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# Transitioning towards agroecology through digital technology: an empirical study of design activities in an agroliving lab

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## ABSTRACT

To support the necessary agroecological transition of the conventional agricultural model, technology is seen as very promising and agroliving labs are supposed to be relevant for developing technologies aimed at supporting this transition. However, very little is known about these living labs, particularly about design processes. This exploratory study contributes to the understanding of these processes based on an analysis of video observation and self-confrontation interview of a design workshop. Results show a misalignment between the expected and the actual course of the workshop, creating a difficult experience for the workshop facilitator. This gap finds its roots in a lack of problem framing. Perspectives are proposed to better understand and support the design activities in the agroliving lab.

## CCS CONCEPTS

• **Human-centered computing**; • **Interaction design**; • ;

## KEYWORDS

agroecology, living lab, design activities, self-confrontation, misalignment

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## 1 INTRODUCTION

The conventional agricultural model has shown its limitations considering its negative impacts on environment, human health and farms viability [31-32]. To tackle this social and ecological obsolescence [30] agroecology opens up new perspectives to reconcile environmental, economic and social pillars for a more sustainable agriculture [19-35-45]. Among the various levers that can support agroecological transition, digital technology is seen as very promising [9-28-34-47]. This “digital agriculture” embraces a plethora of software and hardware combined systems that allow data acquisition, transfer, storage, and processing, at every scales of the agricultural production and its ecosystem [10]. If digital

agriculture is experiencing a strong growth, its spread is still limited [18-49]. Indeed, classical top-down innovation approaches to design and implementation of technology suffer from several limitations to deal with complex problems like agroecological transitions. They often result in solutions that are not adapted to the specific context and need of farmers [16]. Living lab approaches are seen as a response to these limitations [10-11-40-54] as a mean to set-up participatory approaches to contribute to a sustainable agriculture. In living labs, seen as open innovation ecosystems, public and private partners, end users, enterprises, public agencies and researchers are supposed to be engaged in designing, prototyping, validating and testing new technology and services in real-life contexts [33]. However, living labs ecosystems remain unknown in many aspects [1-6-25-37-53]. The design processes implemented in these ecosystems are barely visible and formalized [8-39], and knowledge on design processes that are set up in agroliving labs are lacking [16]. Considering these gaps, the goal of the case study presented in this communication is twofold. Firstly, to contribute to the understanding of design activities that are implemented in agroliving labs. Secondly, to help to improve these processes to design appropriate technological innovations to support agroecological transition, relevant for activities, expectations and needs of various stakeholders. As this study is in progress, this paper deals with the first objective, focusing on a French agroliving.

## 2 UNDERSTANDING DESIGN ACTIVITIES: CONCEPTUAL FRAMEWORK

Among the activities encountered in design processes, problem framing plays a central role and literature on living labs gives prominence to the classical notion of problem in design sciences. For example, so called “challenge exploration” [1] allows to tackle complex problems [38] addressed by living labs. It is one of the first stages in the living lab processes (i.e. [2]). This echoes to well-known models in design studies. Nickel et al. (2022, p1) describe design as “a decision-making process that transforms a need into a problem to solve and develops a solution to that problem”. The problem space and the solution space characterise every design process (Smit et al., 2024) and are interdependent as they inform each other [57]. At the beginning of the design process, the problem is often ill-defined, ill-structured and unclear [20]. All process long, designers actively frame the problem to discover viable solutions [43]. Reciprocally, the initial problem is revisited during the development of the solution [20]. Novice designers tend to directly solve the problem as it is “given” whereas experts spend time to frame the problem to guide the search of solutions [50]. As underlined by Smit et al. (2024, p3), the space problem and the solution space “need to be addressed in the right way, oftentimes simultaneously or, at least, iteratively”.



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For an activity-centered ergonomics point of view, the design problem is also at the heart of design processes [7-44], sometimes assimilated to a problem-solving activity [56]. Numerous studies have investigated collective design activities, notably analysing the synchronous exchanges between the stakeholders [22]. They show three major collaborative design activities: (1) design generating activities consisting in defining the properties of the object under design and evaluating them. Through communications marked by argumentation, stakeholders try to converge to a consensual and acceptable solution; (2) operative synchronization activities, i.e. the coordination of people and resources, which aims at distributing the tasks and at organizing the collective design activity; (3) cognitive synchronization, referring to clarification and reformulation and aiming at building and maintaining a common ground [21-23-55], including the problem framing [3]. From all this literature, we retained the following definitions and concepts for analysing design activities implemented in a French regional agroliving lab<sup>1</sup>. First, we consider design as an activity that implies individual and collective decision-making processes aiming at solving a problem or issue. Second, we analyse these activities in the light of the distinction between design generating activities, operative and cognitive synchronization.

### 3 CASE STUDY AND RESEARCH QUESTIONS

Located in the South of France, this regional ongoing living lab aims at assessing to be designed or existent technological systems to support the transition towards agroecological practices. A research institute is responsible for coordinating and steering the living lab, which involves, over eight years, some fifty partners (research and education institutes, local authorities, stakeholders in agricultural development, digital agriculture companies, and users-farmers-consumers). In each sub-regional territory of the living lab, seven facilitators carry out design projects including organizing collective workshops with local stakeholders. On April 2023, a collective workshop was set-up to co-build a technology design project for a better water management at a watershed scale. The study presented in this article follows a request, from the involved facilitator, to analyse this workshop to suggest possible ways of improving it. The workshop gathered eight persons for the first time: seven participants (two farmers, two employees from two companies in digital agriculture, two water managers (one from the Agricultural Chamber, one from the Agency of Water) and one researcher in agronomy) and the facilitator. These participants were recruited on the basis of two criteria: diversity and volunteering. A set of four questions guided the workshop: (i) Why this intention? (ii) What are the wished transformations? (iii) What are the technological resources required to achieve this goal? and (iv) The qualification of the imagined digital tool (important positive aspects to guarantee and negative aspects to avoid). Participants had access to (i) the set of four questions, which were displayed, (ii) post-it notes and (iii) a paperboard. The expected duration of the workshop was one hour. A debriefing session was planned, during which a participant (the pitcher) had to synthesize the discussions that occurred in the workshop.

<sup>1</sup>The study takes place in a collaborative research project on agroecological transition.

Analysing this workshop opens a window to understand actual design activities implemented in the agroliving lab. Three research questions guided the analysis: (i) What were the activities performed in this workshop? (ii) What were the goals pursued by the facilitator? (iii) How did the facilitator experience the workshop? (iv) How did the facilitator manage the workshop?

## 4 METHOD

This research combines a video-observation of the workshop and a self-confrontation interview as it is usually done in activity-centered ergonomics (i.e. [13-26-41-42-48]). Observations help to analyse activity in a systematic way as it occurs in real time in context. Self-confrontation interview, consisting in interviewing an actor on the basis of a recording of his/her activity, helps to understand activity from the point of view of the actors, that is through their lived experience [52]. Focusing on people lived experience, this method makes possible to access to the flow of actions, thoughts, emotions, and perceptions [15] from an “internal” point of view (the actor’s one). We conducted the self-confrontation interview with the facilitator, as she is the driver of the workshop at stake, driving the seven participants to co-build a technology design project. This data triangulation enables a deeper understanding of the activity, enhancing the validity of the qualitative research [14].

### 4.1 Video observation

In collaboration with the facilitator, the workshop was video recorded (video duration= 1h18 min). We had informal discussions [46] with the facilitator, before and after the workshop, to gather her first impressions. The video data was processed in two phases. The first one consisted in viewing the video several times, taking notes on each speaking turn (start and end times, interlocutor, main topic, summary notes). This manual thematic analysis enabled us to identify the topic associated with temporal marks for an analysis of frequency like the number of speaking turns, their durations and sequencing [12-27-58]. In the second phase, the speaking turns were categorised according to the typology of collaborative design activities [3]: design generating activities, operative synchronization, and cognitive synchronization.

### 4.2 Self-confrontation interview

The self-confrontation interview with the facilitator was conducted five months after the workshop. It was not possible to organize this interview earlier for different reasons (time needed for the video analysis and the facilitator’s availability). As we wanted to understand the design activities in the workshop through the lens of the facilitator point of view, we selected all the sequences when she spoke during the workshop (n=43). We then selected the most interesting sequences (seven in total) for a total duration of 10min36s ( $\mu = 1\text{min}30\text{s}$ ,  $SD=2\text{min}25\text{s}$ ,  $\text{min}=13\text{s}$ ,  $\text{max}=7\text{min}$ ). The interview lasted 1h30min, was audio recorded and transcribed. During the interview, the questions were related to the facilitator’s activity, more precisely on her lived experience (emotions, perceptions) and the goals she pursued during the workshop. The interview was analysed in two steps: (i) a first reading to identify the recurrent topics and (ii) a second reading to especially look for elements related to the three research questions.

**Table 1: Main topics of participants' exchanges during the workshop**

Topic	Description
Personal presentation	Participants present themselves briefly during the tour de table
Collective organization of the workshop	Participants interact to work together during the workshop (time reminder, rules reminder, proposal to do such task. . .)
Water managers' practices	Participants interact on the practices of the two water managers (Agricultural Chamber, Agency of Water), on what they do, their work, generally speaking (not situated)
Farmers' practices	Participants interact on the practices of farmers, on what they do, their work, generally speaking (not situated)
Project building	Participants draw the project, the future, what could be done to improve the water management
Existing technology	Participants mention existing technology (proposed by their company or another one), technology projects under process
Other	Minor topics, little mentioned (frequency, duration) in participants' talks: contextual elements about water management, online administrative declaration, watershed description. . .

**Table 2: Main topics temporal distribution (frequency and duration)**

Topic	% of speaking turn (frequency)	% of speaking durations
Personal presentation	3	8
Collective organization of the workshop	9	7
Water managers' practices	12	20
Farmers' practices	22	15
Project building	29	19
Existing technology	4	6
Other	21	25

## 5 RESULTS

The results focus on three themes in relation to the research questions. Firstly, the characterization of the collaborative activities performed in the workshop based on the video analysis. Then, drawing on the self-confrontation interview, the goals followed by the facilitator, and her lived experience are described.

### 5.1 Synchronization activities rather than design generating activities

Seven main topics include the 273 speaking turns that occurred during the workshop (Table 1).

Among these seven topics, two of them occupy an important place in the workshop: practices of both water managers and farmers. Indeed, together they account for more than a third of the speaking turns and more than a third of the speaking durations (Table 2).

Moreover, the two topics about practices are present all the along workshop, from its beginning to its end. These topics spread out evenly from  $t=6\text{min}54\text{s}$  (first appearance) to  $t=1\text{h}13\text{min}25\text{s}$  (last appearance).

The project building topic also occupies an important place in the exchanges (29% of the speaking turns and 19% of speaking durations). It is noteworthy that, when looking at the temporal sequencing of the workshop, this topic overwhelmingly develops in the second half (after  $t=39\text{min}$ ), both in frequency and duration.

Indeed, 83% of speaking turns about this topic ( $n=65/78$ ) occurs in the second half of the workshop. Furthermore, 83% of durations of talks on project building ( $11\text{min}24\text{s}/13\text{min}40\text{s}$ ) occurs in the second half.

Finally, the coding of the typology of collaborative design activities shows synchronization activities (operative and cognitive cumulated) are dominant during the workshop, both in frequency (50% of the speaking turns,  $n=137/273$ ) and duration (56% of the workshop duration,  $d=39\text{min}30\text{s}/1\text{h}18$ ). This synchronization is very largely cognitive (41% of total speaking turns, 49% of workshop duration). This reveals participants had to build and common ground, a context of mutual knowledge. The cognitive synchronization prevalence during the workshop reflects the required development of the problem framing between participants, the starting point of design. This prevalence is at the expense of design generating activities, which "only" represent 29% of speaking turns and less than 20% of the total duration of exchanges.

These results may suggest a gap between the expected goal of the workshop (to build a project, characterized by design generating activities) and its actual course (prevalence of synchronization activities). They echo to a frustration feeling expressed by the facilitator in the informal talks after the workshop. This video-based analysis must be put into perspective with the facilitator point of view. The self-confrontation interview was therefore centred on the goals followed by the facilitator, her lived experience during the

**Table 3: main goals expressed by the facilitator with examples**

Goal	Examples of facilitator verbatim (translated from French)
To build a project, answer to the displayed questions	<p>“I have still in mind to complete what we said. The why, what digital mean. . . To really try to complete this.”</p> <p>“We did have the Power Point. With the why, the how, the digital part. We had boxes to fill in. And for me, we had to have things to say. . .”</p> <p>“I expected a project. Even if it was not achievable. To say. . . We are going to try to, for example, to better irrigate the watershed. By satellite, to see the phenological stages of each crop. To see all the crops which are fed by the watershed, to precisely know the water needs for each crop and therefore to anticipate better the water request. And from there, to irrigate better. For example”.</p>
To involve the pitcher in the project building	<p>“And after, it is true that I told myself, I am going to remind that there is somebody that must pitch. Once there will be someone named pitcher, maybe this person will worry about what she will say. And therefore, I will not be the only one to row to try to. . .”</p> <p>“The person who pitches, she also feels a little bit stressed and concerned.”</p>
To encourage mutual knowledge between participants and clear up any misunderstandings	<p>“But after that, I also wanted them to be able to talk to each other.”</p> <p>“Everyone could express in relation with water needs, the quantitative management, and it is really a first step, it allows meeting each other”.</p> <p>“. . . to actually let everybody to meet each other.”</p> <p>“And I think it is there it also enables to see a little bit who does what.”</p> <p>“I think it was good too, that, the Agency of Water, we see it as a funder, [participant name] could have taken the speech to explain a little bit, to nuance a bit.”</p> <p>“So, at the same time, it was what we looked for, to everyone could know a bit the others’ jobs and have a meeting place.”</p>
To facilitate the debriefing by the pitcher	<p>“I told myself it would be good we managed to something that the pitcher be at ease.”</p> <p>“And the pitcher also be. . . Thus I saw it was [participant name], I knew she would be stressed but she should also be at ease to present”.</p>

workshop and the reasons explaining the potential gap between expected goals and actual course of the workshop.

### 5.2 A misalignment between the facilitator’s goals and the actual course of the workshop

At the self-confrontation interview, the facilitator expressed the pursuit of four goals during the workshop: (i) to build a project, answer to the four questions displayed, (ii) to involve the pitcher in the project building, (iii) to encourage mutual knowledge between participants and clear up any misunderstandings, (iv) to facilitate the debriefing by the pitcher (Table 3):

However, these goals do not have the same importance for the facilitator. Two aspects are salient when she talked about what she did or tried to do, in terms of workshop outputs. The first one is to encourage mutual knowledge between participants and clear up any misunderstandings with 54% of verbatim related to goals (n=15/28). The second one is to build a project, answer to the displayed questions (32% of verbatim related to goals (n=9/28)). It is interesting to notice that, even if it is not the first one she set to herself, the facilitator pursued the goal of building “a project”. In her view, it consists in identifying a technology that enables users to reach a specific aim. These results tend to confirm the gap between the expected goal of the workshop and its actual course. They can bring a piece of explanation to the frustration expressed by the facilitator during the informal discussions after the workshop. The self-confrontation interview helped to investigate more deeply her lived experience.

### 5.3 A stressful lived experience

During the self-confrontation interview, the facilitator described her lived experience of the workshop, particularly on emotional and perceptive dimensions. Two main aspects are remarkable, in relation with the two main goals she pursued in the workshop. First, she mentioned how she perceived the way the group operated. On one side, her attention was focused on the interpersonal relations: *“I thought it was great in my group, they were having a bit of a laugh, but at the same time they were also talking seriously. Everyone is talking to each other, listening to each other, looking at each other. And I was happy that there was a chemistry from the start. Where people exchanged ideas, and really exchanged ideas with each other”*. She realized that the participants do not know each other’s jobs and roles. *“I don’t think everyone was clear about water management, particularly farmers, or even the girls who may be working in their start-ups: who looks after whom, and who does what? Who makes the decisions? Or who’s just there to pass on or collate information? This may have contributed to the importance of the two topics revealed by the analysis: practices of water managers and farmers. These perceptions seems to have guided the facilitator in her objective of encouraging mutual knowledge between participants. On the other hand, she was attentive to the way participant were building a project: “And at the end, there were just ten minutes where people refocused a little bit, really saying why, how” [linked with the four questions displayed]. Secondly, the facilitator voiced emotions she felt during the workshop. Especially, she was not comfortable about the project building topic. This translates into different ways. She*

felt embarrassed to constantly bring the participants back to this objective: “Because, you can see, I saw her. I had the impression to be tiresome for her, when I refocused on the project building”. Also, she was torn apart between letting participants to freely talk (and know each other better) and guiding them to launch a project: “Try to do the right middle. Between, sometimes, I let them talk because it is interesting for them and they don’t have the occasion to meet. But after, there is still an objective”. “I know the exchanges were very rich, enriching. But after I told myself we must try to get something out of it”. Furthermore, during the interview, she clearly expressed her difficulty to build a project in the workshop: “I had a hard time, to put on the objective back on the rails”. She considers her role was a key of the workshop success: “Yes but at the same time, I say to myself it is my role. And if I am not here, they are all going to different directions”. Despite her efforts, she had the impression that the project was not going forward: “But I am not sure, at the final, on this project, we made much headway”. When the participants finally began to build a project, she did not understand it: “For me, the project was not clear at all”. During the interview, she gave three explanations to her difficulty to build a project. The first one is the short duration of the workshop: “For me, the building of a project, in very defined and structured manner, it takes more than one hour”. She connected this duration with the diversity of participants: “Afterwards, really, given the diversity of the people here, I had a good idea that it wasn’t in one hour that we would have done a lot of very, very realistic projects”. The third explanation she gave was the mode of reasoning of the participants to build a project, different from hers: “Because I say to myself I would have begun by telling what is the project. And depending on the project, define the timeframe, the partners etc. And them, they went on to put the timeframe, the partners. And me, it was really not in my logic”. This difference manifests on the problematic of the project even if she did not put the lack of building of a shared problem as the first explanation: “I tell myself, we should have first define the problematic properly. And depending on that, define a project. And then precise the timeframe, the partners and so on”.

## 6 CONCLUSION-DISCUSSION

This communication presented an analysis of design activities performed in a collective workshop that took place in an agroliving lab and the lived experience of the facilitator who led this workshop. It contributes to the understanding of a subject barely investigated by research on living labs, particularly regarding the design processes implemented in these structures.

There are two key results to bear in mind. First, in the case study reported here, there is a gap between the expected and the actual course of the workshop. The facilitator thought that her role was to support the building of a project during the workshop. She translated it into identifying a technology that enables users to reach a specific aim and expected design generating activity. However, this kind of activities was on the fringes during the workshop, which was dominated by synchronization activities. This echoes various studies which have shown the importance of synchronization in design [23-29-36-56]. Secondly, this gap, which generated some frustration and negative emotions to the facilitator, could find its roots in a lack of problem framing in this workshop. Numerous

research have well established that problem framing is central in design activities. Here, the workshop, based on a thematic, a set of four questions and some tools, did not appear to be organized around a shared design problem.

Two perspectives emerge from this study. This first one is to deepen our understanding of the design activities in the agroliving lab. At the micro level, the next steps are to analyse other workshops, by putting on perspective the case study we conducted, with others facilitators and the literature on facilitator activity. What are the organizational drivers of these workshops? How the facilitators perceived their role? In addition, the focus on the participants lived experience could enrich the analysis. At a more macro level, it would be interesting to analyse design approaches mobilized by stakeholders: How are these design processes – which are mainly technology driven - thought and implemented? What is the expected role of facilitators and other actors in the process? The second perspective is to explore ways to improve the design activities implemented in the living lab. The study reveals a lack of problem framing in the design process. One key factor of this lack is an over-simplified analysis of work situations that could be transformed by the implementation of the targeted technological artefact. This is a major source of errors in design, such as misalignment between end-users’ activities and the designed artefacts [24]. Ergonomics have long since developed design management methods to tackle this kind of problem [4-5]. In this approach, the first step is to work with the stakeholders to produce a joint diagnosis about the issues they encounter in their activities [17]. Then, through a participative and activity-centered approach, solutions to these issues are imagined, simulated and assessed all their use long. Deploying such an approach could be an interesting challenge in the future of the agroliving lab, bearing in mind that it is not only a question of designing a technology but designing the future work mediated by a technology.

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