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Abstract

This study examines experimentation in the business modeling process, unpacking three different roles of experimentation: learning, signaling, and convincing. Learning is an inherent role of experimentation, as managers typically experiment to engage with the environment and to obtain knowledge. This study uncovers another set of roles, which have a symbolic nature. These roles show that experimentation is not just a learning process, but also a strategic legitimation process, aimed at enacting the environment. Experimentation serves the purpose of signaling to potential customers and other stakeholders, and of convincing them to embrace the business model. Furthermore, this study shows that experimentation takes two forms—purposeful interactions and experimental projects—and that these forms can support the different roles of experimentation.

Keywords: business modeling; experimentation; business model dynamics; business model design; strategic legitimation

INTRODUCTION

The business modeling process is crucial and challenging for managers, as it has a major impact on the company's performance and survival (Zott and Amit, 2007, 2010). It also poses challenges for scholars, as it is not always easy to understand and express how business models emerge, and how organizations use them (Mangematin and Baden-Fuller, 2015; Rumble and Mangematin, 2015). One can broadly define "business modeling" as a set of activities to create value for consumers and the company (Teece, 2010). Cognitive aspects of business modeling are becoming an important avenue of research in strategy (e.g., Baden-Fuller and Morgan, 2010; Martins et al., 2015; Mikhalkina and Cabantous, 2015). In line with these contributions, some authors emphasize that business modeling is dependent on managers' cognition, and on mental representations of the business (Aversa et al., 2015; Martins et al., 2015).

Scholars have started to raise the importance of experimentation in the business modeling process (Andries et al., 2013; McGrath, 2010; Morris et al., 2005). The literature on experimentation in strategy shows that experimentation helps managers to learn actively about their environment (Andries et al., 2013; Berends et al., 2016; Murray and Tripsas, 2004), and to probe the future and new markets (Brown and Eisenhardt, 1997). Some authors argue that experimentation allows the innovation of business models (Berends et al., 2016; Doz and Kosonen, 2010; McGrath, 2010; Sosna et al., 2010). Experimentation remains an emerging subject; we do not know yet exactly what roles it may play and what forms it may take in the business modeling process. The question that guided this research is: What are the roles of experimentation in the business modeling process? Furthermore, we explored how different forms of experimentation can support these roles.

To explore these issues, we adopted a qualitative approach to examine the micro-processes of experimentation. We utilized a processual perspective to obtain a deeper

understanding of this phenomenon (Langley, 1999; Langley et al., 2013; Sandberg et al., 2015). We studied the business modeling process in two start-up companies in their early years, which allowed us to characterize two forms of experimentation: purposeful interactions (small-scale, potentially continuous experimentation with one kind of partner or an individual customer) and experimentation projects (large-scale, time-bound experimentation with one partner or multiple partners). Moreover, this qualitative and inductive study enabled us to discover two roles played by experimentation beyond learning.

Our data confirmed the learning role of experimentation (Berends et al., 2016): Experimentation allows managers to investigate the environment, test hypotheses, and develop skills and competences in the business modeling process. For example, one of the companies engaged in purposeful interactions with doctors and hospital managers to understand their needs and constraints. This approach offered a way to learn about the potential market; as a result, the management team decided to abandon the business model because of the external conditions linked to its implementation.

However, the data revealed two other roles of experimentation that we could not interpret through the lens of existing work on experimentation and business models. We realized that experimental projects could play a role in signaling value or intention, and in convincing other parties to engage in a relationship with the firm. Both signaling and convincing are involved in the strategic legitimation process. The literature on strategic legitimation in nascent ventures suggests that new ventures' strategic actions can enhance legitimacy (Zimmerman and Zeitz, 2002), and that a nascent organization's actions are crucial in explaining organizational emergence (Tornikoski and Newbert, 2007). We argue here that experimentation in the business modeling process plays an important role in signaling, and in convincing other parties of the business model and of the nascent firm's

legitimacy. Business modeling is both a cognitive and an experimental process—and so a way to gain legitimacy.

This paper is organized as follows. First, we present the theoretical background for the study. Next, we explain the research design and methodology. We then describe the study results. Finally, the discussion section highlights contributions to existing theories, implications for managers, limitations of the study, and avenues for further research.

THEORETICAL BACKGROUND

Process of business modeling

Recent research has begun to investigate the business modeling process, i.e. modeling a business model (Aversa et al., 2015; Mangematin and Baden-Fuller, 2015; Rumble and Mangematin, 2015). Aversa et al. (2015, p. 153) define "business modeling" as "the set of activities that cognitively manipulate the business model to evaluate alternative ways in which it could be designed." This processual view on business models is closely related to other terms used in business model literature—such as business model "design," "evolution," "renewal," and "innovation"—as it acts as their antecedent (Aversa et al., 2015).

In business modeling, managers are involved in cognitive processes. They may rely on analogical reasoning (accepting similarities between two systems to support the conclusion that some further similarity exists) or conceptual combining (creating a new concept by combining target and source concepts) (Martins et al., 2015), and they may imitate iconic business models (such as Google or Airbnb) as representations of what they aspire to become (Mikhalkina and Cabantous, 2015). Managers are involved in the process of modeling different conditions, evaluating their potential and deciding how the business model

will create and capture value (Lubik and Garnsey, 2016). In so doing, they cognitively explore different scenarios, and different outcomes of strategic decisions.

In addition to this exploration, managers are also involved in experimentation, which sometimes plays a central role in the business modeling process (Baden-Fuller and Morgan, 2010; Chesbrough, 2007, 2010; McGrath, 2010). Experimentation processes are different from cognitive processes, as they follow a different logic. While the aim of cognitive processes is to build models to represent the world, experimentation has processes of intervening, aiming to change the world (Hacking, 1983). Aversa et al. (2015, p. 153) argue that the turn to business modeling reflects the importance of understanding the underlying dynamics related to business model experimentation and manipulation. Morris et al. (2005) propose that business modeling in entrepreneurial companies is a process that involves the evolution of a model from fairly implicit to informal, intertwined with processes of trial-and-error learning and experimentation. Business modeling requires significant experimentation and learning, as well as a repertoire of leadership actions (Doz and Kosonen, 2010; Svejenova et al., 2010).

Experimentation in business modeling: definition, roles, and forms

Experimentation refers to deliberate and purposeful actions to gain knowledge about the environment or to validate existing knowledge through small tests in relatively controlled situations (Berends et al., 2016; Bingham and Davis, 2012). Bingham and Davis (2012, p. 632) found that even though scholars hold a common view about how to conduct experimentation in controlled conditions to test causal propositions, experimentation in uncertain environments also frequently occurs in a way that requires managers to try variations of practices and products deliberately as they go along. Murray and Tripsas (2004)

examine two ways in which firms can learn about their environments: unplanned trial-and-error learning, and purposeful experimentation. They understand experimentation as a conscious experimental approach to the activity of strategy making; this conscious, deliberate, and purposeful nature of experimentation differentiates it from trial-and-error learning. Murray and Tripsas (2004, p. 70) state that purposeful experimentation happens "when firms engage in clearly articulated problem-solving, based on the identification of a problem or decision, the establishment of a hypothesis, and the testing of that hypothesis through organizational activity." Their definition encompasses four steps in experimentation: An entrepreneur identifies a problem or decision, builds a hypothesis about the likely outcome, takes action to test the hypothesis, and finally evaluates the results. Experimentation usually relates to technology, the market, or a business model (Murray and Tripsas, 2004). In the business model literature, there is no unique definition of "business model experimentation." Researchers use this term to explain different processes, from trial-and-error learning (Sosna et al., 2010) to experimenting with different business models (Andries et al., 2013). Consequently, we build on the contributions from strategy literature—and particularly those from Murray and Tripsas (2004)—and we define "experimentation in business modeling" as processes of deliberate and purposeful developing and testing of hypotheses about a business model, or about one or more of its components, in a controlled or real-life environment.

Apart from identifying experimentation in business modeling, it is important to see how experimentation contributes to the process of business modeling, i.e. what its roles are. Several scholars have established that experimentation facilitates learning (Andries et al., 2013; Berends et al., 2016). This is vital for entrepreneurial ventures, as incorporating feedback from experimentation enables entrepreneurs and managers to learn actively about the environment (Andries et al., 2013). Experimentation is a way to probe the future and new

markets (Brown and Eisenhardt, 1997); it can challenge core business assumptions and bring about change (Doz and Kosonen, 2010). Murray and Tripsas (2004), having studied start-ups, tease out another role of the experimentation process: establishing legitimacy. However, they do not elaborate on or further characterize this role.

Strategic legitimation in nascent venture years

Research about legitimacy has been well developed in the literature. Legitimacy is "a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions" (Suchman, 1995, p. 574). There are three basic types of legitimacy: pragmatic, moral, and cognitive (Suchman, 1995, p. 577). The extant literature approaches these three types of legitimacy in two different ways: from an institutional tradition and from a strategic tradition (Suchman, 1995).

A newer approach, which scholars call "strategic legitimation," takes a managerial perspective; it suggests that organizations can take an active approach to gain legitimacy through strategic actions (Tornikoski and Newbert, 2007; Zimmerman and Zeitz, 2002). Studies have shown that gaining legitimacy is a crucial process in a company's nascent years, as the resource holders are hesitant to get involved in relationships with new ventures (Suchman, 1995; Tornikoski and Newbert, 2007; Zimmerman and Zeitz, 2002). Hence, new ventures need to demonstrate and convince potential partners that they are operational and that they can produce something (Tornikoski and Newbert, 2007).

A new organization can try at least two sets of strategic actions: It can attempt to change itself, for example by creating a business model; and it can attempt to change the environment (Suchman, 1995; Zimmerman and Zeitz, 2002). The literature refers to this kind

of active construction of the environment as a process of "enacting" environment (Salancik and Pfeffer, 1978; Smircich and Stubbart, 1985; Zimmerman and Zeitz, 2002); this includes creating an environment through symbolic actions and social interaction. As Zott and Huy (2007) argue, entrepreneurs and managers—in order to build legitimacy and acquire resources—engage in symbolic actions, such as conveying the entrepreneurs' personal credibility, organizing professionally, demonstrating organizational achievement, and building the quality of stakeholder relationships. Zott and Huy's study (2007) shows that entrepreneurs often engage in prototyping and displaying unfinished products as a symbol of the ultimate goods, to reduce the perception of technological and business risk. Organizations need to show the resource holders that they are capable and operational. Tornikoski and Newbert (2007) found that this behavior is critical for nascent organizations. They identify actions that can help the organization in strategic legitimation, such as creating the impression of a credible organization, transforming resources into finished goods, and manipulating external audiences' perception of the nascent organization.

RESEARCH DESIGN AND METHODOLOGY

We used a qualitative, case study methodology, which is appropriate especially when the boundaries between a phenomenon and context are not clear, and when researchers draw on multiple sources of evidence (Yin, 1984). As experimentation and business modeling are processes, and as we were interested in their mechanisms and dynamics, we adopted a process study approach (Langley, 1999, 2007). The research shift from business models to business modeling emphasizes temporality and flow, and calls for more process-oriented studies. We observed the processual nature of experimentation and business modeling in line with previous literature addressing the dynamics and evolution of business models (McGrath,

2010; Svejenova et al., 2010). In this research, we focused on investigating micro-processes (Langley, 2007) of experimentation as part of business modeling.

Our research approach followed systematic combining and abductive reasoning (Dubois and Gadde, 2002; Timmermans and Tavory, 2012), which is a mixture of deduction and induction. The research had several phases: Initially, we aimed to uncover the business modeling process. We collected preliminary data in the field and identified some intriguing notions and elements of experimentation processes in business modeling. Subsequently, we made a broad search of the literature, and reviewed articles about experimentation and modeling. During this literature review, a new question evolved about the forms and roles of experimentation in business modeling, and—with it—a new theoretical framework. The data revealed novel insights about how business modeling happens, and the roles and forms of experimentation in the process.

Research setting

As experimentation is a vital process in establishing entrepreneurial ventures (Andries et al., 2013; Morris et al., 2005) and in building early-stage business models (Lubik and Garnsey, 2016), we placed our research in a start-up environment in order to observe companies during the process of new venture creation and initial business modeling efforts. The companies we chose for this study had to be involved in business model experimentation and to have a history of business model evolution, so we could trace the modeling process. In order to gain insight into a variety of business modeling processes and practices, but still maintain an in-depth and explorative perspective, we observed two companies whose business modeling processes followed slightly different trajectories. Both were start-up companies based in France, operating in the area of connected health. This type of start-up offered an interesting research area for this study because it is an emerging approach for healthcare management, where patients' needs are at the center, and technology serves to

connect different stakeholders in order to provide the most efficient and proactive care (Caulfield and Donnelly, 2013). Some researchers identify business modeling as a major challenge in implementing connected health solutions, and note that business models must be viable if they are to be widely adopted (Caulfield and Donnelly, 2013; Rosenberg et al., 2015). Also, we wanted to examine the companies in their early years in order to identify business modeling processes before the organizations became active on the market. We discovered that there was considerable uncertainty in the process. To protect the firms' anonymity, we gave each company a pseudonym—DataScent and PortLab.

DataScent is a technology platform company created by a team of scientists and entrepreneurs in 2014. The company's main product in development is an innovative smell-recording device that can be adapted to different applications and market segments. PortLab is a company created in 2013 by scientists working in a large research laboratory. It is developing a mobile point-of-care device that can perform different medical tests using capillary blood. It is also a communication device that maintains the link between the patient/caregiver performing the test and the healthcare team following the patient's care.

Even though the companies are similar in terms of size, culture, stage, and main activity, it is their different business modeling processes that led us to select these two specific cases. Both companies started with two business models; however, the modeling process resulted in different outcomes. While the models remained the same but were constantly renewed during the modeling process in DataScent, PortLab eventually abandoned both business models as a result of experimentation and entered a new modeling cycle with a third business model.

Data collection

We collected data on the business modeling processes in DataScent and PortLab. To increase the study's validity, we used triangulation and several data sources (Eisenhardt, 1989; Yin, 1984); we present these below.

In-depth interviews. Semi-structured interviews were the primary data source, being the most appropriate method to obtain retrospective and real-time data about the experience of people who are directly and deeply involved (Gioia et al., 2013). We interviewed top managers from DataScent and PortLab, as they are involved in business modeling processes in their everyday work. We especially focused on the CEOs (who, in both cases, are also co-founders), as they have chief responsibility for the business modeling process. This follows Langley et al.'s recommendation (2013) to focus on how their experiences of particular individuals unfold over time, based on earlier experiences, interactions, and expectations. We asked questions regarding the business model, and also regarding the business idea in general, in order to identify when and how the CEOs started to conceptualize the business, what form the initial business model took, how experimentation influenced the business model, why they conducted experiments, and how these experiments were designed. Hence, our questions aimed to uncover not only the CEOs' experiences and expectations, but also all the interactions that resulted in their altering the business models.

We conducted multiple interviews with the CEOs at several points in time. The interview guides evolved with each encounter—starting generally from the business modeling process and focusing increasingly on roles and forms of experimentation. This enabled us to track micro-changes and how experimentation in real time was changing how actors were thinking about and designing the business model. We conducted three interviews with PortLab's CEO, and six interviews with DataScent's CEO. Each interview lasted 60

minutes on average, and was both retrospective and in real time, referring to past and to current business modeling and experimentation processes.

Archival data. Relevant internal documents (more than 200 pages of reports, presentations, business plans, and internal documents) and publicly available secondary data (company websites, press releases, and press interviews with company members) supported the interviews. This helped to contextualize the processes included in the study, and enabled us to add more details and another perspective to the analysis.

Observations. One of the researchers attended meetings regarding the business modeling processes in DataScent from November 2015 to June 2016 (approximately one meeting per month). This researcher took field notes and recorded the meetings. The focus was on observing how managers constructed experimentation, and how experimentation influenced business modeling. In some of the meetings, participants reflected on what had happened in previous experimentation processes; in others, they planned new experimentation. Thus, the researcher was able to observe how DataScent managers integrated feedback from experimentation into the new business model and into new rounds of experimentation, as well as noting the role of experimentation. This helped to validate the interview data and secondary data.

We also used investigator triangulation, as multiple investigators were involved in data collection. The latter was a joint effort, and used Eisenhardt's multiple investigator strategy (1989), in which researchers take different roles in data collection. One author was deeply immersed in data collection. The second was a little more distant, only taking notes at the main interviews. The third—not involved in data collection—provided a different perspective on the data in the analysis process.

Data analysis

Data analysis was an iterative process between the theory and data, in line with the abductive approach that we took in this study. We started by identifying the business modeling processes in the two cases. Then, to trace experimentation processes, we used the definition described in the section on the theoretical background. We identified when experimentation started, and how questions about business models were developed and then translated into experimentation. The questions that marked the beginning of the experimental part of business modeling were those requiring managers to engage with the environment to obtain answers. It was not enough just to manipulate the business model cognitively. The subsequent research phase—which focused on the processes, forms, and roles of experimentation in business modeling—was inductive in nature as there were no previous frameworks. We used Gioia et al.'s methodology (2013), and inductively coded the data for the experimentation roles and forms. We used software (Atlas.ti) to facilitate the coding.

During the first part of the analysis, we examined the data and observed how the business modeling process actually takes place. We analyzed the components of the business models using Baden-Fuller and Mangematin's framework (2013), which has four components: identifying customers; customer engagement; monetization; and value chain and linkages. This helped us to identify different business models in the two cases: two business models in DataScent, which we refer to as the "technology platform" and the "product" business models; and three in PortLab, which we refer to as the "patient," "hospital," and "lab" business models. We examined and compared the business models at the various stages in order to assess the impact of experimentation and to understand its role in business modeling.

We used several of Langley's strategies (1999) to make sense of process data (narrative strategy, visual mapping, and temporal bracketing). First, we used narrative

strategy as a preliminary tool to describe all the processes, so we could observe the sequence of events. After completing the initial coding, we created chronological narratives for each case; we included the quotes from the data to support each event. This step helped to identify the processes and different experimentation projects that emerged. We sent these narratives to key informants, who confirmed our understanding of the business modeling process. This enhanced the study's reliability (Yin, 1984). The data revealed that the companies had gone through episodes in their business modeling processes, and that the processes were not linear.

Next, we outlined the business modeling process in each company. We employed a visual mapping strategy so we could illustrate different components and sequences of processes; this was especially helpful in identifying the experimentation process. To identify connected temporal periods, we used a temporal bracketing strategy, which helped to separate and analyze episodes in the business modeling process. We present simplified versions of chronological narratives for each company in Tables 1 and 2. The outcome of this phase was an evolved business modeling framework.

Insert Tables 1 and 2 about here

The second, inductively driven phase involved a deeper investigation into mechanisms behind the process, and into roles and forms of experimentation in the business modeling process, adopting a Gioia methodology (Gioia et al., 2010, 2013). First, we employed open coding to see what first order concepts were prevalent in the data. Next, we identified second-order themes, connected them to theoretical standpoints, and created a data structure from the cross-case analysis. The outcomes of this phase were roles and forms of experimentation that emerged from the data. Then, as the research focused on the roles of experimentation, we closely examined their mechanisms and interaction, and built a model of what experiments "do" in the process of business modeling.

FINDINGS

We have organized the findings section as a narrative that reflects the analytical process and mechanisms explaining the role of experimentation in business modeling. We first present why companies engaged in experimentation in business modeling (business modeling problems), which is the start of experimentation. We then present how the companies organized themselves in order to experiment (forms of experimentation), and what experimentation achieved in the business modeling process (roles of experimentation).

Business modeling questions

Both companies in the study identified certain problems in business modeling, i.e. questions that they could not answer without engaging with the environment. DataScent's business modeling process began in 2013, a year before the company was founded, when the CEO first had the idea of starting the firm. He had several potential business models in mind to address different markets, and two models emerged as most appropriate from his point of view. An important consideration was whether to pursue a product or a technology platform business model predominantly. In the former, the company would have distinct product lines for different markets and technology applications, and would lead the process from product development to marketing and sales; in the latter, it would license its technology to as many clients as possible for various markets and applications. Three challenging questions emerged for both business models: How could the company create value, for whom could it do so, and how could it be monetized?

The issue was how to create value for the customer in a niche and undiscovered medical market. Apart from that, another potential way to create value—this time for the company—was to build synergy between the business models. The CEO's hypothesis was

that this would happen if he built a database to which different technology users would contribute data, so improving usage for everyone. The main question raised was how people would use the device to create a database and additional value. Monetization was a big issue because some of the technology applications were new to the market so there were no previous pricing standards. The CEO and board collectively decided that the company would engage first in a technology platform business model, but retain the product business model as a secondary one to explore with one product line.

The modeling process in PortLab took a different path from that in DataScent, having two cycles. The company's founder (the CEO) was interested in creating a start-up; he began thinking about the technological possibilities within his reach, and about designing a business model that could work for the company. After the company was founded, the management team had a vision about an ideal world in which the firm would work directly with patients. Simultaneously with the patient business model, the management team explored a hospital business model, in which it would sell the device to hospitals. In building this model, the management team explored different geographical markets (the Arab world, France, Germany, Switzerland, and the UK), to understand how their healthcare systems work, and so how business models could be built with hospitals as clients. The main issues were how to establish a relationship with the final users and/or hospitals, whether these users would be willing to pay, and what monetization mechanisms would work.

PortLab's experimentation with the two business models brought negative feedback. Even though the technology was perceived as positive, the healthcare system in France was already established; the managers concluded that there was no room for their innovation and no potential monetization mechanism. Therefore, they engaged in a second modeling cycle and started talking to a new type of client—laboratories (lab business model). In general, the managers experienced a very negative attitude toward connected objects at the point of care.

There was uncertainty as to whether PortLab's technology was a threat or an opportunity for laboratories:

> *They see all the connected objects coming up and they do not know how this will change their lives and their work. At the same time, they have something that they feel can be an opportunity.* (CEO, PortLab).

Therefore, questions emerged about how to establish a relationship with laboratories and how to convince them that the business model offered them the opportunity for value creation. There were also questions about monetization mechanisms, value chains, and linkages. To answer these questions, PortLab set up different forms of experimentation.

Forms of experimentation

Two themes emerged from the data, which indicated two distinct forms of experiments (Figure 1).

Insert Figure 1 about here

To address the business modeling challenges and questions, the companies engaged in experimentation. They turned their questions into hypotheses about the business model or its components; they then tested these hypotheses through two forms of experimentation—purposeful interactions and experimental projects. Table 3 presents representative quotes for both forms of experimentation in both organizations.

Insert Table 3 about here

The first form of experimentation was *purposeful interactions*. This included interactions with customers, partners, experts, and other external actors tested one or more business model components in day-to-day work. In DataScent's technology platform business model, the CEO intentionally aimed the first interaction with clients at the most demanding group, as he thought its members would provide the most valuable feedback:

> *The important point was to interrogate people from the flavor and fragrance industry because they were considered to be the more demanding. They have a lot of equipment and they are very good at smell analysis and they know everything about it.* (CEO, DataScent)

The interactions were mostly aimed at evaluating the technology and the kind of value it could create for customers. Another experiment was about monetization. In this business model, as the technology was new and its application in some markets was innovative, there were no standards in terms of price, so it was very important to test the monetization and price elements with clients:

> *Some of the markets are new for us and we have the same problem. How much are they* [the customers] *willing to pay? They do not know how much they want to pay, so how much are they willing to pay? What is good for them?* (CEO, DataScent)

For the product business model, the CEO viewed the customers as final users, so the first step was to interact with them through a small market study. The company organized a street survey and conversations with people in its town to check opinions on whether there was a need for the product, how they would use the device, and what kind of business model would work for them.

In PortLab, the CEO tested hypotheses about the patient and hospital business models through purposeful interaction with experts, potential customers, and partners. The CEO engaged in months of close interaction with patients and practitioners in order to answer

questions about these business models; this resulted in a decision to abandon both. PortLab also experimented with purposeful interactions for the lab business model. It designed an offer that it pre-tested on a smaller scale, with one laboratory and with lower-level management. After this, the company was ready to test the model with higher-level management in this laboratory and in others.

The second form of experimentation identified from the data is the *experimental project.* DataScent developed a mobile app as a means of interacting with customers, investigating how they would use the device to record smells, and identifying what kind of value database it could create. This activity was a real-life experiment, as it included interaction with potential customers—both final users and industrial partners—in a real-life setting. The aim was to investigate how people were recording smells, how many people would be interested in this sort of activity, and what kind of value it would create for customers and for industrial partners. This experiment started in summer and autumn 2014, six months after the company began operating. It was a lower-risk experiment for the company, being inexpensive to implement. However, experimentation failed to answer the questions regarding the use and habits of smell recording, because the app itself did not work well and there were issues with the database. These problems resulted from the lack of clarity in the business model about the role of the database, which ultimately impacted the technological design. DataScent halted the project in December 2014, and postponed testing until the technology could enable sensor integration with a smartphone, thus improving both the app itself and the business model. However, this also provided an opportunity to discuss potential cooperation with companies from different industries:

> *We discussed this with large companies. We said we wanted to sell the data to them. We wanted to tell them beforehand to buy the first, the professional version. You can show what is happening and you also have objective data.* (CEO, DataScent)

PortLab also developed an experimental project with the lab business model. The project involved multiple partners: one big French laboratory, one nursing home for older people, several nurses, and 200 patients. The idea was to test usage of the device usage in a nursing home, and to identify what kind of value it could create for all parties (the laboratory, nursing home, patients, workers, and company). This experiment lasted a year, and was partly financed by the public call for the project; thus, the risk for the start-up was lower.

Roles of experimentation

We identify different roles of experimentation, i.e. how it contributes to the business modeling process. The learning role—inherent, traditional, and primary—is present in both forms of experimentation. However, data show another two roles that are more symbolic and legitimating in nature: signaling and convincing. Figure 2 presents the data structure and emerging themes for roles of experimentation, while Table 4 presents quotes as supporting evidence for the coding.

Insert Figure 2 about here

Insert Table 4 about here

Inherent role: learning. The companies engaged in experimentation to learn about the environment and to gain knowledge that could help them to create viable business models. We found three learning mechanisms that supported this role: investigating, testing hypotheses, and developing skills (learning by doing).

First, both companies investigated the environment in order to understand the needs and constraints. This resulted in specific questions about the potential business model or about its components. When these questions could not be answered by cognitively manipulating the business model, companies engaged with the environment to obtain knowledge through experimentation. Managers translated questions into hypotheses, which they tested through two forms of experimentation. Experimentation resulted in feedback, which was checked against the initial business model hypotheses, thus enabling the model to evolve.

Feedback from experimentation on both business models in DataScent was useful as it impacted the business model and pushed experimentation further. After initial feedback regarding the technology, and an indication from different clients that the business model had potential, the company ran several experiments aimed at customer interactions to test monetization. These experiments, using the technology platform business model, brought new insights not only about the price itself, but also about the necessity of the whole monetization mechanism being flexible in line with different clients' needs. The company received different feedback about the price from different markets, and had to reconsider monetization for each market, and then adapt its offering accordingly.

For example, for the professional version of the sensor, the prototype price was more than ten times higher than the company intended in the first version of the business plan. The company incorporated the feedback, and adjusted the average price in the following version of the business plan. However, in the home-automation market, client feedback indicated an acceptable price five times less than that proposed by the company. This challenged the entrepreneur, as that price would have made the project unprofitable. The solution lay in changing not just the price but also the whole business model (the value proposition and monetization model). Instead of a component that was wholly integrated into home

appliances, the company would sell only the core component; this met the technological specifications for the client's asking price, which followed a subscription model. The company later adopted this model for other clients where price was an issue. What worked for one market did not always work for the other.

Apart from obtaining feedback on specific hypotheses, companies can also gain surprising results, which can help them to explore the environment. Through experimentation with the mobile app—even though feedback from the final users was lacking, as the design was flawed—DataScent received valuable feedback from industrial clients:

> *We did mention it to the first clients and they were quite interested. Everybody understood that once it is converted to the sensor, then it will gain another dimension. It is a good idea.* (CEO, DataScent)

This led to a change in the business model, as the new insights inspired managers to connect the app with the industrial product as a bonus feature, since experimentation had revealed customer interest.

Another aspect of learning was found in DataScent: learning "how to do things," i.e. how to develop a mobile app. The company identified the role of experimentation:

> *Yes, it was to test and to learn how to develop an application.* (CEO, DataScent)

Furthermore, this was even seen as the main objective of experimentation:

> *The main objective remains learning to develop a mobile app, because we know that we will have to do it.* (CEO, DataScent)

Purposeful interactions with potential customers in PortLab about the patient and hospital business models brought worrying feedback. The response was that the system was already established, and there was no place for "revolutionizing healthcare"; the constraints would make the proposed business model unfeasible. The biggest challenge was

monetization, as the feedback indicated that even though potential customers were enthusiastic about the technological capabilities of the device, they were just not willing to pay for it, as there were no institutionalized means for reimbursement for this system. As a response to the feedback, the start-up had to reorient its vision and develop another business model. In the process, it had to abandon both the patient and the hospital business models:

> *We made the choice to adapt our ideal world to reality. This does not mean that you will not change how things happen. It just means you will not change how people take care of patients or how money flows. Those are the two things we do not want to touch.* (CEO, PortLab)

As a result of this feedback and of abandoning its previous visions, PortLab developed another business model, in which it cooperated with laboratories rather than with users directly. In contrast with the previous modeling cycle, the company conveyed in its lab business model that the device was not a threat to—but rather an enabler of—value creation. This was an important decision and brought very promising feedback, which promoted the business model in several experimentation cycles—first through small-scale purposeful interactions and then through a larger-scale experimental project with multiple partners. Experimentation brought new insight for the business model, and new questions to test. In the experimental project, the company tested the business model on value creation for—and usage by—different users. This represented a crucial step in fine-tuning the business model before going to market.

Symbolic roles: signaling and convincing. With experimentation, managers intervene in the world of customers and stakeholders. In their business model experimentation, managers of the two companies intervened not only to gain knowledge but also to signal to and convince stakeholders. We found two kinds of signals in the experimental projects: signals of value (in both cases), and signals of intentions (in PortLab).

In DataScent, the CEO explained that even though the app did not provide the exact information needed about usage of the device, and the value of the database, it played a signaling role:

> *It was this period, just three to six months after the creation of the company. It was our first product, the first product that we achieved. It is also something that you do to prove that in a new company you can achieve something.* (CEO, DataScent)

Before starting a business, it is crucial for the entrepreneur to investigate whether the business model makes sense. The entrepreneur must also share findings with potential stakeholders (board members, customers, etc.) to signal to and convince them that the new venture will be successful. The CEO of a start-up needs to know which customers to target, to what extent the new proposition could create value for these customers, whether the various actors in the new environment will accept the new proposition, and whether the customers will be willing to pay:

> *This way of practicing—with pilot projects, thus has several advantages: First of all, it allows us to have real feedback from this domain, which is essential and enables our product to evolve with a real understanding of the user, while—on the other hand—it is precisely this demonstration that enables us to convince industrial partners, distributors, etc.* (PortLab CEO)

In this quotation, the entrepreneur explained that the experimental project was not only an instrument of investigation but also one of signaling and convincing. In the new, connected health context, characterized by uncertainty, it was important for entrepreneurs to convince their various partners along the value chain how they could create and capture value.

Signaling does not end with a set of customers involved in the experimentation; it may also extend to other potential customer groups, as in the case of PortLab. However,

PortLab used another type of signaling—signaling good intentions of the new entrant to the incumbent and convincing them that the business model was good for them. The external conditions were challenging for the company: The customers it was targeting with its device (laboratories) were highly suspicious about how connected devices might influence their business, and so they were rejecting cooperation. Thus, the company had to signal its intentions and that its business model could create value for customers. Experimentation in the form of projects was a convenient means to achieve this, not only because the cost and risk were lower than in immediate engagement in full partnership, but also because it could signal intentions to other parties too:

> *You want your customer to be convinced that you are not lying or telling a nice story.* (CEO, PortLab)

As PortLab faced the challenging situation of a potential client doubting both it and the business model, it had to go one step beyond signaling: to convincing potential clients to actually engage in a relationship with the company. PortLab's experimental project with one big medical-test laboratory allowed it to demonstrate the potential value of a connected device, then to convince the laboratory to embrace this product and the business model in the role of a strategic partner. This laboratory even became a champion of the technology and promoted this new approach, based on partnership, to other large laboratories.

Signaling took both forms, while convincing happened only in experimental projects. Table 5 presents a cross-case analysis of the different roles of experimentation, their antecedents, and how they impact the business model.

Insert Table 5 about here

Interaction between roles. Three experimentation roles—learning, signaling, and convincing—interact during the business modeling process. We observed that these roles are simultaneous and complement each other. We argue that this interaction helps companies to activate or to enhance specific aspects of pragmatic legitimacy, which includes exchange legitimacy, influence legitimacy, and dispositional legitimacy. Exchange legitimacy is support for an organizational policy based on that policy's expected value to a particular set of constituents (Suchman, 1995, p. 578). When companies experiment in order to learn about customers' and partners' behaviors, and to test business models, they simultaneously give a signal and may (or may not) be convincing. When the company is able to validate a business model, it signals to the potential customer that there is value. Signaling value in combination with convincing can enhance the exchange legitimacy. Influence legitimacy is gained when resource holders support the organization, not necessarily because they believe that it provides specific favorable exchanges but rather because they see it as being responsive to their larger interests (Suchman, 1995, p. 578). One can activate this type of legitimacy through signaling intentions and through convincing. Dispositional legitimacy is also closely connected to signaling intentions and to convincing, as it refers to situations where legitimacy is attributed as organizations are perceived as trustworthy in essence (Suchman, 1995).

However, in the case of DataScent's failed experimentation with its app, we found that the two roles contradicted each other. Even though business model validation was lacking due to the experimentation design, the company continued with the project as it fulfilled the role of signaling value. It was also a way to establish relationships and adapt the business model to industrial customers. DataScent continued the signaling until realizing that this could be counterproductive, inadvertently creating the impression that it was a company producing apps rather than sensors. It was for this reason that DataScent discontinued the project.

We have demonstrated that even experimentation that failed in its original learning role due to flawed design (as in DataScent's experimentation with an app investigating usage) nonetheless indicated that the company could achieve something just three months after creation, and signaled value to potential customers and shareholders. However, there is a risk of wrong signals, which—instead of convincing—can elicit the opposite reaction from customers and partners, or can confuse them. This is why it is important to know and understand all the roles of experimentation before, during, and after the process is done—and to view them as symbolic actions. This can have a critical impact on business modeling.

DISCUSSION

This research investigated roles and forms of experimentation in the business modeling process, as well as how experimentation impacts business modeling. We analyzed the early and formative years of two start-up companies in order to identify different processes and mechanisms of business modeling and of business model experimentation. We defined and characterized different roles of experimentation, and explained how they interact.

Case studies uncovered three roles and two forms of experimentation in the business modeling process (Figure 3). The roles refer to three underlying mechanisms by which the experimentation process helps companies to engage with and to enact their environment: learning, signaling, and convincing. We found that managers start with questions about a business model and make hypotheses, and then engage with the environment and learn; we term this form of experimentation "purposeful interaction." From another standpoint, through experimental projects, companies prototype the business model and signal to resource holders their legitimacy, convincing them to establish a relationship through actively creating (i.e. enacting the environment). These roles enable managers to validate, adapt, or abandon a business model, and to strategically legitimate the business model and venture.

Insert Figure 3 about here

Characterizing the roles

Expanding on the previous literature, which focused on learning as the role of experimentation in business modeling (Andries et al., 2013; Berends et al., 2016; McGrath, 2010), this study's micro-processual focus revealed three different roles of experimentation: learning, signaling, and convincing. In Table 6, we present definitions of roles and forms of experimentation derived from the inductive analysis of the case studies.

Insert Table 6 about here

Learning. We confirm that learning is an inherent role of experimentation, as described in the literature on scientific (Hacking, 1983), strategic (Murray and Tripsas, 2004), and business model experimentation (Andries et al., 2013). We extend the literature by showing the mechanisms behind this role. Further characterization of the role shows that experimentation is used to investigate the environment, test hypotheses, and develop skills and competences. Triggered by the questions they cannot answer without engaging with the environment, managers use experimentation to test their assumptions and hypotheses about business models. The feedback they receive from the environment allows them to validate, adapt, or abandon each model.

The mechanisms of learning in experimentation are: investigating the environment, testing hypotheses, and developing skills. First, managers investigate the environment to understand needs and constraints; they then integrate this knowledge into hypotheses about business models—who the customers are, how to engage with them, how to monetize the

models, and how to organize to do so. As early as this stage of learning, the company can see whether a business model makes sense; some models are abandoned immediately after this investigation. The process of investigation allows specific hypotheses about business models to be developed. Subsequently, managers test hypotheses about one or more business model components, usually first through purposeful interactions, and then through experimental projects. Feedback from experimentation is again transferred into knowledge for business modeling. As a result of experimentation, individuals or companies can validate, adapt, or abandon business models. The third mechanism of experimental learning, not previously studied in the context of strategy and business models, is learning by doing (e.g. von Hippel and Tyre, 1995): developing skills and competences through work in an experimental project. Through interaction and engagement with the environment in experimentation, the company obtains knowledge not only from the environment but also from the process itself.

Symbolic roles. A more important and surprising element of the study is that it uncovered two more roles of experimentation, which researchers had not previously considered: signaling and convincing. As Zott and Amit (2010, p. 217) point out, "the overall objective of a focal firm's business model is to exploit opportunity by creating value for the parties involved, i.e, to fulfill customer's needs and create customer surplus while generating a profit for the focal firm and its partners." Therefore, it is important to validate a new business model externally. To do this, companies can use experimentation as a way to demonstrate the robustness of a business model, and to convince potential customers and partners to embrace it. Murray and Tripsas (2004) intuited from their data that experimentation plays a role in legitimacy building, but they have not explored this idea or characterized this role. Our study provides further insight into how and why managers use experimentation to legitimate a business model and, ultimately, their venture.

This study shows that in business modeling, experimentation can be symbolic and can contribute to strategic legitimation (Tornikoski and Newbert, 2007; Zimmerman and Zeitz, 2002) through enacting the environment (Smircich and Stubbart, 1985; Zimmerman and Zeitz, 2002). In experimentation, through signaling and convincing, organizations demonstrate the business model to resource holders, legitimate it, and convince them to engage in a relationship. The study connects literature on business modeling with legitimacy and signaling theories, so elaborating the business modeling process. Some researchers have viewed business modeling as a strategic action to gain legitimacy, aimed at changing the organization internally (Zimmerman and Zeitz, 2002). However, we show that experimentation in business modeling includes intervening, and enacting the environment. Research to date has examined the business model as a performative narrative device (Doganova and Eyquem-Renault, 2009), which can be used to build legitimacy through narrative sensemaking (George and Bock, 2011). We show that when business modeling is seen as a process that includes experimentation, business models can become more than stories: Companies can use them in experimentation as a way to convince customers and partners to engage with the company. Experimentation is thus important for managers and entrepreneurs, as it is not just a way to learn about the environment, but also a strategic action to enact the environment.

This research reveals two types of signaling in experimentation: signals of value, and signals of intention. Signaling explains behavior when two (or more) parties (such as a start-up and a potential customer, in our cases) have different levels of access to information (Connelly et al., 2011; Sanders and Boivie, 2004). In this situation, it is important for start-ups to signal quality and intention—i.e. the value of their business models—through forms of experimentation.

Convincing is another symbolic role of experimentation, closely connected to signaling. However, the two roles are slightly different. While signaling is aimed at building legitimacy, usually for the long-term future, convincing takes the venture one step further, as it refers to a purposeful attempt to establish a relationship that involves sharing resources. We found that these two roles are especially important for gaining what Suchman (1995) calls "pragmatic legitimacy". This type of legitimacy is related to an organization's most immediate audience, such as potential customers and partners. As business modeling is a process that involves asking questions about customer and partner identification, and about ways of creating and capturing value from exchanges, this type of legitimacy is highly relevant for organizations, especially in their nascent years.

Experimentation outcomes: impact on business modeling

Even though the inherent role of experimentation is learning, the symbolic roles of signaling and convincing are equally significant. This legitimation component shows that experimentation in business modeling is a distinct concept, which differs from similar concepts such as trial-and-error learning and experiential learning. Our results show that experimentation serves as a connection with the real world, which—in the case of business model experimentation—means a world of customers and partners: the business environment. Experimentation includes intervening (Hacking, 1983): Managers interact with the business environment by tweaking business model components and by interacting with stakeholders to gain knowledge about the viability of the business.

Data showed that roles trigger the environment in two ways, thus leading to two outcomes for business modeling: One refers to engaging with the environment, integrating feedback, and then validating, adapting, or abandoning business models; the other refers to enacting the environment, thus providing strategic legitimation of the business model and

venture. While the learning role helps managers to obtain knowledge from the environment, the other two roles help them to enact it. Through experimentation, business models (i.e. managers' cognitive representations) are made material, and the company shares them with potential clients and partners.

Experimentation can lead to validation, adaptation, or abandonment of the business model. If the experimentation results are encouraging and validate managers' assumptions, the company incorporates the feedback, supporting or adapting the model (as in DataScent, and the second modeling cycle in PortLab). It then enters another round of questioning and experimenting. If the results do not validate managers' assumptions (as in the first modeling cycle in PortLab), the company reconsiders the business model. As in PortLab, business models can be abandoned as a result of feedback. In this situation, PortLab restarted the modeling process, integrated components from previous experience, and created a new business model. Another outcome, associated with the signaling and the convincing roles of experimentation, is connected to the strategic legitimation process (the validation of the business model not only by the company, but also by its environment). Through experimentation as a set of symbolic actions, companies can demonstrate the business model and legitimate the venture.

Managerial contributions

This research emphasizes the importance of experimentation in business modeling, since a major issue for companies is to engage with clients, partner firms, and investors, particularly in the early years of the venture. Different stakeholders need engagement in different ways and at different times; the model provided here can help managers and entrepreneurs to make better use of experimentation, depending on the role they wish it to play and on the target audience.

For example, during the seed-funding phase, entrepreneurs can use learning-focused experimentation in order to better understand the environment, and to design and adapt their business models. They can conduct experimentation in the form of everyday, purposeful interactions, and with little investment. The important thing is to follow the experimental design: to identify a question, to test a hypothesis about a business model or its components, and to integrate feedback into a new round of business modeling.

In a first or second round of funding, experimentation that engages with clients and other firms in the value chain will allow the signaling of intentions. This is a way to anticipate the reactions of other firms in the value chain (e.g. PortLab's involvement of big laboratories in purposeful interactions, and the pilot project to show that its business model could fit into the ecosystem without destroying the laboratories' business model), and responses of potential competitors. Start-ups may struggle to convince potential partners—and, in particular, large incumbent companies. They need to convey their vision of a hypothetical future, and very often this vision is not part of the strategy of large incumbent firms, which have technological roadmaps defined for the next five years and so have already allocated resources. Experimentation in business modeling is key to convincing potential partners to deviate from their roadmap and to engage with the start-up.

Establishing relationships with potential investors can also strongly build on experimentation. Entrepreneurs need to convince them that the new venture will lead to return on investment; experimentation can make the business model more tangible and easier to understand. It legitimates both the managerial team and the business in development. Experimental projects—such as designing a first app, and setting up an experiment with a group of targeted customers—are more formalized and require more planning than purposeful interactions. However, they can demonstrate to investors that the business model

works (or will work following the post-experiment modifications) and that the risks can be mitigated (one of the lenses through which investors look at new ventures).

Applying this model to the process of business modeling will allow entrepreneurs and managers not only to effectively design a business model, but—very importantly—to adapt the roles and forms of experimentation to the target audience (clients, partners, and investors), as each group calls for a different type of engagement.

Limitations of the study, and avenues for further research

This study has several limitations with regard to the research setting and design choices. First, we decided to place the study in the early years of venture creation to obtain an in-depth look at the micro-processes of business modeling. It will be important to investigate whether the process also applies to established companies when creating a new business model, and whether roles and forms of experimentation in the business modeling process are similar. Another limitation derives from the fact that we had only two (albeit in-depth) case studies. We observed that purposeful interactions could take on the roles of learning and signaling. However, whether or not purposeful interactions can take on the role of convincing requires further exploration.

Apart from scrutinizing companies that are more established, future research may address the business modeling process and experimentation in different industry contexts. Our field of study was technology start-ups in the field of connected health, which is subject to a great deal of uncertainty. It would be interesting to see whether companies operating in a more stable environment also engage in experimentation. In addition, business modeling processes in this study were particularly complex because the models were multisided, with the companies creating value for different types of customers.

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TABLES AND FIGURES

TABLE 1
Key events and activities in business modeling and experimentation in DataScent

Time period	Key events and activities	
2013	Initial interest in creating a start-up	
2013–2014	Preliminary experimentation	• Purposeful interactions with scientists and technology experts to select the technology • Experimentation with a street survey and purposeful interactions to test the business model idea • Purposeful interactions with clients from the flavor and fragrance industry about technology
April 2014	Founding the company	
2014–2017	Business modeling with two models: technology platform and product business models	
2014–2015	Experimentation with technology platform business model	• Purposeful interactions with clients from home-automation industry about monetization • Purposeful interactions with clients from the flavor and fragrance industry
2014	Experimentation with product business model	• Running an experimental project with a mobile app
2015	Experimentation with technology platform business model	• Running a monetization experimentation for home-automation clients
2016	Experimentation with technology platform business model	• Further purposeful interaction with industrial partners regarding monetization

TABLE 2
Key events and activities in business modeling and experimentation in PortLab

Time period	Key events and activities	
2011	Initial interest in creating a start-up	
2011–2013	Preliminary investigations	• Investigating in order to understand the market, and to identify the big players and their relationships • Exploring the possible technologies, interacting with the inventor of a first patent, and choosing the technology • Conducting market research that allowed the technology to move toward a business model vision
December 2013	Founding the company	
2012–2014	Business modeling and experimentation: patient and hospital business models	
2012–2014	Designing and experimenting with the first model: patient business model	• Testing the vision internally and externally, and testing market constraints • Obtaining feedback about addressing consumers directly (showing this would not work in the French market) • Abandoning the business model
2012–2014	Designing and experimenting with the second model: hospital business model	• Purposeful interactions with doctors and healthcare professionals to investigate possible monetization • Obtaining feedback (that family doctors were enthusiastic about the technology, but were unwilling to pay for it, and that the healthcare system was already established) • Abandoning the business model
2014–2017	Reorienting the vision; experimentation with the business model with laboratories	
2014	Experimenting with the business model with laboratories (first step)	• Designing an offer and pre-testing this on a smaller scale, through purposeful interaction with one laboratory and with lower-level management
2015–2016	Experimenting with the business model with laboratories (second step)	• Further testing of the business model through purposeful interaction with more laboratories and higher-level managers • Developing a pilot project to test the product and business model with laboratories
2016–2017	Experimenting with the business model with laboratories (third step)	• Developing a pilot project to test the product and business model with laboratories

FIGURE 1
Data structure for forms of experimentation

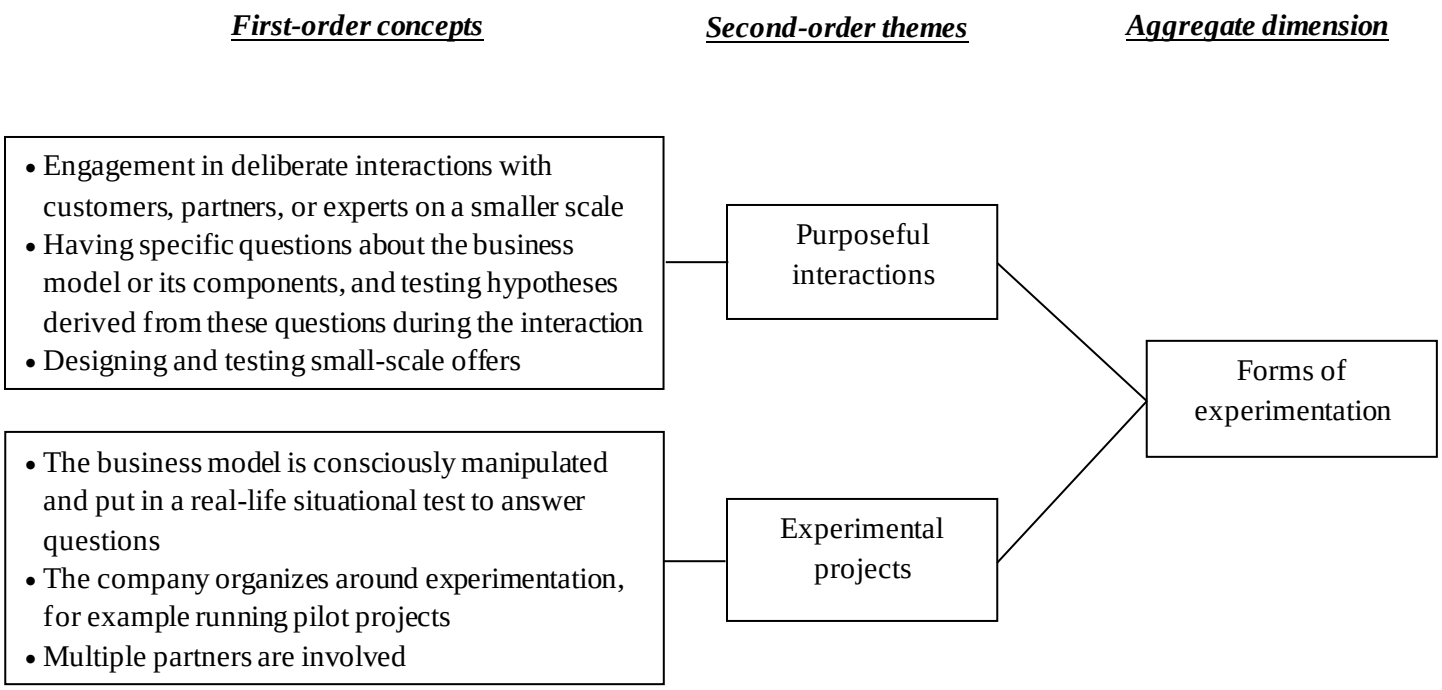

TABLE 3
Illustrative evidence for forms of experimentation

Dimension	Theme	Example quotes
Forms of experimentation	Purposeful interactions	"*Then you design some kind of offer that can be tested. The way we worked was we thought about an offer that we could present to labs. At the beginning, you test it with people who are not very influential. If your offer is not good, you do not want to lose your credibility.*" (CEO, PortLab)
		"*The first clients helped us to see that we were on the right track.*" (CEO, DataScent)
		"*One important point was to interrogate people from the flavor and fragrance industry, because they were considered to be the more demanding.*" (CEO, DataScent)
	Experimental projects	"*We work with health professionals and patients, we provide trackers, and we put them in a real-life situation.*" (CEO, PortLab)
		"*It was a call for projects to streamline the way healthcare systems take care of elderly people. This is why we tried to fit our business model into this call for projects. Naturally, we came to that solution. The director of this big lab wanted to work with us. It was a good opportunity to start with something concrete.*" (CEO, PortLab)
		"*We wanted to learn how to make the application, so we organized it with an IT consultant. Also, we chose to develop an application before, because it takes three months for an application and three years for the technology, so they cannot start at the same time. In three months, we had this application that, of course, was a pilot and made us think about what people would do if they could record the smell.*" (CEO, DataScent)
		"*We want to show the results of the sensor on an iPhone. It was a way for us to organize that.*" (CEO, DataScent)

FIGURE 2
Data structure for roles of experimentation

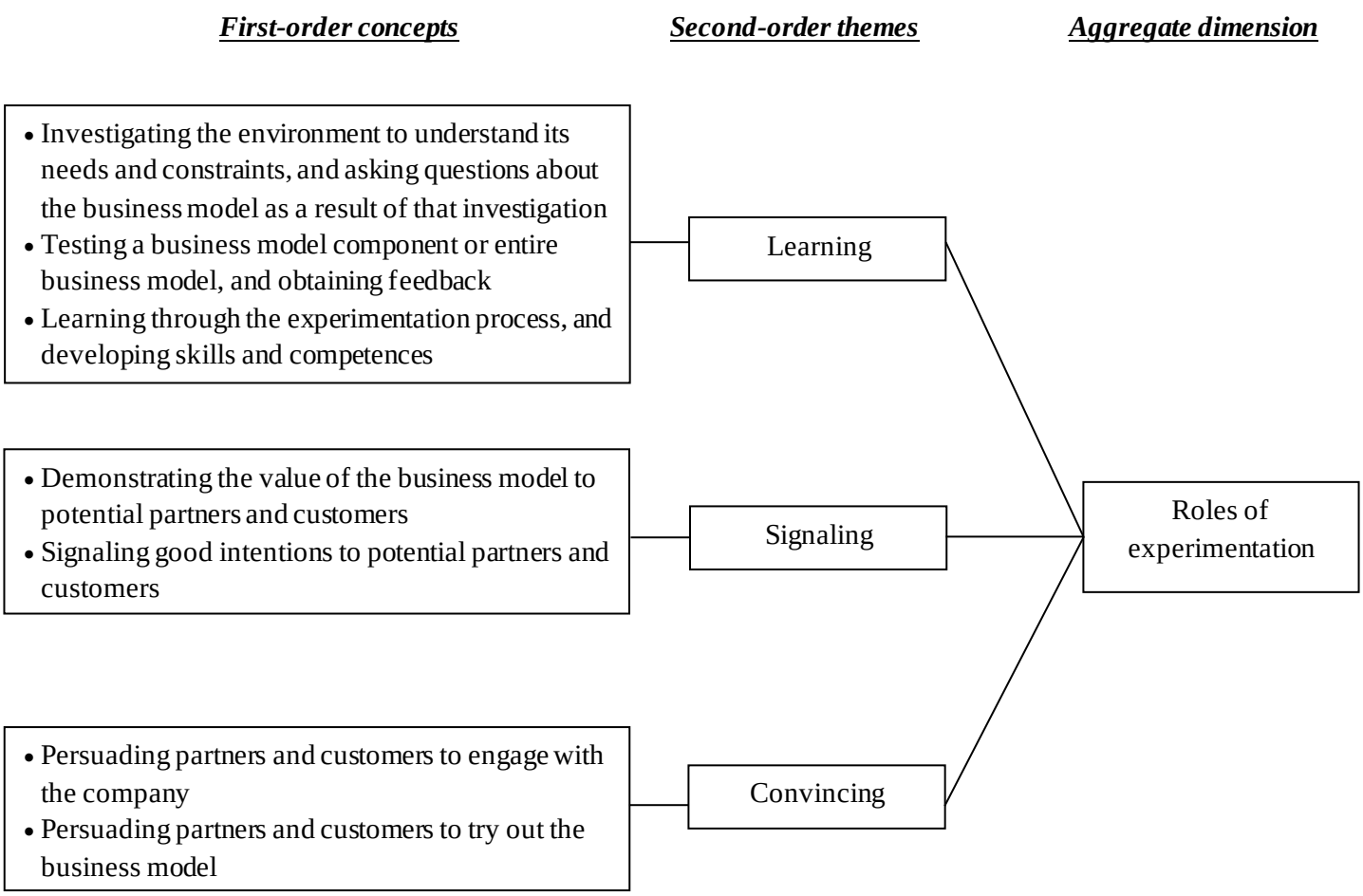

TABLE 4
Illustrative evidence for roles of experimentation

Dimension	Theme	Example quotes
Roles of experimentation	Learning	"*Then you go directly to a real-world market study. You go to the people and talk to them. You go to practitioners and patients. You understand their needs and constraints. It is very important to talk to people. Then you design some kind of offer that can be tested.*" (CEO, PortLab)
		"*This way of practicing—with pilot projects—thus has several advantages: First of all, it allows us to have real feedback from this domain.*" (CEO, PortLab)
		"*You want to go into the field and see how it can be implemented.*" (CEO, PortLab)
		"*Some of the markets are new for us and we have the same problem. How much are they willing to pay? They do not know how much they want to pay, so how much are they willing to pay? What is good for them?*" (CEO, DataScent)
		"*We wanted to learn how to make the application, so we organized it with an IT consultant.*" (CEO, DataScent)
	Signaling	"*And we already have an example that will demonstrate that we are credible when we tell them that our goal isn't to take over their business.*" (CEO, PortLab)
		"*It was this period, just three to six months after the creation of the company. It was our first product, the first product that we achieved. It is also something that you do to prove that in a new company, you can achieve something. It is not perfect, but we could do it, so it was interesting.*" (CEO, DataScent)
	Convincing	"*It is an experiment. It is the next step, when you convince people you want to do it. When you do sales, it is the same everywhere. You want your customer to be convinced that you are not lying or telling a nice story. You want to go into the field and see how it can be implemented.*" (CEO, PortLab)
		"*This big lab is also connected to lots of big labs in France, so if it is working right, it will go viral.*" (CEO, PortLab)
		"*I believe we have to show them that it works on the field, to definitely convince them to switch to our product and our way of working. Then we will find a solution. If we want to work together, we will find a solution.*" (CEO, PortLab)

TABLE 5
Cross-case analysis of experimentation roles and forms

Case study	Business model	Antecedent: Why experiment in business modeling?	Form: How do companies experiment in business modeling?	Role: What does experimentation do?	Impact on the business model
DataScent	*Technology platform business model*	Reduce uncertainty about the value of technology and the company's offer	Purposeful interaction with potential clients from the flavor and fragrance industry	Learning	Business model validation
	Technology platform business model	Investigate monetization	Purposeful interaction with clients about price for home automation	Learning	Business model adaptation
	Product business model	Investigate the business model and technology potential	Purposeful interaction with people in the street (non-customers)	Learning	Business model validation
	Product business model + technology platform business model	Investigate how to form and use the database	Experimental project: designing an app to capture odors	Learning	Experimentation stopped—no validation
		Demonstrate that the company can do something		Signaling (value)	The company pursued signaling despite non-validation, until the point where it acknowledged it was an app company
		Test potential business model with clients		Signaling (value)	Use the app to establish a relationship with clients for another business model—business model adaptation

Case study	Business model	Antecedent: Why experiment in business modeling?	Form: How do companies experiment in business modeling?	Role: What does experimentation do?	Impact on the business model
PortLab	*Patient business model*	Understand needs and market constraints	Purposeful interactions with experts, potential customers, and partners	Learning	Abandon the model, as the perception was that the healthcare system was already established
	Hospital business model	Understand needs and market constraints	Purposeful interactions with doctors and hospital managers	Learning	Abandon the model because of external conditions—no reimbursement
	Lab business model	External challenge: Laboratories perceived connected health companies as a threat to their business model, and resisted cooperation, so the company signaled its intentions in several interactions	Purposeful interactions with laboratories	Learning	Validate the model
				Signaling (intentions)	Validate the model
	Lab business model	Investigate and test business model components and value creation	Experimental project with one medical-test laboratory	Learning	Validate and adapt the model
		Show the client that the business model creates value		Signaling (value)	Validate and adapt the model
		Overcome a challenge, and start a relationship with the client		Convincing	Engage in strategic legitimation of the model and venture

FIGURE 3
Roles and forms of experimentation, and their impact on business modeling

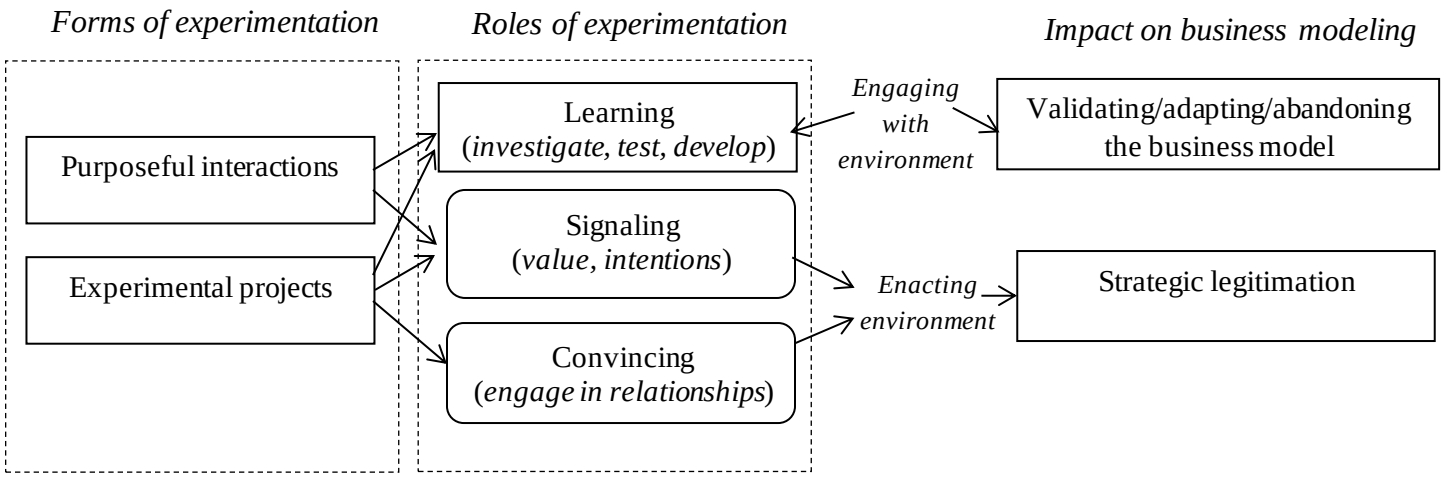

TABLE 6
Characterization of roles and forms of experimentation in business modeling

Dimension	Theme	Characterization	Definition
Form of experimentation		*How do companies conduct experimentation in business modeling?*	Forms of experimentation include different ways in which managers can conduct experimentation in business modeling
	Purposeful interactions	• Small-scale • With one kind of partner/customer individually • Continuous	Experimentation as interactions with customers, partners, experts, and other external actors in testing hypotheses about one or more business model components in day-to-day work
	Experimental projects	• Larger-scale • With one or multiple partners • Time-bound	Experimentation in a purposeful, time-bound project, which includes testing one or more hypotheses about a business model or its components, with one or multiple partners
Role of experimentation		*What does experimentation do in the business modeling process?*	Roles refer to ways in which experimentation facilitates the business modeling process
	Learning	Supported by three mechanisms:	Experimentation helps companies to learn about the environment and gain knowledge, so helping them to develop better business models
		• Investigating	Exploring the environment to learn about needs and constraints, leading to hypotheses to be tested through experimentation
		• Testing	Testing hypotheses about one business model component or more through experimentation
		• Developing skills	Developing skills and competences through the experimentation process

	(e.g. learning how to develop a mobile app)

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