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LIVING LAB AS A SUPPORT TO TRUST FOR CO-CREATION OF VALUE: APPLICATION TO THE CONSUMER ENERGY MARKET

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ABSTRACT

Open Innovation is widely explored, and many technologies are developed to support the involvement of stakeholders in its distributed co-design process, i.e. when actors work asynchronously and at a geographical distance. One of the fundamental parameters for the success of distributed collaborative approaches is the trust that the actors have in each other, in the current process and in technology. However, practitioners make little use of trust as a parameter for piloting and supporting co-creation of value. The lack of understanding of the mechanisms involved seems to explain this situation. Using a multiple-case-study analysis of co-design in the field of energy, this paper proposes to identify the levers in Living Lab favouring the trust between stakeholders. In addition to practical illustration, this paper provides a first co-design project management framework for practitioners, through the development of the “Co-coon Matrix”.

KEYWORDS. Trust, Open Innovation, Living Lab, Co-creation of Value, Co-design.

JEL Codes: O31, O33, L17

INTRODUCTION - THE CHALLENGE OF CO-CREATION OF VALUE

Chesbrough (Chesbrough, 2003, p. 43) introduced and defined the concept of Open Innovation (OI): “*Open Innovation means that valuable ideas can come from inside or outside the company and can go to market from inside or outside the company as well.*” OI is a company-centric paradigm, the aim of which is to open the boundaries of companies’ R&D departments to the outside world. This concept and its related practices are now widespread in the socio-economic world. In this context, the challenge is no longer to disseminate OI but rather to identify the levers to strengthen it, relying in particular on the areas linked to this flagship concept. Different evolving literature streams co-exist in parallel with OI, such as User Innovation (UI) or User-Driven Innovation, which we will address through Living Labs (LL) (Schuurman, 2015). User Innovation is clearly consumer-centric (Von Hippel, 2005). The aim is to co-design products and services with its users. As proposed by Schuurman, the Living Lab concept is at the intersection of OI and UI. To co-create value with the external world, the company’s boundaries must be porous enough to facilitate the exchange of ideas, concepts or prototypes, whether it is an outside-in or inside-out exchange. Tools and techniques provided by UI are used in OI contexts.

Within an organization, OI underlies a twofold process of openness. (1) The first level of openness concerns project teams in the upstream phase of innovation, whose members are expected to interact regularly in an iterative way with the end customer, or even the user of the product or service that is in the co-design process (Sanders and Stappers, 2008). In addition, the organization itself must be part of an OI process requiring interaction between teams and all or part of the organization with its ecosystem (suppliers and economic, institutional and academic partners etc.) It is no longer a bilateral relationship between the company and its users but numerous interactions in a complex ecosystem of actors. In LLs, the model used to analyse a typology of actors is named the Quadruple Helix, composed of companies, public authorities, academics and citizens (Arnkil *et al.*, 2010). Thus, the increased recognition of inventiveness and innovation as essential differentiating factors in an increasingly competitive world, the rise of the collaborative economy involving sustained exchanges between peers and the strong interest in introducing a principle of co-design into innovation projects strengthens, disseminates and even invites us to rethink the OI, interpersonal relations and governance.

In such a complex system (Kurtz and Snowden, 2003), in order for the co-design process to function and develop in an optimal and fluid way, it is useful to identify what can stop or – on the contrary – stimulate the motivation of individuals to engage as co-designers or at least contributors with a process over which they seem to have no control.

This paper focuses on the links between trust, the co-design process and co-creation of value. Indeed, research shows that trust is a key success factor in the development of organizations and the integration of users into OI processes, as we will see in the next section. In addition, (Greco *et al.*, 2017) highlight the potential contributions of OI to the energy sector with the key role of five variables: (1) government involvement, (2) university involvement, (3) customer and supplier involvement, (4) absorptive capacity and (5) innovation novelty. More specifically, in the world of energy distribution, co-design (for example, the design of new technology or new services) represents an opportunity for the development of customer relations and value co-creation. Numerous benefits of co-design have been mentioned by (Steen *et al.*, 2011, p. 58), who categorize it in four groups: “*Improving idea generation, improving the service, improving project management and improving longer-term effects*”. The challenge is to put the user at the centre of energy innovation, at the beginning of the value chain, in trades and practices that are more oriented towards technological innovation (Dupont *et al.*, 2017). This evolution of the context offers the opportunity to understand, and even measure, as soon

as possible in the arrival of new practices, the contribution of user integration to the innovation process in the field of energy services.

Given the novelty of this field, as described in the research design part, we have decided to adopt a research approach based on multiple-case-study analysis. Thus, through two energy-related case studies, we will illustrate how trust is a major issue, particularly in situations where projects are based on research by a wide diversity of actors, including users, in both quantity and quality (i.e. fields of expertise, focus of interest). The discussion part proposes to highlight and articulate specific Living Lab functions that promote trust in the co-design process to support the co-creation of value. The challenge is to verify that an idea is appropriate or rejected for what it is, and not because of the co-design process followed, the technology used to bring it out and represent it or because of the initial actor who carries it. Through the outline of a functional specification (Pohl, 2010), we will more specifically highlight the characteristics that a co-design process must offer to stakeholders.

THE CHALLENGE OF TRUST FOR INNOVATION

Trust: an essential lever for inter- and intra-company innovations

As already explained by Koschatzky (2001, p. 6), “*firms which do not cooperate and which do not exchange knowledge reduce their knowledge base on a long-term basis and lose the ability to enter into exchange relations with other firms and organizations*”. This observation is now widely shared by the OI scientific community. Nevertheless, the quality of this cooperation remains a challenge for companies to increase innovativeness and further reduce time to market. Working on the robustness of the process can be beneficial, for example by ensuring that it is more in line with users’ needs. The co-design process can also become more eco-responsible by mobilizing processes that respect the principles of sustainability by favouring short channels, socially responsible choices, the well-being of employees, etc. One of the common denominators of all these areas for improvement is trust. It is found at all levels of an organization and can be a lever for development: trust between peers in a community of co-designers, trust between companies and external contributors, trust between a company and its employees, trust between partners, trust in the methods and tools underlying the innovation process.

Trust contains three dimensions (Mayer *et al.*, 1995): (1) benevolence (the perception of a positive orientation from one person towards another); (2) ability (group of skills, knowledge, know-how in a particular domain); (3) integrity (“relates to the perception that the other party adheres to a set of principles and values that the trustor finds acceptable, such as delivering on promises” (Shazi, Gillespie and Steen, 2015)). Taking these principles into account, it can be seen that several levels of maturity in terms of trust can be observed and developed within companies and their partnership relations. Thus, researchers propose a model that ranges from “limited trust” to “collaborative trust” (Fawcett, Jones and Fawcett, 2012).

Within companies, the research of Pirola-Merlo (2010), using West’s “innovative team climate” model, shows that there seems to be a positive correlation between a team’s climate and the speed of completion of a research and development project. Four dimensions characterize this climate (West, 1990): (1) the sharing of clear and valued objectives; (2) a non-threatening environment where members can influence discussions and decisions; (3) the pursuit of excellence through quality work and critical evaluation; (4) the valuing of innovation and supporting of working practices to achieve innovation. West and Sacramento (2006) recall that some authors consider that learning and innovation can only take place when group members trust the intentions of other members.

In 2014, a study conducted on a panel of 48 member companies of the German Maintenance Services Association showed that three elements are needed to achieve a medium to high level of innovation: contracts, trust in a supplier to respect collaboration and ability to fulfil the obligations agreed between the parties (van der Valk *et al.*, 2016). This same study showed that in order to reach certain levels of innovation, certain thresholds must be respected for each of these three parameters. Under certain conditions, innovation performance depends very directly on the level of detail of contracts and the quality of trust established between partners. At the enterprise level, the establishment and maintenance of trust-based-relationships in B2B reduces risks, transaction costs and long-term relationships (Dovey, 2009). This is particularly true for innovation and creativity processes (Shazi *et al.*, 2015).

Innovation requires creativity and a certain amount of risk taking, so the results are uncertain and unpredictable, making it impossible to draft precise terms and clauses of a contract in advance. More flexible mechanisms are needed to guide a partnership or collaboration, in which it is necessary to balance trust between partners and the establishment of contracts. In addition, a 2011 survey (Wang *et al.*, 2011) of 315 Chinese companies shows that while, in certain circumstances, contracts and trust can replace each other and guarantee the same performance, in situations of uncertainty trust between the parties is much more effective than the (costly) implementation of contracts. Managing an OI project requires the ability to understand and anticipate the environment in which the project will be deployed.

Furthermore, researchers underline the role of trust at the macro level. Indeed, they demonstrate that societal trust promotes firm innovative efficiency in an open innovation context (Brockman *et al.*, 2018). Plus, according to Nestle *et al.*, “*trust turns out to be a significant facilitator of open innovation cultures*” in firms of a German high-tech cluster (Nestle *et al.*, 2018, p. 7). This research on systems of innovation suggests that adequate infrastructure supported by local governments and a dedicated cluster manager could promote network activities and establish mutual trust between actors of firms.

Finally, the literature highlights the importance of addressing trust to promote business innovation processes, the culture of open innovation, and potential economic dynamism. At the same time, the state of the art shows that little work is being done on this topic. Thus, the relationship between users, trust and open innovation would benefit from being better studied and understood to improve the process of co-creation of value.

Trust at the heart of user engagement and collaboration in Living Lab

Living Lab is a recent phenomenon. Research on Living Labs still needs structuration and an “*Organizing Proposition*”, which is true of all newly researched phenomena, as mentioned by Davis in his seminal paper, “That’s interesting” (Davis, 1971). In 2015, Schuurman proposed a structuration different from Pallot *et al.* (Pallot *et al.*, 2010) *LL research landscape*, with an interesting model separating three layers: the macro, meso and micro level, as shown in Table 1.

Table 1 - Different levels of analysis in LLs, adapted from Schuurman (2015)

Level of analysis	Definition in LL terms	Literature streams
Macro (system)	Living Lab constellation consisting of actors (PPP partnership) and infrastructure	Open Innovation
Meso (project)	LL innovation project	Open & User Innovation
Micro (stage of the project)	LL methodology consisting of different research steps	User Innovation

The macro level of Table 1 refers to the “Open Innovation” stream, with the constellation of actors in a public-private-people partnership. The meso level represents the innovation projects. The micro level refers to the “User innovation” stream and is composed of the LL methodology. Definitions of LLs vary, as the research is still emerging to study the phenomena. Mastelic proposes the following definition of Living Labs in her doctoral thesis on the subject (Mastelic, 2019, p. 58).

A Living Lab is an innovation intermediary, which orchestrates an ecosystem of actors in a specific region. Its goal is to co-design products and services in an iterative way, with key stakeholders in a public-private-people partnership and in a real-life setting. One of the outcomes of this co-design process is the co-creation of social value (benefit). To achieve its objectives, the Living Lab mobilizes existing innovation tools or develops new innovation tools. Without a co-design process, the phenomena cannot be termed “Living Lab”. Observational studies can be mobilized to better understand the social practices but, by themselves, they cannot be considered as innovation tools used in LLs. Without the Quadruple Helix represented in the partnership (Arnkil *et al.*, 2010), a project is not considered a Living Lab. Public authorities, academics, private companies and citizens must be part of the ecosystem of actors that co-design products and services. Each actor has a specific role and does not participate in each phase of the co-design process (idea, concept, prototype, product); a selected group of actors are involved, depending on the goals of each step, coordinated by the LL manager.

The notions of trust and contract are strong issues in LL. Indeed, LLs as innovation networks require the establishment of strong links of cooperation and collaboration. In the context of LL, this cooperation is done with the users who are at the heart of the projects. From experience, (Guidat *et al.*, 2011; Dupont *et al.*, 2014, 2015; Dupont *et al.*, 2015; Mastelic *et al.*, 2017), we can point out that projects in LL mode induce tacit contracts between participating users, project leaders and potential method leaders without being able to guarantee the intellectual (and/or industrial) property of what could be produced. In addition, the mobilization of actors is generally based on mutual trust, which must be built and nurtured.

We suggest transferring the work of Shazi, Gillespie and Steen (2015) on innovation networks within business projects to LL projects. Thus, we recognize that users bring different skills depending on the subject and the time of mobilization (diagnosis, idea generation, feedback, etc.) to provide expertise and know-how useful for innovation. On the other hand, in all cases, their benevolence is required and necessary. It remains a nodal point in the relationship being built. Research shows that integrity is also a fundamental characteristic. A competent employee who lacks integrity will be actively avoided in the setting up and development of innovation projects. Our experience with LL projects has confronted us with some recurring questions from user participants in relation to project sponsors: What will be done with our contributions? Do we serve the general interest or a particular interest? Will our expression be respected? Conversely, project leaders who adopt a LL approach aimed at involving users in their approach sometimes wonder about the integrity of the actors who will join them: will they respect a certain confidentiality if it is required? Will they be in line with our values? Will they be “sincere” or “authentic”? In practice, since it is impossible to verify *a priori* the full interoperability between participants, facilitators and project leaders, it is necessary to accept that actors withdraw or are excluded during the process.

Co-creation of value and trust: forgotten by collaborative environments?

What do we mean by co-creation of value? When a company decides to open the boundaries of its R&D department to the outside world (OI), and to put in place a co-design process with its users (UI), the goal of this process is to co-create value. We see the co-creation of value as the

outcome of a co-design process. As Vargo and Lusch express it, there is no value created until the service is consumed (Vargo and Lusch, 2004). The consumer is always a co-creator of value. In a co-design process, the user becomes a co-designer and is integrated at the beginning of the value chain, in the “*fuzzy front end*” (Sanders and Stappers, 2008).

A study conducted in 2018 on collaborative immersive environments (Dupont *et al.*, 2018) provides interesting insights into the notion of trust and co-creation of value. Collaborative immersive environments include tools, methods, digital systems (from Web 2.0 to immersive devices), or even physical spaces that allow and facilitate the work of groups composed of eclectic people, distributed or not, in synchronous or asynchronous work (Recker *et al.*, 2013; Tran, 2014; Bayrak, 2015; Dupont *et al.*, 2018). The analysis, based on 23 scientific articles published since 2000 in international journals and one thesis, highlighted four recurring dimensions for Collaborative eXperience: (1) Sense Making; (2) Trust Building; (3) Shared Meanings; (4) Mutual Understanding. This study also identified two properties by dimension, respectively: context understanding and relevance; interpersonal relationships and trust; knowledge sharing and knowledge creation; group dynamics and collective intelligence. Dupont *et al.* (Dupont *et al.*, 2018) reveals that two properties are not very well researched: trust and knowledge creation. The small number of studies on collaborative immersive environments that focus on these properties raises questions about the importance given to concepts that are at the heart of collaborative processes, which are by nature open and by nature part of a knowledge creation process, consubstantial with the innovation process.

The various elements from the literature underline the fundamental nature of trust for each member of a company, for example through the belief in his or her own abilities. Trust between the members of a company is also necessary to ensure balanced and profitable relationships. Trust must therefore be found between the hierarchical and functional levels. Finally, loyalty is an essential factor in an organization’s relations with its partners and other stakeholders in its environment, particularly when it comes to involving users in the process. More generally, it is also a question of having confidence in your market and your ability to adapt to more or less predictable changes.

Despite the relevance and clarity of these findings, it still seems difficult to establish and maintain relationships of trust. Although context and technology can respond to a number of challenges on an ad hoc basis, there are still obstacles to overcome in order to strengthen trust at the different levels we have been able to identify. It seems necessary to understand and equip the processes of the upstream phase of innovation to ensure an OI process that fills the gap.

RESEARCH DESIGN

Multiple-case studies from longitudinal exploratory research

In this article, we adopt a multiple-case-study approach (Yin, 2018). Indeed, we focus on contemporary events over which we have no control and our research questions are more explanatory and deal with the tracing of operational processes over time. In fact, we want to know “how” and “why” our living labs had worked (or could work better). In particular, we focus on the “trust” variable in two Living Lab projects. Thus, this method allows us to shed light on the question of trust through the complementary analysis of two case studies of OI applied to the field of energy services for two European countries (Switzerland and France), both of which have been the subject of a Living Lab initiative over a relatively similar period. Fell proposes the following definition: “*Energy services are those functions performed using energy which are means to obtain or facilitate desired end services or states*” (Fell, 2017, p. 137). The innovative nature of the deployment of OI approaches for companies in this industrial

sector encourages us to capitalize and analyse concrete experiences to develop and characterize transposable methodologies. This work also allows us to provide additional analyses to the research of Greco, Locatelli and Lisi (Greco *et al.*, 2017) who deplore the small number of studies on OI for companies in this sector. Europe is putting in place an energy transition based on two main pillars: (1) energy efficiency and (2) the development of renewable energies. 40% of the energy consumption is related to the building sector in Europe (European Commission, 2013). Ambitious goals are set at the European level: “*by 31 December 2020, all new buildings are nearly zero-energy buildings*” (European Commission, 2013). The energy sector is still traditional and focused mainly on technological innovation. Cases of OI in the sector are emerging, closely linked to Smart City initiatives in Europe. In the LL network, for example ENoLL, actors are developing action research projects such as the Lorraine Fab Living Lab® and the Energy Living Lab. In this research, we use three data collection sources: (1) individual perceptions from researchers; (2) individual and collective behaviours and attitudes observed during the project; (3) process outcomes (how and why it works). The data collection used different sources of evidence: (1) documentation such as research papers or reports from the projects; (2) archival records as capitalized ideas; (3) direct observations from researchers; (4) participant-observation as researchers involved as makers; (5) physical artefacts as well as digital and physical platforms.

The first case presents part of the results of a longitudinal exploratory study conducted during the creation of the Energy Living Lab (ELL) in Switzerland, whose challenge is to create an innovation ecosystem to promote the co-design of energy services for one of the 700 energy distributors.

The second case presents the French project Link by Makers (LbM) of the University of Lorraine. This project, driven by academics and makers (i.e. members of a FabLab), received the support of ENEDIS, the French electricity distributor, and Université de Lorraine (Chair REVES project), as a way to experiment with some form of OI in connection with the smart meter installed by the distributor who manages 95% of the French grid.

Two different teams of researchers designed these cases independently. Nevertheless, they adopted the same living lab approach on the same topic. The first team, involved in a Swiss LL, conducts research on marketing and innovation management. The second, engaged in a French LL, does research on industrial engineering and innovation management. The two case studies that we will detail below emerged in different local contexts, but in both cases the researchers considered that the stakeholders concerned in each situation trusted each other. They also assumed that users trusted the process set up by academics to generate a real co-design dynamic. The first work presented independently validates the ability of processes to generate co-creation of value. The cross-referenced analysis of the two teams’ feedback on the implementation and management of these two cases allows us to return to the premise of the trust placed *a priori* in the process by the stakeholders. The latter is not automatic. Barriers to change can be avoided. Good practices have been identified to establish a climate of trust between stakeholders in an innovation process that is open over periods of six to eighteen months. Finally, it seems possible to use technological levers to accelerate this innovation process and guarantee its agile nature.

Case study 1: The Energy Living Lab, lack of trust as a limit to the co-design of energy services

This case study describes one of the first projects of the Energy Living Lab. It began in autumn 2013 and lasted two years, in a context of transition in the Swiss energy sector. Indeed, during this period, distributors will move in the near future from a monopolistic status in their jurisdiction, with captive customers, to a competitive context, in which customers are free to choose their energy distributor. The challenge of this ELL project is to use co-design to develop

energy services and co-create value for the partner company. The method followed is structured in four steps: (1) the formulation of the challenge, (2) the co-creation platform (www.i-brain.ch), (3) the target audiences, (4) the nature of the data collected, as well as the successive steps of data processing and analysis. This case has been described in a previous paper (Dupont *et al.*, 2019) and Figure 1 shows the co-design process and its outcome (co-creation of value) stage by stage, supported by specific technologies.

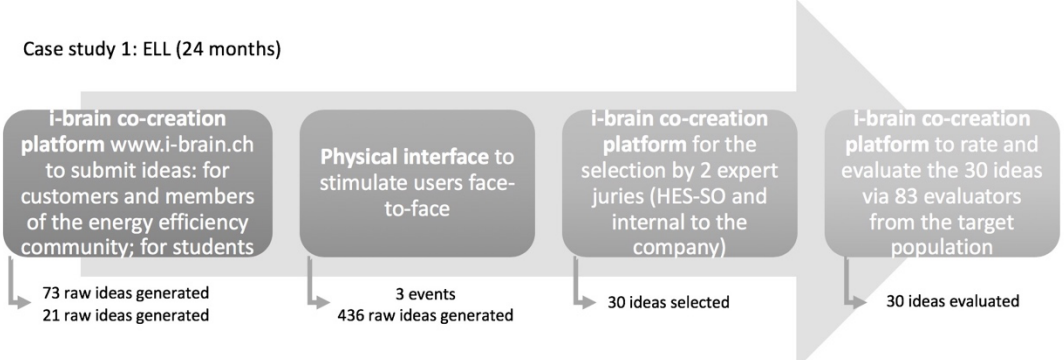


Figure 1 - Sequential vision of the complementarity of the support platforms for co-creation within the ELL project (adapted from (Dupont *et al.*, 2017))

Users’ interest in co-creation of value was measured by the number of ideas submitted by users in the different contexts (physical and virtual interfaces). The number of responses desired by the economic partner was achieved, but it was necessary to switch from the virtual interface to a physical interface in order to stimulate face-to-face users (see Table 2). The challenge presented had to be explained during these interactions, which could suggest that the question was too technical or complex, and that it was not appropriated by users, which could have been a barrier to participation via the virtual interface. The research team hoped that the participation rate through virtual interfaces would be higher. Their confidence in the ability of users to address this issue individually and virtually was overstated.

Table 2 - Synthesis of the results of the co-design process implemented by ELL

	Distributor’s customers	Members of the energy efficiency community	HES-SO Bachelor’s and Master’s students	Total
Number	30,000	5,000 (some of which may be from customers)	4,707	between 30,000 and 39,707
Participants	Around 500			Around 500
Ideas submitted via Internet platforms		73	21	530
3 Dedicated events		436	Not Concerned	
Origin of the selected ideas		21	9	30
Average of the scores assigned (via Student test)		7.59 points	8.12 points	7.74 points

The ideas selected by the company nevertheless raise several technical, legal or operational issues and the company carries out further analyses to confirm their feasibility and, if necessary, the implementation modalities. It should be stressed, however, that no ideas proposed were

considered to be really new and many of them were redundant, which is not surprising in an idea generation phase where the aim is to understand the latent needs of users. These raw ideas must then continue a long way in the innovation process to be transformed into concepts, then into prototypes and finally into services. The critical phase is to continue the design of the service after this ideation phase within the company, at which point the risk of the “*not invented here syndrome*” (Chesbrough, 2011) may appear, which is characterized by the rejection of ideas not generated within the company and blocking the process.

The company’s approach underlines the company’s clear desire to integrate the user at the heart of the discussions; the profound changes that the energy market in Switzerland is undergoing have a direct impact on the company’s internal culture and a genuine global opening strategy makes it possible to prepare it for market liberalization (the implementation of an Internet exchange platform, which is at the same time informative, incentive and collaborative, is now a testament to this global approach which has been initiated).

Physical interfaces seem to yield a greater number of ideas than purely virtual interfaces. Three hypotheses could explain this point: (1) the energy is not “*top of mind*” with the users questioned and it is necessary to stimulate the group face-to-face so that it gives ideas, (2) the challenge posed was badly formulated and not very comprehensible for non-experts, (3) the virtual interface does not offer enough guarantees in relation to the uncertainty generated by the approach (need to reassure and to quickly respond to the questions or misunderstandings that direct physical relations generate).

The group solicited seems to have an influence on the number and quality of ideas submitted. The student group submitted more ideas in proportion to the number of people invited. Ideas from this group were considered to be of better quality (more ideas selected on a *pro rata* basis in proportion to the ideas submitted). The company that participated in the research has recently begun to change its relationship with its customers in view of the forthcoming liberalization of the electricity market for households in Switzerland. It is possible that the relationship of trust and loyalty is not yet strong enough for customers to engage in co-creation of value via a digital platform. Because, as Cova and Cova (2009, p. 95) highlight, “*the process of governance underlying the new consumer’s discourse must remind companies that they must not believe that all their customers have succumbed to the formatting of the creative consumer and that they all now have the skills to dialogue, play a role and integrate the company’s offers*”, this process takes time and requires several iterations before they can transform their customers into change agents.

The divergent opinions of the expert groups can be explained by various hypotheses; the internal jury is under the influence of a latent internal strategy, a realism as to the applicability of the ideas suggested or a “*time-to-market*” reflection. However, there is no evidence that the composition of two external and homogeneous juries would have led to selections of converging ideas: the flexibility left to the juries as to the organization of the selection process accentuates the exploratory process of such a study. This may also be due to the “*not invented here*” syndrome mentioned earlier. However, the interest in seeking ideas from outside the company, as Chesbrough points out, is to overcome this syndrome by working on openness, particularly in a monopolistic environment. We therefore come back to the question of the trust of the company’s members in the outside world.

If the Swiss case study allows us to understand the intangible dimension of creativity through a process of generating raw ideas, the French case study on the smart meter allows us to deepen the transition from idea to prototyping in a context of mobilizing very eclectic actors among a population that is not clearly identified.

Case study 2: Linky by Makers, building trust between industry, academia and makers

Between 2013 and 2022, ENEDIS is to deploy 35 million smart meters in France. These meters are the property of the electricity distributor. The meter itself is in the process of being installed for commercial operation. The “smart meter” product can be described as “finished” but the smart grid system will only be fully operational when all the meters are installed in French territory. Furthermore, the ongoing technological and industrial transition and the issues it raises generate controversy (Assemblée Nationale, 2016) that we will not study here.

Linky by Makers (LbM) examines the use of smart meters and smart grids (<http://linkybymakers.fr/in-english/>). This national project began at the end of 2015 during an exchange between industrialists, academics and makers within the Lorraine Fab Living Lab® (LF2L). At the instigation of Nancy-based makers networking with other French makers in five French regions via five “Regional” FabLabs (FLR), this project, initially planned for six months, was extended by 12 months in part because of trust issues.

LbM is based on the principle that academics, consumers and suppliers can work together (Carayannis and Campbell, 2012), in particular to understand the uses of a technology that is still little known to the greatest number of people, even though we are all electricity users. The experimental project posits the following hypothesis: makers who are used to “tampering with” could: (1) be an avant-garde community that enriches the understanding of the possible uses of the meter (via additional developments in open hardware); (2) support reflection on new forms of production/consumption/use of electricity from so-called smart grids.

The project’s objective was then to allow the French FabLabs, or those who considered themselves makers, and who were interested in the question of energy, to take up this challenge themselves. The University positions itself as a research support to help stakeholders communicate with each other and share ideas, as well as capitalize on and analyse the experience.

Different aspects of this case have been described in two previous papers (Dupont *et al.*, 2017, 2019). Figure 2 focuses on the co-design process and its outcome (co-creation of value) stage by stage, supported by digital and physical platforms.

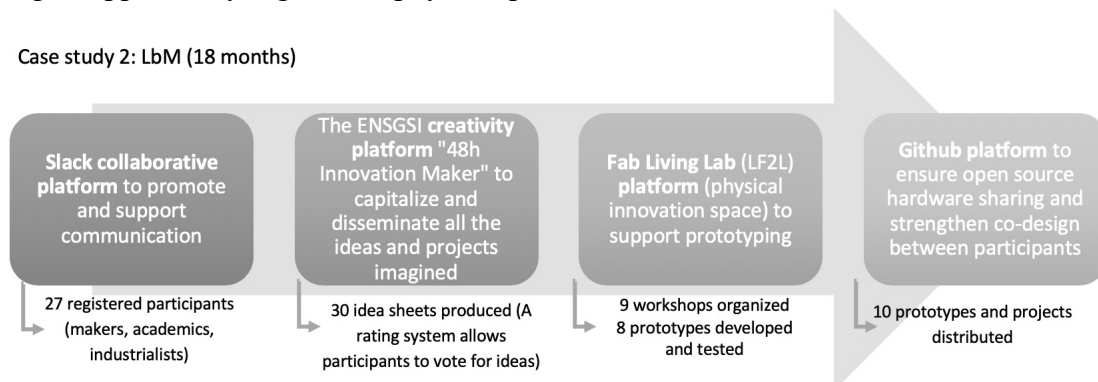


Figure 2 - Sequential vision of the complementarity of the support platforms for co-creation within the LbM projects (adapted from (Dupont *et al.*, 2017))

LbM’s main challenge is to get actors from different parts of France to collaborate with each other, with different timeframes (full-time and/or occasional contribution, paid or voluntary, etc.), different practices, etc. In other words, it is a question of articulating four dimensions (Dupont *et al.*, 2017): (1) **Geography** with FLRs in four different regions, themselves composed of actors distributed throughout their territory, leading to a lack of face-to-face interactions (lack of spontaneity); (2) **Conceptual** because the terms “creativity”, “energy” and “open source/hardware” do not refer to the same representations and uses according to the actors;

moreover, the project started with an approach to creativity (i.e. producing abstract concepts with an academic method) while the makers are in the “make” (disassemble, reassemble, reproduce, transform, etc.); finally, LbM brought together and confronted structured organizations and very agile or fuzzy organizations with sometimes contradictory governance modes; (3) **Technology** with a strong initial limit – the distributor did not want to lend smart meters and the participants had no in-depth technical knowledge of this technology or of other aspects of the project (measuring electricity, developing objects in open hardware, working in open source, etc.); (4) **Time**, which is expressed in terms of the time available to participants according to whether they can invest themselves over six months, two years, the time of a weekend, etc. Time also concerns the management of the knowledge produced: how to leave contributions that others can take up and enhance?

Beyond these four barriers to be overcome to ensure collaboration, this case study highlights three observations related to the process of identifying and co-creating the uses of electricity distributed by smart grid: (1) Each has its own practices and objectives: an “engineering” company with an industrial strategy, academics with a research project, FabLabs with their specific history, logic of action and different interests, etc. (2) The makers (at the time of the LbM project) are ultimately not very interested in or accustomed to energy issues; moreover, it is necessary to learn to give concrete expression to intangible elements (energy, electricity, trust, data, communication etc.). (3) The integration of users in the product launch phase, when irreversible strategic decisions have been taken, is too late, which inhibits self-determination and the motivation to be part of a co-creation process. It is a question of co-constructing a vision shared by all the actors in the upstream phase.

Like the Swiss ELL context, the French context has largely conditioned the predispositions of the actors to collaborate, requiring the transcendence of individual and specific practices and centres of interest strongly rooted in each other to build a community of interest in a vague and tense context (Assemblée Nationale, 2016).

Finally, we can summarize the management of the LbM project in 5 challenges that had to be overcome to create a favourable climate of collaboration between the actors: (1) Having a common representation of the project; (2) Ensuring interactions between communities at the right time in a process under construction; (3) Developing governance compatibilities through peer-to-peer negotiation; (4) Managing internal and external communication; (5) Giving a concrete explanation to intangible elements and using different media to materialize both the project process and its outputs. By proceeding in an iterative and constructivist manner, the research team, in interaction with the participants, deployed and accompanied or adapted the use of the following collaborative technologies.

We are aware of the non-exhaustive nature of the approach to be taken, particularly with regard to energy transition issues. The work of Koirala *et al.* (2018) highlights in particular the importance of local communities for involving citizens and users in the development of new responses such as community energy systems. This study also shows that trust in the local community is one of the key factors for engagement.

TOWARDS A SUPPORT SYSTEM FOR TRUST IN THE CO-CREATION OF VALUE

Findings from the two case studies

The two experiments we have carried out and studied allow us to highlight the challenges related to building stakeholder confidence and trust at the different levels of a Living Lab project. Beyond the limitations encountered in the implementation of projects, their observation

and analysis give us the opportunity to better understand the mechanisms in place between communities that are distributed and solicited to contribute to a common project. The researchers' commitment to the design, installation and activation of the processes and the extensive nature of the analyses we were able to produce from these two projects, 24 and 18 months respectively, allow us to access both a quantitative and qualitative reading of these original research materials. Figures 1 and 2 thus present the main technological elements deployed to support co-design in ELL and LbM projects and foster trust between stakeholders. The physical or virtual platforms mobilized are classified in order of appearance in the process of each project. These diagrams also indicate the quantitative productions resulting from each of them.

Based on the observations and analyses reported in the section dedicated to research design, we can improve each of these processes in order to strengthen co-creation of value between the actors (Figure 3). It appears that two functions are not yet fulfilled by any of the projects: the appropriation within companies of ideas generated outside and the ability to retain and engage consumers or communities in a co-design process involving a company. In both cases, it should also be pointed out that academics have probably played a role as trusted third parties in the process and in the issues submitted to users. The proposal to support service design conceived by ELL can be assimilated to the practice of LF2L and implemented for the LbM project, and finally, the prospect of the emergence of a platform connecting buildings, consumers and producers is specific to the French case, and therefore not yet generalizable.

For each platform and technology used during the co-design process, it is necessary to consider the trust that users place in them, as well as the role that these technologies play in the level of trust that stakeholders place in each other. How does the integration and implementation of these technologies generate a favourable climate among stakeholders to build mutual trust and collaborate together? In other words, by drawing on the elements of the literature relating to trust (West, 1990; Mayer *et al.*, 1995), how to ensure that these technologies encourage an innovative climate within an Open Innovation process involving users: (1) benevolence; (2) the ability to fulfil the "obligations" agreed upon between the parties; (3) sharing and adhering to clear and valued objectives; (4) the emergence of a non-threatening environment where the parties can contribute and influence decisions by being recognized and valued in their contribution; (5) the pursuit of excellence through quality work and critical evaluation; (6) the enhancement of innovation and support for working practices to achieve innovation.

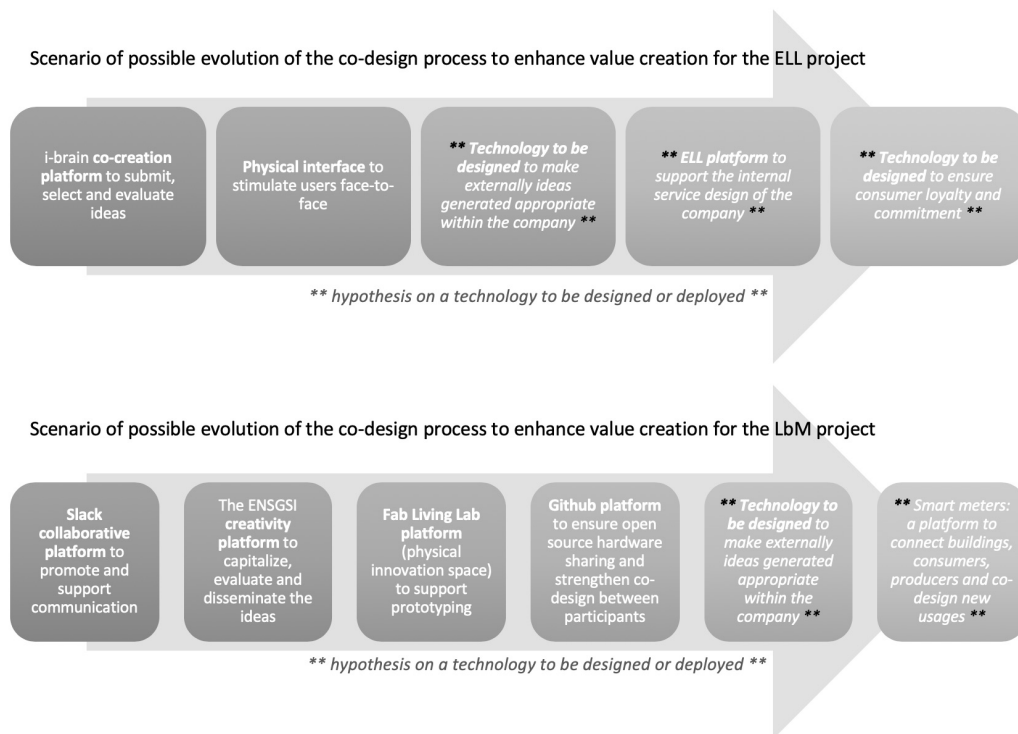


Figure 3 - Proposed evolution of technological supports to strengthen co-creation of value for each of the ELL and LbM projects

4.2 Outline of an integrated process for co-creation of value

In the light of the previous findings, we can outline a process with new technological responses. Figure 4 below thus proposes an integrated vision of good practices to establish a climate of trust between the stakeholders in a Living Lab process. This potential process is built by aggregating and scheduling the various data and feedbacks from the two case studies. We have identified eight main functions (Figure 4) that a Living Lab must perform to strengthen the trust in a co-design process: (a) Communication, defined by “to promote and support physical and virtual communication”; (b) Ideation defined by “to submit, select and evaluate ideas”; (c) Materialization defined by “to support collaborative prototyping of products and services”; (d) Contribution defined by “to ensure the sharing of co-creations in open source hardware”; (e) Appropriation defined by “to make externally generated ideas appropriate within companies”; (f) Validation defined by “capitalize on tests by use (and feedback)”; (g) Compensation defined by “to engage communities and make them loyal”; (h) Publication defined by “to guarantee transparency”. The definitions we use for these functions come from the cases studied and our experience in the field of project co-design as a project manager for 15 years. The sequential presentation of functions follows the order of occurrence observed in the practical cases, without freezing these steps, which can sometimes be carried out concurrently. Feedback loops, or at least iterations, should also be considered.

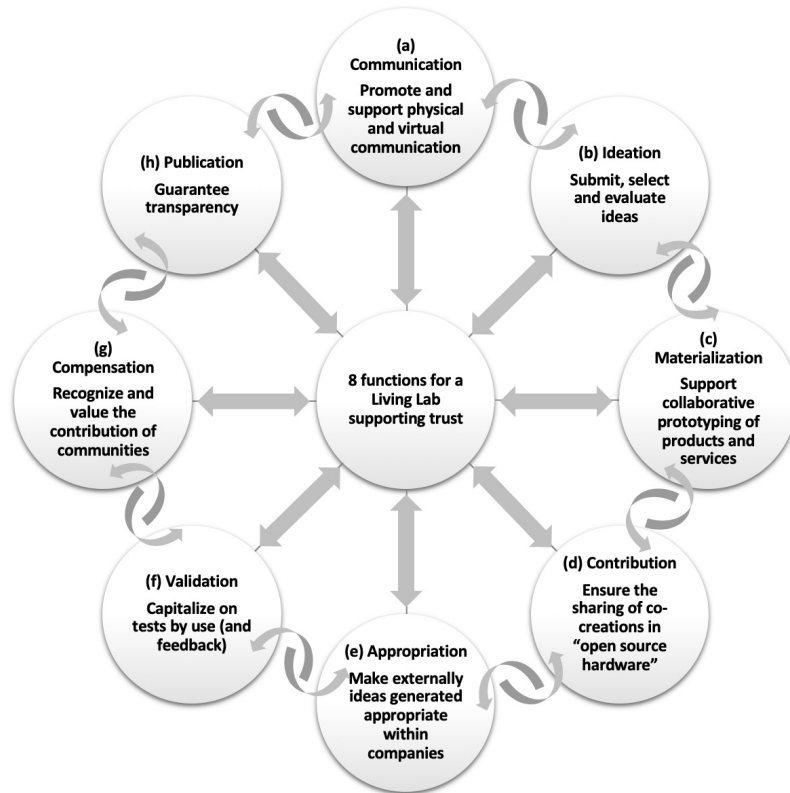


Figure 4 – Eight main functions for a Living Lab supporting trust

To characterize and refine the eight functions that a Living Lab must perform, we have crossed them with the determinants of trust from literature within a co-design process including users. This method allows us to sketch a matrix, called “Co-coon” (for co-creation, confidence and trust), which we have completed from the work presented in the previous sections. The content of the matrix constitutes exploration work for researchers and practitioners as a guide to good practices and possible avenues for implementation.

Towards a Living Lab process supporting trust for augmented co-creation of value?

Trust (adapted from West 90; Mayer et al. 95)	Towards a Living Lab process supporting trust for augmented co-creation of value?							
	(a) Communication	(b) Ideation	(c) Materialization	(d) Contribution	(e) Appropriation	(f) Validation	(g) Compensation	(h) Publication
(1) Benevolence	Within and between communities <i>C1 – C2</i>	Let the actors express their ideas <i>C1 – C2</i>	Give implementation to a third party <i>C1 – C2</i>	Let others modify your idea <i>C2</i>	Value external ideas and agile methods to include the customer <i>NE</i>	Guarantee the right to make mistakes for yourself and others <i>NE</i>	Identify all the contributors <i>C1 – C2</i>	Allow anonymity <i>C1</i>
(2) Ability of the parties to fulfil their obligations	Increase awareness of your skills <i>C2</i>	Support or seek conceptual skills <i>C2</i>	Support or seek prototyping skills <i>C2</i>	Support or seek computer skills <i>C2</i>	Develop a corporate culture <i>NE</i>	Share evaluation criteria <i>C1 – C2</i>	Share the capital gains <i>NE</i>	Be aware of your abilities and prove them <i>C1 – C2</i>
(3) Sharing clear and appreciated objectives	Describe the framework for each <i>C1 – C2</i>	Specify the selection procedures <i>C1 – C2</i>	Show progress towards objectives <i>C1 – C2</i>	Expose and share the 1st results of the co-creation <i>C2</i>	Bring communities together <i>C1 – C2</i>	Commit to objectives and adapt them if necessary <i>C1 – C2</i>	Listen to needs <i>C1 – C2</i>	Respect the objectives or explain drifts <i>C1 – C2</i>
(4) Non-threatening environment to contribute and influence decisions	Dispel misunderstandings <i>C1 – C2</i>	Expression of divergence <i>C1 – C2</i>	Materialise to guide the choice <i>C2</i>	Enable co-construction <i>C2</i>	Encourage collective and team spirit <i>C1 – C2</i>	Share decision criteria <i>NE</i>	Reward the contribution <i>C2</i>	Keep a record and be able to consult it <i>C1 – C2</i>
(5) Achieving excellence through quality work and critical evaluation	Encourage listening and interaction <i>C1 – C2</i>	Deepen and compare ideas <i>C1 – C2</i>	Confront ideas with their feasibility <i>NE</i>	Seek improvements through the collective <i>C2</i>	Accept constructive criticism <i>C1 – C2</i>	Confront ideas with usage <i>NE</i>	Ethics of compensation <i>NE</i>	Evaluate the impact and terms of sustainable development <i>NE</i>
(6) Valuing innovation and supporting practices	Multiply the modes of communication <i>C1 – C2</i>	Encourage the submission of ideas by teams <i>C2</i>	Rely on innovation spaces <i>C2</i>	Develop "smart contracts" <i>NE</i>	Disseminate the innovation process <i>NE</i>	Share feedback <i>C1 – C2</i>	Towards shared properties <i>NE</i>	Engage in a prospective approach <i>NE</i>

C1: observed in ELL – C2: observed in LbM – NE: Hypothesis from the Literature but Not Experimented Here

Figure 5 – Co-coon Matrix to strengthen co-creation, confidence and trust in a Living Lab process

In concrete terms, the Co-Coon matrix, based on the analysis of the literature and our case studies, proposes possible actions at each stage of the process to strengthen trust. Each box is a sub-process of co-creation of value reinforcing one of the six properties and performing one of the eight functions. Our multiple-case study generated data for thirty-five cells. For example, box (1-d) comes from an LbM project where the Github platform allows you to modify or enrich individual production; (5-a) underlines that a mediator has to dispel misunderstandings. Thirteen (grey) boxes are filled with data from literature and professional experiences. In 1-d, literature suggests to use agile methods popularized by the notion of agility in the IT field (Highsmith and Fowler, 2001). Agility is available at different scales, from the small team within a company to complete organizations, whether industrial or public. For example, (Dikert, Paasivaara and Lassenius, 2016) specifically study agile transformations at the level of large industrial scales. (Mergel, 2016) focuses its work on governments.

Limits

These works are pioneering in two ways: in terms of Living Lab, trust, and co-creation of value, through an original reading of literature and a linking of concepts; in terms of field of observation and implementation because the energy sector is currently undergoing change. In this paper, we assume the iterations and exploratory logic between the action-research of researchers engaged in Living Lab projects on energy and a more classical state of the art work. The involvement in our long-term projects enabled us to identify and validate the research gaps. We were also able to build a first project management model. Nevertheless, it is now necessary to test and validate or improve the Co-Coon matrix by building new projects applied to the consumer energy market and other topics. It could also be relevant to measure the creation of potential value for each box or to assess the risk of destruction of potential value in the event

of non-implementation. New resources are therefore needed to engage many actors in such an approach over a long period of time.

CONCLUSION AND PROSPECTS

In this article, we have recalled the fundamental aspect of developing trust within innovation processes to guarantee and amplify their open character and strengthen users' involvement. Nevertheless, the literature highlights the lack of research to understand and accurately characterize the mechanisms underlying the establishment of shared trust in collaborative processes, such as co-design. Two case studies based on a greater consideration of users in the field of energy distribution and management allow us to illustrate and highlight some of the determinants of trust for the co-creation of value. This longitudinal study on projects that took place between January 2014 and July 2017 would need to be supported by the exploration of new data from specifically oriented work on this subject. Putting the user or consumer at the centre of an innovation process and at the heart of service development, for example, does not guarantee their loyalty and commitment. On this point, seeking to test the statistical correlation between the implementation of co-design process methods and the appropriation of the services thus developed by users would legitimize this approach. Because, as Gassmann and his colleagues observe (Gassmann *et al.*, 2010), there is a lack of measurement of the effectiveness of this process. It would also be relevant to conduct research in other industrial fields to validate the generic dimension of the proposed model to support the co-design process (Figure 5). We have deliberately not integrated the technologies of the smart meter into the latter. These make it possible to collect usage data in near-real time, opening up new perspectives in the relationship with the user and the development of service offers for customers. The creation of these data by users, their collection and use is the subject of a democratic debate in France (Assemblée Nationale, 2016). The controversies in several European countries about smart meters also underline a certain distrust of these newly deployed technologies.

Moreover, the recent *a priori* diffusion of the OI paradigm in the energy sector (Greco *et al.*, 2017) may generate different practices from industrial sectors already largely engaged in this logic. A comparative approach would undoubtedly strengthen the Co-coon Matrix we are proposing. Finally, the intangible, even abstract, nature of energy and electricity seems to make it difficult to mobilize neophyte actors with low energy literacy on issues that can quickly become technical or at least require the assistance of specialists to shed light on particular points. A greater effort in communication, vocabulary creation and shared representations seems necessary to overcome this difficulty. The development and use of innovation spaces that bring stakeholders together and collaborate could provide a favourable framework for the emergence of collective intelligence (Morel *et al.*, 2018) in the service of projects and ecosystems. To enhance the efficiency of our model, the time dimension will also need to be studied. Indeed, our two case studies describe projects that span almost two years. Is it a constant or a contest of circumstance? Minimum durations should be measured to ensure the success of each step of the Co-coon Matrix – and to evaluate how the industrial domain concerned, the diffusion of open innovation, and societal engagement influence the temporality of the process.

More generally, all the elements of the Co-coon Matrix can be the subject of an experimental program to consolidate and enrich this first proposal with a better consideration of trust in co-design processes. In addition, Co-coon Matrix proposes functional building blocks from a multitude of physical and virtual platforms. Based on this model, it would be interesting to study the possibility of deploying a digital technology that integrates all these functionalities and that would be the “digital twin” of a physical platform dedicated to collaborative

innovation, generating a framework where the appetite for creativity is truly released. The recent emergence of the blockchain (Nakamoto, 2009) in support of the decentralized system of trust seems to offer new perspectives in many fields, such as democracy (Caseau and Soudoplatoff, 2016) and manufacturing. This technology also seems to provide specific answers to the challenges of co-creation of value (Seulliet, 2016; Duvaut *et al.*, 2018). Technological building blocks combined with a relevant organizational model could therefore offer a climate of trust in the communities of co-designers and give meaning and motivation to the actors involved in OI processes.

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