Innovate with Living Labs:
An Empirical Analysis of their Role during Knowledge Creation

Abstract

In Living Labs, customers experiment with innovations in an everyday context. Policy makers, firms and research institutions increasingly invest in such knowledge brokers which facilitate collaboration between diverse parties. This study establishes common characteristics of Living Labs and investigates their role during experiential knowledge creation. Drawing on a unique sample of 64 Living Labs, this research blends quantitative and qualitative research in two steps. First, Categorical Principal Components Analysis extracts two meta-characteristics, user contribution and contextual reality which identify four clusters of Living Labs. Second, the assessment of in-depth interviews offers a fine-grained picture of the impact of these characteristics on knowledge outcomes and its limitation in generating radical changes.

Keywords*: Living Labs, Knowledge Creation, Open Innovation, User Involvement*

Track*: Innovation and New Product Development*

1. Introduction

The development of new products and services have been shown to provide firms with a fundamental advantage over its competitors (Sorescu et al. 2003) and hence is a key priority for policy makers, managers, and researchers alike (MSI 2012). The innovation process is essentially a knowledge creation process (Madhavan & Grover 1998) in which firms increasingly benefit from the knowledge, skills, and resources of their external partners (Chesbrough 2003). The greater market complexity, convergences of industries, and the shorter time-to-market increasingly demand the collaboration of multiple parties (Hult 2011). Yet, their differences in industry, size, purpose, power, resources, and profit orientation also demand a systemic approach with norms and rules for the collaboration. The Living Lab is such an innovation approach where multiple stakeholders examine users in real-world environments using a combination of research methodologies (Almirall, 2008; Eriksson et al. 2006). For example, in the LeYLab, established in Belgium more than 100 families are equipped with fibre-to-home infrastructure and experiment with various services in a real-life setting, while participating universities (firms (IT hardware, media, software) and the city government with support from governmental institutions (e.g. Agency for Science and Technology) and a specialized research institute (iLab.o, the Living Lab division of iMinds) observe consumer behavior over an extended period of time. With more than 500 established Living Labs worldwide, their use has been increasing in popularity, yet lots of them have failed to fulfill expectations (Schuurman et al. 2012). Reasons might be lack of clarity of the approach and of its role during the innovation process. Hence, practitioners and researchers would benefit from a greater understanding of the determinants of Livings Labs and of how they contribute to the knowledge creation for innovations.

Academic literature on this topic has only recently emerged, and it has failed to reach agreement on the fundamental role of Living Labs in knowledge creation. Edvardsson et al. (2010), for example, view Living Labs as a family of methods to simulate contexts of user innovation, while Eriksson et al. (2005) highlight the integration of stakeholders which forms an ecosystem of knowledge creation. Følstad (2008) made an initial review of research to synthesize existing understanding of Living Labs, and found a lack of conceptual and empirical clarity regarding their role in knowledge creation. Extant literature in strategic marketing, innovation management, and organizational knowledge creation may offer conceptual underpinnings of Living Labs as a knowledge broker (Hargadon & Sutton 2000; Schuurman et al. 2012a).). Such an intermediary between innovating organizations facilitates users' experiences of new products and services. The experiences are continual interactions between the individual, the environment and the product/idea (Dewey, 1916). In line with the constructivistic approach towards learning, individuals process stimuli from the environment and are actively involved in a process of meaning and knowledge construction. Thus, learning from experiences might be a useful perspective to examine Living Labs, where contextual stimuli are continuously modified and learning takes place through recursive cycles (Kolb 1984). Indeed, earlier research on customer involvement suggests that the environment (Mahr & Lievens 2012) and the process (Carbonell et al. 2009) influence innovation-related outcomes and trade-offs between them (Fang 2008). Hence, research on experiential learning and customer involvement might be helpful to assess the role and usefulness of Living Labs, which has not yet been empirically established. This research addresses these gaps by establishing the defining characteristics of Living Labs, and identifying their role and impact on innovation-related knowledge.

This research contributes to the literature streams of innovation management and knowledge creation. First, the study elicits the defining characteristics of Living Labs as an intermediary which facilitates innovation involving multiple parties. This first quantitative investigation of many Living Labs reveals their distinction from other innovation approaches and hence offers foundations for future research. Moreover, we extract two meta-characteristics, user contribution and contextual reality that identify Living Labs and determine their implementation. Second, this research conceptualizes knowledge creation during the innovation as learning from users' cyclic experiences. Through this view on Living Labs, we demonstrate their characteristics' distinct impact on knowledge creation stages and on the knowledge's novelty, relevance and feasibility. Rather than developing radically new ideas or specifi c products, this approach seems to offer firms and policy makers a collaboration framework for a broad discovery and validation of knowledge.

The remainder of the article is structured as follows: The literature review compares the existing definitions of Living Labs, and conceptualizes the experiential learning that takes place in them. Then, we introduce the research methodology and present our results which draw on the quantitative analysis of 64 Living Labs as well as on quantitative and qualitative analysis of in-depth interviews with key informants.

2. Conceptual Background

This research draws on literature from innovation management, services marketing, and knowledge creation. Hereby, innovation is essentially viewed as an organizational activity directed at the creation of a knowledge base (Huber 1991; Moorman 1995; Slater and Narver 1995). The value of created knowledge for the organization may be assessed on basis of its relevance, originality and feasibility (Mahr and Lievens 2012). In spite of recent increase in research on the topic, many innovation attempts still fail. In particular, innovation involving multiple partners from private and public sector is prone to failure because it involves partners with heterogeneous, partly contradictory goals (e.g. Jaspers, 2009). Moreover, these partners often aim to establish new business models which are complex and demand changes of consumers' daily routines (Frissen & van Lieshout 2006). The Living Lab approach emerged as a large scale organizational activity that integrates public and private sectors and involves the final consumers to assure their needs are met.

The Living Lab approach originated in the US, and it was first used to describe a laboratory environment with all the facilities of a regular home, optimized for multi-day or multi-week observational studies of single individuals, and constructed to resemble a 'real' home as closely as possible (Intille et al. 2005). This definition sees the Living Lab-concept merely as a research facility that tries to overcome issues associated with the artificial lab-context (Schuurman et al. 2012). The recent proliferation to more than 500 Living Labs led to multiple types of Living Labs varying in motives, user involvement, size, duration, partner diversity etc., and to a plethora of incoherent definitions. For example, Feurstein et al. (2008) define Living Labs as an 'innovation approach in which all stakeholders in a product, service or application participate directly in the development process'. Others focus on Living Labs as a 'context for user innovation', which might be virtual or physical and where an organisation can interact with its surrounding (Edvardsson e t al. 2010). Lack of conceptual clarity led to initial attempts to synthesize and reconcile the different views. In the most comprehensive review Følstad (2008) lists nine characteristics that may impact Living Labs' role in knowledge creation: A Living Lab contributes to the innovation and development process by: (1) investigating the *use context*, (2) providing insight into *unexpected uses* and new opportunities, (3) *user validation* and evaluation of new solutions or (4) conducting *technical testing* (5) whereby *users cocreate* (6) in a *familiar context* and (7) *real-world context* new solutions in a (8) medium- or *long-term duration* and (9) with a *large user sample*. Since not all characteristics emerge in all Living Labs (Almirall & Wareham, 2011), an empirical investigation of the characteristics would advance research and may offer reasons why some succeed or fail.

Overall, there appears to be an agreement that Living Labs are knowledge brokers that serve as intermediaries between otherwise disconnected knowledge resources (Hargadon & Sutton 2000). They capture users' experimentation with new services and products and facilitate the transfer of complex knowledge between different parties that are not directly related and rarely interact. Taking a constructivist perspective on knowledge creation, users' experience of innovations is viewed as an interactive process between prior experiences, their perceptions, the environment, objects, and other moderating variables (Dewey 1916). Hence, all involved parties learn from the experiences which occur in experimentation, i.e. attempting to solve a problem through activity (Arrow 1962). Experiential learning encompasses all sub-activities such as experiencing, reflecting, thinking, and acting in a recursive process that is responsive to the learning situation and to what is being learned (Kolb, 1984). The central element, i.e. the involvement of users, might actually invoke different, positive as well as negative results. While research on lead users (e.g. von Hippel 2005) and on customer co-creation (e.g. Prahalad and Ramaswamy 2004) demonstrate that user/customer involvement leads to more successful innovation, other studies suggest that it might hinder new service developments, because blind adherence to customers' wishes may restrict the development of novel knowledge (Christensen 1997; Knudsen 2007). Recent research advocates a fine-grained view of the impact of external sources on innovation outcomes (Magnusson 2009; Mahr and Lievens 2012). Considering knowledge as a multi-dimensional construct that differs in novelty, relevance and feasibility could offer a more fine-grained and accurate assessment of the knowledge created in Living Labs, but has not been applied so far.

3. Methodology

The relative paucity of research on Living Labs advocates an exploratory approach that augments the research status-quo with qualitative and quantitative insights. A triangulation of complementary research methods offers a more accurate picture of the research topic (Jick, 1979). The unit of analysis are high-tech Living Labs registered at the European Network of Living Labs (ENoLL). This is the largest federation of Living Labs world-wide, which fosters 'co-creative, human-centric and user-driven research, development and innovation in order to better cater for people's needs' and benchmarks Living Labs across Europe (ENoll 2012). Cooperation with the network enabled us to access the non-public registration documents and facilitated contact with a key responsible at each Living Lab, resulting in a unique data set.

The data collection took place in two steps. The first step - "Living Lab Characteristics" - encompassed a quantitative assessment of Living Labs, based on the nine characteristics established in Følstad's (2008) review. Two experts, one part of and one distant to the author team reviewed the publicly available material and the internal registration documents, and independently assessed the characteristics of all 64 Living Labs on scale from 1(low) to 4(high). The second step - "Knowledge Creation"- augmented the data from the first step with in-depth interviews with key informants at the Living Labs. We developed an interview guide that contained both closed and open questions on the background of the interviewee and the Living Lab, its knowledge creation process as well as knowledge and innovation outcomes.

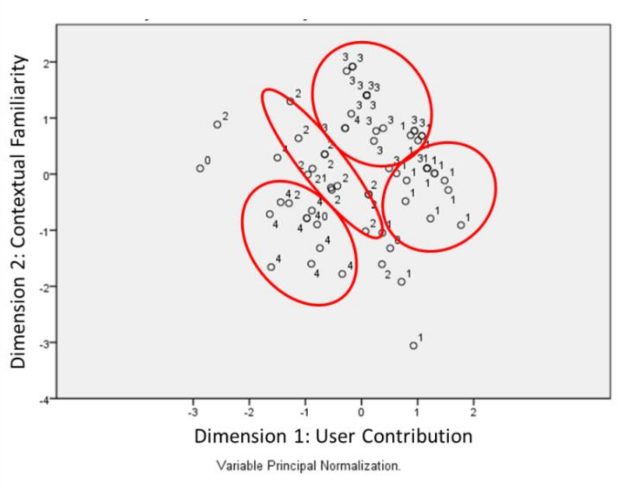
The analysis of the data followed two steps which paralleled the data collection. Step 1 ("Living Labs characteristics") encompassed the assessment of 64 Living Labs. The coding of the experts showed high reliability (Krippendorff α >.8), except for co-creation and technical testing (α >.6). Disagreements were re-examined and dissolved. To uncover higher-order characteristics among the nine Living Labs characteristics, and cluster the Living Labs, we conducted a categorical principal components analysis (CATPCA) which can fit data with ordinal, numerical variables in a spatial representation (in our case, a biplot). We conducted the CATPCA with an ordinal scaling level in IBM SPSS Statistics 19 and obtained two dimensions (meta-characteristics), along with the object scores for each Living Lab for each dimension. Afterwards, we conducted a hierarchical and a k-means cluster analysis (with the standard squared Euclidian distance) to establish the optimal number of clusters and the Living Labs' cluster membership (Odekerken-Schroeder et al. 2011).

In step 2 ("Knowledge Creation") we explored the data of the closed interview questions for the statistically significant correlations ($p < .10$) of the Living Lab characteristics and the intensity of knowledge creation stages, and the knowledge outcomes (novelty, relevance, and feasibility; generative vs. incremental learning), relying on established scale items. To inform the results, we analyzed the open-ended questions by means of grounded theory to detect common patterns. Quotes are also used to support the findings and make them more vivid.

4. Results

As mentioned above, step 1 aims to identify two meta-characteristics to distinguish Living Labs clusters. By means of CATPCA, we extracted two that achieve eigenvalues greater than 1 and sufficient reliability for exploratory research (Cronbach's $\alpha = .92$), while also accounting for more than 70% of the total variance. Meta-characteristic 1, which we term "user contribution", includes *unexpected uses*, *user co-creation* and *user validation*. Meta-characteristic 2, which we term "contextual reality", includes *familiar context*, *real-world context* and *large user sample*. The characteristics *use context, technical testing,* and *long-term duration* are not included as they do not discriminate between clusters. Afterwards, we developed a four- cluster solution that is statistically sound, balanced in terms of Living Labs numbers and conceptually strong (see Figure 1).

Figure 1: Living Lab Clusters in the CATPCA Dimensions Biplot



For the description of the Living Lab clusters, we used the cluster means of the original nine characteristics, relative to the overall means (Table 1). Cluster 1 comprehensively implements user contribution opportunities and contextual variation but with a small set of users. In contrast, Cluster 2 involves a large number of users but focuses more on technical testing of devices rather than active user contributions. Cluster 3 also includes many users within their natural environment rather than under lab conditions. Cluster 4 mainly explores unexpected uses in laboratory conditions.

Table 2: Characteristics and Descriptions of Living Lab Clusters

CATPCA Dimensions	Characteristics according to Følstad	Cluster 1: *Small scale observation of users at home*	Cluster 2: *Large scale, tech testing in lab*	Cluster 3: *Large-scale, continuous observation in realistic context*	Cluster 4: *Exploratory lab*
User Contribution	Unexpected use	+	-	o	o
	User cocreation	+	o	-	-
	User validation	+	o	o	-
Contextual Reality	Familiar context	+	-	+	-
	Real-world context	+	-	+	-
	Large user sample	-	+	+	-
	Use context	+	-	-	o
	Technical testing	+	o	-	o
	Long-term duration	-	+	+	o
	Sample (total: 64)*	*20*	*14*	*16*	*11*

*Key: Compared with overall mean: +: higher; o: similar; -: lower; *3 Living Labs excluded*

Step 2 includes data from interviews to understand knowledge creation and outcomes of Living Labs (correlation analysis in Table 2). The characteristics summarized under the meta-characteristic 'user contribution' tend to co-occur with the first two knowledge creation stages. This suggests that Living Labs with intense user contribution opportunities focus on capturing and disseminating knowledge with parties close to the Living Labs rather than distant ones such as employees of other departments. At the same time, contextual familiarity is strongly associated with profoundness in the later stages. Knowledge stemming from realistic contexts might be easier to explain and hence to spread throughout the entire organization.

Table 2: Correlations between Living Lab characteristics and knowledge creation

	Knowledge Creation Stages				Generative Knowledge Creation[1]		Knowledge Value		
	A. Experiencing	B. Reflecting	C. Thinking	D. Acting	Innovation	General processes	Novelty	Relevance	Feasibility
Unexpected use	.308*	.295*	.227	.254	-.291*	-.260	.318*	.194	-.075
User cocreation	.627*	.488*	.097	.000	-.366*	-.267	.251	.213	.039
User validation	.460*	.562*	.218	-.244	-.114	-.071	.145	-.056	.552*
Familiar context	.067	.325*	.488*	.327*	-.260	-.298*	.328*	.478*	.120
Real-world context	.269	.285*	.318*	.143	-.602*	-.444*	.068	.435*	.324*
Large user sample	-.173	-.101	.278*	.087	.138	-.059	.036	.239	.006
Use context	.178	.261	.100	.382*	-.268	-.085	.120	.140	-.074
Technical testing	.250	.363*	.066	.023	-.391*	-.204	-.084	.069	.273
Long-term duration	-.243	-.258	-.041	-.183	.350*	.155	.169	-.017	-.359*

* sig at p <.10; [1]*Insights substantially changed the thinking about…*

Our two items for generative learning display negative correlations with the characteristics. The insights generated in Living Labs seem to be important but not to be used to generate fundamentally new ways of thinking. Moreover, the results pertaining to the three knowledge value facets are mixed. Originality is enhanced through unexpected use and familiar usage context, while relevance gains from familiar usage and real-world context. Knowledge feasibility is the highest when user validation is included and real-world contexts applied. The results clearly support our more fine-grained analysis of the usefulness of Living Labs and user innovation in general.

To obtain a better understanding of our findings we obtained qualitative feedback via in-depth questions. To begin with, many of the managers expressed their opinion that there is still a lot of "ambiguity and unclarity" about the exact meaning of Living Labs, with answers ranging from test-bed, user panel, laboratory to "a meeting place, where companies and institutions meet each other, in order to exchange ideas" (Respondent A, 2011). This lack of clarity corresponds with our initial observation of research but also in practice. Interviewees also pointed towards obstacles they faced. For example, the diversity of involved parties led to imparity between small, entrepreneurial start-up firms and large, resourceful but less innovative and slowly acting large cooperations.

5. Conclusions

This study investigates the emerging phenomenon of Living Labs as a systemic approach for user innovations. We clarify common characteristics of Living Labs, and empirically assess our conceptualization of experiential learning taking place. Our findings demonstrate the distinct effects of the characteristics on knowledge outcomes and the usefulness of Living Labs to foster collaboration between multiple private and public organizations.

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