

Review on Living Labs

Their predecessors, their principles and the diversity of their applications.

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Abstract— In this paper, we are going to present the Living Lab concept. Through the last few years, many researchers have been arguing about this controversial term. Thus, there is a plethora of definitions been given to them and many case studies have been conducted, so as to conclude to a generally accepted explanation of this marketing phenomenon. The Living Lab (LL) theory is based on an Open Innovation ground and it co-exists with other marketing and production strategies such as Mass Customization, Open Source, Open Evaluation, Lean Production and so on, aiming to cover customers desires as much as possible. More and more organizations are confronted with highly dynamic external ecosystems. This notion is not an optional activity, but it stems from the fact that consumers seem to be more sophisticated and demanding about what fits their needs better. Colossal companies apply or even, are willing to adapt, these new ways of thinking. Moreover, European countries have already detected the emerging needs leading to the establishment the European Network of Living Labs (ENoLL). In periods of economic recession, innovation prevails and companies need to change their minds and be more “open” and conciliatory. The purpose of this shift is to utilize the majority of information deriving from all kinds of users. Till now, Marketing departments emphasize in approaching only the lead-users. Due to the fact that neither personalization nor customization was discerned, a vast amount of customers were unsatisfied. To conclude, users should have a dual action: they should be both innovators and developers. This will assist products and services to become more adaptive in real markets.

Keywords-Living Labs; Open Innovation; openness; Mass Customization

I. INTRODUCTION

Innovation is a new way of accomplishing our visions. It may refer to the enrichment of the evolution of a new product or a service. Luecke & Katz (2009) presented one of the many definitions available concerning “Innovation”: Innovation...is generally understood as the successful introduction of a new thing or method... Furthermore, it represents the embodiment, combination, or synthesis of knowledge in original, relevant, valued new products, processes, or services. It typically involves creativity, but is not identical to it: innovation incorporates acting on the

creative ideas to make some specific and tangible difference in the domain in which the innovation occurs. For example, Amabile et al. (1996) propose: "All innovation begins with creative ideas... We define innovation as the successful implementation of creative ideas within an organization. In this view, creativity by individuals and teams is a starting point for innovation; the first is necessary but not sufficient condition for the second".

Innovation is a key-factor of business success [1], but in “many organizations, especially those with a traditional approach, innovation is often only seen as valid when it is completely ‘homemade’. This conventional view of thinking, usually referred as “Closed Innovation”, completely disregards the growth market of demand-driven innovation” [2] or Open Innovation (Fig. 1).

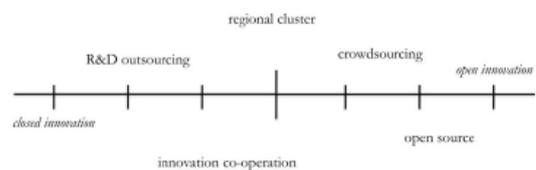


Figure 1. The Innovation Continuum [3]

For innovation to happen, we need something more than the generation of a new idea or an insight. There is a high need of tools, rules and disciplines. Towards this end, emphasis is put on a more general process of creation, progressive thought and action.

Innovation may represent:

- A totally new product, unknown to the customers, produced from scratch
- A new production method
- A new target group
- A new supplier
- The preserve in the field of commerce

As Werner Sombart said [4], Innovation and Entrepreneurship are the core of "creative destruction". Once you destroy something, something new is going to emerge. At the same time, innovation has a dual action. Its first stream is Closed Innovation and the second is Open

Innovation, where the latter supersede the former, due to practical reasons.

The remainder of the paper is structured as follows: In subsection I.A we present Closed Innovation concept, whilst in subsection I.B we discuss the Democratized Open Innovation. In Section 2, we briefly discuss what LL represents, with a view to the reader's introduction to the field of innovation theory and the correlation between Mass Customization and Open Innovation. In section 3, we attempt to approximate the notion of a LL by presenting the tools needed. Furthermore, previous work, in all over the world and Greece, on LL and open environments is noted. When all is said and done, in the last section we recapitulate the facts and we gravitate to the contribution they have in new life circumstances.

A. Closed Innovation

The first form of innovation that appeared was Closed Innovation. Its key component is control. To begin with, every single industry has to manage the ideas, the production, the marketing, the distributions, the financing and generally every obligation needed. This type of innovation, dominated during the 20th century and it is attributed to the total absence of Universities and governmental interest in the field of exploiting science [5]. This, in turn, had a domino effect, while industries were organizing their R&D systems with the absence of any assistance. The lack of time and the imposition, in order to cooperate with external factors, caused to the companies autarky and unsociability. Company's boundaries were sealed and impenetrable (Fig. 2) [5].

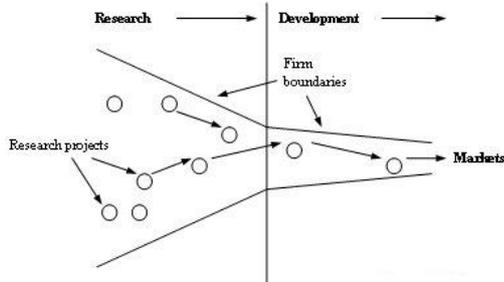


Figure 2. Closed Innovation

Gradually, a plethora of factors caused the erosion of Closed Innovation. Some of those factors are mentioned below:

- Workers' mobility
- Market extension
- Unused external ideas
- Capability for external suppliers

Those mentioned were the vital factors which contributed, in order to build a new knowledge market. Knowledge and information, is not any more company's monopoly, instead it belong to employees, suppliers, customers, competitor and universities. Thus, during these processes Closed Innovation changed into Open Innovation.

B. Open Innovation

More and more organizations are confronted with highly dynamic external organizational environments. MIT professor, Eric Von Hippel introduced the "Democratizing Innovation" concept [6]. In his book, he insists on innovation communities and their significant role towards the openness of innovation. In particular, it is clear that users have no more reservations in revealing their innovative thoughts and actions.

In a world where free speech and knowledge liberty take place, companies can no longer afford the financial weight of research and this is why they prefer to buy or even rent ideas and innovation from external stakeholders. This happens with the purpose of supplementing their internal innovative functions. Of course, it is apparent that Open Innovation is no longer a linear procedure, while innovation is distributed to more than one stakeholder. All in all, the conclusion is that, a company acting under the umbrella of Open Innovation has penetrable bounds, as illustrated in Fig. 3 [5], so as to serve external knowledge relations between innovation networks.

According to R. Freund [2], "Open innovation works from external ideas and knowledge in conjunction with the internal research and development activities. This bidirectional relationship offers new ways to create value. The existence of many "smart" people outside a company is not a regrettable problem for the prosperity of the company, it indicates also an opportunity for the company".

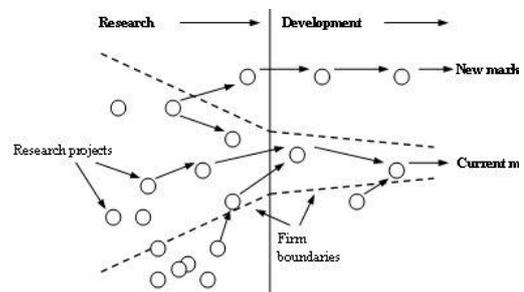


Figure 3. Open Innovation

II. WHAT'S UNDER THE UMBRELLA OF OPEN INNOVATION?

Before starting to elaborate on Open Innovation extensions, let's first focus on the themes found in the existing literature on Open Innovation [2], based on research activities. R. Freund [2] mentions that: "Research activities has been focused on the notion of Open Innovation, business models, organizational design and boundaries of the firm, leadership and culture, tools and technologies, IP, patenting and appropriation, industrial dynamics and manufacturing". Successful Open Innovation depends on the open character of the business model and on network-like interactions between multiple parties in the process of innovation. The foregoing themes and their inspirers are concisely presented in the following Table I, as been presented by R. Freund [2]:

TABLE I. THE THEMES FOUND IN THE EXISTING LITERATURE ON OPEN INNOVATION

Themes	References
The Notion of Open Innovation	Chesbrough, 2003, 2004, 2006; Chiaromonte, 2006; Gassmann & Reepmeyer, 2005; Gaule, 2006; Gruber & Henkel, 2006; Motzek, 2007; West & Gallagher, 2006; West, Vanhaverbeke, & Chesbrough, 2006
Business models	Chesbrough, 2003, 2007; Chesbrough & Schwartz, 2007; Van der Meer, 2007
Organizational design and boundaries of the firm	Brown and Hagel, 2006; Chesbrough, 2003; Dahlander & Wallin, 2006; Dittrich and Duysters, 2007; Fetterhoff & Voelkel, 2006; Jacobides & Billinger, 2006; Lichtenthaler & Ernst, 2006; Lichtenthaler, 2007; Simard & West, 2006; Tao & Magnotta, 2006
Leadership and culture	Dodgson, Gann & Salter, 2006; Fleming & Waguespack, 2007; Witzeman et al., 2006
Tools and technologies	Dodgson, Gann & Salter, 2006; Enkel, Kausch & Gassmann, 2005; Gassmann, Sandmeier & Wecht, 2006; Henkel, 2006; Huston & Sakkab, 2006; 2007; Piller & Walcher, 2006; Tao & Magnotta, 2006
IP, patenting and appropriation	Chesbrough, 2003; Henkel, 2006; Hurmelinna, Kyläheiko & Jauhiainen, 2005
Industrial dynamics and manufacturing	Berkhout et al., 2006; Bromley, 2004; Christensen, Olesen & Kjaer, 2005; Cooke, 2005; Vanhaverbeke, 2006

A. Mass Customization and Open Innovation

As a consequence, after Open Innovation, new strategies emerged. One of them was Mass Customization. Concisely, Mass Customization meets two converse principles at once. On the one hand there is the price and on the other hand is the personalization of the product. Price, quality, flexibility and velocity must be taken into account.

The notion of Mass Customization was born by Stan Davis in 1987 [7], who supported that, the more you personalize a product, the more competitiveness you gain. Through years, Mass Customization has been described as the opposite of Mass Production and it uses agile processes, which aim to produce a variety of differentiated and personalized products or services.

Trying to integrate consumer in an Open Innovation environment, a new type of consumer, the “procumer” (producer + consumer) [8], emerges. By this we mean that consumers are also able to configure and shape their own products. According to Kondylis, under this contemporary philosophy, people are independent and equal beings, with separated roles and rights without facing any social

discrimination. In fact, the acceptance of uniqueness boosted Mass Customization, from a social point of view. Kondylis referred to “Mass Democracy”, but he was subconsciously referring to Mass Customization [9].

B. Living Labs and Open Innovation

A LL represents Open Innovation environments where real life conditions do exist. User-driven innovation is totally adapted to co-creation processes and Open Innovation Functional Region consists of SMEs Collaborative Networks and Virtual Professional Communities in a Public, Private, People Partnership.

In the previous sub-section, we discussed about Mass Customization phenomenon and this because it is the tie binding Open Innovation and LL. As we have already mentioned, their common characteristic is “openness” [10]. Another reason why we correlate these marketing strategies is the attention paid on the subjective and individual user needs [11].

III. ANALYZING THE LIVING LAB CONCEPT

In the next subsections we are going to present some key issues about LL, so as to make its meaning, function and use clearer.

A. General Information about LL

With the purpose of covering new needs in a meta-capitalist society, new practices are indispensable. In LL approach, users act as co-creators and constitute the core of the laboratory. Enterprises focus on user’s deeper thoughts and needs. Furthermore, this is the biggest gain for an enterprise, while all the previous years, companies were struggling so as to have access to this fount of knowledge.

For one thing, historically the LL idea appeared during the 90’s aiming to grasp new technologies in people’s own habitat [12]. The sheer fact is that, LL was established in order to empower coordination in the European area and build a more anthropocentric profile. During the years, LL has been characterized as environments, methodologies or systems. Undoubtedly, they can be used as an anthropocentric research and development area, where everything is co-designed, controlled and evaluated under open and co-operative real world’s circumstances.

In Europe, LL represents a very forceful tool in R&D processes. Thus, there is the ENoLL [13] which is a European User Driven Movement. At the moment there are 129 websites correlated with LL, with different scopes of interest. The 129 LL network represent an impressive partnership of:

- Public bodies
- Companies
- Final users



Figure 4. Some Companies that Use LL Concept

TABLE II. LIVING LABS IN GREECE

NAME	REGION	PURPOSE	CONTACT
Thessaly Living Lab	Thessaly Volos	- Quality of Life	[13][14]
Lever Thessaloniki Lever for Open Innovation	Macedonia Salonica	- Innovative ICT Products and Services	[13][15]
LIFENET UTH	Thessaly Volos	- e-Participation, Social Care, Emergency Network, SMEs Involvement, e-Transportation	[13][16][17]
Chania LL TUC	Crete - Chania	Smart Cities	[18]
Xanthi LL DUTH	Thrace - Xanthi	Connecting Industries to University	[19]

Another familiar strategy to LL is Open Evaluation. Selection and Evaluation of innovative ideas or concepts are typical activities of the company itself. “The benefit of Open Innovation is a much larger base of ideas and technologies” [26]. Open Innovation tools e.g., lead user method, toolkits, communities or innovation contests, allow external partners too to evaluate and select. Internal and external (IT-) evaluation of ideas is called Open Evaluation [27]. To handle the huge amount of ideas created by online communities isn’t that easy. A good example is Google’s Project 10¹⁰⁰ where thousands of people from more than 170 countries submitted more than 150.000 ideas, from general investment suggestions to specific implementation proposals. These ideas were evaluated by 3.000 Google employees [28] and not by the crowd (community).

B. Definition of LL

What’s a living Lab? There is a great amount of definition about LL and that’s because it is a really new field of experimentation. Folstad presented three classes for a LL [10]:

- Those for experience and experimentation in software, bears resemblance to open source practices.
- Those which function as Open Innovation platforms.
- Those where users interact with products and services in order to better develop and shape them.

Indeed, all three classes consider human to be the only source of innovation.

In addition, LL has been defined as “experimentation environments in which technology is given shape in real life contexts and in which (end) users are considered ‘co-producers” [23]. This definition differs slightly from the previous, but emphasizes in experimentation and not on research.

Needless to say, users are not “guinea pigs” but innovators. They aren’t also employees, but an interesting and interested group which contributes to productive processes. A Living Lab environment should include the following stakeholders: users, academia, emerging technology, firms and public.

The utmost partnership is the University-Enterprise-Government one. But here is the problem: “European private enterprises usually assume that their responsibility in the education process should start when the university system ends: once the (new) graduated engineers are recruited. Then, their responsibility is limited to (re)train new employees for specific job positions. Industry pressure to universities looks for including in university curricula the technical content capable of reducing cost and time to getting full usefulness of the recent graduates at the minimum time” [14].

Thus we conclude that there is no good collaboration between the components. And this explains why a LL approach is difficult to be applied, under the existing mentality.

C. Three Tools to Exploit Living Labs

We distinguish three kinds of “tools” to exploit a LL:

- Ethnographic research: it is hardly used any technology at all, but only ordinary human observation by other humans, while ‘living together’.
- Observation tools and technology: Such as cameras, microphones, etc.
- Cultural probes: Such as diaries, disposable cameras, voice recorders, etc. which make use of participants’ own observations and self-reporting. E.g., give people a camera and ask them to photograph each relevant occurrence or incident on the subject you are studying, have them return the camera, develop/print the pictures and interview the participant about what he/she has recorded.

The first two are synchronous observation (which could entail a lot of un-useful information), the third is asynchronous.

D. Some Examples of Living Labs

The Place Lab [25]: Stands for a consortium of the MIT House_n and TIAX, LLC. They have developed an

apartment-scale shared research facility where new technologies and design concepts could be tested and evaluated in the context of everyday living. The Place Lab was constructed by TIAX and operated by both TIAX and MIT. It was completed in 2004 and this 1000 square-foot facility is located on the ground floor of a new full-service condominium building between Harvard and MIT buildings.

The home is rapidly becoming a center for proactive health care, distributed energy, learning, communication, commerce, entertainment, and work. This creates exciting opportunities and daunting challenges for companies developing related products and services. Consumers are reaching a limit to the number of stand-alone technologies that they will accept into their lives, and products and services developed and tested in laboratories often fail because designers often make erroneous assumptions about the effectiveness and use patterns in complex natural settings such as homes. The interaction of people with other human beings and with devices leads to unexpected behavior that is difficult to anticipate with focus groups, surveys, and other standard product development and marketing inquiry methods.

On the other hand, the Visible Living Lab [26] represents a Space Management and Real Time Occupancy Tool developed by Johnson Controls company. It is a unique web-based wireless application, which monitors and analyzes, in real time, the position and movement of occupants within a workplace – recording working behaviors, tracking movement and space utilization. The objective is to deliver, through active technology, an intelligent, analytical graphical assessment of the efficiency and effectiveness of the layout, occupancy and utilization of the workplace.

This technology was designed to help corporations identify space occupancy and utilization improvements to increase productivity and reduce the total cost of ownership (save 20-30% of occupancy cost).

The GALILEO project [27]: It is a Living Lab for location-based services that took place that took place in Holland having the assistance of the University of Leiden.

Location-Based Services (LBS) are based on the principle information be made available at any time and place. In the GALILEO project, the European Union is launching 30 new satellites in order to produce a very accurate signal as a basis for this. The current state of technology already offers multiple modular technologies, such as content management, maps, navigation systems like GPS and hardware like PDA's. However, with the coming of GALILEO and the advances of hardware, software and connectivity, a new dimension of location-based services will become possible.

The position signal alone, however, is not yet a location based service. Applications need to relate the position to data e.g., maps, traffic jams, weather forecasts, or even medical records. And in order to deliver this data to the devices, network connectivity is needed – for instance by glass-fiber for stable locations, or even more importantly, wireless networks for mobile devices.

“The living Lab Location-based services is a perfect opportunity for examining whether applications of Satellite-

Navigation Technology might have a larger impact upon the region than the life sciences do” [28].

IV. CONCLUSIONS AND FUTURE WORK

When all is said, not only are LL applicable, but they could have a great impact on our daily life. Emphasis should be placed on application domains such as culture and tourism, health and care, mobility and work. Incentives are necessary to enable this development, aimed at cluster-innovation management. We should also highlight LL extensions to Marketing. In this way customers' interest could be easily captured by involving them directly in design and development processes.

Future work is going to focus on the different ways of networking that can be applied in a Living Lab, so as to serve its purpose in the best way. Some tools that suit the purpose are mathematical, algorithmical and technological. The challenge is to combine them.

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