Real-life experiments and business model innovation process: lessons from the Living Lab literature

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Abstract – If research has established experiments as an essential part of the BMI process, the literature has not elaborated on which alternative approaches exist to implement them, and how these may differ regarding their impact on the whole BMI process. One essential and underdeveloped aspect of experimentation is the testing environment, which is supposed to reproduce real-world constraints and opportunities while not undertaking the cost and risk of full-scale implementation. For this reason, this article investigates how disposing of a highly realistic environment, in the case of real-life experiments, affects the BMI process. This research addresses this question through a systematic review of the living lab literature, which contains many examples of real-life experiments. Our analysis suggests that experimenting in a real-life environment has wide consequences in the articulation of the multiple stages of the BMI process. It also suggests seeing experimentation, not only as a mean to engage with the environment to generate learning and reduce uncertainty, but as a mean to "enact" the environment by generating opportunities through action. Our findings point out the importance of methods to enhance stakeholder contribution in the exploration phase to complement testing and experiments in the BMI process.

Keywords – **Business model innovation, real-life, Living Lab, Experimentation**

1 Introduction.

Business model innovation (BMI) has become a central issue in strategic management research. BMI was first considered as a necessary act to unlock the latent value of technology (Chesbrough & Rosenbloom, 2002) via the correct form of commercialization. However, in the wake of the multiple challenges the firm must now overcome, the outcomes and merits of BMI have changed. BMI has received increasing attention as a process through which firms change the core logic of value creation, delivery and capture in order to meet the new standards of the XXIst century, such as sustainability or resilience (Evans et al., 2017; Buliga et al., 2016).

However, scholars who have adopted this view have pointed out the uncertainty of the process, and the difficulty for managers to analytically ex-ante design a new suitable business model (MacGrath, 2010). As Instead of an ex-ante analysis that leads to the new optimal business model, as well as the detailed plan that includes all intermediate steps to achieve it,scholars prefer to qualify BMI as a trial error process and highlight the role of learning from previous experiences to rethink the assumptions behind their new BM (Sosna et al., 2010; MacGrath et al., 2010). However, this process may come at the risk of a costly failure, which may discourage the attempts of managers to set up a new BM in the first place (Sund et al., 2021). To enable exploration of new BM ideas at minor costs, and to overcome organizational inertia due to the lack of legitimacy of the new BM, some authors have insisted on the role of experimentation (Chesbrough, 2010; MacGrath et al., 2010; Sosna et al., 2010).

Geissdoerfer et al. (2022), based on the literature on observed practices, defines BM experimentation as " a structured and systematic way of testing key business assumptions about opportunities and bottlenecks of successful commercialization by formulating hypotheses,

designing and executing tests to either accept/reject the hypotheses or pivot the experiment to other directions".

This definition translates the potential of experimentation to allow managers to gain control over and guide the design process of the new BM, despite the complexities and uncertainties of the BMI process. Literature has widely acknowledged learning as a key outcome of business model experimentation. Research has also discussed the role of experimentation in the BMI process. While Frankenberger et al. (2013) argue that experimentation is typically done at the implementation phase, Bocken et al. (2020) perceive experimentation as an operation that can occur at any stage of the business model development, especially to assess customer needs, preferences and market fitness. If BM experimentation exact role may diverge depending on the design approach chosen to conduct the BMI process, there is a wide agreement that experimentation can lead to unforeseen learning that trigger a feedback loop with the previous stage of the BMI process.

Nevertheless, the literature misses a more granular and accurate understanding of the components and aspects of an experimentation approach To the best of our knowledge, very few articles try to decompose experimentation into different components in order to try to analyze and assess the importance of each of them separately. One particular aspect, the testing environment, seems to have been somewhat overlooked given its potential impact on the outcomes of BM testing. To study how the testing environment affects the BM development process, we would like to call on the literature in innovation management, especially the one of Living Labs (LLs).

Indeed, the literature in innovation management studies has shown how environments and contexts can shape the whole innovation process and outcome (Ortt & Van der Duin, 2008).

The environment of innovation is an unmissable feature of new approaches for innovation, such as LLs. The formers can be defined as "real-life experimentation environments in which new products and services are given shape through collaborative efforts of users and developers."(Hakkarainen & Hyysalo, 2016). LLs have a particularity that other innovation approaches do not: activities take place in a real-life environment. This feature can be particularly relevant, as Chesbrough (2010) state that the degree of fidelity of the testing environment to the "real" business environment is important to decide the viability of experimentation results. If they are often associated with traditional forms of innovation, due to their wide impact on stakeholders selection (Schuurman et al., 2019), on the integration of complementary assets (Dell'Era & Landoni, 2014) and on market readiness (Almirall & Wareham, 2011), business models can also be considered as a relevant innovation outcome of LLs.

This is why; in order to discover how real-life experimentation affect the development of a new BM I, we would like to gather insights from the LL literature, which contains many cases displaying the intricate link between methods to engage stakeholders in an open and iterative innovation process, a testing environment, and innovation outcomes (Veeckman et al., 2013). Therefore, thanks to a systematic literature review on living labs (LLs), we will answer the following research question "How may real-life environment experimentation of business models affect the BMI process?"

- The role of a real-life environment in guiding innovation processes and outcomes in LLs
- The implication for the design of the BMI process
- The implication in terms of outcomes of experimentation

2 Theoretical background.

2.1 A process view of Business model Innovation.

BMs essentially describes how a focal organization creates, delivers and captures value for its stakeholders (Zott & Amit, 2012). The literature has hardly managed to provide a unanimous representation of what a business model is (Wirtz et al., 2016). However, some authors explain this is because for the complexity and plurality of the sources of competitive advantage, making it difficult condensate in one single representation or description all possible configurations leading to better firm performance (Massa et al., 2017). Indeed, competitive advantage may not stem from having a better technology, a better positioning in the value chain, but may be the result of an architecture of choice, and complementarity between all aspects of firm strategy, whether supply-sided or demand-sided (Priem et al., 2018).

The idea of Business Model Innovation (BMI) appeared as BM scholars were increasingly interested in the dynamics of BMs. These dynamics could occur rather endogenously as BM components interact with each other, as the environment forces change on the firm activity and strategy, or as managers would make voluntary decisions to modify it after they spot a new opportunity (Demil & Lecocq, 2010). To designate the former type of change in the BM, the concept of BMI was introduced, which can be described as a change in the logic of value creation and value capture (Zott & Amit, 2012). As literature comprises many examples of successful business stories led by voluntary changes in the BM (Chesbrough, 2010), BMI began to be perceived as a source of differentiation and competitive advantage. This would lead to BMI beginning to be categorised as a new type of innovation alongside more traditional forms such as service, product or process innovation. Nevertheless, it became evident the stakes associated with BMI are not limited to acquiring a new competitive advantage. According to Foss & Saebi (2018), BMI can be treated both as an outcome or as a

process. The BMI process view highlights the uncertainty of new business model development, due to the many intermediate variables and factors that act as barriers or enablers of the successful implementation of a new BM (Chesbrough, 2010). There are indeed many factors making BMI a difficult process to achieve. First, some authors raise the issues of limited cognitive abilities of top management, making it difficult for the organization to properly scan the environment, to perceive and correctly interpret the need of consumers, and to identify the emerging trends in the market, as well as assessing the limitations of a project, such as costs, duration and risks (Bucherer et al., 2012; Teece & Leih, 2016). Managerial cognition limitation shows the importance of search strategies and learning mechanisms to cope with an uncertain environment, identifying opportunities and trends (Rivkin, 2000). Therefore, cognition is a central factor in explaining heterogeneous propensity to innovate BMs between companies. In addition, several elements linked to intra-organizational inertia can lead to difficulties to innovate the BM. Reluctance to change the organizational culture can be one of them (Foss et al., 2012). BMI can also induce a change in the composition of payoffs among workers of the company, who are likely to oppose such changes if they consider themselves as losers. The resistance to BMI can be even stronger among incumbents for several reasons (Sund et al., 2021). Among large companies with several business units acting separately, there may be a lack of centralized initiatives to change the business model, as well as a lack of coordination and cooperation. A recurrent problem observed among incumbents is the conflict generated between the old and new business model. To add to that, the ability to develop a new BM (exploration) while safekeeping the returns of the current one (exploitation), is deemed as essential to innovate the business model in already established firms. The different business units may have diverging interests between which to prioritize (exploration vs exploitation). In the case of networked industries, this dilemma may reach beyond organizational boundaries, as

different partners may hold different interests in pursuing of innovating the BM (Hamani & Simon. 2020). The difficulty to generate incentives for partners to conform with the business model also strongly reverberates with the very discussed appropriation dilemma in the Open innovation literature (Snihur, Zott & Amit, 2021).

In order to develop a practical approach to solve these problems in the right timing, the BMI process has been decomposed in several stages, with each featuring its particular purpose, tasks and guidelines (De Reuver et al., 2013; Frankenberger et al., 2013). These representations show BMI is a progressive process, with each stage requiring the firm to acquire new knowledge, or new capabilities, to get to the next stage. Frankenberger et al (2013) present four stages for BM development. The first is initiation, in which the environment is scanned the need of stakeholders is examined, and the drivers of change identified. The second one is ideation, where ideas for new business models are generated. This stage requires managers to overcome the current business logic and to adopt a "business model thinking attitude" in order to have a systemic representation of the activities of their firms. The third is integration, which consists in transforming these ideas into concrete Business models using the four dimensions (Who, What, How, Why). The final one is implementation, which requires massive investment and risk taking because full testing of the BM can only happen the BM is fully implemented. Experimentation is typically undertaken to mitigate risk in this critical phase of the BMI process. This is also a phase where the focal firm needs to convince all its partners and overcome internal resistance. While this four phases model seems to represent BMI as a linear fashion, the authors insist on potential iterations between all phases, mostly about between the integration and implementation phases.

Overall, the process view of BMI puts great emphasis on management capabilities and leadership as well as learning to overcome barriers to BMI. Overcoming these barriers is right

now seen as more and more critical as issues tackled by BMI extends simply getting a new competitive advantage. BMI studies have increasingly concentrated on issues such as sustainability (Evans et al., 2017), circularity (Bocken et al., 2017), resilience (Buliga et al., 2016). These studies have shown the overlap between capabilities to overcome barriers to BMI and obstacles to accomplish strategical objectives of the firms.

2.2 Testing approaches for BM development

The necessity to test assumptions behind business model is a deduction of managers' imperfect cognition, preventing them to properly gather process and analyze information contained in their environment (Bucherer et al., 2012). MCGrath (2010) explains the impossibility to solve the problems behind BMI equations through analytical thinking. He opposes an ex-ante analytical approach to a discovery-driven approach. In an ex-ante approach to BMI, managers would use all information they have beforehand to make assumptions, design intermediate steps through planning and strategizing, and modify the BM without modifying assumptions between each intermediate steps. The problem with this approach is the "mismatch between the knowledge a firm actually possesses and the knowledge its planning systems assume it possesses." According to McGrath, this approach is invalidated because of the uncertainty the environment, which prevents managers to accurately predict the future. Instead of planning and analytical thinking, McGrath favours a more stepwise approach, which contains formalizing assumptions, testing, and potential revaluation of the plan. At each step, assumptions are revaluated and potentially updated. De Reuver et al. (2013) suggest a roadmap approach that adopts the same stepwise process and suggests that after several BM scenarios are drawn, testing could intervene to select between business models.

In these models, one of the most obvious outcomes of experimentation is learning. BM experimentation is sometimes registered along the organizational learning literature (Sosna et

al., 2010), which emphasizes on uncertainty. In that regard, one of the benefits of experimentation is to discover characteristics and properties of the environments that cannot be perceived with mere scanning strategies. Experimentation is associated with single loop and double loop learning (Sosna et al., 2010; Bocken et al., 2017; Bocken et al., 2021). While single loop learning remarks deviation with expected results, it does not lead to fundamental questioning of their assumptions, activities, and goals. On the contrary, double –loop learning is reflexive and can lead to more fundamental changes in the company's BM. If experimentation is sometimes more associated with single loop learning and incremental modifications to the BM (Bocken et al., 2020), experimentation may come to question core assumptions behind a BM, leading then to new assumptions to be further tested. The uncertainty of the learning process is due to the high possibility of unforeseen outcomes that can be revealed during the testing phase.

Apart from learning, some authors highlight the possibility of other outcomes to BM experimentation. For Bojovic et al. (2018), experimentation can play a "signaling" and "convincing" effect. Several publications had shown that convincing partners and overcoming consumer acceptance was a great challenge to implement a new BMI. These authors suggest that engaging partners and users in in experimenting may convince them of the desirability of the new BM. These authors apply the concept of "enaction" of the environment (Zimmerman and Zeitz, 2002) which consists of playing an active part in building an environment, instead of simply trying to adapt to it. This aspect of experimentation outcomes can be associated to Zott & Huy (2007) work on strategic legitimacy: for which entrepreneurs or managers, in order to access resources through strategic relationships, would engage with stakeholders to demonstrate their credibility, capability and achievement. Zott & Huy (2007) also discuss about the potential of prototypes in order to reduce the perception of risk. Therefore, the literature has

identified several ways experimentation can contribute to the progress of the BMI process. Nonetheless, otherwise, there are many interrogations regarding experimentation for BM development. Chesbrough (2010) emphasizes the role of experimentation in overcoming barriers to BMI. However, he also notices the lack of knowledge about how to lead an experiment in the BM context.

According to him, a first possible tool to assist experimentation is "business model mapping", which requires to decompose the BM into several components in order to clearly represent the process underlying them, as well as presenting different alternate BMs under a more graphical and practical form. Well-known mapping approach is (Osterwalder & Pigneur, 2010; Demil & Lecocq, 2010). Mapping can show its value by enabling simulation of various possibilities and compare different configurations of elements. However, mapping alone is not sufficient and only represents a possibility to model a hypothetical BM. Chesbrough (2010) identifies several key parameters regarding the quality of experiments. The first is fidelity, meaning the extent to which experimental conditions are representative of reality. The second one is cost, which can itself be understood as the direct cost of the experiment, the costs associated with the experiment not reaching the desired results. Other parameters comprise the time required for feedbacks, and the amount of learning resulting from the experiment. Other authors introduce general patterns to testing approaches for BM development. All these parameters will vary according to experimentation strategy and form. Bojovic et al., (2018) distinguishes two forms of experimentation: purposeful interactions and experimental projects. The first consists of intended interactions with business stakeholders in the continuity of BM activities in order to test assumptions and assess potential BM development ideas. It is rather small scale and happens continuously. The second one is experimental project, which is more large-scale, time, and occur alongside multiple (kinds) of partners. Andries et al. (2013)

classifies experimentation strategy between focused commitment, which engages the company with one single BM, and simultaneous experimentation, where the company has a portfolio of BM experiments. The latter approach possesses the advantage of increasing variety and chance of survival in the long term.

Finally, there are diverging conceptions regarding the testing role and location within the BMI process. We have discussed earlier about multiple phases of the BMI process. We had implied experimentation took place in the implementation phase. Regarding the specific concept of experimentation, some authors agree on this (Frankenberger et al., 2013 ; Bocken et al., 2020). Nonetheless, Geissdoerfer et al., (2022), thanks to a literature review, underlined nuances about three terms commonly used in the literature about testing approaches for BM development: prototyping, experimentation and piloting. The distinction is made according to one main criteria: whether the testing approach is inductive or deductive. Experimentation, according to the article, happens when a firm has already identified a rather small set of already established assumptions that it can test in a structured and systematic manner. Experimentation occurs when the concept it tries to exploit through its BM is already in a mature state. It validates pre-established hypothesis or re-orient experimentation. On the contrary, prototyping is rather more exploratory and inductive. It is mainly used when a firm does not have a clear frame of mind regarding the directions of its business model. Last, piloting runs part of the business in part of the market. Hence, it requires a moderately mature BM concept that is it is going to confront to a realistic business environment to discover its potential limitations. This conceptual clarification implies that different approaches for testing BMs may impact the BMI process at different stages.

To summarize, we have highlighted two aspects that decide how testing affect the development of a new BM. The first aspect is the stage of BM development where testing

intervenes. We have explained that different experimentation approaches may affect the BM development at different stages. The second aspect is how experimentation trigger progress in the development process.

2.3 Living Lab (LL)

Table 1 presents several definitions for LLs. These definitions illustrate the diversity of interpretations of LLs. Literature on LL has indeed pictured them as innovation intermediaries (Almirall & Wareham, 2011 ; Hyysalo & Hakkarainen, 2016), innovation network (Leminen et al., 2012), an innovation platform (Leminen et al., 2015), a methodology for research (Dekker et al., 2020) and design methodology around the user (Dell'Era et al., 2014). LLs, while being often decried for the conceptual ambiguity that surrounds them, can be considered as innovation approaches fulfilling four criteria (Schuurman, 2015; Dell'Era & Landoni, 2014):

- A multistakeholder approach
- A strong user contribution
- Real-life environment
- A multi-method approach

LL research is rarely undertaken to examine what LL represents for a company and its strategic objectives. LL outcomes are often associated with social, product or service innovation (Hossain et al., 2019). To our knowledge, no LL study explicitly takes BMI as its theoretical framework. However, many studies mention LL activities that can be considered relevant in a BMI process. Authors mention for example LL can increase consumer acceptance (Almirall & Warehamn , 2011) and facilitate market readiness reveal tacit and latent needs, integrate, or develop joint resource or infrastructure. In this article, we then consider LLs as vessel for testing key assumptions for BM, or directly part of the BM. LLs possesses several characteristics that

make them particularly valuable for experimenting on BMs. Last, LLs are a place where stakeholders can be equally involved and active in the development process. Contrary to many experiments approaches where the company would be the only one learning while other stakeholders would have a passive role, learning would be extended to all stakeholders. As a result, experiments in LLs may drive change not only to the focal firm BM, but to other stakeholders' behavior as well.

Article	Definition
(Leminen et al., 2012)	"physical regions or virtual realities in which stakeholders form public-private-people partnerships of firms, public agencies, universities, institutes, and users all collaborating for creation, proto-typing, validating, and testing of new technologies, services, products, and systems in real-life contexts."
(Eriksson et al., 2005)	"a research methodology for sensing, prototyping, validating and refining complex solutions in multiple and evolving real-life contexts"
(Ballon et al., 2005)	"Experimentation environment in which technology is given shape in real-life contexts and in which (end) users are considered 'co-producers'".
(Farry Fulgencio & Hans LeFever, 2012)	"human-technology interaction innovation entity utilizing a mix of methods, tools and principles drawn from known disciplines (design, science, ICT, etc.) and set in a real environment and on a local/societal scale"
Louna Hakkarainen and Sampsa Hyysalo (2016)	"Living labs are real-life experimentation environments in which new products and services are given shape through collaborative efforts of users and developers."

Schaffers & Turkama (2012)	“we understand living labs as constituting a setting for collaborative innovation by offering a collaborative platform for research, development, and experimentation with product and service innovations in real-life contexts, based on specific methodologies and tools, and implemented through concrete innovation projects and community-building activities"

Table 1: Some Living Lab definitions

3 Method

In order to answer our research question, we decided to conduct a systematic review of the literature on LLs. We indeed had prior knowledge of research done on this relatively novel innovation approach and of the multiple case studies it contained. We had prior knowledge that LLs were widely recognized as an iterative approach to innovation characterized by active stakeholder participation in co-creating and experimentating in a real-life environment. If few of these case studies do not directly relate to BMI or BM, many of these deal with issues that are prevalent in the BMI literature, such as gaining customer acceptance, gaining network access, reducing the uncertainty contained in the environment.

Therefore, our approach was to get an overview of the literature to get insights from all directions. However, our review had to obey to two constraints. The first was to reduce potential bias due to misreading or misinterpreting results that are not applicable given our differing theoretical framework. The second was the focus of our study on real-life environment as a key aspect of the experimentation approach used in LLs. Therefore, we conducted our review following several steps. First, we did a targeted inquiry of the literature to answer the following generic question: “how does real-life environments shape innovation outcomes and processes in LL ? ”. Second, linking to existing literature on experimentation for BMI and the role of experimentation, we applied deductive and conceptual approach to apply these findings in the

more specific framework we have outlined to answer our research question. Finally, we link these findings to examples contained in the literature to ensure the validity of the newfound insights.

Defined criteria	Justification
Inclusion criteria	
Address Living Lab	Main topic of our systematic literature review. Search terms: "living lab"
Articles in WoS and Scopus	Scientific article published in a peer-reviewed journal to meet a level of rigor and quality.
Theoretical, conceptual, empirical, qualitative, quantitative and conceptual methodologies, literature reviews.	The goal is to include as many relevant academic publications as possible.
Exclusion criteria	
Other language than English.	The language most often used by the most relevant management databases.
Conference papers, articles from business magazines, editorials or similar publications.	Only articles from scientific journals were considered.
Other research area than management, business, and economics	Categories the most relevant for our study.

Table 2: Inclusion and exclusion criteria.

To build our sample, two databases were used: SCOPUS and Web of Science. Our search contained the term "living lab" the title. A first sort is made using the criteria presented in table 2. We can note that we did not operate any filtering based on journal ranking. Indeed, research on living lab is fairly recent and may lack publication in highly ranked journals (Greve et al., 2021). For this reason, we decided that restricting our analysis to top tier journals may eliminate too many potentially relevant papers. After this, a second sort is realized after reading

abstracts and full texts. At this stage, to ensure LLs are not treated in an anecdotal manner, selected articles must follow at least one of the three following criteria:

- Exploring the concept of LL itself
- Exploring a concept tied to LLs (user involvement, open innovation network) and where LLs are part of the empirical analysis
- Exploring an application of LL while LL is presented as a key approach to obtain the innovation outcomes

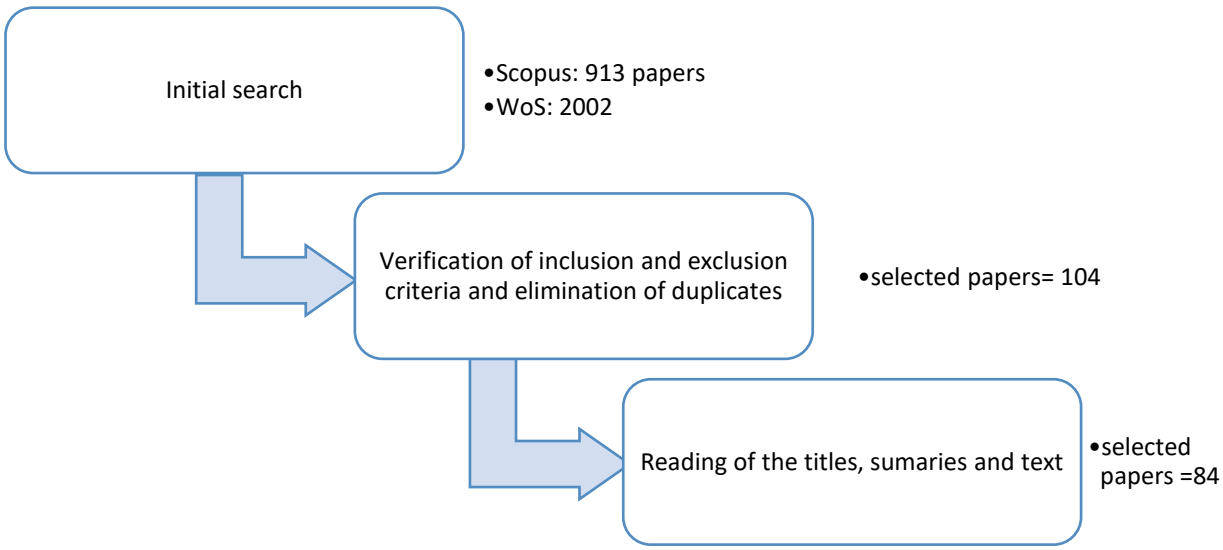

Figure 1: Process for selection of scientific papers

After going through the first sort and after having read articles and summaries, we have a final sample of 84 articles. Figure 1 represents our process for selecting the papers.

4 The central role of a real-life environment in guiding innovation processes and outcomes in LLs

To first discuss the real-life environment as a feature of BM developing, we need first to describe and analyze it as a key feature of an innovative approach called Living Lab and understand the role it plays in guiding innovation outcomes and processes.

LLs have seen many studies trying to enumerate and describe their characteristics in order to have a better picture of an emergent phenomenon (Hossain et al., 2019). Among these, there is a consensus that innovation activities occurring in a real-life environment are a defining characteristic of LLs. Leminen et al. (2012) considers, for example, that LLs are real-life contexts where technology is developed and tested. The meaning of real-life environment may be subject of debates as it may be difficult to draw general properties as LLs appear in many different contexts and settings. “Real-life environment” may be infrastructure for testing and evaluation (Guzman et al., 2013; Dell’Era & Landoni, 2014; Nÿstrom et al., 2014; Leminen et al., 2017)). These infrastructures can typically be education organizations, homes, IT infrastructure. Real environments can also be geographical territory, such as in Urban Living Labs (Voytenko et al., 2016; Mora Sanchez et al., 2021; Waes et al., 2021), communities (Hughes et al.; 2018), or sometimes an association of actors reflecting a social and industrial context (Allais et al., 2021; Leminen et al., 2017). These authors tend to highlight how LLs are intertwined with a geographical and social context that represents as well the boundaries of the economic activities and the local constraints of a given project. On top of representing specific problems tied to a context, LL tend to represent the values and social aspirations of their participants. LLs are indeed tied with many sustainability initiatives (Ståhlbröst, 2012).

However, if real-life environments are important features of LLs, other aspects are equally important to define them. Dell’Era & Landoni (2014) invoke two key characteristics to

define LL: real-life environment as experimentation context, co-involvement of users in the innovation process. Nÿstrom et al (2014) view LLs as open innovation networks, emphasizing the collaboration of several actors in the production and circulation of knowledge to accomplish innovation goals. Schuurman et al. (2019) underline the role of LL in orchestrating activities led by a diverse set of actors by helping the formulation and articulation of needs, as well as selecting, involving and providing structure to stakeholders for the sake of creating novel ways to create value.

In relation to these two facets, Almirall & Wareham (2011) identify two functions assumed by LLs. First, LLs close the "pre-commercial gap by manifesting initial demand for products and services" thanks to the implication of users in the innovation process, which provides ground to assess and then improve consumer acceptance. Second, LLs orchestrates "the action of disparate actors in order to gain critical mass for the creation of a product or service". We may then wonder: How does the presence of a real-environment of testing and experimentation contribute to accomplish these two functions? The literature gives several possible answers.

First, as exploring and discovery user needs and preferences is one key activity of LL, LLs have the specificity to directly confront consumers to a high fidelity contest of use. Through testing, practice, or even by co-creating with developers, users may reveal preferences or needs that would have remained undetected with simple inquiry methods, such as surveys (Dell'Era & Landoni, 2014; Almirall & Wareham, 2011). These authors refer these types of knowledge being tacit, experiential or latent knowledge, as being difficult to codify and communicate, and requires specific approaches, often involving "learning by doing", or "learning by interacting" (Hakkarainen & Hyysalo, 2016), to reveal. One manifestation of this particularity is the ability given to users to experiment and reevaluate their interpretation of the value and function of a

given product, to find new use or new configuration around an already existing product (Almirall & Wareham, 2011). This process highlights the possibility that LLs are not simply experimentation environments for new technology, product, or service development, but can also re-evaluate and bring change to the social and technical configuration within which products are interpreted and value is generated (Engels et al., 2019).

Second, the real-life environment can act as a platform for multi-stakeholder collaboration by providing material, infrastructures and a social setting (Nÿstrom et al., 2014), in which each contribution can be collectively managed and structured. This platform can gather knowledge and information in order to provide a picture of the existing actors, resources, policies and challenges in a given industrial and local context. This picture can then serve as a reference to guide actions such as stakeholder's selection and involvement, tailoring value proposition, structuring value-creation activities, implementation of an adapted governance system and potentially directing public policies. This is visible in Allais et al. (2021) where multiple stakeholders engage in multiple interactions in order to understand the challenges and opportunities related to repairing and recycling in France, map actors and interconnections, identify potential actors conflicts, and finally find leverages for changes. According to the same autors, representativeness of the participating sample is critical for the success of this approach.

We have previously described two roles played by real-life environments in guiding innovation processes and outcomes in LLs. From these two roles, we will derive implications for the design of the BMI process as well as for the outcomes of experimentation within the BMI process.

5 Implication on the BMI process

5.1 Implication for the design of the BMI process

Frankenberger et al. (2013) finds that testing BM is mostly occurring in the implementation stage, with possible iterations occurring between the different stages and especially between the integration and implementation stages. The observation of real-life experiments in LLs cases may not invalidate this model, bur show indeed very complex patterns and high level of iterations inside the BMI process. First, experiments in LLs can be used to check and verify assumptions concerning user needs and preferences, which in turn provide ideas for opportunities to exploit and are typically associated with the ideation phase. Second, the possibility to detect unforeseen user needs may provide materials and ideas to explore in the ideation stage of the BMI process. Indeed, real-life environments tend to reveal tacit or latent knowledge that is hard to detect through the simple observations and scanning strategies that are typically led in the initiation stage.

On top of that, the effects implied by the real-life environment can be combined with the contribution of multiple stakeholders and especially users, who may have several roles (Nÿstrom et al., 2014) and may be involved in all stages of the development process. The synergy between a highly realistic environment and stakeholder involvement is mentioned in other articles of the literature. Lehmann et al. (2015) examines the pattern of knowledge occurring in LL. It states that the synergy between a highly realistic experimentation environments and stakeholders involved in co-creation activities could lead to a virtuous cycle between exploration and co-creation activities, which leads to establish prototypes to evaluate, and a highly realistic testing environment, which can assess with reliability a given design, and potentially lead to unforeseen elements. These elements can turn into materials for the conception of new prototypes or new experiments, prolonging the process until a satisfying

outcome is found. Schuurman et al. (2019) display similar examples of iterations between exploration methods involving different stakeholders designed to generate assumptions about the optimal BMs, and a testing protocol to validate or invalidate these assumptions. This study shows some examples where real-life experiments led firms, alongside stakeholders, to reevaluate their BM along multiple dimensions such as customer segments, value proposition, revenue models, choice of partners in an iterative process of hypothesis generation and validation.

This pattern is quite alike some methodologies to develop BM such as lean-start-up (Ries, 2011), which can be applied to BM development by drawing patterns of consecutive phases of hypothesis generation and hypothesis validation or refinement through testing (Bocken et al,. 2020). However, the non-linearity and complexity of the BMI process is likely to be amplified in LLs, thanks to the combination of two features: a highly realistic experimentation environment leading to unexpected and unpredictable discoveries, and co-creation activities leading to more exploration and more ideas to be tested.

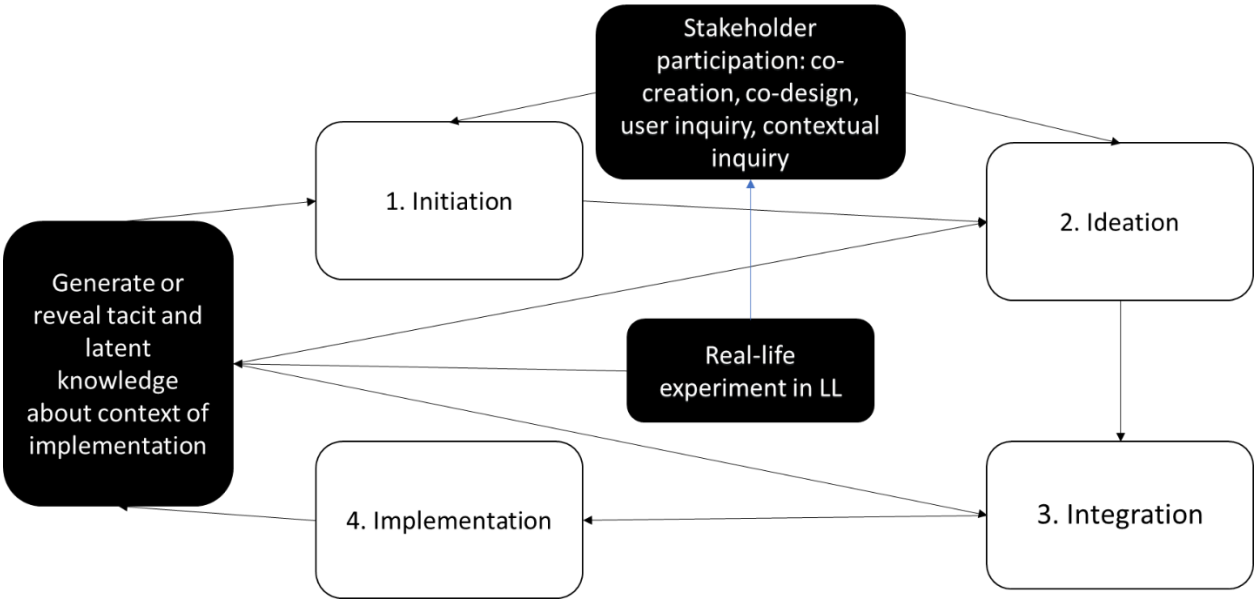

Figure 2: Using Frankenberger et al. (2013)'s framework, the impact of real-life experiment on the design of the BMI process

5.2 Implication for outcomes of experimentation

Outcomes of experimentation in the BMI process refers to the mechanisms that lead to a progression in the BMI process, as well as increasing fitness of BM relative to market and other stakeholders. Typically, BMI scholars see learning as one the main outcome of experiments. Learning is also a key outcome of LLs experiments (Leminen & Westerlund, 2012). However, one key standout in LLs is that learning is collective and reciprocal. This standout exists because LL engage stakeholders that are active contributors and take active interests in the development of a solution. In LLs, firm may learn about market composition, user needs and preferences. User may learn to discover new ways to adopt and appropriate technologies, giving birth to new potential value propositions. Learning may also apply at the level of network (Leminen & Westerlund, 2012) where stakeholders lean towards more effective modes of collaboration. Modes of governance may also be improved as a result of learning through interactions of the multiple actors of the LLs (Engels et al., 2019). LLs may indeed be a place where political problems, caused by the non-alignment of needs and

preferences among diverse actors, can be solved through implementation of collective governance mechanisms (Almirall & Wareham, 2011).

As, the learning outcome of experimentation goes beyond the frontier of the firm, this learning may trigger active transformation and evolution among all stakeholders (Lehman et al., 2015).

Bojovic et al. (2018) distinguished between "engaging" with the environment and "enacting" the environment. Engaging the environment, done through interactions with the BM stakeholders as well as with the context of application, can generate learning, leading to validation, adaptation or abandoning BMs. However, in a scenario of engaging the environment, the firm considers its external environment as static and just adapts its BM depending on what it learns about it. However, in LLs, learning and evolutions happen simultaneously between all stakeholders. Therefore, the environment in LLs may not be static and may evolve to enable new opportunities for value creation or value capture. Consequently, the concept of engaging the environment may not encapsulate all outcomes generated by real-life experiments in LLs. On the other hand, Chesbrough (2010) has described "enacting" the environment as taking actions to create "new information that reveals latent possibilities in the environment". LLs can enact the environment to generate new BMs opportunities in several ways and at multiple levels. First, thanks to the real-life environment who help generate experiential knowledge through "learning by doing", users may shift their interpretation about the meaning associated to a given, product service, generating new possible uses for existing products and giving ways to new value propositions. Quite similar to the "signaling effect" found in Bojovic et al. (2018), LLs may be a way for firms to communicate their good intention and demonstration the value of their product/service before market launch. Second, LL can be also fulfill the "convincing role" described by Bojovic et al. (2018) by helping organizations

gain “strategic legitimacy” and get access to a wider network of partner. De Vita & de Vita (2021) finds legitimization was not an initial objective of the organization they monitored, but was a consequence of proving their value to the participating stakeholders of their projects. Legitimization in many cases not only had effects on their external partners, it helped them gain acknowledgment inside their organization. Third, LLs can facilitate ecosystem access and integration of external resources by providing a governance structure through which political problems preventing effective collaboration and resource sharing can be solved (Engels et al, 2019).

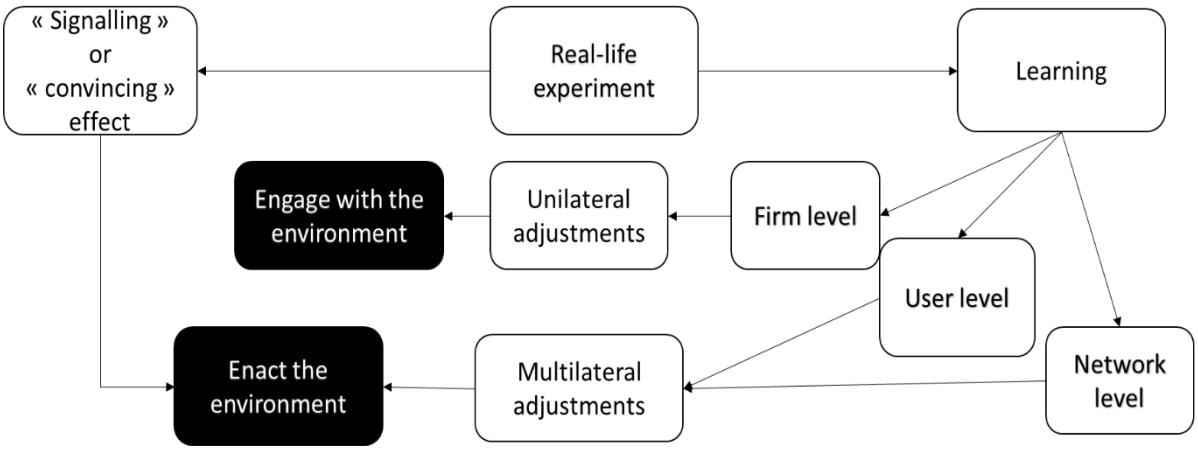

Figure 3: Inspired from Bojovic et al. (2018), outcomes of real-life experiments

6 Extending our understanding of BM experimentation and avenues for future research

Our paper provides some evidence that real-life environment are not neutral in the way BM experimentation affect the BMI process. However, our findings leads to many questions regarding the exact role of the testing environment in the BMI process. If the experimentation environment has been previously described as a counterfactual in the literature to assess the validity of the new BM in its implementation environment (Chesbrough, 2010), this article

shows that the environment has a much wider role in the BMI than just being a deductive and systematic approach to filtering BM ideas. By enabling tacit, experiential learning, experimental environments can become influential in generating new ideas that can be assimilated as new hypothesis to be tested via further experimentation. That is why we would like to propose to differentiate the concepts of BM real-life experimentation and BM experimentation. As the latter expressively tightly links experimentation to a deductive approach to trial-error learning (Geissdoerfer et al., 2022), we would like to enlarge the notion of real-life experimentation in the context of BMI so that it communicates its inductive and transformational properties. Hence, we suggest to define real-life experimentation in the context of BMI "as semi-structured way to engage the focal firms, its potential consumers and partners to engage in a reciprocal process of trial error learning leading to successive changes in the proposed new BM, or to the context of implementation of the BM, and whose final purpose is to improve the fitness between the focal firm business model and each stakeholders' prerequisites for adopting the new BM".

This understanding of real-life BM experimentation raises several questions that may not surface the same way when having a purely deductive and formal understanding of the concept. These questions represent potential research avenues for future research.

The first question raised is the non-neutrality between the methods to engage users and potential partners in the innovation process and the outcomes of experimentation in the BMI process. Indeed, it is first critical that an experiment gathers the actors that partly constitute the real environment of the firm in order to increase the fidelity of the experimental environmental to the projected implementation environment (Chesbrough, 2010). Second, methods and approaches to improve commitment from participating actors as well as to structure their contribution may contribute to the maximization of the returns of experimentation. We suggest

literature on innovation approaches, especially on user innovation, may contain some answers as to how best include users and partners in experimenting.

On the other hand, our article also explores the potential of real-life experiments for "enacting the environment". However, the processes through which this enactment takes place lack characterization and conceptualization. The literature has already identified some of the effect that allow a firm to exert influence over his environment, including through experimentation, such as the signaling effect or convincing effect (Bojovic et al., 2018 ; Snihur et al., 2018). However, our findings suggest other effects could occur and help a firm enact its environment. For example, Almirall & Wareham (2011) describes the possibility for users to renegotiate the "social meaning" of an already existing technology, leading to new potential uses and value propositions. While this is just an example, these processes of social renegotiation can be associated to the sense-making and sense-giving concepts that have been at some occasions mobilized in the literature as essential parts of the BMI process (Andreini et al., 2022). Indeed, these two concepts study the role of interpretability and communicability in the adoption of new business models. Therefore, further research could explore the ability for experimentation to give room to reinterpretation and communication of sense in the context of adoption of a new BM. Finally, our findings point out to another driver of environment enactment: experimentation of new forms of governance potentially leading to new collaboration possibilities (Engels et al., 2019). Indeed, governance has been deemed important in the BMI literature (Zott & Amit, 2012) as good governance mechanisms means lower coordination costs between partners and hence enable value creation through a network of relationships (Hamani & Simon, 2020). Therefore, future research could investigate the idea that experimentation can improve governance mechanisms and therefore lower the inter-organizational barriers to BMI.

Finally, as our approach is content neutral and our analysis does not include the outcomes of the whole BMI process, future research could investigate if a similar approach to Living lab, which associates stakeholder participation in a real-world environment, is related to radical or incremental innovation, or leads to architectural or modular changes in the BM. In addition, innovations simultaneously generated and tested in real-world environment may tend to be more idiosyncratic as it may tackle the specific challenges and integrate the specific constraints of a given context. Therefore, there is some uncertainty on whether the BMs generated through approaches resorting to real-world experimentation can apply to other geographical, cultural or societal contexts.

7 Conclusion

This article aimed at investigating the role of the testing environment in guiding and modifying the shape of the BMI process. Through a literature review of the LL literature, it has provided ideas and arguments as to how experimenting in high realistic environment such as LLs can shape and advance the BMI process. We have described two roles played by real-life environment in shaping the innovation outcomes: (1) by enabling a form of "learning by doing" to reveal unobservable and latent knowledge (2) being a platform that enables and orchestrate stakeholder collaboration. These two roles have overall implications on the design of the BMI process and greatly shape the outcomes of experimentation. We have seen that real-life experiments have the potential to add complexity and iterations in the BMI process, due to generation of new knowledge during the testing phase, fueling the BMI process with new possibilities. They can also do it by reinforcing the proximity between exploration activities and testing, leading to greater interaction between these two. Regarding outcomes, real-life environment triggers learning at multiple levels: at the user level, at the organization level, at the network level, at the society level. Apart from learning, real-life environment

experimentation can help organizations enact their environment by showing the value of their offer to the customers and gain consumer acceptance, or demonstrate the reliability of their business model to potential partners and gain ecosystem access, as well as developing governance mechanisms to facilitate collaboration through learning by interacting mechanisms.

However, this paper may face several limitations. This paper has made the choice to only cover the process view of BMI, and excluding content from our analysis. However, process and content may be intertwined as the patterns and design of the BMI process may not be independent to the nature of the components subjected to modifications. Hence, future studies should consider how approaches for experimenting the BMs could change depending on whether part or all the BM is tested, and which components are tested.

Finally, our research may suffer from some bias coming from two potential origins. First, we have excluded every papers of our database that is not associated to business management or economics. That includes every papers coming from various social sciences, which may have provided different perspectives to our understanding the LL approach. Our motive was based on the possibility that the findings of these papers could not be easily translated due to our differing perspectives to understand the LL phenomenon. However, this exposes our research to omission bias as some of these papers may have provided useful insights and were not incorporated in our analysis. Second, a further source of bias is potentially our perspective centered on the BMI process that is hardly reflected in the literature. Indeed, few adopt a BMI perspective or even a BM perspective to analyze LL innovation outcomes. Those who do focus on the BM of LLs, and omits their contribution on their partners' (Schuurman et al., 2019). Schuurman et al. (2019) is by the way the only article of our database that focuses on LLs as a tool to develop BMs. The difference in perspective could result in interpretation bias, where some findings may not translate to our theoretical framework. However, we do not

think this is a strong enough factor to alter our results. Indeed, even though BMI is not a central focus, the literature mentions aspects such as user, market or ecosystem knowledge, market acceptance, scanning and perception of needs, networking and forging new collaborations, orchestration of activities among a network of partners, as powerful motives for firms to engage in LL activities (Santonen & Julin, 2019). These aspects are also mentioned in the BMI literature as strong drivers or barriers to BMI (Bucherer et al., 2012; Foss & Saebi., 2017; Chesbrough, 2010). Because the literature on LLs treats elements that are also relevant for BMI, we think the findings of the articles of our database are applicable to the BMI process.

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