



Sustainable Agriculture through ICT innovation

Innovation in ICT for agriculture: example of an e-services portal for the reduction of pesticides

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ABSTRACT

One of the main challenges for today's agriculture is to increase drastically the production while at the same time being more sustainable. Innovation is seen in Europe as the key solution and ICT have a great potential to boost innovation in agriculture. As the complexity of the innovation process still remains difficult to manage, an experimental Public-Private Partnerships Action of the ICT AGRI Era-net was launched and is presented in this paper. This one-year action aimed to gather together all the players involved at the European level for crop protection and to boost concrete innovation in ICT to reduce the use of pesticides, especially around a unified platform of information and services. The main conclusions of this study, especially on the method tested, are presented in this paper and some recommendations are made for next innovation management actions.

Keywords: Innovation process, methodology, value-chain, ICT, e-services portal.

1. INTRODUCTION

Over the next 40 years, agriculture has to increase by over 60% to meet societies' needs. Hence, the main challenge remains to find more sustainable ways of producing this huge amount of food and resources (AFO, 2012¹). These issues, associated to an agricultural market becoming more volatile and an increased competition due to globalization, imply important changes for agricultural practices, technologies and knowledge. The development of innovation is seen in Europe as a key element both to these challenges in agriculture and to economical growth and employment. In agriculture, ICT have a great potential and a crucial role to play to boost innovation. Indeed, in the fast changing multi-functional agricultural sector of the 21st century, flexible and responsive capacities are more important than ever, and ICT as technologies used during the innovation process or as a result itself of this process could offer great solutions.

The idea of innovation regarded as a 'source of energy' for economy first appeared in social sciences in 1939 by J. Schumpeter (Carroll, 2006), but the interest around the question grew later in the United States (1960s) and then in Europe (1980s) (Fagerberg

¹ AFO. 2012. Summary 2012 Edition - OECD - AFO Agricultural Outlook 2012 - 2021.
<http://www.oecd.org/site/oecd-faoagriculturaloutlook/>

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and Sapprasert 2011). Two main aspects of innovation have to be highlighted from these several studies.

First, innovation is mainly defined in its contrast to invention. Briefly, when invention is novelty, innovation is the process by which organisation “master and implement the design and production of goods and services that are new to them, irrespective of whether they are new to their competitors, their country or the world” (Mytelka, 2000). Hence, not only researchers are involved in the innovation process, but also other activities and players. Secondly, looking back to the evolution of the innovation studies, their focus moved gradually from various isolated aspects of the innovation to a more holistic and complex approach describing “systems of innovation”.

This brief and non-exhaustive overview of innovation studies helps to provide a better understanding about what is innovation and how it works or not. Innovation is a complex and collective process, involving a lot of various players, taking place in a context and, more important, for which success or failure isn't often due to technical or scientific problem but ‘generally involves ethical; social, management, organizational and institutional problems.’ (Smits, 2002). But a lot of work still remains to be done and the ‘European Disease’ is not so far behind us: it is still a main challenge for Europe to lead to many innovations, and to increase productivity, despite of its production of excellent scientific knowledge. As highlighted by the European Commission and by several current research and policies, there is still today a gap between research and end users practices (For instance, see the EIP initiative from EU²). This gap, and the work which remains to be done, are not so much part of the innovation theory elaboration, but are rather operational challenges (Hall, 2007). Hence, managing the innovation process seems a great challenge and is the question developed in this paper.

In this work, a specific operational action in the agricultural and environmental sectors is presented and analyzed in order to study the management of the innovation process in a particular context. This action took the form of a Public-Private Partnerships Action within the context of a European Era-net and aimed to encourage the set up of PPPs to develop innovations using ICT and robotics in agriculture. This paper focuses on the analysis of few experienced aspects of the innovation process which are crucial to boost innovation. First, we will briefly describe the experimental PPP Action we studied and its context. Then, we will focus on the method we used to set up this action and analysed it, in parallel with a quick overview of interesting methods already existing. Finally, the main aspects of the actions analysed will be highlighted and some conclusions and recommendations for next actions will be provided.

2. MATERIEL AND METHOD

2.1 Materiel

² EIP – European Commission communication http://ec.europa.eu/agriculture/eip/pdf/com2012-79_en.pdf

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ICT-AGRI ERA-NET [European Research Area Network for Coordination of Information and Communication Technology (ICT) and Robotics in Agriculture and Related Environmental Issues] is one of the ERA-NETS, funded under the 7th Framework Programme for Research (FP7). Initiated on May 2009 and running until March 2014, this ERA-NET has 18 partners and 14 observers from 21 countries. Its key concerns are to strengthen the international competitiveness of the European Union and to reduce the negative impact of agricultural production on the environment by using ICT and Robotics. To date, ICT-AGRI ERA-NET formulated a Strategic Research Agenda³ for ICT and robotics, 2 calls were launched and a Meta-Knowledge Base⁴ (an online resource) was created.

Apart from its main activities mostly focused on research, ICT AGRI ERA-NET has always tended to boost innovation by strengthening its links, among other, to private actors and associations. It took the form of an experimental one year Public Private Partnerships Action (PPP Action), which runs from November 2011, to December 2012. This PPP Action is defined here in a broader sense: it includes all types of partnerships between actors from public research and other stakeholders such as end users, private companies or intermediaries (industrial clusters, professional associations,...). This action aimed both to:

- Generate the formation of concrete partnerships (to boost innovation)
- Design a methodology to boost the collective innovation process in the agricultural area using ICT, Robotics and Automation. 2/ Design and study a methodology, based on existing methods, to manage the collective innovation process.

This experimental action was managed by Irstea, and included a participant from each country of the ERA-NET.

In the PPP experimental action, we focused on the design of three types of innovation and, among other, of an e-services portal. This paper focuses on this later. New ICT technologies (Cloud, wireless sensor networks, Linked Open data) offer to farmers more open tools. We tried collectively to define the different elements and corresponding actors needed to provide an open e-service portal where each actor could propose services (DSS tools for instance) able to mobilize data or software from other services. The idea was to build an open innovation platform based on standards (data, exchange, software).

2.2 Method

Several methodologies to manage the innovation process are used both by academician and by practitioners. Without providing an exhaustive list in this paper, we will present

³ <http://db-ictagri.eu/ict-agri/content/SRA.php>

⁴ <http://db-ictagri.eu/usr/Home.php>. For more details on the design of the Meta Knowledge Base, see Mertens *et al.* (2012).

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quickly an outline of these methods, focusing on some of their main aspects, before discussing the method applied in our PPP experimental action.

Participatory methodologies, among others, try to find out about local context and life to improve the innovation process. These methods, such as PRA (Participatory Rural Appraisal) and PLA (Participatory Learning and Action), has particularly spread and been applied in the 19980s – 2000s worldwide. They evolved and are still practiced nowadays (Chambers, 2007).

Then, some other methods focus more on linking private sectors to public players (such as public laboratories). What should be emphasizes in this **Public-Private Partnerships (PPPs)** methodologies is the focus on the linkages between private and public sector players in order to boost the innovation process. It is also worth noting that PPPs practices vary substantially from complex and detailed analysis, such as used by industrial development (for instance UNIDO⁵) to easier operational tools.

These PPPs, understood in a broad sense, not only involve private sectors but also ends users and other types of players. Then, it could include other types of methods used to manage the innovation process, in particular the **open innovation**, ‘one of the hottest topics in (current) innovation management’, which helps practitioners and scholars to ‘rethink the design of innovation strategies in a networked world’ (Huizingh, 2011). It focuses obviously on the openness and the sharing of information and includes a wide variety of knowledge and practices as ‘open innovation reflects much less a dichotomy (open versus closed) than a continuum with varying degrees of openness (Dahlander and Gann, 2010). It has to be mentioned that a version of open innovation is, for the ICT sector, open source developments.

Finally, other methods important to include in this brief overview are the **Living Labs**. These open innovation approaches, currently used, are part of Public-Private partnerships actions because they involved all types of players, but with a focus and experimentation on the real-life condition (Leminen *et al.*, 2012). It seems important to note in these two last approaches, a free space is created for innovation and diversity to emerge, as proved by some empirical experience of Living Lab launched by an European Project agriXchange⁶: « In a living lab, there is not always a clear goal, but all sorts of questions and problems together with existing solutions can lead to surprising, unexpected results.” (Wolfert, 2011).

The two most interesting points highlighted by these methodologies are first, their attempt to involved all the players of the innovation process, and more lately, their recognition of the variability and flexibility needed in this process. Based on these two main aspects, we tried for our specific action in its context (ICT for crop protection), to develop and test a method to design and boost innovation using some characteristics of the methodologies mentioned above. In the context of the ICT AGRI ERA-NET, a specific space was created in order to develop and experiment a methodology. To find or design the right method which will faces the external constraints of the action; a particular emphasis was placed on three aspects:

⁵ http://www.unido.org/fileadmin/user_media/Services/PSD/ICT/GSA%20White%20paper%205.12.08.pdf

⁶ <http://www.agrixchange.org/>

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- **Efficiency:** the method in this case aimed at boosting concrete innovation or, at least, to develop concrete partnerships in a short-term perspective. A right balance between a detailed and deep analysis and short duration and operational action should be found.
- **Involvement of all the stakeholders** in the chain: even if the action focused first in involving the private sector, all the other types of players such as public authorities, intermediaries and end users were supposed to be involved in the collective work. The value chain method described later was used for this purpose.
- **Time:** As the action aimed to be operational as soon as possible, the method chosen was based on the existing methodologies with some improvements due to the specificities of the area, context, players involved, etc. Then, the evolution of the method was also important to analyze.

Our method aimed to develop PPPs, used in a broad sense: the emphasis was placed on having public, private players and end users working together. The degree of openness was up to the players involved and could have been different regarding the partnerships created. In order to nurture the first spark of discussion between the players, a **value-chain approach** was adopted. This approach allow identify all the players who are involved in the innovation process ‘from conception, through the different phases of production (...), delivery to final consumers, and final disposal after use’ (Kaplinsky and Morris, 2000⁷). Then, each brick of the innovation process provide a useful basis for the discussion and collective work. If the right persons are involved in this collective work, this basis give them a good overview of the possibilities of innovation, the difficulty they could meet, and so forth, at various levels (*see figure 1*)

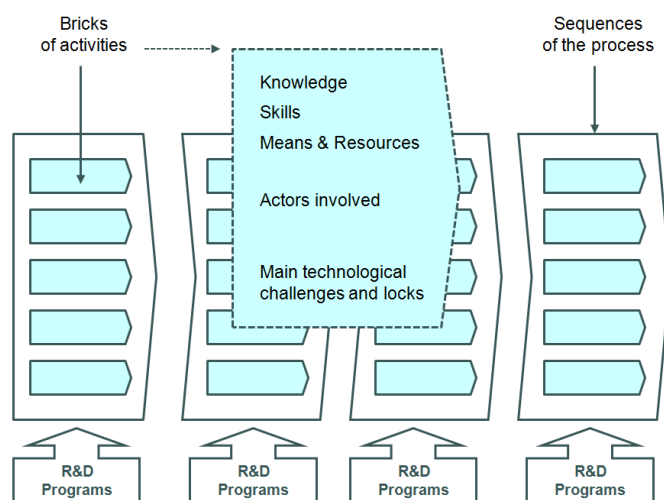


Figure 1 – The tool used to describe each brick of the value chain of an innovation process tested during the PPP Action of ICT AGRI Era-net.

Our general objective was to create the right condition to stimulate interactions and collective work of the participants around a concrete suggestion of innovation, in our case, an e-services portal for the reduction of pesticides. 6 steps were planned: from

⁷ http://asiandrivers.open.ac.uk/documents/Value_chain_Handbook_RKMM_Nov_2001.pdf

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internal consultation and mapping of the players involved in the several countries to dissemination and collective work with the private partners.

1. RESULTS AND DISCUSSION

The experimental PPP action of ICT AGRI ERA-NET ran during one year at the European level and both the evolution of the action and the results (positive and negative) are important to analyze. The concrete results were links made with several partners interested by crop protection, better knowledge of these players, a 200 conference organized with two other European projects (AgriXchange and Smart AgriFood projects) which also aimed to develop innovation processes and some recommendations included in the ICT AGRI Era-net and applied in the follow up of this era-net. We present and discuss in this chapter some of the main conclusions which are important regarding these results and the concrete management of an operational innovation process. In parallel, we present also the two main conclusions regarding the collective work around the e-services portal.

More than 20 persons of the era-net were involved at the beginning but it gradually decline during the several steps of the era-net to a small group of 8 motivated people in charge of the evolution of the action. The same applied for the external people concerned and involved in the action, such as private sectors players, intermediaries or other public research actors. Even if more than 100 players were listed and mapped, less has been contacted and even less were involved in the action. This reflects two aspects particularly important describing in this paper.

First, it highlights that the **role of intermediaries** such as the ICT AGRI ERA-NET in this case, is very important in order to link the various players, who don't have time themselves to do it on their own. The number of players involved is not important, but the **competency of these players** is crucial. Indeed, "the real issue is less about motivating and more about attracting highly motivated and highly capable individuals" (Kogut and Metiu, 2001). Hence, intermediaries have a major role to play in this challenge. In our experimental action, we noticed that some time was needed to map out all the stakeholders involved in the innovation process of an e-services portal, and more time to identify the right players, who could have a real interest in the project. It is true for the players involved, but also for the action's managers. Hence, the experimental PPP Action begin with one participants by country and finished with a more efficient and motivated group of 8 participants. Besides, even if intermediaries were found and involved, it was not done at the right scale: local intermediaries were showing more interest and were more active than most of the intermediaries contacted at the wider level. Finally, the ICT-AGRI ERA-NET was, in the case of this action, the appropriate intermediary to get into contact with public partners, from research or governments. But this action missed of another intermediary with a real solid understanding and contacts with the private area.

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Strongly linked to the previous aspect, another essential point highlighted in the action analyzed is the **motivation of the players** and the **way to manage it**. As mentioned by Hartwich *and al.* (2003), PPPs are interesting for both public and private players. For public players, it ties research more closely to users' needs (and can augment investments in research). And for the private sector, it improves competitiveness (as other forms of outsources activities). But, in the operational action, players don't really measure the interest of these partnerships and the PPP action of ICT AGRI ERA-NET experienced that. A constant reminder of the interests and gains for each player is necessary, as well as other form of motivation (such as financial help to set up the project for example). The follow up of the ERA-NET will be build to offset this issue. Furthermore, for the e-services portal collective work, it was difficult to mobilize industrial partner because the project was in a too early stage. An important improvement of the method used would be perhaps to divide the work in several steps, including the organization representing all the players at the beginning and, in a second time, involve directly the more concerned actors.

4. CONCLUSION

To sum up, this experimental PPP Action produced several conclusions regarding the management of process innovation in ICT and Robotics for agriculture:

- Intermediaries are crucial partners for the innovation process, especially local intermediaries. At the European level, the sharing of experiences and good practices of innovations projects should be encouraged, and links between local projects should be promoted, more than real common projects. 'Community of practices', as suggested by Hall (2007) makes perfect sense in this context.
- Players are already existing, such as software platforms, local intermediaries, ... An important work of mapping is still needed in order to contact the right person with the right competencies.
- Several form of organizations or managements of the innovation process should be encouraged as the interest of the partnerships differs regarding their partners. Our experimental actions showed that, regarding the participants, different types of partnerships were considered.

5. ACKNOWLEDGEMENTS

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