Diversity of innovation support services and influence on innovation processes in Europe – Lessons from the AgriSpin project

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Abstract: *The role of agricultural advisory services (AAS) has considerably evolved during the last decades and a diversity of new innovation support service (ISS) functions has emerged. The plethora of new forms of ISS has one common feature, which is the activity of linking actors within the Agricultural Knowledge and Innovation System (AKIS).*

So far, there is dearth of information concerning the diverse ISS and thus the need for empirical research and systematization of findings. Mapping ISS and their functions within innovation processes is thus necessary for targeted strengthening of such services.

As part of the EU funded AgriSpin project (www.agrispin.eu), which aimed at "creating space for innovations" in agriculture across Europe, this contribution addresses the above mentioned knowledge gaps by

a. elaborating a generic typology appropriate to capture the variety of ISS,
b. structuring selected innovations along the degree of technological change and coordination levels, and
c. testing the generic ISS typology by way of addressing the research question "Which innovation support services (ISS) are most appropriate and qualitatively best match innovative stakeholders' needs with respect to their degree of technological change, actors' coordination, and across phases of innovation process?"

After applying an exploratory case study approach for data collection and analysis, results show varied outcomes with regards to the assumption that types of innovations may shape types of ISS intervention. ISS are seen to be associated with various groups of innovations as well as vary in relation with different phases of the innovation process across farm, territorial or value chain levels.

Keywords: *innovation support services, innovation process, innovation systems, learning networks, multi-actor approach*

1 Introduction

Recently it is acknowledged that innovations in rural areas may be triggered not only by researchers but by a variety of other actors including farmers, advisors and staff of public, private, profit, non-profit or third sector organisations (EU-SCAR 2012). Generally, innovations are only successful when they reach a broader application and acceptance. As a rule, this requires steps of innovation adaptation and dissemination before they are widely adopted within a social system such as rural communities, farmer peer groups or regional networks (Mc Intyre et al. 2009, Rogers 2003).

The linear paradigm of innovation dissemination (Arnold and Bell, 2001; World-Bank 2006) i.e. the understanding that innovations originate from scientists, are transferred by extension agents and are adopted/applied by farmers characterised this field of study for many years. This focus is gradually giving way to an emphasis on joint learning in the context of open networks. Open networks are spaces where social learning takes place between actors “creating a purposefully designed ‘space’ or ‘platform’ which brings together the experiences of those involved in purpose-driven learning and knowing processes, that allows for the creation of synergies and meaningful working linkages” (Hubert et al., 2012, p. 180).

In such learning networks, specifically acknowledging multi-actor and Agricultural Knowledge and Innovation System (AKIS) settings, the role of agricultural advisory service (AAS) providers has changed. Previously, they were viewed as the main actors to support innovation processes through technology and information transfer, but this view is no longer as pervasive. Other actors with new roles have emerged, promoting and enhancing innovation processes by carrying out intermediary functions and offering innovation supporting activities. These are for instance, facilitating networking, facilitating access to financial resources, enhancing demand articulation of innovation actors, strengthening institutional support – especially for niche innovations, and providing general consultancy and backstopping (Mathé et al. 2016).

In an attempt to capture the emerging support services and their diversity, Röling and Jong (1998), Ozelame et al. (2002), Albert (2000), Leeuwis and van den Ban (2004) have focused on types of service providers and content of services. Furthemore, Labarthe et al. 2013, Allebone-Webb et al (2016) and Kilelu et al. (2013) have differentiated ISS according to “service functions”. However the link between ISS and innovation processes is not straightforward. For example, Faure et al. (2017) recently distinguished innovations along a) the level of technological change and b) the level of coordination amongst actors thus leading to four types of innovations and suggested that classification may become a basis for examining the relationship between support services and innovations. In spite the many attempts at classifying and structuring ISS, it is still to be determined how to appropriately and systematically diagnose relevant ISS to support the diversity of innovation, especially in the agricultural sector across Europe. There is therefore a need for systematisation and development of a typology able of capturing ISS in a generic and comprehensive manner in relationship with innovation processes. The clear mapping of ISS activities, their providers and corresponding relations with the innovations and relevant processes, forms the basis for any effective intervention towards further strengthening both innovation support systems and innovation processes. As part of an EU funded project (AgriSpin - www.agrispin.eu) in an attempt at filling these knowledge gaps, with this contribution we a) elaborate on a conceptual basis of a generic typology for capturing ISS, b) structure selected innovations along the degree of technological change and coordination levels following Faure et al (2017) and c) test the generic ISS typology by way of addressing the following research question:

> *Which innovation support services (ISS) are most appropriate and best match stakeholders’ needs with respect to the type of innovation and the phases of an innovation process?*

Within the context of a wider study which addressed the generation and creation of learning space for innovations and ISS across Europe, this contribution zooms in to the experiences in 18 cases drawn from the Campania region - Italy (C-IT), Brabant region - Netherlands

(NL), Basque region – Spain (SP), Flanders region – Belgium (BL), and the Aarhus region – Denmark (DK).

2 Conceptual frameworks

2.1 Systems of innovation

Rogers (2003) describes innovations as everything ‘that is in some case new, or a change for an individual or a community that may help in doing things better, making things easier or solving problems’ (Rogers, 2003). In a similar light, the OECD (1997) and Eurostat (2009) have defined an innovation as the implementation of a new or significantly improved product (good, service or practice), a new marketing method or a new organisational or institutional (rule, norm, standard) method in business practices, workplace organisation or external relations. Our theoretical basis relies on the systems of innovations approach (World Bank 2006) which recently conceived innovation in a systemic and interactive way, i.e. that innovation emerges from networks of actors as a nonlinear social (and institutional) as well as a technical process, where interactive learning takes place around a common concern or impulse of change (Knierim et al. 2015, Touzard et al. 2015). Therefore we, in parallel with current EU rural and innovation policies, conceive innovations as emerging from AKIS which comprise multiple actor groups interactively engaged in the phases of innovation process (Hruschka 1994, Rogers 2003, Wielinga 2016) along value chains, related to specific products or regions or jointly addressing a cross-cutting challenge or problem (EU-SCAR 2013; World-Bank 2006).

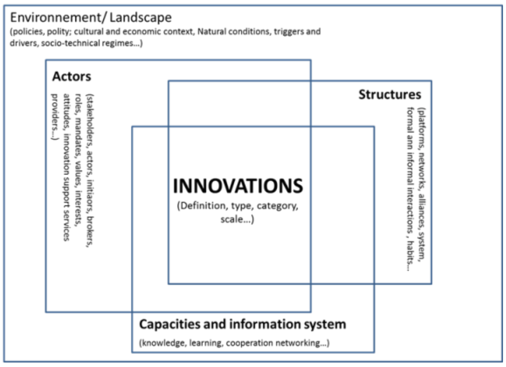


Figure 1: Structural perspective to an innovation process (Knierim et al. 2015)

Notes

Major influencing factors to an innovation situation are viewed from a structural or static perspective. The main emphasis here is on the static nature of the components captured at a given point in time as they are embedded or have been shaped by the context in which they are found.

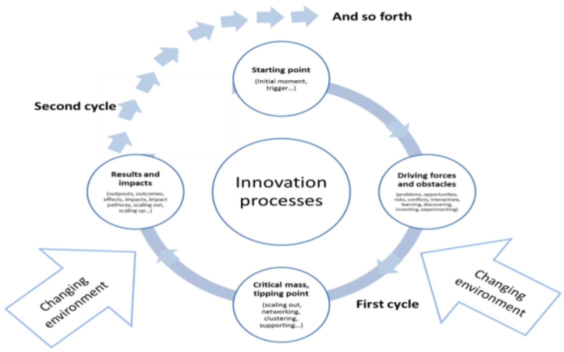


Figure 2: Dynamic perspective to an innovation process (Knierim et al. 2015)

Notes

This links an innovation process to an iterative cycle or to a sequence of loops that repeat and adjust or improve over time and is constantly influenced by a changing environment. Emphasis here is on the non-linear nature of the process.

Our main emphasis is on processes around innovations in which knowledge is constructed through social interaction (Knierim et al. 2015). Thus particular attention is given to (social) exchange, co-ordinated action and networking. We are further inclined to the works of Klerkx and Leeuwis (2009) who highlight that in order to overcome gaps resulting from networks and institutional failures, growing attention should be given to actors such as ‘intermediaries or facilitators’ and to relate actors with innovation support services (ISS).

Furthermore, innovation processes can be viewed from a structural, static perspective or from a dynamic perspective (Knierim et al. 2015; see, Figure 1 and 2, respectively). Our assumption is that it is necessary to differentiate between the analysis of the elements as structures of a system from the analysis of the elements which create interactions that govern the process (Laperche et al. 2013) across possible phases (Figure 3) (Wielinga el 2016). The importance of innovation phases and interactions between and within each phase is different in each innovation in relation to the institutional context and the nature of innovation.

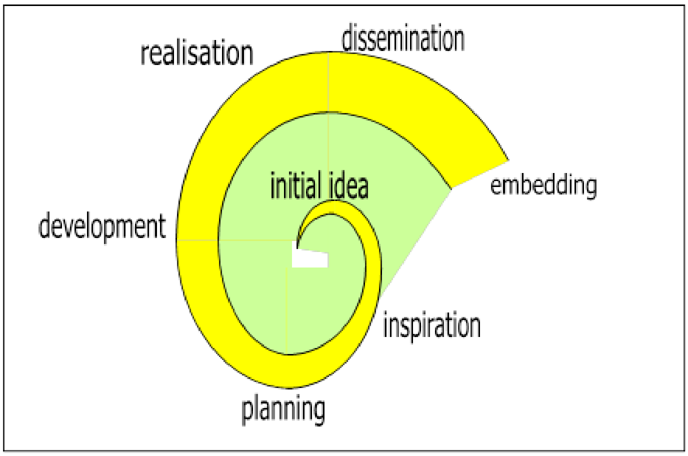


Figure 3: Phases of the innovation process (Wielinga et al. 2016), building on Rogers (2003) 5 stages innovation decision process.

- *Initial idea phase: At this phase, actors get a new idea because of a problem or an opportunity.*
- *Inspiration phase: At this phase, others become inspired and form an informal network around the initiative.*
- *Planning phase: At this phase, initiators formulate plan for action, they negotiate space for experiments*
- *Development phase: This is the phase of experimentation to develop new practices and to collect evidences.*
- *Realization phase: The innovation here goes into implementation at full scale.*
- *Dissemination phase. This is the phase where effective new practices are being picked up by others.*
- *Embedding phase. As the last phase in the process, the new practice becomes widely accepted. What matter is new rules, laws, subsidies, taxes, etc. to mainstream the innovation*

2.2 Technological change and actors coordination for innovations

According to Faure et al. (2017), ISS are expected to vary according to the types of innovations. As there are many ways to describe the diversity of innovations, a need results for a generic classification of innovations which, in turn, will allow better addressing of this diversity. The proposed classification refers to two dimensions which orient an innovation. First, there is the (high or low) level of technological change necessary for the envisaged changes (at farm level, value chain level, territory level) - this dimension mainly relies on an innovation's dominant "hardware" component defined as new technical devices and practices (Leeuwis and Aarts, 2011). Secondly, we differentiate the high or low degree of coordination activities among actors (including service providers) implied to achieve the desired changes - this dimension mainly relies on an innovation's "orgware" component defined by Leeuwis and Aarts (2011) as new social institutions and forms of organisation.

Such a classification leads to four groups of innovations with distinctive characteristics (Faure et al. 2017:12; Figure 4):

> *"Group A:* *innovations with a high level of technological change and low level of coordination needs among stakeholders.* Such innovations are more likely to occur with radical changes at farm level or among small processors but with secured access to markets." The assumption here is that "there is no need for strong coordination among actors to stimulate the innovation and ISS may be focused mostly on the knowledge awareness and exchange, advisory, consultancy and capacity building service functions."

> *"Group B:* *innovations with a low level of technological change and a high level of coordination among actors."* The assumption here is that "ISS may emphasise mostly demand articulation, networking, and capacity building services. Such innovations may occur for promoting new management practices for farmers based on new advisory services, new value chain and new marketing practices of existing products."

> *"Group C:* *innovations with high levels of technological change and high level of coordination change among stakeholders.* Such innovations are challenging and are

more likely to be radical." Innovations in this group are expected to exhibit characteristics of both groups, A and B above. While ISS in form of knowledge awareness and exchange, and capacity building services are expected to be attracted for serving the high technological dimension (hardware component), services for networking and facilitation, advisory and consultancy amongst others are expected to serve expectation of coordinating actors (orgware component). Such innovations cover both farm value chain and territory scales.

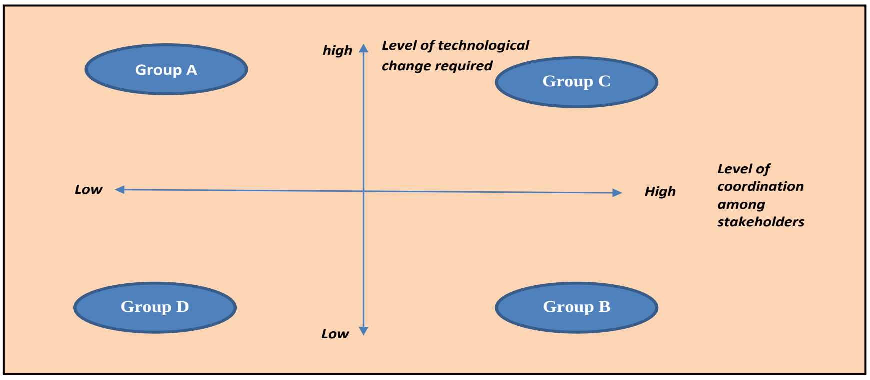


Figure 4: classification of innovations depending on technological change and coordination (Faure et al. 2017:12).

"Group D: innovation with low level of technological change and low level of coordination change among stakeholders. Innovations here are mostly incremental because both technological and organizational changes are light. Here, ISS largely relate to traditional individual advisory services and consultancy at farm level or other firm level" (Figure 4) without the necessary wide mobilisation of other actors.

2.3 Framework for analysing ISS

An innovation support service (ISS) can be either understood as an actor or organisational body or as an activity. For this paper, we adopt the definition of ISS related to service as an activity. Based on the state of 'service' discussion in economic and agricultural extension literature (Faure et al. 2012; Labarthe et al. 2013, Mathe et al. (2016) postulated that *"……by its nature, an ISS is immaterial and intangible and involves one or several providers and one or several beneficiaries in activities in which they interact to address a more or less explicit demand emerging from a problematic situation and formulated by the beneficiaries and to co-produce the services aimed at solving the problem..."* (p. 6).

On the basis of this definition a literature review on support services in agricultural innovation led Mathe et al. (2016 p.10) to develop an initial generic classification of seven support service functions (ISS): *[…Knowledge and technology transfer; Advisory, consultancy and backstopping; Marketing and demand articulation; Networking facilitation and brokerage; Capacity building; Access to resources; Institutional support for niche innovation and scaling mechanisms stimulation…].* For our purposes this classification has been further elaborated based on an extended literature (cf. Table 1). The assumption is that the generic functions occur a) at various decision-making scales i.e. from farm to territorial or value chain, b) at different phases of the innovation process (Mathe et al. 2016, Wielinga 2006, cf. section 2.3).

Table 1: Revised generic innovation support service (ISS) activities (based on Mathe et al. 2016)

ISS functions	Brief definition of function	Conceptual basis of functions
1. Knowledge awareness and exchange (ISS1)	*All activities contributing to knowledge awareness, dissemination of scientific knowledge, or technical information for actors. For instance, providing knowledge based on information dissemination forums (website, leaflets), meetings or demonstrations and exchange visits.*	Findings of Leeuwis and van den Ban (2004:31) point in this direction by distinguishing four kinds of services which include "raising awareness and consciousness, exploration of views and issues and information provision. Kilelu et al. (2011) link these services to the distribution of knowledge and to putting it into use. Knowledge awareness and exchange are seen to have similar features with fuzzy boundaries and both terminologies in some cases are used more or less in an interchangeable manner.
2. Advisory, consultancy and backstopping (ISS2)	*Advisory, consultancy and backstopping depict targeted supportive activities aimed at solving problems regarding for instance, a new farming system or new value chain design. The provision of advice (technical, legal, economic, environmental, social etc.) during the innovation process based on demands of actors and the co-construction of solutions, all fall in this category.*	We base this understanding on the work of Leeuwis and van den Ban (2004) who sees "advisory communication" as a function of service delivery. In the same light, Edquist (2011) highlights the importance of provision of consultancy services for the innovation process, while Heemskerk et al (2011) see this as technical backstopping especially with regards to providing advice on economic, social or technical issues. We acknowledge an overlap of activities among advisory, consultancy and backstopping and in the context of ISS, we frame these under one service function.
3. Demand articulation (ISS3)	*This specially involves services targeted to help actors to express clear demands to other actors (research, service providers, etc.). This is targeted support of the innovator towards enhancing his /her ability to express the needs from other actors.*	Kilelu et al. (2013) identify in one of their six service functions, service in form of "demand articulation". They see it as vision building, diagnosis or foresight activity. Oakley (1991) on his part sees it as a form of intermediary service where innovators are linked to existing services including strengthening their ability to be able to effectively articulate and make choices from a range of services (e.g. including the procedures and mechanisms for dealing with these services). In the same light, Kilelu et al (2014) in their study concluded that helping farmers to express clear demands is one way of contributing to the dynamic innovation processes.
4. Networks, facilitation and brokerage (ISS4)	*Provision of services to help organize or strengthen networks; improve the relationships between actors and to align services in order to be able to complement each other (the right service at the right time and place). It also includes all activities aimed at strengthening collaborative and collective action.*	Following Albert (2000), interactive facilitation and building linkages is a form of extension strategy which relies heavily on partnerships and networking. While Kilelu et al. (2013) refers to facilitation as "network brokering" (i.e. match-making of partners), Oakley (1991) sees it as the act of assisting rural people to undertake specific actions designed to strengthen their participation (acquiring technical skills, gaining access to available resources or translating their own ideas into feasible projects) as a network. According to Oakley, the development of links between rural people is an act of networking, facilitation and brokerage. Malecki and Tootle (1996) see brokers as the spark plugs who guide an innovation networks into existence, and they are the first sine qua non of networks, helping innovators to access the variety of tangible and intangible resources that are needed to realize an innovation. Other authors see facilitation as the process of stimulating and assisting the process between stakeholders with the objective of improving the quality of interaction (Heemskerk et al. 2011). While facilitation according to Auvine et al. (2002), Koutsouris 2012; "is designed to help make groups perform more effectively" with focus on how well people work together, Roth (2003) sees knowledge brokerage as the facilitation of the spread of knowledge within and between organisations and thus as a means to stimulate innovation. Both definitions show a close linkage in both activities with no clear cut boundary as they both perform co-learning function (Koutsouris

			2012). This function signifies rather new role requiring specific and largely unexplored skills (Koutsouris, 2012). As networking and facilitation, all have similar features, with fuzzy boundaries, in the context ISS, we choose to frame them under one service function
5.	**Capacity building (ISS5)**	*Provision of services aimed at increasing innovation actors' capacities at the individual level and at the organizational level. The services may comprise the provision of classical training and of experiential learning processes.*	Capacity building is recognised as a strategy for service delivery (Leeuwis and van den Ban, 2004), which can be in form of education and training, amongst others (Albert 2000). Following Labarthe et al. (2013), enhancing farmers' skills and facilitating their access to knowledge through training in order to increase farm performance is a form of service, which builds the capacity of the farmer. Many studies have laid emphasis on the support for innovation processes by strengthening capacities of innovators (Allebone-Webb et al. 2016; Kilelu et al. 2013; Heemskerk et al. 2011; Oakley, 1991) and some (e.g Edquist (2011) refer to this as competence building.
6.	**Enhancing / supporting access to resources (ISS6)**	*Provision of services for innovators aimed at enhancing the acquisition of needed resources to support the process. This could be facilitating access to inputs (seeds, fertilizers etc.), facilities and equipment (technological platforms, labs etc.) and funding (credit, subsidies etc.).*	Following Albert (2000), Labarthe et al. (2013), interactions between supply and demand actors of a service is considered as functional relationships of the service systems linked to several components such as financing, input delivery, insurance etc. Hekkert et al 2007, revisited in Klerkx et al. 2009, stated that innovation brokers can contribute in facilitating the realisation of these services within an innovation system. This may particularly relate the role in guidance on the search for resources and creation of Legitimacy over them. Particularly for resources mobilisation, this may include facilitating access to both financial and human capital (Hekkert et al. 2009) as basic input for the innovation system. Examples of these activities may include facilitating access to funds for long term research and development, programs set up by industry or government to develop specific technological knowledge, and funds made available to allow testing of new technologies in niche experiments (Hekkert et al 2007). While Hekkert et al 2007, in their study within the frame of innovation systems functions referred to these services under one name as "resource mobilisation function" in our case for mapping ISS functions we call this "Enhancing access to resources".
7.	**Institutional support for niche innovation and scaling mechanisms stimulation (ISS7)**	*Provision of institutional support for niche innovation (incubators, experimental infrastructures, etc.) and for out scaling and up scaling of the innovation process. This refers to support for the design and enforcement of norms, rules, funding mechanisms, taxes, and subsidies etc. that facilitate the innovation process or the diffusion of innovation.*	Faure et al. (2014) describe service relation as an institutional arrangement, while Gadrey (1994) refers to the institutional environment as an influential factor to the service construction. In a similar way, Kilelu et al. (2013), identify "Institutional support" as institutional change and boundary spanning activities. Heemskerk et al. 2011 relate institutional support to "advocacy" seen as buying-in and supporting of those who matter to support the innovation process. This includes informing policy makers and calling for policy change. Other authors e.g. Edquist (2011) highlight provision of institutional support for niche innovations (e.g. provision of incubators centres, experimental infrastructures etc.), and furthermore, all administrative enhancements fall in this category.

3 Methodology

3.1 Data gathering procedure

Data for this contribution was derived using an action research approach (Checkland and Holwell 1998, O'Brien 1998, Faure et al. 2014) where a specific exploratory case study method (Cross Visits) was used as part of an EU funded project (AgriSpin: www.agrispin.eu) as reported in Faure et al (2017). Following the design of the methodology (Wielinga 2016), a total of 13 Cross Visits in 12 European countries were undertaken. A Cross Visit typically lasted 3 – 4 days and involved a mixed team of between 7 and 10 project partner members drawn from science and practice. The aim of each Cross Visit was to study innovation support services (ISS) in 4 to 5 innovation cases proposed by one host organisation and validated by the projects' Steering Committee (Ndah et al. 2016).

The selection of the innovation cases was aimed at observing a diversity of situations in terms of main topics addressed (agriculture sector, food sector, etc.), the scale of innovation (farm, value chain, territory) and of main actors leading the innovation (Ndah et al. 2016). The visits of each case included interviews of key actors, visits of farm and firms, and time dedicated for collective analysis.

After each cross visit, the host organisation prepared a visit report, which summarised the findings and included graphs and visualised results such as the jointly prepared timeline, the innovation spiral, pearls, puzzling's and key recommendations. In addition, the host organisation prepared narratives, which summarised the case by case outcomes from the cross visits combining the host's perspective with that of the visiting team.

3.2 Analytical procedure

Following the principles of qualitative inductive content analysis (Thomas 2006, Punch 2005; Faure et al. 2017), three tools to analyse the data have been used: i) an innovation characterisation matrix and, ii) an innovation support service matrix (Ndah et al. 2016) and the above presented classification scheme (see 2.2). The innovation characterisation matrix contains information about the geographical scale of the innovation, main actors driving the innovation, main issue addressed and the main support service functions. The innovation support service matrix on the other hand contains, for each case study, information on the types of support service functions, the content of the support functions, the providers involved, and the phases of the innovation process.

3.3 Choice of cases

The choice of innovation cases followed the generic classification of innovations introduced in 2.2. Within such a framework, group D innovations, which relate more to cases where a one-to-one farmer - advisory relationship was observed, are not fully in line with the focus of the current paper, which addresses innovations that had a multi-actor dimension. Thus, we limit our cases to innovation groups A (high technological change, low coordination needs), B (low technological change, high coordination needs) and C (both dimensions high), and report on a total of 18 cases drawn from five case study regions in Europe (Table 2).

Table 2: selected innovation cases and characterisation

	Region and Country	Innovation cases	Dominant issue	Level of innovation	Innovations' group type
1.	Basque region (SP)	Geopos	Hardware	*Farm level*	*Group A Low level of coordination, and high level of technological change required*
2.	Aarhus, Denmark (DK)	SWAP-PEN	Hardware		
3.	Basque region (SP)	Seed Capital	Hardware		
4.	Basque region (SP)	Itera-AA	Hardware		
5.	Aarhus (DK)	Chemicheck App	Hardware		
6.	Brabant region (NL)	Vair Varkenshuis	Hardware		
7.	Basque region (SP)	Karabeleko	Orgware	*Value chain and or territorial level*	*Group B High level of coordination and low level of technological change observed*
8.	Campania region (IT)	Bio-District	Orgware		
9.	Flanders region (BL)	DistriKempen	Orgware		
10.	Campania region (IT)	Mediterranean centre	Orgware		
11.	Flanders region (BL)	Agrocoach	Orgware		
12.	Campania region (IT)	Organic Farm	Orgware		
13.	Brabant region (NL)	Precision Agriculture	Orgware/Hardware	*Farm level, value chain and or territorial level*	*Group C High level of technological change required, and high level of coordination amongst stakeholders*
14.	Brabant region (NL)	Dutch Quinoa	Orgware/Hardware		
15.	Campania region (IT)	Tenuta Vannulo	Orgware/Hardware		
16.	Flanders region (BL)	Food Innovation Academy	Orgware/Hardware		
17.	Brabant region (NL)	Supply Chain	Orgware/Hardware		
18.	Aarhus region (DK)	Mini Wetland	Orgware/Hardware		

Notes:
Orgware innovation: implies the dominant issue in the innovation which attracts ISS is the organisational process.
Hardware innovation: implies the dominant issue in the innovation which attracts ISS is the product, process learning.

4 Results

Following, the results of the case studies analysis as guided by the main research question and the generic classifications of innovations (see 2.2.) are presented.

Table 3: Overview distribution of ISS functions across group A B C

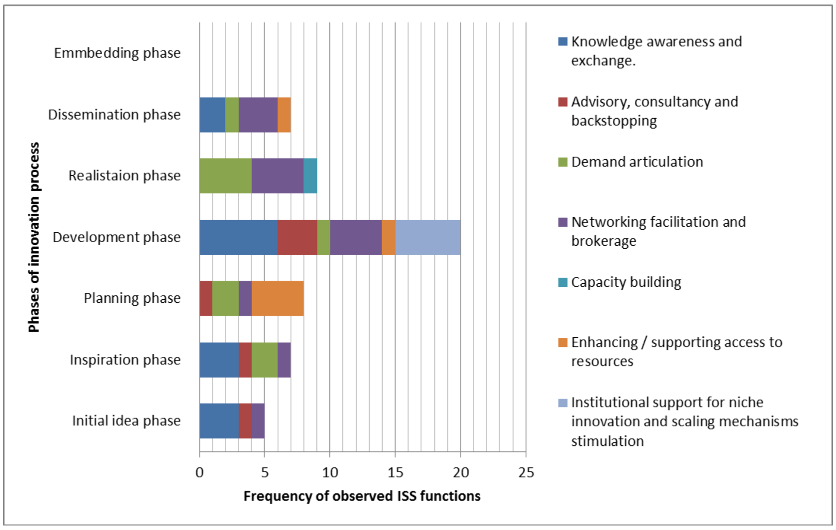
Innovation support service functions (ISS)	*Frequency distribution of ISS functions across innovation group types*					
	A	%	*B*	%	*C*	%
1. Knowledge awareness and exchange (ISS1)	*14*	*25*	*9*	*20*	*6*	10
2. Advisory, consultancy and backstopping (ISS2)	*6*	*11*	*9*	*20*	*8*	14
3. Demand articulation(ISS3)	*10*	*18*	*1*	*2*	*11*	19
4. Networking facilitation and brokerage (ISS4)	*14*	*25*	*11*	*24*	*14*	24
5. Capacity building	*1*	*2*	*5*	*11*	*5*	9
6. Enhancing / supporting access to resources (ISS5)	*6*	*11*	*9*	*20*	*11*	19
7. Institutional support for niche innovation and scaling mechanisms stimulation (ISS6)	*5*	*9*	*2*	*4*	*3*	5
Total	*56*	*100*	*46*	*100*	*58*	100
Total number of ISS mentions observed = 160						

Comparing the frequencies of ISS functions provided per group (Table 3), we see some commonalities and differences: in all groups, the networking function (4) has the highest mention while capacity building (5) and institutional support functions (7) rank relatively low. In contrast, the groups clearly vary with regard to the combination of the three or four most important functions (A: function 1, 3 and 4; B: function 1, 2, 4 and 6; C: function 3, 4, and 6).

4.1 Influence of innovation support services and group A innovations

[innovations with a high level of technological change and low level of coordination needs among stakeholders]

Data analysis showed that observed ISS for this group portray a certain concentration of ISS: Across the seven generic service functions, "Networking facilitation and brokerage" and "knowledge awareness and exchange" feature at top of the list (14 counts each), followed by "demand articulation" (10 counts) while on the other hand, "Capacity building" is observed only once (**Σφάλμα! Το αρχείο προέλευσης της αναφοράς δεν βρέθηκε.**).



Notes:

Group A innovation cases: Geopos (SP), SWAP-PEN (DK), Seed Capital (SP), Itera-AA (SP),Chemicheck App (DK), Vair Varkenshuis (NL)

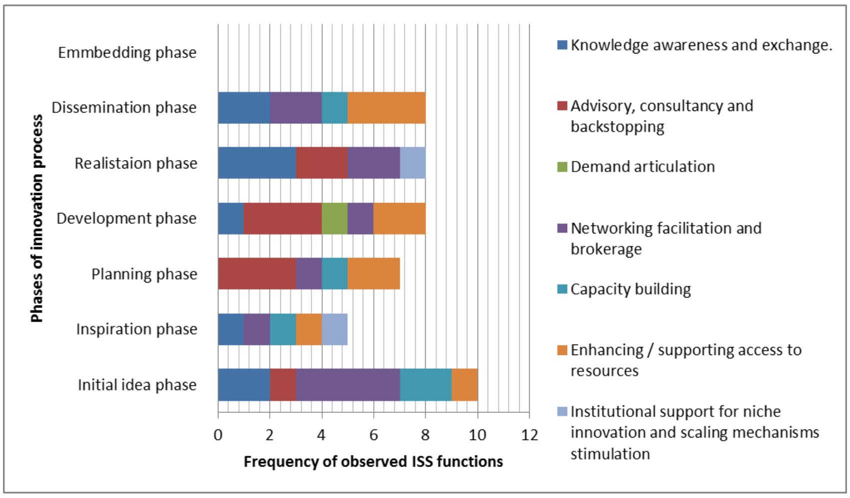
Figure 5: ISS and phases of innovation process for group A innovations

With regards to ISS and phases of innovation process, a prominent concentration of services is observed in the development phase (Figure 5) with almost all ISS functions (6/7) being present at this phase. On the other hand, the early (initial idea to planning) and later (from realization to dissemination) phases show a much lower intensity of occurrence and diversity of service functions. Lastly, the Embedding phase appears not to have attracted any services. This phenomenon is due to the fact that the six innovations studied were all "young" innovations that not yet reached this stage.

4.2 Influence of innovation support services and group B innovations

[innovations with a low level of technological change and a high level of coordination among actors]

In total, group (B) shows a much lower number of ISS mentions across the seven generic functions compared to groups A and C. Nevertheless, comparatively high mentions are observed for four functions, namely "Networking, facilitation and brokerage functions" (11 counts), followed by "advisory, consultancy and backstopping", "knowledge awareness and exchange functions", and "Enhancing / supporting access to resources" (9 counts each) (**Σφάλμα! Το αρχείο προέλευσης της αναφοράς δεν βρέθηκε.**).



Notes:

Group B innovation cases: Karabeleko (SP), Bio-District (IT-C), istriKempen (BL), Mediterranean centre (IT-C), Agrocoach (BL), Organic Farm (IT-C)

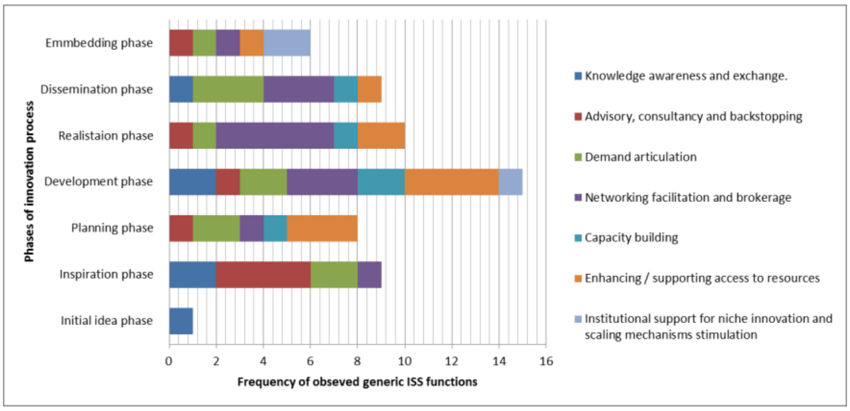
Figure 6: ISS and phases of innovation process for group B innovations

With regard to phases of innovation process and ISS, results show that most of the ISS functions are spread across almost all phases of the innovation (5/7 functions) except for the embedding phase with no services. Nevertheless, there seems to be a certain degree of service concentration at the initial idea phase (10 counts), followed by Development, Realisation and Dissemination phases (8 counts each) (Figure 6).

4.3 Influence of innovation support services and group C innovations

[innovations with high levels of technological change and high level of coordination change among stakeholders]

Results show that all seven ISS functions were observed for group C innovations though with varying intensities. Service activities under “Networking facilitation and brokerage” appear to dominate (14 counts), followed by “Demand articulation” and “Enhancing / supporting access to resources” functions (11 counts each) (**Σφάλμα! Το αρχείο προέλευσης της αναφοράς δεν βρέθηκε.**).



Notes:

Group C innovation cases: Precision Agriculture (NL), Dutch Quinoa (NL), Tenuta Vannulo (IT-C), Food Innovation Academy (BL), Supply Chain (NL), Mini Wetland (DK)

Figure 7: ISS and phases of innovation process for group C innovations

With regard to ISS and phases of the innovation process, results show that all phases of innovation received some kind of support though with varied intensities. However, as with group A, most services are observed at the Development phase with all seven service functions involved. On the other hand, the Initial idea phase receives the least of the services with only one service function (knowledge awareness and exchange) noted (Figure 7).

5 Discussion

The above results shows varied outcomes with regards to the assumption that types of innovations may shape the type of ISS intervention. This is especially glaring when these innovations are examined following their possible degree of technological change and the level of stakeholder coordination involved as has been the case with this contribution.

5.1 Innovation support services and group A innovations

[innovations with a high level of technological change and low level of coordination needs among stakeholders]

While it is reasonable to expect that innovations with high technological change and low coordination levels would attract mostly services relating to "technology transfer, advisory, consultancy and capacity building" as suggested by Faure et al. (2017), our findings have shown that this assumption does not hold true in all cases. Results showing a strong presence of ISS for "networking and facilitation" and low level of "capacity building" are rather surprising outcome for this group. Especially as far as "networking and facilitation" is concerned, on the one hand, this kind of function was not expected given the low level of coordination at farm level of this group. On the other hand though, such functions may be necessary for farmers to get in contact with actors (other than farmers) who will assist through "Knowledge exchange" with high level technology changes. Such a networking function, as the gateway to acquiring other services (esp. "knowledge and information" which is underlined in the assumptions), is a lesson which should be noted in supporting ISS for this group of innovations. For example, the Basque (SP) cases, although technologically oriented in nature, still make use of networking services offered by service providers within the region (Table 2). For instance, the case of ITERA_AA (SP) where:

> *[…a single farmer needed advise on his intended decision of investing in buying a second milking robot for his farm. He then requested external advice from an advisor (Abelur Advisory Centre), who then linked him to joining a wider project group (Itera-AA project). Within this group, the farmer together with others facing different sustainability issues jointly exchanged and networked amongst each other to arrive at solutions to their problems. Within this network, the farmer then obtained advice from a technician who then introduced him to the idea of selling surplus milk using a Vending machine. This then eventually became the focused innovation in his farm…]*

Results also point to the importance of "knowledge awareness and exchange" for group A. Although this finding was not expected from the classification logic either (Faure et al. 2017), it is plausible when the angle of "knowledge sharing and exchange" amongst involved stakeholders beyond the farm level is considered. This is especially important as innovations with a high degree of technological change demand intensive "knowledge awareness and exchange" for innovating farmers to effectively address the challenges posed by technology's specialised nature (Leeuwis and van den Ban 2004:31, Kilelu 2011).

5.2 Innovation support services and group B innovations

[innovations with a low level of technological change and a high level of coordination among actors]

For this group, findings indicating the dominance of ISS under "Networking facilitation and brokerage", "advisory, consultancy and backstopping functions" tally with the strong need for actors' coordination across the value chain or territorial level for such orgware dominated innovations (Faure et al. 2017). However, the seemingly high service intensity under "knowledge awareness and exchange" functions is a surprising outcome as this, complements our conceptual expectations (Faure et al. 2017). A plausible explanation for the presence of "knowledge awareness" refers to its relation to awareness creation, consciousness, information exploration (Leeuwis and van den Ban 2004:31) within the multi-stakeholder interactions and coordination (orgware) at value chain and or territorial level, than is the case with awareness with technological knowledge (hardware) with group A innovations. This is especially so, given the emerging non-linear view on promoting and supporting innovation processes (Hubert et al., 2012, p. 180). Examples of service activities to cite for innovation in this group include:

…case of the Mediterranean Diet centre (IT-C) where

> *"[…awareness about research studies acted as a stimulant for the decision to create the International Centre for Meditarenean Diet (IT-C). It is an example that shows how a new idea emerged based on research findings from studies and projects. This corresponds with the ISS function Knowledge awareness and exchange…]*

… case of Bio district (IT-C) where

> *[…with overall coordination and continuous influence over the years from AIAB, the "Bio-district innovation case" was successfully established involving associations, public authorities, farmers and tourist operators. This service activity corresponds both to the ISS functions: network facilitation and brokerage; advisory, consultancy and backstopping…]*

… case of Food innovation Academy (BL) where

> *[…In an attempt at stimulating farmers to think outside the box regarding packaging and new product development, Innovatiesteunpunt (ISP) organised a one day bus tour to supermarkets in the United Kingdom (UK). This consisted of marketers, product designers and farmers. From the intensive exchange and photo interpretation with the assistance of designers during the visit, each farmer was able to take home at least 1 idea on how to improve product packaging...]. Such a service corresponds with the knowledge awareness and exchange function.*

5.3 Influence of innovation support services and group C innovations

[innovations with high levels of technological change and high level of coordination change among stakeholders]

By exhibiting both a high degree of technological change and actors' coordination, (hardware and orgware component respectively), cutting across the farm, value chain and territorial levels, it is expected for group C innovations, to attract most of the seven generic ISS functions. In spite of such an expectation, findings showing the much stronger appearance of "Networking facilitation and brokerage", "Demand articulation", and "Enhancing / supporting access" deviate from expectations (Faure et al. 2017). This calls for the need of prioritising support starting with the three service functions, in efforts aimed at promoting the support service subsystem. Nevertheless, the visible presence, to a certain extent, of all 7 service functions, confirms the conceptual assumption of addressing the dual dimensions of such innovations: a high degree of technological change (hardware dominated characteristics) and a high level of actor coordination required (orgware dominant characteristics). The following quote provides an example of a service activity for the Quinoa case (NL), that falls in this group and relates to the ISS "enhancing access to resources" ISS function", where

[…through the joint initiative of Southern Dutch Farmers and Horticultural Organisation (ZLTO) and, the government authority of Northern Brabant (LIB), the innovator was able to obtain the Nuffield provided scholarship of €7500, and €2500 from LIB which together paved the way for his trip to South America. There he learned and familiarized himself with the different varieties of the Quinoa crop, and how it grows under different conditions…] Paree (2015)

5.4 Innovation support services and phases of innovation process

A comparative overview of the findings on ISS in relation to the phases of innovation process reveals a strong variation across the three innovation groups (A, B, C). While groups A and C indicate strong attraction and concentration of services at the "development phases" (Figure 5, Figure 7), group B seems to have an equitable distribution/attraction of ISS across the seven phases of innovation process - with the exception of “initial idea phase” (Figure 6). The concentration of ISS at the development phase in A and C can be attributed to the high level of technological change in both groups which calls for intensive support concerning the hardware component of the innovation. This ranges especially from services towards ensuring an intensive knowledge awareness and exchange, to advisory and consultancy, networking facilitation, capacity building and resource mobilisation to actually develop the innovation. The spread of services for group B innovations reflects the multi-actor nature of such innovations (orgware component) thus with a much stronger need for stakeholders interaction, exchange and coordination at either value chain or territorial levels. The relation of ISS to the phases of innovation is in line with Klerkx and Leeuwis’ (2009) who remarked that the application of service functions, depends on the different requirements of the innovation network in different phases of its development and the composition of the network in terms of density and strength.

6 Conclusion and outlook

With respect to an explicit political emphasis on innovation generation in the agricultural sector (EU SCAR 2012, 2013) and an increasing pluralism of service providers within the European AKIS (Knierim et al. 2017), we aim to provide an improved understanding and systematisation of innovation support services (ISS). With the here presented results, we proposed innovation classification categories and a typology for ISS functions with the overall aim of capturing in a comprehensive manner, innovation support services as basis for effective intervention towards strengthening both the support systems and innovation processes.

We purposefully constructed a three-grouped data set from a larger total, reflecting cases of similar innovation features (dominant component *orgware* and/or *hardware*) and of two different levels of technological or social complexity. Group A represents low level of coordination and high level of technological change; group B represents high level of coordination and low level of technological change and group C stands for cases with high level of technological change and high level of coordination amongst actors. Across these 3 groups, we analysed the frequency of provided ISS functions and their occurrence in the course of the innovation process’ phases.

With 160 ISS mentions observed for the 3 groups with 6 cases each, we observed some commonalities and differences or patterns that beckon for a deeper reflection on the preliminary assumptions and which could guide in elaborating more substantiated questions for further research.

The cross-cutting predominant role of the ‘networking facilitation and brokerage’ function is somewhat surprising as we did not expect it for the group A (low level of coordination). However, the initial, project-related selection criteria for all cases, that is a “multi-actor innovation process setting” (Ndah et al. 2016) might have been dominating against the classification scheme. Secondly, the relative importance of the ‘knowledge awareness and exchange’ function for groups A and B compared to C came equally as somewhat of a surprise as it challenges the assumed relationship between a high level of technological change and a relatively higher need for access to new knowledge. We conclude from this result that a) there might be a need to check the way this function is operationalised across cases and b) the relationship between particular knowledge needs and technologically complex innovations is not unambiguously supported by our data.

In relation to the phases of innovations, the high level of technological change in both groups A and C calls for a concentration of ISS at development phases in which intensive support towards effectively realising the technological innovation is needed. This ranges from services for ensuring an intensive knowledge awareness and exchange, to advisory and consultancy, networking facilitation, capacity building and resource mobilisation for the actual “development” of the innovation.

On the other hand, the multi-actor nature of group B innovations (orgware dominant) calls for a service spread across all phases of innovations in order to address stakeholder’s interaction, exchange and coordination at either value chain or territorial levels. Thus, the more equally distributed pattern of ISS across phases is plausible as seen from an ex post perspective. However, the relationship between innovation support services and the phases of innovation depends on the different requirements of an innovation network in different phases of its development and the composition of the networks in terms of density and strength, which varied across the explored cases, and thus require a cautious interpretation.

Equally, the patterns observed of ISS functions across the innovation phases do not allow for clear-cut conclusions, but give first indications for interesting research pathways. For example, the ISS requirements in the 'development phase' of hardware dominated innovations merit increased attention. In contrast, the role of ISS for the initial phase seems to be highly case-specific or possibly, even underexplored.

All in all, we conclude from this analysis that the proposed classification for innovations is a start but is not yet fully satisfying with regard to the systematisation of ISS function. Also, we are aware of the fact that we base our observations on a restricted and purposefully selected sample of cases which is likely to have repercussions for the occurrence of ISS patterns.

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