

MAP OF LIVING LAB NETWORK AND THE VISUALIZATION OF FOCUS AREAS OF LIVING LABS

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Abstract

Innovation is one of the fundamental concerns of companies, societies and countries due to changing economic and social conditions of the world. Companies or countries seize the opportunity of collaborating with stakeholders to harvest innovative ideas through open innovation. Living labs create strategic innovation partnership with municipalities, industrial, commercial and financial organizations, universities, non-government organizations and foundations. In this paper, the main focus areas of living labs around the world mapped and the network of living labs (country based) visualized in global innovation ecosystem with social network analysis. The research data were generated from the website of European Network of Living Labs. Health & Wellbeing and Smart Cities & Regions were found the emerging innovation trends created by living labs and in global network. While the majority of these Living Labs are located in Europe, Taiwan, Nigeria, India, Senegal, Canada, Japan and China have also invested on living labs.

Keywords: Living Labs, Open Innovation, Innovation Trends, Network Map, European Network of Living Labs

JEL Classification: M1, M10, M19

YAŞAYAN LABORATUVARLAR AĞ HARİTASI VE ODAK ALANLARININ GÖRSELLEŞTİRİLMESİ

Öz

Ekonomik ve sosyal koşullarda yaşanan değişimler inovasyonun işletmeler için önemini arttırmaktadır. İşletmeler veya ülkeler açık inovasyon ile yenilikçi fikirlere ulaşarak dış paydaşlar ile iş birliği yapmaktadırlar. Yaşayan laboratuvarlar (Living Lab) belediyeler, sanayi, ticaret ve finans kuruluşları, üniversiteler, sivil toplum kuruluşları ve vakıflar ile stratejik inovasyon iş birlikleri yaratmaktadır. Bu çalışmada sosyal ağ analizi ile dünya genelinde faaliyet gösteren yaşayan laboratuvarların odak alanları ve küresel inovasyon ekosistemindeki laboratuvar ağı (ülkeye dayalı) oluşturulmuştur. Araştırma verileri Avrupa Yaşam Laboratuvarları Ağı'nın web sitesinden elde edilmiştir. Sağlık-Refah ve Akıllı Şehirler- Bölgeler, global yaşayan laboratuvarlarında öne çıkan inovasyon eğilimleri olarak tespit edilmiştir. Bu laboratuvarların çoğu Avrupa'da bulunurken, Tayvan, Nijerya, Hindistan, Senegal, Kanada, Japonya ve Çin'de de yaşam laboratuvarları olduğu saptanmıştır.

Anahtar Kelimeler: Yaşayan laboratuvar, açık inovasyon, inovasyon trendleri, ağ haritası, Avrupa Yaşayan Laboratuvarlar Ağı

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1. Introduction

Living labs as a phenomenon that provides tools, diversified partners and creative working places in real life context has been attracted the interest of many researchers, public sector authorities, institutions, practitioners and individuals (Schaffers, Cordoba, Hongisto, Kallai, Merz, & Van Rensburg, 2007; Dutilleul, Birrer & Mensink, 2010; Edwards-Schachter, Matti, & Alcantara, 2012; Gualandi & Romme, 2019; Schuurman, Herregodts, Georges, & Rits, 2019). There is a shift from innovating under the roof of an organization with the limited resources and competencies to co-create innovation with many stakeholders and share the risk with involved partners such as end-users, suppliers or manufacturers (Ståhlbröst & Holst, 2012). Therefore, living lab is an important intermediary that provide several advantages for both companies, innovators or society as a whole, mainly about shortened time to market or turn ideas into sustainable and technology-based innovations (Baltes & Gard, 2010).

Living labs are initiatives that encourage collaboration in the innovation process between large diversity of stakeholders such as entrepreneurs, citizens, authorities and researchers. It becomes a part of innovation ecosystem by bringing creative people, innovative ideas and technology together. The underlying idea behind living lab approach is providing knowledge and technical equipment, sharing experiences, co-creating and developing prototypes in real life context and testing before market entrance with end-users. Living labs are served as open research and innovation platform by involving users and developers (Pallot, Trousse, Senach & Scapin, 2010). Therefore, the role of living lab should be considered as beneficial in value creation process of innovation.

As a growing community, network of living labs gives an opportunity to engage global users to validate and reach more desired product or service ideas in innovation process. On the other hand, living lab approach allows generating multicultural knowledge, building better business models and increasing user satisfaction. The rise of the co-creating with stakeholders will allow innovators and users to build mutual beneficial relationships. As a global innovation networks, living labs aim to combine user involvement, multi-stakeholder partnerships, research and practice driven innovation processes by operating as intermediaries among citizens, researchers, companies, cities or regions. Consequently, it is assumed that living labs will have a profound impact on user-oriented innovations over the coming years around the world (Leminen, Rajahonka, & Westurland, 2017). However, there is a lack interest on mapping the focus innovation areas of living labs network. Even there is a categorization of the main project topics announced by European Network of Living Labs (ENOLL), living labs that are scattered around the Europe give support on different concentration areas. In order to get a deeper understanding on living labs, focus areas of innovations should be illuminated to understand emerging innovation trends in global living lab innovation ecosystem. Therefore, the purpose of this study mapping focus areas of living labs in different locations to make an inference about changing innovation trends.

The study is designed to clarify and classify the focus areas of members of European Network of Living Labs. A definitive framework of living lab initially is presented followed by providing main arguments regarding working principles and features of living labs. Subsequently, the map of innovation areas of living labs is demonstrated.

2. Literature Review

The concept of living lab is sometimes hard to grasp because of an abundance of contradictory definitions in the literature. There is not an agreed upon definition that covers all aspects of living labs principles and cases (Bergvall-Kåreborn, Eriksson, Ståhlbröst, & Svensson, 2009). However, the common factors that are mentioned almost in all definitions are; various stakeholders, user experiences, technology, real life environment and evaluation or market validation (Van Geenhuizen, 2018; Schuurman, Coorevits, Looghe, Vandenbroucke, Georges, & Baccarne, 2015; Almirall, Lee, & Wareham, 2012).

Most cited definition of Living labs is “*physical regions or virtual realities where stakeholders form public-private-people partnerships (4Ps) of firms, public agencies, universities, institutes and users all collaborating for creation, prototyping, validating and testing of new technologies, services, products and systems in real-life contexts*” (Westerlund & Leminen, 2011). As it can be understood from the definition, labs become a technologically equipped meeting point in the innovation ecosystem.

Even though, the notion of “living lab” was mentioned along with the name of Professor William Mitchell, the concept was generated in the early 1990s. Afterwards he suggested to create a space where innovators can meet with users and capture or measure their responses to innovations in early stages for studying smart/future homes (Leminen, Westerlund, & Nystörm, 2012). The structure was expanded and spread around the other region of the world. Especially, the shift of innovation paradigms from closed to open model (Chesbrough, 2006) turn living labs into a key solution for economic competitiveness and societal challenges (Dutilleul et al., 2010; 63). In the meantime, co-creation paradigm simultaneously foster customer as an important source of innovation by joint problem solving and knowledge sharing approach in an iterative innovation process. Thus, living labs encompass collaborative learning environment, in which customers-users’ needs are focused (Van Geenhuizen, 2018).

Living labs aim to capture public interest continuously to co-create in value chain. Therefore, open innovation principles should be evaluated as a guide for labs in order to leverage creativeness of larger populations for long term periods (Santoro & Conte, 2009; Bergvall-Kåreborn, & Ståhlbröst, 2009). Living labs account for a structured approach to open innovation philosophies for improving, developing, creating, prototyping, validating and testing by involving users in the early stages of innovation process (Schuurman, De Marez, & Ballon, 2016). According to Ferronato, Merce, Roberts-Smith and Ruecker (2019) “*Living labs are more than a human-centered approach. Instead, they are about the openness of design to collaboration and transdisciplinary. Openness is crucial to the innovation process in a Living Lab, where it is necessary to gather a multitude of perspectives that can lead to faster and more successful solutions to complex social problems*”. Added to this, it is stated that one of the most important characteristics of labs is to act as open innovation networks (Leminen, Westerlund, & Nystörm, 2012). In other words, open innovation can be considered as a wheel for the operation of living labs.

On the other hand, living labs relies on intensive user involvement through co-creation many studies has been conducted to understand user contribution in living labs, actor's roles or learning process (Ståhlbröst, 2008; Schuurman et al., 2015; Nyström, Leminen, & Westerlund, 2014; Almirall, Lee, & Wareham, 2012; Ogonowski, Ley, Hess, Wan, & Wulf, 2013; Salminen, Konsti-Laakso, Pallot, Trousse, & Senach, 2011; Schuurman, Lievens, De Marez, & Ballon, 2012; Svensson, Ihlström Eriksson, & Ebbesson, 2010; Gascó, 2017; Ståhlbröst & Host, 2016). Many methods developed for involving users actively or investigated the relevant dimensions for user selection. The concept of living lab ensures the unity of individuals and technology as it is one of the requirements of digital transformation. The hot discussion topic of nowadays is how human and technological solutions integration will be achieved during the new industrial revolution. Although it is assumed that technology replaces people, the multiple role of individuals become more important in value creation process as well (Huws, 2014; Friedman, 2016; Hecklau, Galeitzke, Flachs, & Kohl, 2016). According to Eriksson, Niitamo and Kulkki (2005), living labs allow individuals to play different roles in many contexts such as a citizen, user, consumer, researcher or worker. They stated that the aim of living labs is to create a spiral of technology, innovation and society through a human-centric and technology-based approach.

The features that distinguish living labs from other innovation portals can be ordered as below (Kviselius, Ozan, Edenius, & Andersson, 2008; Mulder Velthausz, & Kriens, 2008; Santoro & Conte, 2009; Dutilleul et al., 2010; Westerlund & Leminen, 2011; Issa et al., 2018);

- Cooperation with many different sized companies, organizations and engaging in larger user or cocreators in an open environment
- Technology availability
- Early interaction with consumers or markets for market validation
- Knowledge sharing and mutual learning
- Diffusion of Innovation through global network
- Decision making support through user involvement
- Socializing activities in ENoLL network (workshops, conferences exc.)
- Real life context
- Public- private partnerships and Fostering of inter-regional collaborations
- A contact point for innovation enthusiasts
- The harmonization of approaches, methods and tools
- Cost sharing and shorten time to market

Living labs are supposed to merge all resources and capabilities of companies/organizations, end-users/customers, researchers/academicians and public institutes to promote mutual beneficial innovation processes with the support of technology in an open environment (Issa, Schumacher, Hatiboglu, Groß, & Bauernhansl, 2018). According to Bergvall- Kåreborn and friends (2009) key principles of living labs are divided into five. *Openness* refers to allowing collaboration between people of different backgrounds, perspectives and experiences in innovation process. Besides, companies catch opportunities to strengthen their innovation capacities through learning from others with the principle of openness.

Secondly, *Influence* is the other principles of living labs. Influence stands for evaluating users as active and competent partners who has the decision-making power during the creation of innovation on the behalf of society.

Their needs and suggestions should be implemented as they are representative of heterogeneous group. *Realism* emphasizes the need of realistic, natural, real life settings for innovation process. Living labs facilitate an open environment that reflects diversity of users, different perspectives or purposes to generate results that are valid in real markets. Although, all aspects of innovation process in living labs should be as much realistic as possible from users to products that are created.

The principle of Value is an outcome of living labs efforts that create mutual benefit for partners. It is important to keep in mind that each of the participant in innovation projects has different value expectations. Economical value (monetary returns), business value (health and wellbeing of a firm in long term) and consumer/user value are the main outcomes that are supposed to be created with living lab methodology. In other words, all stakeholders and labs itself would desire to obtain a value. Lastly, *Sustainability* signify for viability of labs and contribute to social concerns related to environmental, social and economic. Sustainability will be supported by becoming an international wide living lab network.

European Network of Living Labs (ENoLL) was established for the purpose of connecting living labs for knowledge and experience sharing and creating collaboration between different labs in 2006 (Scuhaarman, De Marez, & Ballon, 2016). Since then, over 150+ members are currently active (440+ historically recognized over 12 years), located in mainly Europe but also diffused in South Africa, Asia and South America (Ferronato et al., 2019). As an open community ENoLL is intended to create an innovation ecosystem to enhance interactive collaboration and community engagement through living labs that act as intermediaries among citizens, research organizations, companies, cities and regions.

ENoLL tries to position itself as a facilitator platform for innovation projects that target in different domains such as energy, media, mobility, healthcare, agri-food etc. The organization clusters current and past projects of living labs under nine sectors which are health & wellbeing, smart cities & regions, culture & creativity, energy, mobility, social inclusion, social innovation, government, education (ENoLL, 2019). However, members of ENoLL have generated a great deal of interest in diversified areas such as health & wellbeing, smart applications.

The recent literature on living labs has produced valuable effort in the literature to enriched understanding on how Living Labs participating in the innovation ecosystem of many industries and by which means. Some scholars conducted many researches on investigating inputs and outputs of collaborating in living labs, examining intellectual property rights issues in living labs or comparing project across living labs by conducting case study analysis and generate frameworks to evaluate living labs performance factors (Van Geenhuizen, 2018, Veeckman, Schuurman, Leminen, & Westurland, 2013; Pitkänen & Lehto, 2012; Leminen, Westurland, & Nyström, 2012). However, there is a lack interest on analyzing distribution map of living lab network and focus areas of living labs on the basis of map. The benefit of having analyzed the distribution and focus areas of the living lab would be making an inquiry regarding the diffusion of living labs as a global network and determining innovation trends of living labs.

3. Research approach

In this study it is aimed to visualize the ENoLL's members network maps based on located countries to understand distribution of the concept around the world and focus areas of living labs in different locations to have an idea on emerging innovation trends. As the European Network of Living Labs are supposed to enhance cross-regional and cross-national network of innovation that improve technology developments and mass customization in some specific areas (Mirijamdotter, Ståhlbröst, Sällström, Niitamo, & Kulkki, 2006), it is considered that the subject based evaluation of the network would be insightful contribution to conceive emerging trends of innovation. In order to provide a depth analysis, the main research questions are formulated as below;

- Which countries are the main actors in the network due to the number of active living labs (centrality of network)?
- What are the common focus areas of living labs?
- Do the focus areas differ by the geographical location?

Based on network mapping, structural relations of Living labs network are intended to illustrated. Although the relationship in small groups can be observed easily, larger networks may involve many actors as ENoLL that are needed to be analysed with some techniques. Network mapping techniques assures reducing the complexity and heterogeneity of networks by clustering, classifying that display similar patterns of relations in the network (Mirijamdotter et al., 2006).

The social network analysis is based on graph theory and the main feature that distinguishes it from other similar methods is the connection of the network (Freeman, 2004). In other word, the focusing point of analysis is not only individuals or social units (a person, a group, a nation, a blog, so on) observation of the relationships between units are possible. Therefore, graph theory provides a tool for visualization of relationships in a network. It is stated that *“Graph Theory, and more generally a graph, is one of the best and clearest way to represent and detect the structure defined by the way a relation (or some relations) connects different individuals of a social group. The evident advantage of the graph representation is that it provides an immediate interface through which it's possible to find, and also easily to understand, the way individuals in the network are connected.”* (Martino & Spoto, 2006).

Consequently, an interface (www.graphcommons.com) were used to apply network analysis to discover central actors and map them. Graph commons is a tool to transform data into interactive maps and understand the relations in communities. Therefore, the visualization tool of social network analysis was used to provide a subject network map of living labs.

The study is design as below:

The data were generated by collecting information about member labs and their located countries and focus areas on the website of ENoLL.

Preparation of Data Matrix: Initially, the data matrix of the study was prepared according to information gathered from ENoLL's website. Since 2006, ENoLL labelled 440+ living labs. However, this study was performed only through the active living labs that are listed in the network page of ENoLL website.

The first matrix consists of living labs' names and located countries and the second one is about countries of living labs and all the focus areas (innovation projects topics) according to the declaration of the living labs.

Analysis: Secondly, the country clusters of living labs are depicted to be able to see the member countries of ENoLL. Living Labs were separated according to the countries in which they are located. Afterwards, the focus areas of living lab for each country have identified. The living labs have focus areas that are labelled as nine different topics by ENoLL. For this reason, the map should be interpreted as emerging innovation trends of countries. Eventually, the network maps are explored with the data matrix.

4. Findings

The analysis of the study focuses mainly on how living labs are distributed locally in the world and how their focus areas are clustered related to their location. With regard to this the network map of ENoLL members are visualized with an interface. The size of the dots is related to the number of members. The more ENoLL members there are in the country, the larger the dots appear (Please check Appendix 1). As it can be seen from Figure 1 ENoLL have members from 40 different countries (ENoLL is included in the figure). According to degree centrality of ENoLL network, top 5 countries are France (25 living labs), Spain (24 living labs), Italy (22 living labs), Belgium (12 living labs). It is, however, remarkable that there are many living labs in different countries outside of Europe such as Senegal, China, South Korea, Japan, Nigeria, Canada, USA, India, Tunisia.

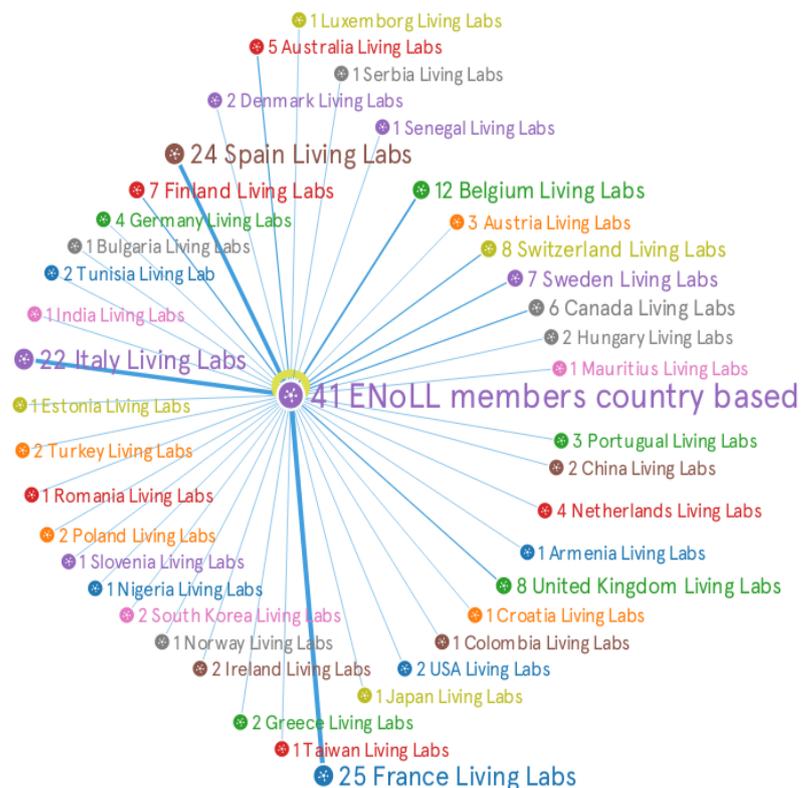


Figure 1: ENoLL Members Location Based Map

The second part of the study is creating a map to get insight on focus areas of living labs based on their countries. As it mentioned before, ENoLL classified living labs focus areas under nine different topics. Based on this classification, it is aimed to be find out countries objects of study of living labs.

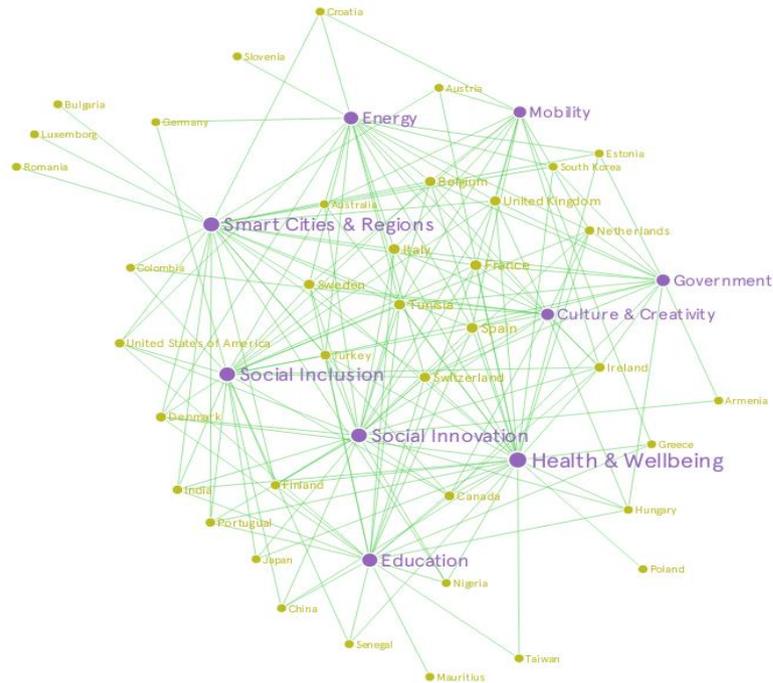


Figure 2: Living Labs Focus Areas -Location Based

As it is illustrated above, Health & Wellbeing (Figure 3), Smart Cities & Regions (Figure 4) are the most studied topics of living labs. These are followed by social inclusion and social innovation. On the other hand, a considerable number of labs provide education to their participants. Government as focus areas represent the established relationships with governmental institutions. 15 countries have related to government in their local community.



Figure 3: Cluster of Health and Wellbeing

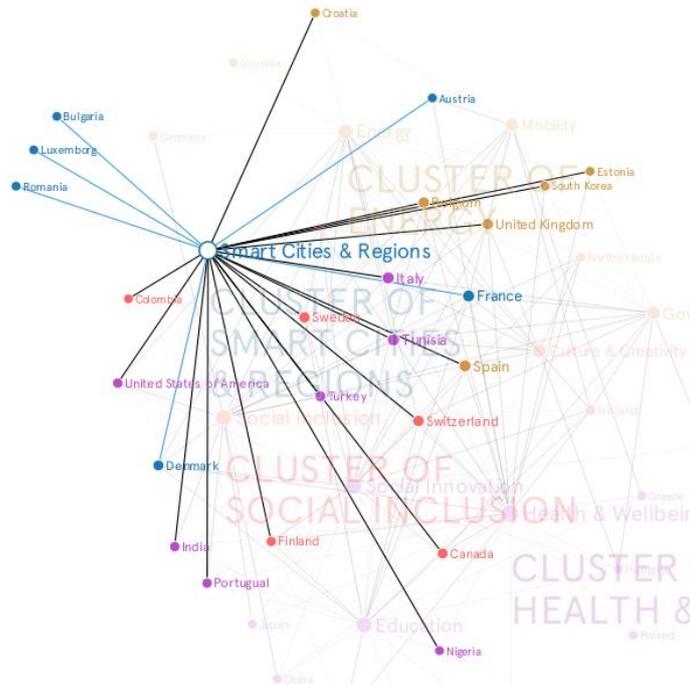


Figure 4: Cluster of Smart Cities & Regions

Italy, Tunisia, France and Spain declared that they manage projects in all areas included relationships with governmental organizations. Some of the living labs prefer to focus on only energy like a living lab in Switzerland or culture and creativity in Italy's one of the living labs.

Besides, there are some specific living labs focus on a single issue in some countries. For instances, future farm, agriculture, space technology, cancer, aeronautic and mechanical industries, rural development, land and water, library and archive, neurological disability, weather warning technologies or gastronomy. They positioned their self as a core technology centre that responses these issues.

5. Conclusion

The results of the study show that living lab network expands as a social space that brings stakeholders together in the innovation ecosystem in different part of the world. So far, more than 440 labs (150+ active) in more than 40 countries have created value globally through innovation network. Diversified focus areas of living labs provide innovative projects to meet the regional and global needs. In the light of the findings, it has been observed that the living labs work at similar focus areas according to their regional distribution. In other words, living labs located close to each other appear to have more common focus areas. For instances, living labs located in Europe region work on similar topics such as health and wellbeing.

The group of countries particularly generate projects on health and wellbeing consists of 28 countries out of 40. While the majority of these countries are located in Europe, Taiwan, Nigeria, India, Senegal, Canada, Japan and China have also invested on the topic. This result is not surprising considering the increasing investments made by OECD countries for health and education purposes for recent years (OECD, 2019).

Changing environmental conditions, aging population and rapid changes in consumer trends and life styles are estimated to be important factors in the popularization of the issue.

Besides, smart cities and regions is another hot topic due the increasing role of technology in human life. The findings obtained coincide with the findings and suggestions in the global innovation index report (2019). As it is stated in the report medical/health innovations should have an important share in global healthcare provision. It is claimed that emerging economies has an advantage to leverage health related innovation when it is compared to developed markets. Living labs which produce innovation projects related to health and wellbeing in developing countries should focus on merging technology into innovative solutions to shape the future healthcare.

Global problems such as depleted natural resources and global warming increase the need for technology. The solutions that will ensure the unity of technology and human in urban life are among the fields of interest of the living labs. This finding confirms the general subject distribution in case studies in the literature. The project topics of living labs which have been discussed in many studies in the literature show a similar trend (Leminen, Nyström & Westerlund, 2019; Levén & Holmström, 2008; Schaffers et al., 2007; Edwards-Schachter et al., 2012).

The results of the study also reflect the social dimension of innovation. Social inclusion is one of the key responsibility of many living labs around the world to bring citizens, policymakers, businesses and researchers to work together. 23 countries are interested in social inclusion from Colombia to India, Tunisia, France, Finland and so on. Likewise, social innovation is declared as a focus area by many countries (Japan, China, Nigeria, USA, Armenia, Ireland).

As stated by Mulgan, Tucker, Ali and Sanders (2007) development of social innovation should be urgent task for countries for future growth and well-being. Therefore, it would be important to improve societies social innovation capacities to solve their problems by providing an innovation platform for different stakeholder under the roof of a living lab in the country. Added to this, Living Labs as a knowledge and experience sharing platforms provide education to participants. Thus, the culture of innovation and creativity is supposed to be expanded. 21 countries focus to give education on innovation related topics. These findings overlap with other studies in the literature (Dekker, Contreras, & Meijer, 2019).

France is founded as the main actor in the network due to the number of member labs. Living labs spread is observed at a close scale in the other European Countries. One of the surprising findings is the adoption of living lab approach in other continents of the world. The fact that there is only one living lab in these regions shows their motivation to produce value together.

To sum up, innovation is not only a profitable tool for businesses. Many countries aim to ensure sustainability through innovation by utilizing common intelligence and technology in many areas. Therefore, Living Labs are thought to contribute significantly to the innovation power of countries at the macro level. The expanding network of Living Labs will be an important source of innovation for global problems. Although focus areas of the Living Labs are assumed to be determined according to the needs of the region, it will be useful to diversify. Based on the findings, the fact that living labs have started to spread outside the borders of Europe is thought to have an effect on increasing global innovation power. However, it is considered that living labs should be diffused according to more specific innovation needs of the country and religion to enhance the impact of collaboration. Apart from this, establishing common working principles between laboratories would create an important leverage effect.

Eventually, although the width of the network is an important indicator, it is recommended to measure whether the laboratories are effective and efficient for the future studies. It would be worthwhile for future studies to explore differences across the nature of Living Labs and present a taxonomy that differentiates the way they operate, differences as compared to others, the processes that they use to attract and retain talent and participation.

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