



Budapest University of Technology and Economics  
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**PHD THESIS SUMMARY**

**The opportunities of Living Lab-based interactive value production in product  
development and the evaluation of Living Labs**

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## **1. Research overview**

### **a) Introduction of the topic**

The research aims to analyse the theory as well as the practical implementation of the Living Lab (hereinafter referred to as "LL")-based interactive value production. This is complemented by the analysis on the evaluation method of LLs, and my suggestions for the further development of the evaluation methods. The basic definition of open innovation was introduced by Henry Chesbrough: "Open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively" (Chesbrough, 2003, 1. pp.) The LL-based-interactive value production is a special form within the open innovation theory, in a way that builds on the active, initiating and cooperating role of the users. (Pascau and Lieshout, 2009, Almirall, Lee and Wareham, 2012) LL is a research concept and practice, in which the experimentation and co-creation is conducted in real environment (Lehmann, and Frangioni Dubé, 2015), together with real users. The end users, researchers, companies and public institutions interact with each other in order to design, plan and implement the new and innovative products<sup>1</sup>. The concept means, that the end user have an active role at least in one element of the product development process. The users are involved either early, in the design, or later in the development of the final product phase. The most complete form of the LL concept is driven by the users, from the creation of the product concept till the development of the final product. (DG INFSO, 2009).

### **b) Literature overview**

The development of corporate innovation processes did not focus yet on interactive value production by the Millenium. Innovation processes focused more on the improvement of corporate research and development. Transforming the company's internal knowledge base was required by the end of the 20<sup>th</sup> century. Its main reason was, that the already existing internal knowledge base, research and development efforts were no longer suffice to encourage and keep competitive advantage on the market. This change in the corporate development processes resulted in the company's more active role in inter-organizational, contract based collaborations. Besides exploiting corporate research and development capacities, open innovation activities provided the required added value for the company. By the end of the 20<sup>th</sup> century the utilization of external knowledge by corporate collaborations was a significant

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<sup>1</sup>According to the „product“ definition of Philip Kotler, under the term „product“ I mean physical goods and services. Kotler (2003, 40-41. o.) define „product“, as: "Product is anything that can be offered to someone to satisfy a need or a want".

alternative to corporate capacity improvements. (Allen, 1983) The key feature of open innovation and interactive value creation is, that the majority of data, information and knowledge flows into the company as a result of collaborations and outsourcing on a regular basis. (Hippel, 2005b) In order to explain interactive value production, explaining the term, “sticky” information (Hippel, 1994), the hidden, tacit, "implied" knowledge (Polanyi, 1958, Dasgupta and David, 1994) and the term explicit knowledge is essential. “Sticky” means all the information of the expectations of the users related to the product, which is hardly explicable. The latter includes also that the information is "sticky", as even its existence is hardly recognizable. The transaction cost of transferring knowledge and the information descends rapidly, while the company's need for scientific-technical innovation potential increases. These tendencies result in the expansion of supply. However, the rapid growth of the companies on the supply side should meet with the rapidly growing and changing demand of the users, evaluated qualitatively. If the changing demand and supply do not meet, it might lead to the emergence of “wasteful economy”. It may become regular, that the supply does not meet with the ever-more specialized demand-side, and try to influence it unsuccessfully. (Hronszky and Fésüs, 2011) To avoid the emergence of “wasteful economy” there is a new kind of interaction required in the collaboration with the customers. Both the information and a large part of knowledge is now incomparably easier to obtain than in the past. (Chesbrough, 2015) However, the internet and the emergence of the variety of interactive community networks, (Bogers, Afuah and Bastian, 2010, Poetz and Schreier, 2012) the extremely rapid development of marketing research theory and practice, and the integration of knowledge into company processes are not in align yet with the specific consumer needs. Regular opening and qualitatively new practices are necessary towards other companies, suppliers, competitors and perhaps even towards the users. The global potential of "knowledge economy" is "open innovation". In relation to the published literature on innovation and economic processes, it is obvious that there is a new tendency of changing the innovation processes serving mass production. This tendency follows the basic principles of “open innovation” introduced by Chesbrough (2013). Chesbrough differentiates and compares the “closed” and “open” innovation concepts. In the closed innovation model companies strive to develop what they can by themselves, and preserve their patents from the competitors to benefit from it. In contrast to that, in the open innovation model companies consider fundamental importance to the external resources. In addition, companies sell their development on a regular basis, if they do no longer fit into their innovation strategy. (Hippel and Krogh, 2006, Dittrich and Duysters, 2007, Hronszky and Kovács, 2010, Hronszky, 2011) Considering legal aspects, Chesbrough

understood the interaction between companies as the emergence of an open market, trading with intellectual property rights till 2011. He narrows down his analysis accordingly. However, opening up the process of innovation, encouraging the in- and outflow of knowledge may emerge not solely as a result of company interactions. The active role of users or user groups can also be a source of new ideas and knowledge. (Hronszyk, 2011) At the same time, till his book was published in 2011, Chesbrough only mentions the users, whether they are part of companies or groups of users as possible sources of knowledge in the innovation process. He did not analyse the possible active role of users in the innovation process yet. However, Chesbrough in his book titled *Open Services Innovation* (2011) stressed, that the community obtain more and more knowledge and information on low cost, as a result of internet usage, while the lifecycle of products and the time required for developing the products shortens. Chesbrough in his book about services (Chesbrough, 2011) the customer is in the focus with a central role, who should be integrated in the innovation process. Reichwald and Piller (2009) and Braun et al. (2012) points out that as a result of open innovation, the time required to launch products to the market may be shortened, as well as cost-effectiveness can be increased. Trott and Hartmann (2009) explains that, by opening up the “walls” of the company, the core competence should be protected in order to avoid the core knowledge flowing it out and losing competitive edge. The fundamental part of open innovation processes is choosing the right business model (Giandiodis, Ellis, and Secchi, 2010), the identification of ideas, and their evaluation, sorting, filtering, and implementing it into the company's business model and strategy (Vanhaverbeke and Cloudt, 2014). Open innovation is a management approach and practice, meaning, that the company obtain external ideas, (Almirall and Casadesus-Masanell, 2010) then integrate them into the company's internal corporate culture and innovation process. (Giandiodis Ellis, and Secchi, 2010) (Chesbrough, 2003, West and Gallagher, 2006) The modeling of enterprise innovation processes in the case of open innovation is fundamental since it is necessary to identify existing and missing competencies of the company. (Carroll and Helfert, 2015) The company's open innovation process have to be aligned to the mission, goals and strategy of the company, corporate systems, resource allocations, knowledge management process and should be adapted also to the culture of the company. (Ibarra, Rueda and Arenas, 2015) The corporate business model applying open innovation should be developed by applying three main aspects: (a) its relevance to the objectives of the company (b) consistency with the internal corporate processes and (c) the feasibility of the open innovation model. (Rits, Schuurman and Ballon, 2015) A number of literature on open innovation deals with outsourcing, as one of the most frequently used way of collaboration, when the company

outsource the tasks, which were done internally before. (Chesbrough and Crowther, 2006) The term of open innovation, however, is not to be narrowed only for outsourcing. We should not even consider outsourcing as an essential part of the company's open innovation activity. Instead of outsourcing, open innovation means that the company work intensively, in an interactive way with its environment. (Vanhaverbeke, 2012) In the context of cooperation between the parties involved in open innovation processes, Köpcke (2008) emphasises that open innovation is based on win-win strategy (Sulaiman, Parimoo and Banga, 2016) and trust between the cooperating parties. Trust, as one of the key factors (Hossain, 2015) is particularly important in interactive value production, as high level of trust can result in a more intensive collaboration between the actors. (Akçomak and Müller-Zick, 2013) Many companies use open innovation successfully in practice, as in the development of specific products, it is essential to involve the users in the development process. (Hienerth, 2016) Fulfilling the specific needs of the user in the innovation process might also help developing products which meet the needs of other users with similar characteristics. (Jong et al., 2015) Users who participate in the development process are also willing to publish their developments. (Jong et al., 2015; Jong J, 2016) Innovation processes implemented by user-involvement do not solely target the needs of the involved users. (Gambardella, Raasch and Hippel, 2016) According to the definition given by DG INFSO: "Living Labs are open innovation environments in real-life settings, in which user-driven innovation is fully integrated within the co-creation process of new services, products and societal infrastructures. (DG INFSO, 2009, 5.) In 2006, the European Commission initiated the establishment of the European Network of Living Labs (ENoLL). The number of members was initially 19, which significantly increased, reaching the number of 406 by November, 2016. We should add to the definition of DG INFSO, that in the LL research and innovation platform (Schuurman, 2011), beside user groups, research laboratories, local institutions, policy institutions, and even investors can also collaborate (Pallot et al, 2010) Just a side note, that besides obtaining information and knowledge along with the LL, it is a further added value for the cooperating companies, that by involving users in the innovation process, their loyalty can be also increased. (Grissemann and Stokburger-Sauer, 2012) LL-based interactive value production has its place besides the well-developed and increasingly developing marketing practice. Its main reason is, that the so called "sticky" information, (Hippel, 1994) and knowledge is used by intermediators (Chesbrough and Crowther, 2006, Chesbrough and Schwartz, 2007), who "translate" information and try to use it in the innovation process. This inevitably involves substantial losses. The LL, by using interactive value production with the users solves these difficulties, but other problems also emerge in developing

cooperation. Innovation processes of the organisations shall be opened, when the benefits are higher than the advantages to keep and protect information. (Elmqvist, Fredberg and Ollila, 2009) This is an important element of the emerging practice of LLs, the product development method conducted in real environment (Balloon, Pierson and Delaere, 2005), and based on interactive experimentation. In order to produce value, companies should establish adequate infrastructure and, of course, the professional background including consultancy, as well as the tools needed for interactive value production. (Hippel, 2005a) LL is about creating a specific participative relationship (instead of mass production and customization), when there is interactive producer relationship created in the innovation process between the producers and users. This may lead to the development of products, which are better suited to the needs of the costumers. (Hronszky, 2011) However, as noted in an article published in 2013 by Anita Füzi, who correctly referred, that the definition of LLs is still evolving. (Füzi, 2013) In accordance with the theoretical concept of LLs, LLs create interactive product development relationship since the very early stage of the innovation chain, by collecting ideas of the users. In align with the definition of LLs, product development will be created in the real life miliou of the users. Based on the definition of LLs, user involvement has several levels. On the one hand, the implementation of LLs can be with minimal interactivity when carrying out testing of the products in real environment of users. The next level of involving users in the development process is driven by the users, when they initiate the development of specific product functions. The interaction between the users and the producers might last during the whole innovation process, and may be driven by the users. Therefore users can have a dominant role in the whole innovation “chain”. LL-based value production is basically the opposite of the innovation method used during mass production. (DG INFSO, 2009, Kovács, 2014) The application area of LLs are in relation to the risks reside in product development and market introduction. It is clear that the application area of LLs are essential in case of products which are not yet mature enough to be introduced to the market. The involvement of the financial resources are therefore difficult, since it is considered that they have high and unknown risk in introducing to the market. Overcoming this problem, the products should be developed interactively with user groups since the early stage of the development process. Therefore the risk of development can be decreased. Through partnerships, problems related to financing the development of products can be overcome. As a result of PPP partnerships there is a more stable institutional background behind product development. The establishment of LLs requires at least a minimum infrastructure, which is hard to create by small and medium sized enterprises. Therefore it is crucial for them to use the services provided by the LLs. Its main added value is to reach their

end-users with minimal infrastructural expenses. (Hronszyk, Kovács and Veress, 2010) The companies participating in LLs have to create their infrastructure in accordance with the requirements of user-involvement. They have to learn to integrate, evaluate and decide about the focus of product developments. (Ulwick, 2002) Accordingly, business models can vary. Hippel details the role of lead users, and based on his experiences with the lead users, coined the term "horizontal innovation communities" (Hippel, 2007) However, the literature on open innovation have not mentioned so far, and also there was no research done so far about the specific characteristics of products appropriate to be developed with the lead users. There was also no literature about the characteristics of user-involvement and the variety of motivation tools per industries in order to conduct user-involvement successfully. The online user communities can facilitate the identification of users. (Kratzer et al., 2016) At the same time, based on the work of Ulwick, Pataki (2014) draw attention to the fact, that the involvement of users has not only advantages, therefore user involvement have to be managed with significant attention. Can be one of the cons that the companies attach great importance to the user's suggestion for a minor change or for solutions that already exist on the market. The user's ideas does not necessarily constitute a solution, and will not necessarily benefit for other user groups. (Ulwick, 2002, Pataki, 2014) In the business model created by the companies, the employer's commitment on open innovation (West and Sims, 2016) and encouraging the interaction of innovation actors both inside and outside the company play an important role. (Leminen, Turunen and Westerlund, 2015) The results of open innovation are determined if the companies can align their open innovation strategy to their business model. (Saebia and Fossa, 2015) Summing up, the core of the LL conception is based on the collaboration of companies, universities, research institutes and other, relevant actors in the research and development of new products. Their collaboration enables and fosters the interested users to participate actively in the product development process, by creating the required specific conditions. As already mentioned, LL-based interactive value production is the opposite of the innovation processes of mass production. In mass production, the companies, or the partners created a prototype first, then after testing its features (maybe with the users), they started to launch it on the market. With the LL concept, users have an active role, and contribute to the development of the prototype by revealing their needs in order to solve their problems. The users are not necessarily driven by financial motivations. Motivation can be for the users, inter alia, to learn new things. (Veeckman and Graaf, 2015) It can be entertaining for them to participate in LLs, and learn new development trends. (Georges, Schuurman, Vervoort, 2016) For the users open to interactive value production, the joy of collaboration (Fuller, Jawecki and Mühlbacher, 2007),

the challenge and building social capital can be also an effective motivation tool. (Pitt et al., 2006) Companies and the group of companies create the required infrastructure and the appropriate environment for collaboration in order to develop new products with the end-users. The collaboration with the end-users will target the creation of radical innovative products. LLs are ideal to help fostering the innovation processes of small and medium sized enterprises and companies with high risks. (Coorevits and Schuurman, 2014, Schuurman, D., Marez L.D., and Ballon, P., 2016) LLs have a number of advantages. The development of products in real life milieu is one of the relevant step to develop successful products. (Niitamo, Eriksson and Kulkki, 2006) In addition, LLs allows corporate learning, which is necessary for the successful product launch. (Trimi and Berbegal-Mirabent, 2012) It is crucial to involve committed industrial actors to create and successfully manage LLs. (Almirall and Wareham, 2008) By applying LLs – as the users participate in the development stage since the beginning - , there will be more appropriate products developed, meeting the needs of the users. The time required for product development may shorten, the number of feedbacks during development decreases, and the acceptance of the product on the market is more favourable, as it is more likely, that the company develops the right product. The advantages of LLs for small and medium sized enterprises is twofold. Small and medium sized enterprises can be in the producer as well as in the user role, as partners in the development process. Participating in LLs, with a role of a producer is especially advantageous, however as a result of existing financial difficulties it requires a relatively higher effort and resources to create the required infrastructure for them. Among others things, there is a higher innovation performance achievable by the collaboration with the users, other companies and universities. (Hochleitner, Arbussà and Coenders G., 2016) The main advantages of LLs, is that the needs of the users are better understood. The collaboration results in new products, which will be easily and quickly adaptable (Fertő, Molnár and Tóth, 2016) and the innovation process can be considered more successful. (Chiaroni, Chiasa and Frattini, 2010, Köpcke, 2008) Summing up, the LL:

- Cooperation between users and manufacturers/producers, in order to optimize the product development;
- Research and development for the utilization of products and the market opportunities;
- Experimentation with a user community where a theoretical scenario is tested regarding a product development concept;

- Evaluation and concept development regarding the products, considering ergonomic, economic and technical criteria. (Hronszky, 2011a, 2011b)

### **c) Previous research results**

The preliminary researches of the doctorate research were the Hungarian and international researchers targeting the practice of open innovation and interactive value production in Hungary and three member states of the Visegrád region.<sup>2</sup> The analysis covering Hungary had the result, that at the time of the research in 2011, LLs were in initial phase of development. One of the most important task of the Hungarian project was the setting up of an open innovation portal, which was hindered by the lack of trust, even if the legal background was established and there was a stable institutional and legal background behind the project. In contrast to the international experiences, there is a negative or sceptical attitude of SMEs on collaboration and the advantages of open innovation in Hungary. It hinders their participation in open innovation initiatives. Citing the final report of the Central Hungarian Innovation Centre: “In summary we can say that the results of the citizen juries allow the conclusion that the concerned Hungarian society is not really ripe to embrace the open innovation initiative, recently. The same time we can conclude that with appropriate and targeted consultation change in their behaviour can be effectively promoted. We have to develop the legal regulation frame to the working of open innovation initiatives that works abroad quite smoothly. We have to transform that for us, solve the problem that the open innovation conception could fit the Hungarian society.” (Hronszky, 2011b, 14-15. pp.) In connection with the LLs, little is accomplished in Hungary, while the application of the concept is spreading rapidly in Europe. In addition to these projects, establishing the PhD research, there were no other projects in the subject of the PhD research in Hungary. However, a number of researches were done abroad on analysing the users’s role, related to the industry-specific analysis of the PhD research.

Wüstenhagen, Wolsink and Bürer (2007) emphasizes, that the products using renewable energy sources requires special attention in terms of developing products. They highlight the importance of social acceptance in order to foster sales. Establishing and maintaining social acceptance requires the collaboration of all actors in the industry. The importance of the more active role of the users in innovation is confirmed also by the former researchers of the IFZ institute settled in Graz. Ornetzeder and Rohrer (2006), mentions, that: „...*under certain conditions a higher degree of user involvement or self-building groups might lead to a*

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<sup>2</sup> Funded by the International Visegrad Fund, the working mechanisms and results of LLs were analysed in Poland, Slovakia and Hungary. The company coordinating the research was the Central Hungarian Innovation Centre in Hungary.

*successful mode of innovation which has often been neglected and which could contribute to the design and diffusion of certain energy technologies.*” (Ornetzeder and Rohracher, 2006, 139. pp.) Heiskanen and Lovio (2010) studied the interaction between the users and producers in the field of Finnish, energy-related developments. As a result they confirmed, that the involvement of users has a high added value to foster the acceptance of technologies using low level of energy. They also emphasize, that the knowledge in the innovation process should come from several sources, even from the side of the users. Producers have to manage to channelize this knowledge, information into the development processes. (Heiskanen and Lovio, 2010) This requires the collaboration of all company departments. (Sloane, 2011) The significant institute dealing with innovation-related research, „ZSI – Zentrum für Soziale Innovation” conducted a research in the field of innovation, and mentioned: *“From our point of view the market success of sustainable products should rather be achieved by involving users and other relevant social groups as early as possible and by considering their ideas in the design, than by marketing campaigns in the dissemination phase. From this perspective it is of crucial importance that future innovation processes consider not only ecological criteria (...) but also social aspects.”* (Ornetzeder et al., 2008, 3. pp.) The results of researches conducted in the topic resulted, that the role of users in renewable energy innovation is in align with the global trends, (Leitner, Warnke and Rhomberg, 2016), so it is changing, and the role of users is ever dominant in the development of new products and their optimization to each other. Enhancing energy efficiency and developing the renewable energy industry is a special economic development area not only for Hungary. In my point of view, the added value of LL-based interactive value production should be used with high importance in this industry. Therefore, building on the research results on the innovation processes of the renewable energy industry, I attempted the industry-specific analysis of LL-based interactive value production in my dissertation.

## **2. Objectives**

On the basis of the results of the researches executed before the doctoral research, it was clear that the clarification of the concept and practice of LLs requires further research with two basic reasons. One of the reasons, that the added value of LL-s for small-and medium-sized enterprises is indisputable because of their growing importance in employment and value production. Therefore, it is important to analyse the added value of LLs, as an economic development concept in the development of small and medium sized enterprises in Hungary. The results of researches done in the Central Hungarian Innovation Centre, that the enterprises in Hungary are not open and they are not ready yet to participate in open innovation

initiatives, in LLs. The doctoral research aims to uncover the problem and attempt to propose a solution, on how companies could open up, along with their development. In addition, based on the domestic and international experiences, I considered the clarification of the concept, exploring the application area and added value of LLs especially important for the Hungarian small and medium sized enterprises. Another reason for the choice of this topic is attached to the added value of the renewable energy industry, and the analysis of the added value of the industry-specific analysis of the LL concept. In Hungary, and in the whole European Union it is a priority to increase energy efficiency and to promote the use of renewable energy sources. Consequently, LLs may have significant added value in the development of energy efficiency as a central topic in economic development. Unfolding the potential added value of LL-s for our country and to explore the concept with industry-specific analysis of the renewable energy industry, therefore, it is also a top priority. Based on the results of the Hungarian and international researches, carried out before the start of the doctoral research, the research question was formulated, as why there is an obvious contrast between the wide spread of the method and the application of the concept and its failure in Hungary (and in Central and Eastern Europe). Especially the Hungarian research provided inspiration and inputs to start the PhD research. The researches done abroad gave inputs to formulate an industry-specific analysis, especially for the renewable energy industry. I used only these results of the preliminary researches. The research consisted of three parts. The first part highlighted the added value of the LL concept by pursuing a critical analysis on the literature of open innovation and LL-based interactive value production. The forms of open innovation including the role of users in the innovation process are also part of this analysis. This analysis was extended by the relevant aspects of interactive value production in the renewable energy industry. The literature analysis was closed with a critical analysis on the literature of open innovation and LLs, highlighting on the shortcomings and the importance of the research. The next part of the research dealt with a questionnaire survey targeting the members of the European Network of LLs (ENoLL). The research highlighted the operation and results of LLs, which aligns with the research objectives. In the following, the research identified the necessary conditions to create LLs in Hungary, as well as its possible added value and the possibilities to foster the emergence of LLs, as an innovation concept in Hungary. For this purpose, by using structured expert interviews, the possibilities to create and apply LL-based interactive value production, the attitude of potential participants and their initiatives were analysed. The research targeted an analysis of enterprises active in the field of renewable energy in the Styrian region. It aimed to clarify, if the innovation process of industrial actors opens up towards open innovation, especially to LLs. The research

continued with an analysis on the Hungarian companies, then the Austrian and Hungarian research results were compared. The research had the following aims:

- a) Analysis on the literature of LLs. Analysis on the evaluation method of LLs, and providing suggestions for their development.
- b) To determine the possible added value of LL-based value production in the renewable energy industry.
- c) To determine whether LL-based value production might foster the utilization of renewable energy sources in Hungary.
- d) To determine whether the creation and sustainable operation of LL-based value production has any hindering factors in Hungary. If so, determine these factors.

### **3. Research methods**

The research was built on continuous literature analysis and participation in international conferences, where the actualities of the topic could be followed. The industry-specific analysis was launched by interviews done with the LLs, through phone or Skype, and a desk research and literature analysis. Subsequently, in the spring semester of 2012, I made a research with the professional support of the institute IFZ - Inter-University Research Centre for Technology, Work and Culture<sup>3</sup>. I have prepared structured expert interviews personally with the local, relevant institutions, with the majority of the cluster members of Eco World Styria. Building on the Austrian experiences, the interview series was continued in Hungary. The organizations with the same profile were targeted with structured expert interviews conducted in person. The research questionnaire targeting the ENoLL members focused on the analysis of the specifications of working LLs, among others the methods of product development and user-involvement. The closing part of the Hungarian research dealt with the evaluation of the questionnaires, and with targeting innovation experts about the topic in Hungary. I took into account the findings of the innovation specialists without mentioning their names. The interviews were needed in order to confirm the Hungarian research results on the low acceptance of open innovation and LL-based interactive value production in Hungary. The structure and details of the research are summarized in the 1. Table.

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<sup>3</sup> The research was conducted by the professional support of the institute “IFZ - Inter-University Research Centre for Technology, Work and Culture”, settled in Graz, Austria. The research was done in the period of January – April, 2012. The funding agency of the scholarship: ”Austrian Agency for International Cooperation in Education and Research, Centre for International Cooperation and Mobility, Austria” (<http://www.oead.at/>). Scholarship ID: ICM-2011-03428

1. Table: Research structure

Research	Statistical population	Data sample	Research method	Number of the related hypotheses	Related paragraph in the dissertation
<b>Analysis on the operation of LLs I.</b>	354 <sup>4</sup>	52	Questionnaire	1	4
<b>Analysis on the operation of LLs II.</b>	29 LLs working in the field of “energy”.	29, so all LLs were analysed, but only 5 organizations could be targeted with structured expert interviews.	Desk research	2	4
<b>Industry-specific analysis I. - Austria</b>	59 organisations	30 organisations	Structured expert interviews	2	5
<b>Industry-specific analysis II. - Hungary</b>	32 organisations	12 organisations		2,3 Research questions	6
<b>Analysis on the evaluation methods of LLs</b>	Methods used by ENoLL	Desk research		4	7

The structured expert interviews followed the logic of the LL Harmonization Cube (Mulder, Velthausz and Kriens, 2008), as the basic method to evaluate and compare LLs. The research planned and executed by the professional support of the institute IFZ, were built on a qualitative research. Of course, relying solely on qualitative assets cannot be reliable to accept or disprove a hypothesis. At the same time taking into account the specific features of the investigated theme, I considered the qualitative research method the most suitable. The reasonableness of the qualitative research:

The LL-based interactive value creation can be considered as a new area of scientific research, therefore it should be analysed with structured expert interviews targeting company representatives. In the frame of interviews, the misunderstandings, definitions, details of the concept can be cleared, and new research questions may arise during the interviews. The basic reason of this, is that a CEO of a company can not be aware of such a new and evolving concepts of innovation, like LLs. Therefore, it was necessary to specify the relevant components of the

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<sup>4</sup> ENoLL had 354 members in 2014, however the questionnaires were received only by 314 e-mail addresses. It is supposed, that the majority of members do not conduct any activity.

research. In the case of a questionnaire, a query supported by mathematical or statistical methods, might lead to erroneous, misleading results, even if filling in the questionnaire happens with the presence of an expert. On the one hand, the survey refers to the level of user-involvement, and on the other hand, it refers to the openness of the company.

By using solely quantitative tools the current attitude of the companies can not be revealed reliably. The Cramer-indicator was additionally used, in order to summarize the answers and reveal association between the answers. The Cramer-indicator can be used to measure association between two nominal variables. Its value is between 0 and 1. The value is 0 if there is no connection between the two criteria. Its value is 1, if there is association between the variables. (Kerékgyártó, Mundruczó and Sugár, 2003) Based on the research I draw conclusions, only if there was a close association, or there was no independence at all between the variables. The already operating LLs were targeted by questionnaires, which contained clear questions about the working model of LLs, therefore the analysis could be performed reliably by simple quantitative methods.

#### **4. New scientific results**

One of the novelties of the doctoral research, is that the LL theme is analysed in an industry-specific approach. A theoretical framework was elaborated, which can be applied to the industry. This framework can be used for the purpose of a comparative analysis, in order to identify the drivers of interactive value creation. The research identified the attitude of the economic actors on interactive value production, the initiatives on LL-based interactive value production, and the relationship of the institutions with the users. In accordance with the objectives set at the beginning of the research of the thesis, the added value of LL-based interactive value production was determined in the renewable energy industry. A relevant part of the research was done in a well developed industrial area, of the province of Styria, Austria. Then it was continued in Hungary, aligned to the specifications of the industry. There is a different attitude in Hungary and in the Styrian region of Austria for LL-based interactive value production. The difference resides in the Hungarian innovation practice and culture, the low level of trust between the economic actors and the lack of openness of the enterprises. It is obvious therefore to involve the government to solve these hindrances. This is especially important in areas where social innovation is in focus. However, the role of the government should be limited in fostering the operation of LL-s. In addition to the regulatory role of the government, the enterprises have to foster the implementation of the open innovation approach, with a focus on its business sustainability. Therefore the added value of LLs can be utilized on

a long run. The business model of the companies have to be aligned to the internal operation of the company, its aims, and the specifications of the products as well. In the literature of LLs, the Harmonization Cube method to evaluate the activity and development level of the LL organization has a significant role. Building on the Harmonization Cube method, a new method was introduced in the dissertation, which is appropriate to neglect the industry-specific aspects when evaluating and comparing LLs. The added value of the method was introduced by the analysis of the user-involvement aspects of a LL active in city development. As a result of analysing the hypotheses the following theses and the related publications were concluded. (The related publications are numbered referring to the publication list detailed in the 7. paragraph)

- 1. Thesis:** The LLs currently operating were established and is currently financed by building on national and EU resources. The LL organizations participating in the survey choose consciously and foster to involve significant number of users in the development process. Their aim is to make feasible the high-quality development with high number of users involved. The involvement of users in the majority of cases aims in particular the design of user-friendly products. The target of development is also the effective functioning of the products, as well as fitting and aligning them into the already existing products of the user. *Related publications: [1][2][4]*
- 2. Thesis:** LLs, -although it is limited due to the particularities of products-, have fundamental relevance in the development of the renewable energy industry by the development of products utilizing renewable energy sources. Their aim is in particular urban development. They are designed to increase energy efficiency, user-friendliness and creating the commitment of the users to renewable energy products. The active role of the users is observable in the innovation process in the Styrian region, with high consumption of renewable energy. With the analysis method the attitudes of companies towards interactive value creation and their related individual practice can be assessed. *Related publications: [2][3][5][6][8]*
- 3. Thesis and answer for the research questions:** The establishment, economically efficient and socially relevant working of LL-s have particular obstacles in Hungary. The enterprises have low level of innovation activity. The role of users in the innovation process is basically passive, companies do not foster to expand the role of users as well. In contrast to the results of the Austrian research, the Hungarian companies have a low level of trust, which is not sufficient enough to carry out product development in the

frame of interactive value production. The added value of the LL concept could be used in the field of business development and innovation management. Related publications: [2][4][7]

- 4. Thesis:** The analysis of LLs, the more objective evaluation of their development level irrespective of their industry specifications were not reliable with the already existing methods. In order to measure their development level, by using the new scale for assessing the already existing methods, the existing methods can be harmonized. Specifying the evaluation criteria there is an independent value (score) derived for comparing LLs. By evaluating the components of the score, the steps to develop the LLs can be defined. The score may provide a supporting indicator for economic development actions, in order to target the development of LLs with the most appropriate measures. *Related publications: [1][2][5][9][10]*

## **5. Exploitation of the results**

It is essential to implement the open innovation approach and concept into the education of the theory and practice of innovation, basically in the higher education of technology and economics. In addition, it is also necessary to raise awareness of the potential stakeholders on the opportunities. The literature of open innovation, especially the literature of LLs, deals with the fact, that the enterprises have to modify their business model in order to integrate the ideas stemming from the end-users. (Kima, Kima and Fossb, 2016) By transforming the already existing methods for the evaluation and comparison of LLs, we can give support and guidance for the small and medium-sized enterprises to apply interactive value production effectively. Therefore open innovation and LL-based interactive value production is a current and important development area. As a result of the research, the main actors of the industry, and their role in interactive value production were determined.

The practical application of the research results is primarily in the practice of installation and operation of renewable energy products. In addition, the research results can be used in education (e.g. at universities, at companies and private training of economic organizations), and as a guideline for the government to develop economic and enterprise development policies.

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## **7. Scientific publications related to the theses**

1. Kovács, K. (2016): Improving assessment of user-involvement in Living Labs, E-bulletin - Submitted for publication
2. Kovács, K. (2015): Evaluation and Practice of Interactive Value Production in Living Labs, *Periodica Polytechnica, Social and Management Sciences*, Budapest, Vol. 24, No. 1 (2016), pp. 52-59. /**MTMT:1**

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## **8. Further scientific publications**

11. Katalin Kovács (2012): Open innovation in the Styrian renewable energy sector; IAS-STS Annual Conference; Graz, 7 May, 2012
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