Do Smart Cities Produce Smart Entrepreneurs?

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Abstract

Living Labs aim to engage in user-centered design practices where users are included in their daily life environment as innovative agents. However, empirical insights in end user engagement in Living Lab practices are currently lacking. This article focuses on opening up this black box of user engagement by analyzing the involvement of a group of entrepreneurs in a Living Lab smart city pilot in Amsterdam, the Climate street. The goal of the article is to analyze how and to what extent the Climate street enabled the involved entrepreneurs to engage in bottom up innovation. Theoretically, the article explores this pilot from a Science and Technology Studies perspective, specifically its notion of the socio-technical network. The article concludes that user innovativeness was limited by the pre-configuration of the entrepreneur as lay tester rather than as an active user-innovator. Furthermore, it is suggested that the inherent tension in Living Lab practices between configuring users and actual user practices hampers user innovativeness in general. Granting users more agency and opening up Living Lab practices to daily life dynamics stimulates the transition from tester to innovator in a daily life setting and subsequently makes entrepreneurs more readily *smart*.

Keywords: Living labs, Smart cities, Community innovation, Sustainable technologies, Socio-technical networks

1 Introduction

The concept of the smart city (as defined by [13]) at once stresses the importance of investments in ICT infrastructures to enhance the quality of life and competitive capabilities of cities, as well as the recognition that in order to achieve this *smartness*, investments in social capital are necessary. To become *smart*, cities need to innovate technologically, also by making use of the smart, innovative potentials of its citizens. The topic of this special issue *Smart Applications for Smart Cities* calls for papers about the connection between smart environments and bottom up innovation practices, more specifically how for example collaborative platforms and new technologies sustain innovation driven by the creativity of the population and collective collaboration. Living Laboratories are explicitly referred to, in terms of the changing role they attribute to the city and citizens as users and co-creators of new technologies.

Living Labs are characterized as "both a methodology of user-driven innovation and the organizations that primarily use it" (Site 4). They facilitate "public-private-civic partnerships" [16] that bridge the gap between development and use of ICTs by involving users, as co-producers, "on equal grounds" [2], in different ICT design stages. This type of user-centered innovation reverses traditional top down R&D processes; Living Labs aim to engage in bottom up innovation, granting much agency to users. This practice is hoped to lead to unexpected insights into user needs [9], culminating in the development of more successful ICTs. Apart from including *real* (end) users, the *living* part of the laboratory also points to the centrality of daily life environments. These function as "experimentation environments in which technology is given shape in real life context" [16] p. 13, thereby opening up the development process to "the uncontrollable dynamics of daily life" [11].

Literature suggests that although the number of Living Labs has grown exponentially since the conception of the European Network of Living Labs in 2006, achieving user-driven, bottom up innovation is often quite a challenge. This may be partially due to the fact that while users are deemed central, Living Labs do not clearly adhere to a common understanding of how Living Lab processes and methods work to elicit the innovative potential of end users [17]. Furthermore, according to [14] p. 79, relatively little attention has been directed at investigating end user engagement, while acquiring the commitment of users and user communities is a noted challenge [26]. A gap exists between theory and practice; there is an empirical lack of evidence supporting the benefits of user involvement due to the more technology driven focus of current practices [10] p. 4. The same issues come to the fore in smart city-literature, where [1] p. 9 note how smart cities, as platforms, tend to focus on *innovation* and the *promotion of services*, rather than *application* – supporting the market instead of the community. This is interesting, especially as it is recognized that ICTs do not automatically create smart communities, but that these play a role in empowering people to become *smarter* [18] p. 315.

The objective of this paper is to investigate how in practice user involvement and user innovativeness is shaped in a specific Living Lab smart city pilot: the Climate street. During this pilot, which spanned for two years, a number of public-private partner organizations joined efforts to realize and test a sustainable shopping street in the centre of Amsterdam. The main research question of this paper is how and to what extent the pilot enabled users to engage in bottom up innovation. Directly related to this are questions of how the innovative agency of users is shaped in practice and what dynamics are involved in bottom up innovation. To answer these questions, the interplay between users and technologies with(in) the Living Lab-context is analyzed; in this case a group of entrepreneurs testing a number of sustainable ICTs in their daily work environment.

This analysis contributes to Living Lab-literature by providing both empirical and theoretical insights about user involvement in Living Labs which is especially relevant in the light of recognized challenges to do so effectively. Answering the main research question gives insight in a specific case where a Living Lab methodology is applied in a smart city context (i.e. illustrating what practices occur when ICTs are tested in a real life setting) and also helps articulate research challenges related to involving users in smart city projects. For, as the title of this article questions, do smart cities make use of the innovative potential of its citizens, or in this case, its entrepreneurs?

The article consists of 5 sections. After the introduction, concepts from the academic field of Science and Technology Studies (STS) are presented in the theoretical framing in section 2 which enable an analysis of the user role by juxtaposing how the entrepreneurs are on paper configured by the pilot's project description and their actual appropriation of the pilot and the ICTs in practice. This is followed by the presentation of the qualitative research methodology that was required for the analysis. After giving an overview of the Climate street pilot in section 3, section 4 consists of the analysis; how entrepreneurs were aligned as actors within the pilot and how they attributed both meaning and use to the ICTs that were implemented in their workspaces. This leads to the articulation of a number of ambiguities that may explain the limited innovative agency of the entrepreneurs in this case. Furthermore, these ambiguities suggest that there is an inherent tension in Living Lab-practices. Situating experimentation efforts, such as Living Lab-projects, in a daily life setting, makes certain uncontrollable dynamics part of these efforts. Configuring users in a specific role from a top down perspective may play out differently in daily life practices. Opening up project practices to embrace these uncontrollable dynamics may be a challenge. However this would allow for more user agency and, as is suggested, stimulate bottom up innovation.

2   Theoretical frame and methodological approach

Traditionally, users and consumers of technologies are seen as passive; in line with technologically deterministic theories, they are the market that needs to accept a technology *push*. The academic field of Science and Technology Studies (STS) questions this passive user role, working from the premise that technologies are co-constructed; i.e. a product of both technological and societal developments [30]. STS aims to open up technological *black boxes* by deconstructing how technologies configure users and how users actively adapt and appropriate technologies [23]. This includes theories that focus on the domestication or *taming* of technologies [20], the mutual configuration of users and artefacts [21] and processes of negotiation and translation [12]. Previous work on entrepreneurial ICT domestication for instance shows that ICTs need to have added value and should not be "too extraordinary" [24] p. 221 to fit into existing business practices. This mirrors insights into technology adoption dynamics in change management [25] and the (extended) technology acceptance model which stresses how compatibility with user intentions allows for more readily adopted technologies [27].

However, although STS also deals with intentionality and adoption, it differs from the latter approaches in its insistence on the active role of the user in for instance the attributing of meanings to or uses for technologies. Different streams of thought within both STS and Innovation studies (IS) focus on the innovativeness of users by analyzing user-producer relationships; ranging from studies of *lead users* as innovators [29] to notions of *community innovation* [28]. Apart from this, STS focuses on the interrelatedness of user and technological agency; how meanings are attributed to technologies and how user representations inform technological developments. The concept of the Living Lab also points to the perceived innovativeness of users. This may to a large extent explain why users are not only positioned as *users* who adopt or adapt a technology, but also as *equals* in the Living Lab's public-private partnership. There is a promise that by granting users more agency, more successful ICTs will be developed. STS allows for an investigation of this user agency in practice.

The displacement of the laboratory into a daily life setting in Living Labs effectively makes the use of technologies in everyday environments the object of study. How people act with technologies and make these their own by fitting these to their daily routines, informs developers whether or not a technology will be successful. Studying Living Lab-practices from an STS-perspective aids the understanding of how users are currently engaged in these practices and helps articulate wherein the *innovative potential* of users lies. In this article, Living Labs are conceptualized in terms of socio-technical networks that require the enrollment of different actors within these networks [19]. Actors in the socio-technical network, both human and technological, only gain meaning once they are taken up (enrolled) and aligned within the network. When new actors enroll in a network, the network is changed. This enrollment requires making a *translation* (of e.g. an agenda) or adopting a new terminology/language to interact. In this process of translation, new meanings of both human and technological actors are constructed.

In the Climate street, a group of entrepreneurs were enrolled within the network of the Living Lab-pilot. In other words, they became aligned with both the goals of the pilot as well as with the technologies that were part of the socio-technical network. The first step in the analysis of the innovative agency of the entrepreneurs requires investigating how the entrepreneurs were pre-configured in their user role; how they were represented as *users*. Then, the analysis focuses on how the entrepreneurs enrolled in the socio-technical network and *translated* the pilot and the technologies into certain expectations, meanings and uses and fit these into their daily life practices and routines. Once the entrepreneurs enrolled in the socio-technical network, this network changed. This led to tensions between pre-configured representations and actual practices. By analyzing the translations that were made, certain ambiguities can be articulated. These help to gain insight in the dynamics of how user innovativeness was shaped in this Living Lab-practice.

2.1   Methodology

A case study research approach was chosen as the most appropriate method to gain insight in these dynamics. This approach consisted of qualitative methods (interviews, observations and document analysis). This choice was made for two main reasons. The first was to provide a fined-grained and in-depth level of insights into user commitment and practices, which is a noted gap in literature on user involvement in Living Lab-practices. Secondly, this approach was chosen because the case study, generally, is identified as an empirical enquiry which works best to investigate a phenomenon in its real-life context when the boundary between the phenomenon and the context is not sharp, and contextual conditions are potentially important [31] p. 186. It is precisely this boundary, or rather the interconnectedness between the phenomenon (the pilot) and its setting that is part of the object of study here. More specifically, the analysis deals with how this relationship was translated by the entrepreneurs; what kind of meaning did they attribute to the pilot, the ICTs within their daily life setting and practice? The case study approach is therefore used to "understand the dynamics present within [the] setting" [15] p. 534 which requires an ongoing interpretation of data from multiple sources.

This article focuses on alignment processes in the private space of the 40 entrepreneurs - of the 120 entrepreneurs in the street - who joined the pilot. Between October 2011 and December 2011, in-depth interviews were conducted with 7 entrepreneurs (in addition to this, one entrepreneur – Enzo - provided information via a written questionnaire).

Interviewees were selected based on three criteria. First of all, they were part of the frontrunner group so as to ensure they had an intimate knowledge of the pilot process and ICTs. Secondly, they represented a cross-section of the shopping street entrepreneurs - retail stores (Mead, Ravel and Winter), food and beverage shops (Cross and Lyndon), a restaurant (Ava) and a service provider (Strong). Thirdly, some of the interviewees were technology *enthusiasts* whereas others became discouraged and ceased to use the new technologies as the pilot progressed. This last criterion was thought to lead to insights into innovative uses; perhaps the more enthusiastic users, who adopted the technologies, were configured as the more *innovative entrepreneurs*. In addition to this, two other actors were interviewed: the shopping street manager (working as a communicator between the entrepreneurs and other actors and as a spokesperson for the entrepreneurs) and the director of the company managing and executing the pilot (the project manager). Interviewing members of the project team placed the pilot within a project context and gave insight into how the entrepreneurial role was conceived. The interviews and field notes served as the basis to reconstruct user experiences in using the new ICTs.

Interviews were conducted in line with an interview guide which was devised based on primary and secondary document analysis, as well as field notes made while attending several Amsterdam Smart City events between 2009 and 2012. The interview focus was on entrepreneurs' experiences during the preparatory, implementation and test phases of the pilot. Interviews were anonymized and coded using ATLAS.ti software with the aim of identifying common themes and patterns of use after which labels were connected to theoretical notions of translations and enrollment in the socio-technical network. Combining the collected data provided a rather complete and varied image of the role and experiences of the entrepreneurs. After initial insights were gained from the interviews, field notes and document analysis, findings were shared with Amsterdam Smart City during a *dialogue* session about *connecting the community* (January 2012).

A single case study limits the possibilities of drawing grand conclusions about an entire field of practice. This is, however, not the goal of this article. By using methods such as interviews, observations and document analysis, the analysis presented in this article seeks to identify possible explanations as to why user engagement in Living Lab-projects is a challenge and to suggest where further research is necessary. The fundamental qualitative insights gained about this pilot, this particular complexity of network dynamics, may point to ambiguities that are also apparent – although perhaps in different guises – in other Living Lab-projects. Apart from the first limitation, the study is also limited in scope in terms of 1) the number of entrepreneurs interviewed and 2) actor involvement analysis; access to interviews with more entrepreneurs and the companies supplying the sustainable ICTs was not granted. These limitations were however not recognized as insurmountable issues; the collected interview data was deemed rich enough to grant insights in how the entrepreneurs were exactly included, configured and facilitated to engage in bottom up innovation.

3 Amsterdam Smart City's Climate street: Sustainable Technologies, Sustainable Behavior

The Climate street was one of the projects of the cooperative association Amsterdam Smart City. Amsterdam Smart City itself is one of the six projects of Amsterdam Living Lab. Amsterdam Living Lab is "a joint effort to gather and share knowledge about user experience in order to be able to develop new products and services" (Site 2). The main initiators of Amsterdam Living Lab are the University of Amsterdam, Waag Society (a Dutch institute for art, science and technology (Site 6), Novay (research institute (Site 5)) and the Amsterdam Innovation Motor (initiated by the municipality and the ministry for economic affairs to stimulate innovation in the area (Site 1)).

Amsterdam Smart City aims to make Amsterdam a more sustainable city by working along two principles: 1) it wants to "enable partners to apply innovative technologies" and 2) "stimulate behavioral change with end users" [8]. Amsterdam Smart City describes itself as "a platform for sustainable products and innovations in an inner city environment" [3]. One of its overarching goals is to help Amsterdam reach its climate goals (i.e. to reduce CO2 emission by 40% by 2025 compared to 1990-levels and to make the municipal organizations of Amsterdam climate-impact neutral by 2015). Concrete focus areas are sustainable living, working, mobility and public space. Its central actors are Liander (a large energy distributor in The Netherlands) and the Amsterdam Innovation Motor. In the context of Amsterdam Smart City, both organizations aim to bridge the gap between municipal organizations and businesses to stimulate innovations in the region [4] in the area of Smart Energy. Initially, Amsterdam Smart City was to run from 2009 until 2011, starting 15 pilot projects with 71 partner organizations. However, due to its perceived success (it won the EU City Star Award 2011), it will be continued, supported by the EU's Smart Cities and Communities initiatives [5], the city of Amsterdam and new financial partner KPN.

3.1 The Climate Street (2009-2011)

The Climate street became one of Amsterdam Smart City's pilots in June 2009. Prior to that date, the popular shopping street - the Utrechtsestraat - had already initiated a first venture into testing a new technology: in 2008, waste collecting company Van Gansewinkel selected the street to test electrically-powered waste collection vehicles. The company had sought to test these cars in a *typical Amsterdam street* (project manager). To set up that test, Van Gansewinkel contacted the shopping street manager and the entrepreneurial association of the Utrechtsestraat. This

association was just established, in response to the municipality's plans to renovate the street's public space. Once Van Gansewinkel completed the first tests, its director contacted Amsterdam Innovation Motor. When Amsterdam Smart City took up the project, the Climate street pilot was born. Apart from Van Gansewinkel, various other companies *joined forces in one street* (project manager) and joined the pilot; Vodafone, JCDecaux, Philips, Plugwise, TNT, L.A.J. Duncker BV, Tauw, Eneco, Ziut and Home Automation Europe. A new organization, Club of 30, directed by the prior commercial director of Van Gansewinkel, was contacted by Amsterdam Smart City to coordinate the project management of the pilot for Amsterdam Smart City.

The goals of the pilot were four-fold: 1) to create a sustainable platform in a city center environment, 2) to record user insights, as well as 3) insights into collaboration and implementation processes and 4) to stimulate sustainable entrepreneurship amongst SME's [3] p. 94. A number of technologies were introduced in the street over a period of two years. In the workspaces of the entrepreneurs, smart meters, energy displays and smart plugs were installed. In some cases, LED-lighting was implemented. As the Climate street was a *holistic concept* (Ibid.) to make an inner city shopping street more sustainable, changes were also foreseen in the public space and in the street's logistic processes. In the public space, street lighting was dimmed at night to save energy, electrically-powered waste removal vehicles continued to collect waste and piezoelectric technology was to be implemented in the street's speed bumps. In addition to this, the project envisioned tram stops powered on solar energy and equipped with reverse osmosis water (collected precipitation) to clean the stops without using extra water. Furthermore, public space would be enlivened with sustainable flowerbeds, a public water tap, energy-saving bins (compressing waste using solar power) and two electric vehicle-powering units.

During the *closing party* - an open house event on the street - the energy reduction results of the Climate street were presented. CO_2 emissions were reduced by 8% (energy saving) and 10% (saved by switching to green energy) respectively. The pilot's brochure illustrated ongoing efforts to make the street more sustainable, as well as a number of learnings: some technologies still required implementation, logistics needed optimization and entrepreneurs should become more energy aware. Identified as essential to these processes was an increase in the stimulation of collective action [22] p.11. The general statement by the organizing actors was that to further the success of the pilot, entrepreneurs should *take back* the responsibility for the implementation of the sustainable technologies. After two years, the entrepreneurs would have to become owners of the Climate street. This suggests that their role was perhaps more complex than that of piloting new technologies or that over the course of the pilot's runtime, this role evolved. The entrepreneurs were seemingly seen as partners, or even as owners of the pilot.

4   Analysis: User innovativeness in the Climate Street

In this section, an analysis is presented of how Amsterdam Smart City positioned the entrepreneurs in the Climate street. What representations were used and how were they aligned with the goals of Amsterdam Smart City? The latter is subsequently viewed in terms of the meanings the entrepreneurs attributed to the pilot and how these meanings were translated in ICT use. From this analysis a number of pilot-related tensions and ambiguities become discernible that may also be related to articulated challenges of user involvement in Living Lab smart city projects in general.

4.1   The Role of the User: Representations

As a holistic concept, the Climate street was tested with the ultimate goal of eventually exporting the street concept to other cities. The entrepreneurs involved in this pilot were thus not merely testing new technologies, but moreover involved in testing the concept of the Climate Street as such. In a sense, one could say they were *double testers*. To become part of the pilot, interested entrepreneurs joined the frontrunner group. This group of 40 entrepreneurs, selected by the Climate street project team consisting of members of the entrepreneurial association, the shopping street manager and the project management team, was to function as a *test team* or *sounding board*. They would test ICTs to see what kind of added value these offered in terms of making the street as a whole more sustainable. Amsterdam Smart City stressed that "the needs of the entrepreneurs [were] taken into account in the sustainable solutions in the street" [6]. The project team organized a number of sounding board sessions to *help make an inventory of the needs and wishes of the entrepreneurs* (Ibid.).

Apart from finding needs, Amsterdam Smart City explicitly articulated that interactions with entrepreneurs were essential to make the Climate street *successful*; the street needed to be reshaped into a sustainable shopping street *together* with the entrepreneurs (Site 3). The entrepreneurs were not expected to passively observe the changes to their street, but to actively work together to make their street more sustainable. According to Amsterdam Smart City, the entrepreneurs were active, *enthusiastic* [7], *frontrunners* [6] and *pioneers* who *[formed] the cornerstone of the pilot* [3] p. 95 because they *[needed] to adopt the available technologies* (Ibid.).

In hindsight, the project manager described a different image of the frontrunner group. He concluded that the enthusiasm of the group waned over time. There were several reasons for this; e.g. the municipality's changes to the public space were delayed and the communication with and connection to the group of entrepreneurs was not strong enough. The process "[needed to] be explained to the entrepreneurs in a clear manner. It was important for the entrepreneur to be able to understand clearly what the benefits were for the business" [3] p. 97. Actively involving the

entrepreneurs in the project was seen as a challenge by both the project manager and the shopping street manager, because apart from being part of the frontrunner group, *the entrepreneurs still had businesses to run* (shopping street manager).

The entrepreneurs were thus seen as *pioneers*, to whom how to make the most of the concept of the Climate street and the technologies that were implemented still needed to be explained. This seems contradictory; were they leading the way into new and unknown ventures as pioneers, or were they more passive and in need of instruction? It seems that they were pioneers because they joined a sustainable pilot and were willing to invest time and - in some cases - money to make their workspace and street more sustainable. This does not however clarify how and to what extent their pioneering was expected to affect the shaping of both the tested pilot and the ICTs. Joining the pilot entailed changing some existing routines: they needed to sort their waste differently, learn to use the energy display, reduce logistic movements in the street and take the time to talk about their needs in sessions. And apart from doing this on an individual basis, they also needed to reach joint decisions. To realize this, the entrepreneurs needed to become enthusiastic about the concept and the sustainable technologies of the Climate street; to make them feel like pioneers. But how did the members of this group translate these efforts; what meaning did they attribute to the pilot and to their own role?

4.2   Translating Amsterdam Smart City's Goals into User Expectations: Alignment

Amsterdam Smart City, the shopping street manager and the project manager had to work to connect and *translate* the Climate street concept to the entrepreneurs. According to the shopping street manager, this translation was not easily achieved; most entrepreneurs simply did not have the time to think about the environment. The project manager also observed that there was a *doubleness* in the role of the entrepreneurs; they needed to be part of the solution, while at the same time everything *must be explained in a clear manner*. The shopping street manager expressed that there were three ways to convince the entrepreneurs to join the pilot: 1) by ensuring that ICT implementations and use would be worry-free, 2) by convincing them that saving energy would save money and 3) that joining the effort helped save the environment.

When interviewed, the entrepreneurs expressed reasons why they joined the pilot that were in line with the pilot's primary objectives of reducing energy consumption and CO2 emissions, but also clarified that they attributed different meanings to the pilot. Strictly speaking, two main meanings came to the fore: to *save* and to enhance the identity of the street. This was in line with the goals of Amsterdam Smart City. However, when zooming in on what ought to be *saved* and what kind of identity the entrepreneurs wanted to communicate, discrepancies appear.

4.2.1   Meaning 1: Saving Time, Money and the Environment

As the popular proverb stipulates, *time is money*. To the entrepreneurs, the fact that Amsterdam Smart City would organize and bring all sorts of companies into the street to offer different technologies was a major motivator. In their perception, these *professional* companies would not only supply them with sustainable technologies and "instant access to knowledge" (Mead), but would also implement these – effectively making the pilot's execution worry-free. In addition, this ensured that the pilot would not cost them too much time. As one entrepreneur stated; "I joined, but they had to figure out what to do. They instructed me, although I had forgotten the instructions the next day. It should not cost me much time*"* (Strong).

Saving money by saving energy was one of the *smart* elements of the pilot. As entrepreneur Ava effectively explained *you were just crazy if you didn't join in. Saving energy is making money*. According to Cross, the chairman of the entrepreneurial association, *that was the best way to reach the entrepreneurs. (…) You get them to join if there is a win-win situation. Saving costs* (Cross). But saving money sometimes first required the entrepreneurs to invest. For although energy scans and most of the ICTs were installed free of cost, LED-lighting needed to be bought. This investment proved too much for some. One entrepreneur explained that although she recognized the saving potential of LED, her business "could not invest those amounts of money" (Mead).

Interestingly, only two of the eight entrepreneurs explicitly talked about saving the environment in relation to the pilot (Ava and Lyndon). Ava explained that she *started this business on the premise that I would do everything in a sustainable way*. Lyndon noted how his business revolves around reducing his carbon footprint, while *many entrepreneurs needed to have explained that they could save*. For Ava and Lyndon, being sustainable was something that they would have invested in, whether or not the pilot had existed. Joining it just provided an opportunity to be *an ambassador* for the environment, and to have access to more technologies and advice (Ava). Lyndon however, did not find the ICTs on offer very sustainable and thus – although supporting the idea – did not join the initiative to test an energy display or install a smart meter. He felt that he was knowledgeable enough to make his own choices. For him, the second meaning proved more important to join: enhancing the image of the street.

4.2.2   Meaning 2: Enhancing the Street Image

Some entrepreneurs saw the pilot as a marketing tool; to display their environmental involvement to their clientele. As Ravel notes: "I always had the brochure [about the pilot] on my counter. When I told customers about it, they

were always enthusiastic". Or: "I think that the Climate street was a very nice way to report positively about the Utrechtsestraat" (Ava). The involvement of many large companies added to the image that the pilot would bring positive reports about the street; "During the first large meeting all kinds of companies came to pitch their ideas. (…) That gave us the feeling that we were going to do something special" (Strong). This interest made them "very enthusiastic" (Ravel) to join.

However, using the Climate street as a marketing tool to generate a more collective, sustainable identity was problematic according to some entrepreneurs, because working together was a challenge. Chairman Cross expressed that the entrepreneurs should have "[taken] meaningful action together", but that this required a great deal of time and energy. In the end "everyone was really working for their own shop" (shopping street manager) and some entrepreneurs experienced a difference in *power* in the street. Strong, Ravel and Winter (retail businesses) expressed the expectation that joining the pilot would allow them *more say* in the street; "I wanted to be part of all the meetings (…) because I am retail. A lot of food and catering people joined. (…) And they hadn't even thought about some of the things I said" (Winter). So although creating a positive street image was deemed important, taking collective action was perceived to be hampered by the "individual nature" of the entrepreneurs coupled with the heterogeneity of the group.

The entrepreneurs attributed a variety of meanings and expectations to the pilot. By appealing to these meanings, Amsterdam Smart City succeeded in making the concept of the Climate street attractive to the entrepreneurs; they successfully enrolled the entrepreneurs into the socio-technical network. But this enrollment also created expectations of both the pilot and ICTs that were to be implemented.

4.3 Aligning Expectations with the Use of Sustainable ICTs

In the workspace of six of the entrepreneurs who were interviewed, smart plugs, an energy display, and smart meters were implemented. Coupled, these technologies provided overviews of energy usage. The plugs could also be used separately to read electricity use of individual appliances. The energy displays showed real time energy use and provided a translation into energy costs in euros. The smart meter gave readings of both gas and electricity consumption respectively [22]. Seven entrepreneurs had had an *energy scan* prior to the placement of the ICTs; three entrepreneurs installed LED-lighting via the pilot (two had installed LED-lighting via another route); all had joined the electrical waste collection initiative. When asked about the use that they made of each of the respective ICTs installed in their workspaces and how the ICTs were actually used and given meaning in their daily life routines, the entrepreneurs painted a complex picture. Analyzing the *uses* made of the technologies, makes it possible to show how the entrepreneurs tested the technologies and made these and the idea or concept of a "sustainable street" their own.

4.3.1 *Saving* by Using ICTs

The entrepreneurs reported that the moment of implementation was important to subsequent ICT usage, as this was the moment instructions were provided about the technologies. Ava expressed how due to this explanation "[the smart plugs] were easy to use" and gave direct insight into energy use; "[they showed] me that one of the machines that cost me the most was the cooling counter and made me aware that I could turn off the light in the refrigerator to save more" (Ava). On implementation, a shift in awareness seemed to occur. Ravel explained how the energy scan for instance showed how much energy was *leaking away through the big display window*. This prompted her to adapt her already existing plans to renovate her store.

Energy use habits were also changed as a result of the new ICTs. One entrepreneur reported that while he kept his baking oven on all day prior to the pilot, he changed this once the display showed him how much energy he was wasting. Instead, he started to switch it on only when he really needed it. Ravel adapted her behavior by switching off the radio during the day and using the smart plugs as a light timer. The most striking example of changing behavior is Ava, who "became quite obsessed" with checking everything; whether or not personnel was pressing the dishwasher's "eco-button", switching off the refrigerator-light and the cooling unit in the display window at night and seeing a change in her habits as "a constant game to be as efficient as possible" (Ava).

However, learning to use the ICTs cost more time than had been anticipated by some. Ava stressed that there simply was not enough time to learn everything: "As an entrepreneur, you are not going to say: 'Well, tonight I will spend an evening looking at those plugs'". For others, explanations about the ICTs were not sufficient. For although six entrepreneurs had an energy display, they did not readily know how to operate it. One remarked that "learning something like that takes me years" especially when the display did not seem relevant; "When you are already at the bottom of energy use, a display makes no sense" (Strong). Another turned it off after it produced error messages (Mead) or used it so little that they had to ask the developer to explain its instructions again (Strong, Ravel and Ava), which made one entrepreneur "feel really dumb when it turned out I simply had to push a button" (Strong).

Even when time was invested to learn about the ICTs, there were still reasons why they were not used. There were times when running a business took priority over the pilot: "I took out the plugs because they worked against me. When we changed to daylight savings time, my machines got an error. And then you notice: No, my daily business has priority. Take out the plugs. And you know, once you tested it, there comes a moment that you cannot use them

69

anymore. You can use smart plugs to see something, and then you get your result. But that is it. Then you know and save. (…) But how many "aha" moments can you have?" (Ava). Daily life realities, coupled with the feeling that the smart plugs offered too little for continuous use, made this entrepreneur discontinue use. Daily life realities thus obstructed the use of the technologies at times. For Winter, these realities were infrastructural – the store could not be outfitted with a smart meter and display – which almost caused her to leave the frontrunner group. Apart from infrastructural obstacles, there were also financial issues. Installing LED lighting required the entrepreneurs to buy the actual lamps which was "quite an investment" (Strong, who bought four lamps) and did not always seem "a good investment [because] the lights on offer are not attractive for my store" (Ravel).

Some entrepreneurs felt their expectations about *saving* via the pilot were not realized, because they did not feel taken serious. This was both on the business level and on the individual shop level. Strong, for example, felt her service shop was *left out* as she perceived that the ICTs only catered to food and beverage shops. Ava – in the restaurant business - perceived herself as an environmentally engaged entrepreneur, and felt insulted when she received "only one page" of very standard tips. Her annoyance was exacerbated by the fact that she had to "prove" that she had saved 20% on her energy bill "otherwise I would not even have been in the [pilot's] brochure" (Ava).

4.3.2 Enhanced Street Image via ICTs

Despite the fact that not all ICTs were readily used by the entrepreneurs on a daily basis, all the entrepreneurs expressed the expectation that the pilot would enhance the street's image and that by implementing the technologies in their stores, they showed their support. For Mead and Strong, joining the pilot was even more important than adopting the technologies. When questioned about the use made of the display for example, entrepreneurs saw it as their way to show the community and their clientele that they were involved in the pilot and energy aware.

Some entrepreneurs actively looked for alternative ways to use the ICTs to generate a positive image of the street. Ravel suggested – during a brainstorm session about new applications for the energy display – developing a collective *security application* for the display. This application would alert entrepreneurs for *unsafe* situations. This kind of monitoring could increase the street's quality mark for *safe entrepreneurship* and so make the area more popular among shoppers. Entrepreneur Strong had a very similar idea and translated this into use. On finding that she did not use the display to monitor energy use – deeming it too complicated – Strong commenced using it as a security display. The display, mounted to the wall close to her display window, made her think of *modern* security displays. By switching it on at night, she used it *so criminals would think: 'I better not break in here'*. By attributing a *more useful* meaning to the display, Strong moved beyond the display's foreseen use; it came to *symbolize* something new. Her use of the display did not go unnoticed; "some small newspaper wrote about me that I used it as a security display, but nothing further was done with it" (Strong).

Apart from this alternative meaning and use attributed to the display, there were also instances where an entrepreneur expressly refused to use the ICTs because it communicated a *wrong* image: Lyndon felt that accepting the ICTs would effectively make him part of the *unaware community* of entrepreneurs in the street. "[Using the display would] only show me things that I already [knew], or I [would not] see them because they [were] not relevant for me". For Lyndon, the pilot's ICTs did not communicate a positive image. However, he did want to be an ambassador for the pilot as he felt more could be realized in the other areas that the pilot focused on: "Those technologies did a little, but where we could really make a difference is in distribution and logistics" (Lyndon).

4.4   Tensions Between Expectation and Use: Ambiguities

The above sections show how the meanings the entrepreneurs attributed to the pilot and ICTs were not always readily translated into ICT use. These discrepancies draw attention to a number of tensions; tensions which directly relate to how the pilot enabled entrepreneurs to engage in bottom up innovation. Drawing out these tensions gives insight into the complexity of smart city projects like this which seek to test and implement new technologies in daily life settings.

4.4.1   Expert versus Lay User

Entrepreneur Lyndon saw himself as a very energy aware entrepreneur and as an ambassador for the pilot. He applauded the efforts made by the pilot organizers to engage *the unaware community*, but at the same time did not feel like he was part of this community. In line with Ava, who found the energy advice provided in the pilot too limited, he wanted the pilot to take entrepreneurs like himself more seriously. In other words, in order to truly become part of the network of actors involved in the pilot, he felt like he should be treated as a partner, as an equal.

While the entrepreneurs were referred to on paper as pioneers with whom partner organizations should work on equal grounds, the experiences of the entrepreneurs painted a different picture. The entrepreneurs were treated as lay users; seemingly unaware of their energy consumption, they needed instruction and new technologies to enhance awareness and change behavior. In some examples, this image seems fitting; as Ava relates, the smart plugs led to an *aha-moment* about appliances' energy use. Or made it clear to Ravel that energy was leaking out of her display window. *Unawareness* does not however imply that the entrepreneurs did not have innovative ideas. And clearly, in the set-up of the pilot, the idea was to give the entrepreneurs a platform to ventilate their ideas. Brainstorm

sessions about new applications for the energy display were organized. Where a problem surfaced was in the implementation of the ideas of the entrepreneurs; Ravel proposed the idea of a security application, which was not developed. Strong even attributed an alternative (security) meaning and use to the display. This use was not recognized as a *new* use for the ICT. The organization did not create an atmosphere that was favorable to *tapping* into the innovative ideas of entrepreneurs. Rather, the frontrunner group was constructed as a lay community which needed to be educated.

4.4.2   Owner versus Borrower

What enhances the image of a lay community, is the fact that some entrepreneurs were not sure whether or not the ICTs that were implemented were to be returned to the companies that supplied and implemented them. Ravel thought they were on loan and Mead expressed the thought that they were probably too expensive to buy then. Ava had already packed up her smart plugs at the time of the interview: "I am curious when they will come and pick up the plugs. That is also something I wonder about: they will come and pick it up again, right?" The expectation that the ICTs (apart from the LED lights, which were bought) had to be returned, made the entrepreneurs feel like they were testers, not (co-)owners of the pilot.

This image stands in contrast to the statement made during the official close of the pilot, when the chairman of the entrepreneurial association talked about how the entrepreneurs in the Utrechtsestraat, would now have to *take back the ownership* of the Climate street. At the very beginning of the pilot, the entrepreneurs had worked together with Van Gansewinkel and started to test with an electric waste removal vehicle. They had thus been *(co-)owners* of the pilot then. But during the pilot, expectations about their role shifted; the entrepreneurs expected the involved companies to take care of the implementation of new sustainable ICTs for them - thereby making their own role more passive perhaps. Moving the responsibility of implementing new technologies and of reducing the collective energy use of the street back to the entrepreneurs, led to tensions; both the more active as well as the more passive entrepreneurs felt let down.

4.4.3   Project Dynamics versus Daily Life Dynamics

When expectations about the ICTs were not met in daily practice, technologies were cast aside. In addition to this, at least one entrepreneur stated that each entrepreneur in the street "is an island" (Ava). Working together to reduce energy use was not part of the routines of the entrepreneur. Furthermore, the ICTs that were implemented did not invite collective reflection or action either; the meters showed individual shop measurements. As a result of the heterogeneous assemblage of the group – coupled with tensions between entrepreneurs in the street – and the individually oriented ICTs, the group became an "uneasy" test community, that only came together during brainstorm sessions to share ideas.

Another issue that caused tension was the fact that during the pilot, the municipality began to restructure the public space in the Utrechtsestraat. And although this did not cause delays in the implementation of ICTs in the entrepreneurial space, it did influence the entrepreneurs' ideas about to what extent the pilot was generating a more positive image of the street; road works delayed the implementation of new technologies in the public space – making the pilot *less* visible to the shopping public. The implementation of the pilot in this area was even delayed to such an extent that at the closing party, changes were still underway. Keeping the entrepreneurs motivated to continue with the pilot, cost a great deal of work according to the shopping street manager and often culminated in non-use of technologies in the entrepreneurial space as well (shopping street manager, Cross). In reflecting about this, the project manager observed that: "Like in any practical situation, you notice that there are a great deal of obstacles once you try to execute something, obstacles that you did not think about beforehand". In addition to this, he pointed to the inherent problem of executing Living Lab-projects: "you are engaging in a participatory model, while there is a need to act fast [to implement a project] in the first place" (project manager). Project constraints (such as time limits) and daily life constraints made it difficult to implement user feedback. This led to tensions, as Ava summarizes: "If you want us to believe in the pilot, then you need to make sure that we are heard. (…) Really listen to the entrepreneur".

5   Conclusion

Using ideas about alignment and translation within the socio-technical network, this case study illustrates the complexity of the user role in a specific Living Lab smart city project. The entrepreneurs needed to be both actively and passively involved in the pilot: partaking in the process and utilizing new ICTs, while at the same time *only* acting as testers while companies implemented new technologies. This double image is also apparent in the tester/pioneer representations of the entrepreneurs used by Amsterdam Smart City. The noted tensions in configurations as expert/lay user and owner/borrower further underline this complexity in configurations. The fact that one of the lessons of the pilot was that more attention should be given to *collective action* brings out another point. On paper, the entrepreneurs were part of a *frontrunner group*. In practice, this group may have been physically located in one street, but was not necessarily a united community. In much the same way, the analysis shows how although the entrepreneurs did attribute their own meanings, these were not translated into changes to the ICTs: the entrepreneurs were pre-configured is such a way that they were not enrolled as *innovators* in practice. This suggests that the entrepreneurs were rather limited in their *innovativeness*.

71

However, this case study shows a number of highly relevant insights and further research challenges related to user involvement in the field of smart cities and Living labs. First of all, this study shows that involving users and stimulating *bottom up* innovation is very complex and that Living Labs should not only seek a connection to (communities of) users, but that investments should also be made in reflections about how to stimulate this kind of innovation from a *top down* (project) perspective – i.e. through public-private partnerships. Secondly, it illustrates how users, in this case entrepreneurs, are configured in such a way that innovative ideas are precluded. Related to this is the idea that in order to stimulate bottom up innovation, Living Labs should allow daily life dynamics a role in their projects; daily life complexities should be allowed to become part of the socio-technical network. Unforeseen *bottom up* ideas may form in daily life settings, but require recognition by the *top down* structure of Living Labs if they are to be realized. Granting more agency to the users' ideas and articulated problems may stimulate further engagement of involved communities. In order to become *smarter*, cities are said to need to focus more of the innovative, creative potential of its citizens. But what is left of this idea or goal, if the implementation of a project, of the alignment of all the actors in a pilot for instance, requires so much energy that taking the next step (of collecting and implementing bottom up ideas) becomes too much of a challenge? Living Labs seek insights by situating ICT development processes and practices in a daily life setting. But only when daily life practices of users with technologies are recognized and granted agency, can these truly inform further ICT developments.

Acknowledgments

Websites List

Site 1: Amsterdam Innovation Motor
http://www.aimsterdam.nl/

Site 2: Amsterdam Living Lab
http://www.amsterdamlivinglab.nl/index.php

Site 3: Amsterdam Smart City
http://amsterdamsmartcity.nl/#/en

Site 4: European Network of Living Labs
http://www.openlivinglabs.eu/

Site 5: Research Institute Novay
http://www.novay.nl/about-novay/22

Site 6: Waag Society - Dutch institute for art, science and technology
http://waag.org/en

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