Designing for transition in agriculture: addressing the gap between design and innovation

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Abstract. Our article proposes a preliminary framework to analyze an organizational model which can support the intermediation work required to bridge design and innovation. After stressing that ergonomics successfully enriches design processes (first circle), we construct a framework to investigate how innovation processes (second circle) can be understood and managed by activity-centred approaches. We refer to: (1) models of innovation (e.g. Open Source Software) to identify organizational rules enhancing the innovation process (e.g. discussion and production rules) and (2) research in socio-technical system innovation, which highlights the roles of intermediaries in innovation processes. We then apply this framework in the French primary sector to analyze four design-innovation processes contributing to agro-ecological and sustainable transitions. Finally, we discuss the differences that our framework allows us to highlight among these four cases, and point out the shortcomings of this framework that need further investigation.

Practitioner Summary: This paper is a first attempt to formalize a way of understanding and analysing the gap between design and innovation. Ergonomics has developed methodologies to act on design processes in well-defined work or product design contexts. However, practitioners and researcher are called on more and more to contribute to innovation processes, i.e. larger and more long-term transformation processes. This is particularly true in western agricultural contexts in which a massive change of practices is required to reach more agro-ecological and sustainable agriculture. To support innovation processes, ergonomists need to develop methods to analyse the activities of those who participate in these processes. We therefore build a framework which highlights the role of key participants – intermediaries – in innovation processes. This helps us to reveal the organization and the roles of intermediaries in four case studies in France.

Keywords: Design, innovation, intermediary work, management, activity

1. Introduction

Few studies in ergonomics have focused on agriculture, although the primary sector is clearly one in which the working conditions are recognized as being poor (e.g. Murphy et al. 1996; Pinzke 2003). Apart from health issues, work in agriculture is being seriously challenged by several crises: economic, environmental and social. Since the 1980s, agricultural players, policy makers and scholars have been trying to tackle these problems. Many directives and regulations have been issued at European and national levels to support a transition towards what some call an ecological modernization of agriculture (Horlings and Marsden 2011). Such a transition implies the design of new production processes to enhance biological feedback loops in ecosystems (between cultivated crops, weeds, insects, animals, microorganisms) rather than to control the environments of cultivated plots and animal herds by chemical and mechanical means. This also implies the development of new skills and the use of new machinery. There are many initiatives to redesign farming systems, from top-down research and agro-firm technology-driven design processes to bottom-up initiatives driven by farmer collectives. Not all of them share the same design intention: the vision of a more ecological agriculture as a desirable future for agriculture is still controversial. It is however well-recognized now that, in this controversial landscape, a major challenge is to achieve a large-scale change in farming systems and even in larger agricultural socio-technical systems, i.e. a transition towards an agro-ecological agriculture. This means the need to be able to scale-up and scale-out from local design initiatives, e.g. to fostering their more large-scale development and that of the new rules and institutions required to support them. What needs to be examined here is the gap between design and innovation. It is an opportunity to discuss the extent to which ergonomics can contribute to addressing this challenge and
creating space for work analysis and the involvement of future users in the building of a transformative intention during scaling up and scaling out processes.

2. Change management, design and innovation: a challenge for ergonomists?

2.1. The need for a framework to conceptualize the gap between design and innovations in ergonomics

Few ergonomic studies address the gap between design and innovation, at least when new socio-technical working systems are at stake, as in the case of transition towards a more agro-ecological agriculture. Some ergonomists have analysed transitions at farm level or at the scale of small collectives of farmers (Chantre et al. 2015; Coquil et al. 2014). Such studies have furthered understanding of the design work undertaken by farmers to reduce their dependency on chemical inputs and/or on agribusiness firms. Yet, although they have identified the difficulties encountered by these farmers or by their advisors\(^1\) to involve a larger circle of farmers in the transition process, they did not address the design-innovation gap.

Developmental approaches within the activity theories research stream address the relations between design and innovation by paying attention mainly to the relation between design and use activity systems. Some researchers have examined relations between design and use of artefacts. Béguin (2003) has pointed that design continues in use and, with Rabardel (Rabardel and Béguin 2005), has highlighted the instrumental genesis which occurs when the artefact is taken over by users. This has given rise to proposals to bring such instrumental genesis back into the development phase of design (Béguin 2003; Béguin and Cerf 2004; Béguin et al. 2012). But it does not really concern a large circle of users, although it tries to cover a wide range of uses (Cerf and Meynard 2006). A second research trend has explored relations between design and innovation through the relations between activity systems, in third-generation activity theory (e.g. Engeström 2001). In both cases, and following the idea that the activity-theory approach regards the co-design of artefacts as a key to changing practices, a particular focus has been put on how such relations can be supported by intermediary objects and practitioners in a developmental perspective, and how this can be conceptualized (Miettinen and Virkkunen 2005; Rabardel and Béguin 2005). Yet neither of these two trends have paid much attention to the way in which design projects can foster change on a larger scale, either in time or in space.

The gap between design and innovation has more often been the focus of economists and sociologists. For a long time, they have described the innovation process through the S curve of adoption. More recently, new insights have emphasized open innovation (von Hippel 2005) as a way to speed up the innovation process, while drawing on former studies showing the key role of lead users in the development phase. But this perspective is mainly focused on the enhancement of the firm’s innovation capability, rather than on the way users’ involvement contributes to a large-scale change in socio-technical systems. System innovation scholars\(^2\) point out that the inability to extent from a first circle of “innovators” to a larger one might be related to technological and organizational lock-in and/or to system failures within a socio-technical system. They emphasize the key function of brokers (Klerkx and Leeuwis 2009). These brokers both create new links in a network of players and technological artefacts, in order to stabilize a technological niche, and scale this niche up and out (Hermans et al., 2013) or anchor it (Elzen et al., 2012) within the regime when a window of opportunities appears due to changes in the landscape. Some studies take a less functionalist standpoint and focus on intermediation, arguing for the need to analyse it as a specific type of practice in processes of change (Meyer and Kearnes 2013). In line with this proposal, Steyaert et al. (2014) argue that intermediation has to support the dynamic at work between problematization on the one hand, and goals and means setting on other, within a rapidly changing world.

In line with the focus on intermediation to address the gap between design and innovation, we propose to develop a framework to analyse intermediation from an activity-centred perspective. This paper is a first attempt in that direction. The idea is to capture how design and use are intertwined, in order to expand design from a first circle of users (“classical” design process) to a second one (innovation process).

\(^1\) French primary sector is vertically structured. Farmers are assisted by advisors of various organizations (Chambers of Agriculture, cooperatives...) who hand over tools and rules designed by applied research institutes and support farmers in complying with regulations.

\(^2\) Innovation systems studies is a research field grounded in STS and evolutionary economics. The multi-level perspective is a heuristic framework focusing on the interplay of niches, regime, landscape in a transition process (see Geels and Schot 2010 for details).
four different initiatives currently taking place in agriculture, we use this framework to analyse the intermediation work carried out to support change in activity systems outside the first design circle. We then discuss this analysis and draw some lessons from it to reflect upon how we can theorize the developmental expansion of design activities from a first kernel of participants to wider circles within transition processes.

2.2. An ergonomic perspective on the intermediation work: spaces and roles to fill the gap between design and innovation

2.2.1. Design project management: supporting the creation of intermediary discussion spaces?

Over the past thirty years, activity ergonomics has developed an approach to support design processes within a project, e.g. to support a collective action structured around transformative intentions of some work situations. This approach can be described as organizing intermediation spaces in order both to approach potential future activities and to cope with the consequences on current work activities of the translation of the transformative intention into work prescriptions (new tool, new work spatial settings, new organization).

Design project management developed by activity-centred ergonomics (e.g. Garrigou et al., 1995; Barcellini et al., 2014) incorporates an ergonomics work analysis (based on activity and work situation analysis) and the construction of ad hoc participatory structures involving top/mid managers and operators to feed three phases: a phase of analysis of the project (transformation intention) and of the work situation to be transformed; a simulating phase intended to assess or enrich the proposals of designers; and a supporting phase which aims at enabling the progress of the project by proposing simulation loops to support changes in both the designed artefacts and the activity. These three phases create discussion spaces that can be formalized as intermediary spaces. For instance, when the project's intention to transform the work situation is debated by several top managers and nurtured by the work analysis carried out by an ergonomist (phase 1), this discussion space can be seen as an intermediary space which helps in anchoring the complexity of the situation to be transformed, in real world work. In this space, the ergonomist may act as an intermediary between the virtual nature of the intention and the real complex nature of the work situations to be transformed. Similarly, the space created by the ergonomist to simulate future work (phase 2) can be formalized as a second intermediary space both between design and potential use and between current and future activities. Once again, in this space the role of the ergonomist is crucial to carefully design the situation of simulation, in terms of participation of actors and resources supporting the projection of a potential activity in a new work situation. Finally, by sustaining simulation loops, the supporting phase (phase 3) maintains continuous intermediary spaces of discussion throughout the transformation process. This approach has proved its efficiency in managing the first circle of the design process. However, this management process is bound to the time of the project and to targeted participants. The organizational model developed by Online Epistemic Communities (communities structured around a common objective of co-elaborating and diffusing some kind of knowledge, e.g. a piece of software as in Open Source Software, an encyclopedic article as in Wikipedia) can be of particular interest for examining the intermediary work at the scale of larger innovation processes.

2.2.2. Intermediary activities and the building of intermediary spaces in online epistemic communities

Barcellini et al. (2008) have analysed the activity of intermediaries such as “boundary spanners” and “champions” from an activity-centred ergonomics perspective (e.g. Daniellou and Rabardel 2005) within an Open Source Software (OSS) community. In this research, intermediation activities are seen both between use and design and between various spaces of activity. Barcellini et al. (2008) call “boundary spanners” the participants who cross-participate in use and design-oriented mailing-lists (the predominant mode of interaction in OSS communities) on same topic discussions. Boundary spanners provide and share knowledge about both the use-oriented application domain and the design-oriented programming domain, and thus hold a central position in interactions and in the intermediation between use and design (Barcellini et al. 2008). Some boundary spanners can be “champions”, i.e. participants who enhance the design process by proposing “intentions for the evolution” of the artefact under design, and by structuring the design process related to this given intention. Champions both manage discussions related to these intentions and

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3 Boundary spanners were revealed by software design literature. They move across different teams and transfer information, suggesting a role oriented toward knowledge sharing, coordination and support, and compensating for communication deficits.
feed the design process by intermediary objects (in this case pieces of code or specifications). Therefore, they enhance broad participation in discussions and negotiations, by the community at large. This can be seen as intermediation work at the boundary of two activity spaces in an OSS design context: a discussion space (based on mailing-list discussions) aimed at negotiating and co-elaborating knowledge in relation to the design task, and a production space aimed at reifying this knowledge into a tangible artefact. The presence of champions and boundary spanners seems to enhance the success of the design process, from both a productive point of view – their presence may enhance the quality of the artefact designed – and a constructive one – the support they provide to newcomers may enhance the legitimate peripheral participation (LPP)\(^4\) that supports the situated learning processes of these newcomers. In this way, they enhance the possible integration of the newcomers and ensure the sustainability of the community. All these activities are made possible for participants because of specific rules elaborated within OSS communities: (i) discussion rules (e.g. respect for netiquette, systematic use of quotation etc) that enhance the quality of communication and help participants to maintain mutual understanding; and (ii) production rules (e.g. existence of enhancement proposal framework, rules framing the responsibility regarding maintenance of a piece of the artefact) that enhance coordination of the design task and constant evolution and maintenance of the artefact under design.

In relation to our question, one may argue that the OSS model is a good candidate for an organizational model addressing the gap between design and innovation from an activity-centred perspective. Evolutions of the artefacts are open to many participants, who might contribute to the design process according to their own interests and skills and thanks to the mediation of those who have the role of boundary spanners and of champions. A fluid integration of users, LPP, and mechanisms contributing to the continuous evolution of the artefact may enhance the second circle, large-scale appropriation of the artefact, and the development of new usage that challenges the artefact under design. However, this model is not fully satisfying for our purpose, as it is based on voluntary participation of "motivated" participants who tackle tasks of interest to them. Moreover, the artefact under design may not lead to a radical transformation of users’ activities, as in the case of sustainable transitions in agriculture.

2.2.3. A preliminary activity-theory-based framework to analyse intermediation work

The above approaches describe a specific way of organizing users’ participation in design. Although they are grounded in different epistemological backgrounds, they share some features which we will retain to build our preliminary framework (see in the case studies boxes, headings in bold). In the design management approach, it is assumed that the intention is carried by the managers and is not really discussed from a user standpoint. The ergonost creates spaces to open the discussion about the intention, and often acts as the users’ spokesperson. In online communities, the intention to transform is mainly oriented towards the artefact, in order to make it more suitable for users. In this case, the champion is a key player. We retain that there is a need to identify where, who and how the intention to transform is discussed and, more specifically, when it is meant to reach a second circle of users (Who deals with the transformative intention and includes it in discussions with newcomers? Where? And how?). Furthermore, whether it be in design project management or in OSS epistemic communities, the researchers highlight the need for spaces in which new ideas or uses of the artefact under design are discussed. In design project management, the production space is adjusted by the ergonomist to allow users to experiment with a prototype in use situations. In online communities, discussion and production rules and boundary spanners organize the participation of the various members of the community to guarantee their mutual understanding and to frame the process of continuous improvement of the artefact. We note that there is a need to identify the way the production and discussion spaces are organized as well as the intermediaries and rules supporting the discussions and, more specifically, those contributing to peripheral participation (How are the production and discussion spaces organized? What are their means and rules? Who act as boundary spanners?). Finally, we note that ergonomists or champions and boundary spanners act as translators in order to create a mutual understanding among the participants and to support the users’ participation in the design process while fostering its progress. Therefore, our framework has to specify how such translation processes are achieved and carried out by intermediaries (How is translation achieved?).

\(^4\) In the community of practices framework (Lave and Wenger 1991), legitimate peripheral participation (LPP) is a key mechanism measuring situated learning and integration into a community of practice. Newcomers learn a given “practice” by engaging in simple peripheral tasks and are progressively integrated into the community by engaging in more complex tasks.
3. Intermediation work to support the transition towards a 50% reduced use of pesticides in agriculture

Reducing the use of pesticides is seen as a central issue in the transition towards agro-ecological agriculture in France. The 2007 national environmental roundtable (Le Grenelle de l’Environnement) set an ambitious goal of reducing pesticide consumption in French agriculture by 50% within ten years, if possible. Accordingly, in 2008 the Ministry of Agriculture launched a national action plan, Ecophyto 2018 that aimed to foster this change. One of the main actions of this plan, known as Dephy-Ecophyto, was initiated in 2010 to design and experiment cropping systems with farmers, collect data on and promote the diffusion of those systems that use fewer pesticides but are still economically efficient. To achieve this, it relies on agricultural experimentation on 170 experimental sites and on 1,900 “reference farms” scattered across France and covering the country's six main agricultural production systems. Dephy-Ecophyto is a loose top-down process as it prescribes rules to organize the design process of a first circle of farmers and makes recommendations for expanding to a second circle. It nevertheless leaves room to manoeuvre to those who implement this national public policy, e.g. local groups of approximately ten reference farmers supported by a facilitator. Some farmers did not wait for the Ecophyto plan to explore new cropping systems which they claim are agro-ecological. These farmers are organized around a shared transformative intention which federates them and supports their design of new cropping systems. We therefore have the opportunity to explore a diversity of design projects claiming to contribute to a transition towards an agro-ecological agriculture, and differently framed as regards the best way to achieve this. We apply our framework to two contrasting Dephy farm groups (one mainly driven by maize and dairy farmers, the other by apple producers) and two farmers’ initiatives triggered by a specific transformative intention, to analyze how each addresses the issue of filling the gap between design and innovation (see the case studies below).

Case study 1: BASE network is a loose organization which holds an annual assembly of the participants, proposes some training sessions and expertise for the participants, and is based on a shared interest in soil life enhancement. A core team manages two main communication media (discussion spaces): the TCS journal and the “agricool website”. Some participants are regular contributors to these discussion spaces.

Who deals with the transformative intention and includes it in discussions with newcomers? Where? And how? Main transformative intention: any farming practices which can enhance soil life. Discussion about this main intention takes place outside the BASE community. Those who take part in this community share this intention, e.g. they join the community as they know that it will provide them with cognitive resources and discussion forums to start an exploration of new practices.

How are the production and discussion spaces organized? What are their means and rules? Who act as boundary spanners? The production space is distributed among the participants who design on-farm practices for their own farming systems. It is organized by two main rules:

- each participant can join a "platform" dedicated to the capitalization of the on-farm designed practices addressing the same problem (for example: reduce herbicide use in rapeseed crop) or technique (for example: frosting cover-crop)
- the capitalization of the knowledge about the techniques and the agro-ecosystem results from the sharing of participants’ experiences and the input of outsiders, the legitimacy of which whom has to be “certified” by the core team.

The discussion spaces (journal, website) are ruled by the core team whose members:

- facilitate involvement in the production space by introducing novelties and themes to be addressed in "platforms"
- support interaction between design and use by calling on participants to share their experiences and data about them;
- moderate discussions
- stabilize a common language and corpus of knowledge and methods, through the printed magazine mainly;

Fulfilling those functions, the core team sets a general framework for the functioning of their epistemic community, with formal and informal rules. LPP results from an invitation to people who can contribute to solving a specific problem. The main contributors in terms of experience sharing become boundary spanners between the regular participants and the newcomers. The core team may act as a champion when putting up for discussion, inside the network, controversies that take place outside of it. (An example is the discussion they introduced on reducing their dependency on Monsanto for the glyphosate molecule used to control weeds.)

Translation work is achieved by the core team and mainly takes place to:

- open new streams of exploration and support on-farm design
- create a common language that enables mutual understanding and eventually cognitive cooperation
- overcome some criticism addressed from outside the community by those who highlight the drawbacks of the
Case study 2: Rad-Civam is a national organization that coordinates local associations of farmers who explore new farming systems mainly oriented towards a high level of autonomy (decisional, technical, from input sellers and transformation buyers). Each local association is supported by a facilitator. Each group seeks financial support. Contribution of local groups as well as R&D projects can support the national coordination.

Who deals with the transformative intention and includes it in discussions with newcomers? Where? And how?*

Main transformative intention within local design groups: autonomy as a driver for designing new farming systems => due to the Grenelle de l'Environnement, change in the intention: designing farming systems that meet some environmental challenges (less use of pesticides and nitrogen, sustaining of functional biodiversity through landscape infrastructure). This results in the opening of new production spaces (see below): one as a network of design farmers’ groups supported by a facilitator; one as a design space. They address this problem by means of a two-pronged initiative. First, by introducing CAP AEC (Common Agricultural Policy Agri-environment-climate) measures based on their cropping systems. Rad-Civam is thus championing new professional norms by presenting their cropping systems as models validated by science and public policy and, at the same time, providing financial stimulus for farmers willing to change; second, from an instrumental standpoint, Rad-Civam endeavours to transfer their local groups’ successful experiences by changing cropping systems into ‘resources’ (technical references, advisory tools and methods, etc.) that can be used by other farmers and their advisors to foster agricultural change. National organization managers and local groups’ facilitators carry out these actions through research and development projects, as well as lobbying work in Paris and Brussels.

How are the production and discussion spaces organized? What are their means and rules? Who act as boundary spanners?

Three discussion-production spaces can be distinguished:
- the CIVAM groups in which farmers and their facilitator develop on-farm design of farming systems
- the GCE project which was funded by public money. It brought together 50 scattered farmers into 6 groups which develop farming systems in order to meet specifications defined by a core group of farmers. Facilitators and some people from the national organization support the production space discussion. Formal rules (on a contract basis) assign roles to each participant regarding their contribution to both redesigning the specifications and assessing their ability to direct on-farm robust solutions. LPP was mainly achieved by facilitators who invite newcomers to join the project. They identify and invite relevant experts in the groups mainly to contribute to finding solutions or to assessment. The project management team and group facilitators have the ability to define the new specifications. Facilitators act as boundary spanners between local groups and the management team.
- The “system AEC measure” design spaces which are managed under the control of the Ministry of Agriculture. The intention is to build specifications that can be eligible for CAP funding under its AEC measures. In this space, the Rad-Civam members act as champions promoting the specifications they built during the GCE project and negotiating what will be kept to specify the AEM. Rules are mainly informal and politically driven. Finally, only Ministry of Agriculture employees have the ability to set the specifications that will be addressed to the EU administration.

How is translation achieved? There is two-way translation work: from local groups’ discussion space to the Ministry of Agriculture’s, and back. This is achieved: first, through intensive cognitive work consisting of data production and analysis aimed at assessing whether the specifications can drive an on-farm design process and improve a farming system’s environmental impact; second, through negotiating the specifications in a political arena; and third, by developing tools which can support newcomers (farmers and facilitators of farmers’ groups) to use the specifications issued by the Ministry as support for an on-farm design process.

Case studies 3 & 4: Dephy case studies – Dephy is a hierarchical network organization with distributed production and discussion spaces. A national core team develops a database of all the locally designed cropping systems. The core team is related to local groups through IR (local facilitator and information gatherer) and IT (gathering information from 8 to 10 groups, supporting IR work). The national core team, IRs and ITs identify, among all locally designed cropping systems, those which are on a pesticide reduction curve and economically efficient. Main transformative intention carried by policy makers: reduce the use of pesticides by up to 50% if possible. The Dephy national core team considers that involvement of newcomers is to be addressed through communication (on-farm visits and distribution of leaflets describing cropping systems which have successfully reduced their use of pesticides while maintaining their level of income, called SCEP). The production spaces are distributed: one is managed by the core team and is mainly data driven in order to build “SCEPs” (cognitive artefacts), but IT and IR can act as champions for given SCEPs. Local production spaces exist but might differ in their organizational model. Discussion spaces are organized locally and throughout the whole Dephy network mainly among IR, IT and the national core team. Discussion addresses issues of facilitation, data collection and analysis, through on-farm visits for example. Rules are partly established through formal contracts between the groups and the national team.

Maize and dairy farmers’ group

Who deals with the transformative intention and includes it in discussions with newcomers? The local farmer group (farmers and their facilitator) is committed to the same transformative intention but reframes it according to local
conditions. The group has been built so that the farmers can act as “champions” who foster discussions about the transformative intention in the other farmers’ networks to which they belong.

**Production and discussion spaces locally organized**: here, the production space model is relatively ‘horizontal’. Farmers’ exploration work is done partly individually, and partly through collective discussions (facilitated by the IR). There is no common design project as such and no ‘technical’ intermediary object. Group farmers might act as boundary spanners in managing relations with peripheral participants within the networks in which they participate. They do so for example by introducing innovative techniques (for example mechanical weeding machinery) that can result in debates about professional norms (for example defining what level of weed infestation is acceptable in field crops). The group facilitator acts as a champion of “facilitation practices”: a resource that can be used by other advisors to support change among their farmers. No production space has been identified regarding this issue. The facilitators play a boundary spanner role in supporting LPP of innovative farmers outside the group, and of researchers who can introduce knowledge / novelties to the group, mainly through field visits by his group’s farmers

**How is translation achieved?** The group facilitator and farmers translate the public policy prescription to reduce pesticides from a technological question (developing new cropping systems) into one with an important normative dimension (what desirable ways of farming are). They do that not by talking about the need for new professional norms, but by mixing proposals of gradual implementation of innovative techniques with discussions about the need to anticipate changes in regulations that could impose those kinds of techniques on farmers anyway.

**Apple producers’ group**

**Who deals with the transformative intention and includes it in discussions with newcomers?** The group has not yet stabilized a transformative intention and is mainly a space in which the intention is discussed rather than being a driver for a design process. The building of a transformative intention is heavily locked in the economic and technological organization of this industry oriented towards international markets, and by international quality standards. Farmers and their facilitator consider that achieving a 50% reduction of pesticide use requires some radical technological and economic changes which are beyond their reach.

**Production and discussion spaces locally organized**: The production space is mainly organized within the R&D network to produce breakout technologies. Lead users are invited to experiment with and improve these technologies, and to develop technological packages, the use of which will be promoted by the R&D network in relation with apple buyers. In this network, discussion spaces are organized following a top-down or a linear model of innovation. Most producers do not participate in the design process. The local group is an attempt to open a new discussion space in which the transformative intention can be discussed. The facilitator acts as a boundary spanner between the group and other producers, on the one hand, and the R&D network, on the other.

**How is translation achieved?** Pesticide reduction is interpreted by apple producers and facilitators alike as a technological problem, not one of professional norms. “Good” radical innovation is therefore seen as a technique that ensures the production of spotless apples as demanded by largely globalized market standards.

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4. **Discussion and conclusion**

In this paper we proposed a preliminary framework to analyse the organizational model which support the intermediation work undertaken to bridge design and innovation. We applied this framework to four design-innovation processes to understand how some participants open discussion spaces with rules of the game, adopt roles, facilitate mutual understanding and peripheral participation and, in so doing, contribute to expanding new agro-ecological cropping systems from a first circle of farmers to a larger one. We saw that this is achieved differently in the four cases and therefore gives rise to four different organizational models as characterized by the main features we chose to retain in our framework.

Considering these models from a developmental perspective, the BASE model seems to be unintentionally more likely to facilitate loops among those participating in a first circle and those belonging to the second one in order to support design in use processes (in this case on-farm exploration of new cropping systems). But it pays no attention to creating spaces in which the intention to transform the work systems (e.g. the farming systems) and their use can be discussed. Indeed, it takes it for granted that the participants in the BASE community share a common interest in “soil life” as the main driver to develop new farming systems, and that each farmer can find their own way to obtain “good soil life”. By contrast, the CIVAM model is meant to open new spaces in which the principles which guide the farming systems which the participants to CIVAM groups contribute to design are discussed. Indeed, the CIVAM managers wish to make such principles recognized as a relevant driver to achieve a reduced use of pesticides. They seek public economic support for those who wish to use these principles and build various cognitive and social resources. These they offer to various discussion fora so that people from a second circle can assess their relevance to support them in the implementation of these principles, thanks to on-farm design processes. The DEPHY maize and dairy farm model emphasizes the role of boundary spanners to reach peripheral participation while supporting the on-farm design process in the first circle and building capability among
these participants to become boundary spanners. The apple producers’ model is mainly dedicated to the building of a space in which the transformative intention (reduced use of pesticides) can be discussed among farmers and other stakeholders from the food chain. In this case, the role of champions who contribute to design and implement radical innovative technologies aimed at reducing pesticide use is emphasized.

This first investigation shows that our preliminary framework enables us to characterize various organizational models developed by people involved in design projects who are keen to involve newcomers and to support peripheral participation in their design projects. It points to various ways to organize the production space as well as rules to regulate the interactions between discussion and production spaces. It also points out that boundary spanners and champions are key to supporting the discussion through various translation processes. We still need to investigate further the strengths and weaknesses of these models in terms of their ability to bridge design and innovation from a developmental perspective, and propose recommendations for the management of such bridging activities which we have called intermediation work.

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