in Agriculture, Food and the Environment (EFITA,) but it will be necessary to change its organisational structure.

C0271

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Sustainable Agriculture through ICT innovation

- It is important to renew dialogues for politicians to put focus on ICT for rural regions as part of Horizon 2020 activities. It is important to support standardisation awareness, but also deployment of new solutions necessary for rural regions. Currently, ICT for agri-food is not covered in large scale, not in DG Connect research and also not in KBBE calls.
- Due to the global character of Agriculture and Food production and also the fact that agriculture production influences and is influenced by environment, it is important to improve dialogue and transfer of ICT knowledge between developed and developing countries.

Newest ICT research trends in ICT for Agriculture recognise three main pillars of this chapter:

- Future Internet;
- Open Source Software;
- Open Data.

As main issue we see relation between Future Internet (mainly cloud computing) and Open Source Software, which could be in some way considered as competitive approaches, but at the same time they could be in synergy. There are two important aspects:

- Interoperability and service-oriented architecture, which allows easy replacement of one component or service by another one. This concept is already currently broadly used in geographic information systems.
- Support for large scale utilisation of Open Sources by Future Internet. Currently, Open Source generates business for companies which customise solutions into final applications. Such web-based solutions could generate profit for SMEs developers.

Open data initiative and Public Sector Information are considered as important also for agri-food sector. Until now, mainly farmers are limited by restricted access to data, information and knowledge. Linked Data introduce new semantic principles into Web resources and could be useful for agri-food sector.

SRA synthesis

The first part of SRA is mainly analytical; focus was on collecting and analysis of available resources. The synthetic part of SRA was focused on building of a new vision. The vision is built on challenges. There are defined two types of challenges

- Political organisational challenges
- Technological, innovation and research challenges

There are defined next political and organizational challenges

- To improve the representation of ICT agriculture specialists and users in European activities
- To include ICT and knowledge management for agri-food and rural communities generally as a vital part of the ICT policies and initiatives

C0271

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Sustainable Agriculture through ICT innovation

- Support better transfer of RTD results and innovation into everyday life of farmers, food industry and other rural communities
- To accelerate bottom up activities as a driver for local and regional development
- To support discussion and transfer of knowledge between developed and developing countries

And next technological, innovation and research challenges

- To find a better balance between food safety and security, energy production and environmentally and socially sound production
- To support better adoption of agriculture on climatic changes
- Making rural regions as an attractive place to live, invest and work, promoting knowledge and innovation for growth and creating more and better jobs
- To support farming community and rural education, training and awareness building in ICT
- Build new ICT models for sharing and use of knowledge by agri/food community and in rural regions generally.

On the base of challenges we define a list of research priorities for application area. There were recognised next research priorities:

- Collaborative environments and trusted sharing of knowledge and supporting innovations in agri-food and rural areas, especially supporting food quality and security.
- New (ICT) structures to serve sustainable animal farming, especially regarding animal and human health and animal welfare.
- ICT applications for the complete traceability of production, products and services throughout a networked value chain including logistics.
- New generation of applications supporting better and more effective management of sustainable agriculture production and decision making in agriculture ICT applications supporting the management of natural resources.
- ICT application supporting adoption of farming practices adapted to climatic changes.
- ICT application supporting energy efficiency on farm level.
- ICT application supporting rural development and local businesses.
- ICT application for education, training and awareness rising.
- ICT applications reducing administrative burdens in rural areas.

Chyba! Nenalezen zdroj odkazů. shows relation of these research priorities with the challenges.

The development of knowledge-based systems for the farming sector has to be supported by ICT focusing on the areas as defined:

C0271

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Sustainable Agriculture through ICT innovation

- Future Internet and Internet based applications such as sensor technology, cloud computing and machine to machine communication.
- Mobile applications.
- Improving of positioning systems.
- Service Oriented Architecture.
- Methods of knowledge management.
- Semantic models, multilingualism, vocabularies and automatic translation.
- New Earth observation methods.
- Management and accessibility of geospatial information.
- Open data access.
- Open Source development.
- New modelling.
- The power of social networks and social media.
- New e-educational and training methods.

Recommendation

Recommendations for necessary standardisation effort in future related to ICT and agriculture applications priorities for near future stress the following important facts:

- On the level of data standardisation, the agri-food community will be mainly consumer of standards coming from other domains or activities. For example activities related to Future Internet, where intention is to design low level standards allowing developers to access data through standardised API. Similar situation is for example with geospatial data, where access is solved through OGC standards. Also questions like security are mainly solved outside of the agri-food community. It is important to follow this initiative, eventually participate on other initiatives including SmartAgrifood project in Future Internet. There are two areas where further development is necessary inside of the community:
 - ISOBUS for access to information to agriculture machinery;
 - Special agriculture sensors or RFID activities.
- More important seems to be the effort on information level. In accordance with work which was provided in WP4 it is necessary to be focused on protocols (Web services), API and data models for exchange of information in different areas such as traceability, precision farming, live transport, welfare regulations, subsidies systems (for example LPIS), weather information, market information, logistic information. It seems that for the next period the key focus will be in this area. The work could be partly related to activities such as agroXML.
- In the future with the expansion of Web based technologies, more effort will be necessary in the area of knowledge level. Access to knowledge is the goal of many information systems. It is necessary to build knowledge based tools, which will help user in orientation and right decision. It could be ontologies, RDF

C0271

<Karel Charvat>. "AgriXchange vision". EFITA-WCCA-CIGR Conference "Sustainable Agriculture through ICT Innovation", Turin, Italy, 24-27 June 2013.

Sustainable Agriculture through ICT innovation

schemas for open linked data, thesaurus or vocabularies. Such activities already exist, for example under FAO (AgroVoc thesaurus) and different tools of knowledge management. This effort is partly covered by the new project agINFRA.

Chapter ten defines long term strategic goals for sustainability of agriXchange. This strategy follows the political organisational challenges defined in chapter six due to the following reasons:

- In any area there exist two types of standardisation efforts:
 - Community or industry driven effort. For these it is necessary to have structure inside the community, which will take leadership in this area.
 - Politically driven standardisation – in the agri-food area it could include standards for animals welfare, food security etc. For implementation in practice, it is necessary to support related policy. Also, it is good for policy makers to have partners on the community level.
- For any standard it is important to transfer it to community. It is necessary to support communication between researchers, politicians, industry and also final users. It is necessary to transfer all knowledge to the users.
- It is important, that the requirements for standards are not defined only by politicians or by large industry. Standards have to cover needs of users like farmers, regional and local IST developers. Involvement of these communities is crucial.
- Food market is international and for example information about food traceability has to be shared worldwide. It is important in this area to support standards worldwide.

As a reaction on single challenges there are the following recommendations:

- It is necessary to have a better coordination of different activities related to ICT for agriculture, but also related to standardisation. On the basis of the performed analysis, it seems not realistic to establish a new platform initiative. It is not only a question of financing, but it is also a question of building infrastructure, human resources, etc. For this reason, the project team recommends to move agriXchange under the umbrella of an existing organisation. It will increase the chances for financing of future activities. As an umbrella organization, the European Federation for Information Technology in Agriculture (EFITA) would be most suitable. The advantage to have a European body, representing the ICT Agri-food sector, which could be an interesting partner for the European Commission and other policy actors..., in particular for Initiatives such as the European Innovation Partnership.
- Currently ICT for agri-food sector is not covered by any policies and also there is no direct support for such activities. The topic is addressed by different Directorate Generals (DGs), but no DG covers this issue fully. It is important to include these topics as part of the European priorities and also as part of Horizon

C0271

<Karel Charvat>. “AgriXchange vision”. EFITA-WCCA-CIGR Conference
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Sustainable Agriculture through ICT innovation

2020. From this reason, it is important to have strong representative of a community, which will provide the necessary lobbying. On the worldwide level, part of these activities is covered by FAO. But there are gaps between FAO and the worldwide community. It is necessary to improve cooperation.

- Any RTD results and also results of standardisation have to be transferred into practice to local and regional users. In the future, the agINFRA project could be of help. The project has an objective to build infrastructure for sharing agriculture information.
- It is necessary to support open innovation initiatives in rural regions. It will be good to introduce concept of “Smart Rural Regions” similar to Smart Cities.
- It is necessary to support standardisation cooperation also worldwide. FAO or the International Network for Information Technology in Agriculture (INFITA) could play an important role.

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