Proceedings of the Digital Living Lab Days Conference 2021

Change the future together:

Co-creating impact for more inclusive, sustainable & healthier cities and communities

European Network of Living Labs

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“Change the future together: Co-creating impact for more inclusive, sustainable & healthier cities and communities”

The “Call for papers” encouraged contributions from three different paper categories to stimulate a diverse participation of actors: ‘Full Research Papers’ providing consolidated scientific research, ‘Practitioners Presentations’ showing case studies from a practitioner perspective and ‘Research in Progress papers’ presenting relevant preliminary results.

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Monday, 6th September 2021

14:30 – 16:15 CEST

Full Research Paper

Urban Living Labs: Pathways for Sustainability Transitions to Innovative City System from Circular Economy Perspective

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Abstract

There is a growing trend to involve citizens in city development to make urban areas more adaptable to citizen needs. Urban Living Labs (ULLs) are progressive transitions as an explicit form of intervention delivering sustainability goals for cities. We believe that the ULLs can be configured as a pathway for sustainability transitions (ST) to innovative city systems. Based on this statement, our question of this paper is: how could ULLs become pathways for ST to innovative city systems from a circular economy perspective? Our research design was divided into three steps: selection, multiple correspondence analysis, and content analysis coding process to attain this research question. As a result, the triangulation analysis based on these methods, we found that in the multiple correspondence analysis and the content analysis of the articles emerged similar categories (pathways) such as: knowledge production, policymaking, co-creation, geographical embeddedness, urban transitions, networks of cooperation among institutions, culture change, and collaborative engagement. Furthermore, when comparing the results found by three different technics, we can see a trend pattern. This means that all of them are related to the same extent with the concepts of ST, CE, and ULLs.

Key words

Urban Living Labs. Sustainability Transitions. Circular Economy. Multiple Correspondence Analysis. Content Analysis

Introduction

Cities are places with an increased urgency for sustainability transitions and system innovations (Fuenfschilling et al., 2018). There is a growing trend to involve citizens in city development to make urban areas more adaptable to citizen needs. It is important to look ahead in considering the consequences of, for example, climate-related problems in the cities, such as air pollution, flooding, etc., and at the same time, considering the social implications of the solutions that we built in our urban areas. With the grand societal challenges and urban complexity, cities require multiple and interdisciplinary approaches to face them (Chronéer et al., 2019; Ersoy & van Bueren, 2020). To address such complex problems, we must involve not only citizens but also companies, research communities, educational organizations, and the public sector to collaborate towards shared solutions. The Urban Living Lab might be the answer to these kinds of challenges.

In this paper, the concept of ULLs is understood as progressive transitions as an explicit form of intervention delivering sustainability goals for cities and communities. ULLs can even be defined as an ecosystem for innovations. "They are useful spaces to developing new products and services, applying methods to that people participate into the development process as users and co-creators, to explore, examine, experiment, test and evaluate new ideas, scenarios, processes, systems, concepts and creative solutions in complex and real contexts" (Bulkeley et al., 2017; p.13).

In this perspective, Chronéer et al. (2019) say that ULL aims to generate sustainable innovations and solutions in the city-systems in light of the urban sustainability transitions. And the ULL can be placed within the changing dynamics of urban challenges, during which experimentation is used to inform urban practice (Ersoy & van Bueren, 2020) and has become a prominent form of sustainability experimentation across Europe (Bulkeley et al., 2019).

The concerns about urban sustainability experimentation have been driven both from urban studies and by those in the transition studies community who have begun to attend to the city as an important arena within which sustainability transitions are forged and contested (Bulkeley et al., 2019). Based on this context, what role does ST play when it comes to ULLs? ST is directly associated with socio-technical transitions. To Geels (2005), transitions are at the level of societal functions. Thus, they consist of a change from one socio-technical system to another. The idea is to promote a socio-technical city system associated with a circular economy perspective because, according to Prendeville et al. (2018), the circular economy is a productive concept driving sustainability transitions in cities. As such, Geissdoerfer et al. (2017) say that the CE is a regenerative system in which resource input and waste emission and energy

leakage are mitigated by slowing, closing, and narrowing material and energy loops. These can be achieved through durable design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling.

Based on the literature review, the question is: how could Urban Living Labs become pathways for sustainability transition to innovative city system from a circular economy perspective? It aims to characterize how Urban Living Labs could become pathways for sustainability transitions to innovative city-systems from a circular economy perspective. Several literature reviews on living labs have been published (Schuurman et al., 2015; Hossain et al., 2019; Greve et al., 2021); however, no evidence could be found in reviews of Urban Living Labs.

To address this question, the following sessions describe the methodology selected and used to perform the extensive literature review, including the quantitative bibliometric analysis and the qualitative content analysis of the literature bodies, and the result of such analysis, which is further discussed additional conclusions are drawn.

Methodology

This study analyses the linkages between the concepts of Urban Living Labs that could become pathways for sustainability transitions to innovative city-systems from a circular economy perspective in the scientific literature. Our research design was divided in three steps: selection; multiple correspondence analysis; and content analysis coding process (titles, keywords, abstracts, and the discussion and conclusions).

Selection

We will explore three major theoretical concepts in this section, Urban Living Labs, Sustainability Transitions, and Circular Economy in cities. Within the database of Web of science® and Scopus®, we started to construct the literature review. The keyword to start the searching was Urban Living Labs, Sustainability transitions, Circular Economy, and cit*. According to table 1, we present the number of articles found in the search, and we will present the major aspects of each one of them. We did the search on July 5th of 2020.

Table 1. Number of articles found in the databases. Sources: authors, 2020

Keywords	Number of articles	
	Web of Science	Scopus
Urban Living Labs	37	64
Urban Living Labs and Sustainability Transitions	11	12

Urban Living Labs and Circular Economy	14	15
Sustainability transitions and Circular Economy	22	25
Sustainability transitions and Circular Economy and Cit*	1	4
Urban Living Labs and Sustainability transitions and Circular Economy		1
Full-text articles assessed for eligibility	22	

The criteria we applied to consider the articles for state of the art should include concomitantly in each article: urban living and sustainability transitions; Urban Living Lab and circular economy; and sustainability transitions and circular economy. Based on these criteria, we were able to select 22 articles. However, when we applied the criteria Sustainability transitions and Circular Economy and Cit*; and Urban Living Labs and Sustainability transitions and Circular Economy, the article that appeared was discard because they were already selected in the previous set of criteria. Additionally, those articles that did not meet this set of criteria were not considered for this literature review.

Multiple correspondence analysis

The following analysis step was multiple correspondence analysis (MCA), an exploratory multivariate technique for the graphical and numerical analysis without any restrictive assumption (Cuccurullo et al., 2016). Aria & Cuccurullo (2017) state that MCA performs a homogeneity analysis of an indicator matrix to obtain a low-dimensional Euclidean representation of the original data. In co-word analysis, MCA is applied to a Document x Word matrix A. While variables are keywords, the individuals observed are the papers. The keywords are plotted on a two-dimensional map.

We performed our MCA using also a set of illustrative variables, i.e., papers publication periods, to analyse the field evolution. Assuming that the most cited papers are more representative of the structure of the field, we performed MCA considering the weight (citations per year) assigned to the papers. The output was a map, according to a number of factorial axes selected (5 clusters). Given the different approaches used to select factors in literature (prefixed number between 2 and 4; eigenvalue method; screen test), we finally agreed on the choice of the first factorial plan (Axis 1 and Axis 2). The results are interpreted based on the relative positions of the points and their distribution along the dimensions; as words are more similar in distribution, the closer they are represented in the map (Cuccurullo et al., 2016).

Content analysis coding process

We did the coding process of all papers through four stages. First of all, we read the articles. Then, the thematic trends (categories) were identified from titles, keywords, abstracts, and the discussion and conclusions. In the third stage, we selected the context unit that represented the thematic trends. Finally, we created an excel file in which we included: Categories, Register Units, Authors, and Findings and Conclusions, to became our analysis matrix to address how could Urban Living Labs become pathways for sustainability transition to an innovative city system from a circular economy perspective.

RESULTS AND DISCUSSION

MCA: exploring expanded concepts

Figure 1 presents the multiple correspondence analysis of the articles' keywords. The point size is proportional to the macro keyword fundamental contribution. The proximity between keywords corresponds to shared-substance: keywords are close to each other because many articles treat them together; they are distant from each other when only a small fraction of articles discuss these keywords together. For instance, in the case of the laboratories domain (blue cluster), 22 articles constructed the factor related. By the same token, it indicates an immediate correlation with the categories found through the content analysis.

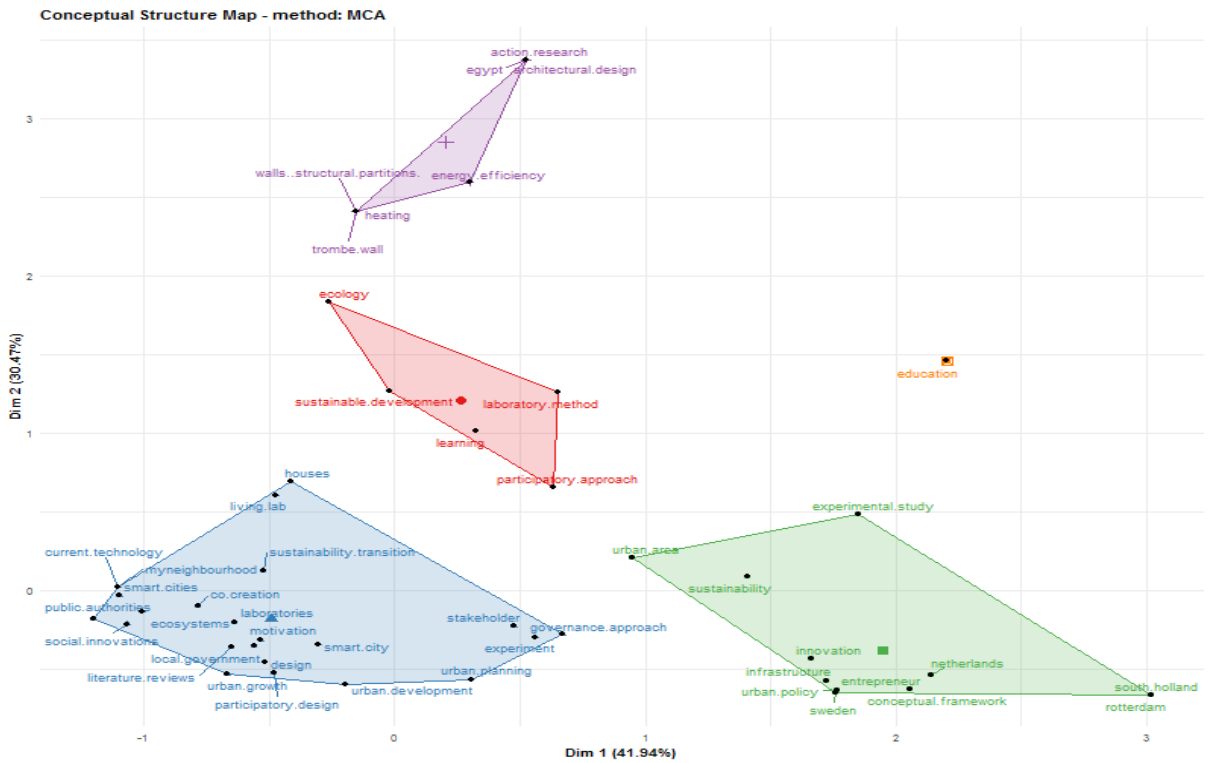

Figure 1. MCA of ULL, ST and CE. Source: authors, 2020

In the innovation domain (green cluster), 12 articles were involved, representing correlations with content analysis categories. The sustainable development domain (red cluster), with five articles, contributed to identifying the content analysis categories. The education domain (yellow cluster) appears in 1 article only. And finally, the purple domain does not specify any domain and indicates some factors do not have immediate connections with this subject of research.

Content analysis: Pathways for sustainability transitions to innovative city system from circular economy perspective

To address this research question, how could Urban Living Labs become pathways for sustainability transition to innovative city systems from a circular economy perspective? We identified eight categories that characterized pathways for sustainability transitions to innovative city systems from a circular economy perspective. They are Knowledge production, policymaking, co-creation, geographical embeddedness, urban transitions, a network of cooperation among institutions, culture change, and collaborative engagement. They will be presented according to the frequencies of articles that contribute to compose them.

According to 16 papers of the literature review, knowledge production is the first one that gave evidence to be a pathway to become sustainability transitions to innovative city systems. In the Knowledge production pathway, we identified five different indicators: transferring of knowledge, diffusion of knowledge, co-creation of knowledge, learning environments, and contextualized knowledge.

The first indicator that we classified was “transference of knowledge”. Schaepke et al. (2018, p.85) argue that ULL might produce “transferability of results, as well as scientific and societal learning and reflexivity”. Also, Amenta & van Timmeren (2018, p.21), explain that ULL “[…] allow for the improvement of waste management and for the revalorization of wastescapes in collaboration with all potential stakeholders”. And finally, Dąbrowski et al. (2019, p.59) say that “[...] the process of knowledge transfers […] taking place within a network of living labs set up to develop experimental solutions and regional strategies for circular economy.” in this sense, we can affirm that, according to literature review one indicator inside knowledge production that Urban Living Labs could become pathway for sustainability transition to innovative city system from circular economy perspective.

Another indicator of knowledge production found in the literature review is “diffusion of knowledge”. Von Wirth et al. (2019, p.229), argue that the ULL are environments that can contributes to the “[…] diffusion of innovations and know-how developed within ULL”. Also, Wright et al. (2018, p.327) says that the ULL can play a “[…] critical role played by government in facilitating and leading sustainability transitions and

contributes to our knowledge of sustainable innovations more broadly". In same token, it can build pathway to "[…] fosters reflexivity for both theory and practice in order to better understand how theorizations and the application of circular economy could be advanced in support of urban sustainability transitions" (Fratini et al., 2019, p.974). It means that, the diffusion of knowledge is one indicator of knowledge production, a pathway for sustainability transition to innovative city system from circular economy perspective.

"Co-creation of knowledge" was identified as another indicator of knowledge production. Frantzeskaki et al. (2018, p.1045) contend that Urban Living Labs can contributes "[…] by co-producing knowledge on new practices and new relations between people and place […] As such, Urban Living Labs facilitate urban sustainability transitions." In the same line, Levenda (2019, p.1) affirms that, an ULL has "the potential of active co-production, and instead relies on the delegation of responsibility for action to a constrained assemblage of smart technologies and smart users". In summary, it became evident that co-creation of knowledge is one indicator of knowledge productions' pathway that contributes to work as ST to became circular city system.
"Learning environment", is also an indicator of knowledge production found in the literature review. According to Koop & van Leeuwen (2017, p.385), says that an ULL works as learning environments "[..] to enhance city-to-city learning and to improve governance capacities necessary to accelerate effective and efficient transitions towards water-wise cities". As a result, learning environment is an essential indicator in which from knowledge productions derive from as pathway that produces sustainability transitions in circular The first indicator that we classified as "transference of knowledge." Schaepke et al. (2018, p.85) argue that ULL might produce "transferability of results, as well as scientific and societal learning and reflexivity." Also, Amenta & van Timmeren (2018, p.21) explain that ULL "[…] allow for the improvement of waste management and the revalorization of wastescapes in collaboration with all potential stakeholders". And finally, Dąbrowski et al. (2019, p.59) say that "[...] the process of knowledge transfers […] taking place within a network of living labs set up to develop experimental solutions and regional strategies for circular economy." in this sense, we can affirm that, according to literature review one indicator inside knowledge production that Urban Living Labs could become a pathway for sustainability transition to innovative city system from a circular economy perspective.

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order to better understand how theorizations and the application of circular economy could be advanced in support of urban sustainability transitions" (Fratini et al., 2019, p.974). It means that the diffusion of knowledge is one indicator of knowledge production, a pathway for sustainability transition to innovative city system from a circular economy perspective.

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"Learning environment" is also an indicator of knowledge production found in the literature review. For example, according to Koop & van Leeuwen (2017, p.385), says that an ULL works as a learning environment "[..] to enhance city-to-city learning and to improve governance capacities necessary to accelerate effective and efficient transitions towards water-wise cities". As a result, the learning environment is an essential indicator of knowledge productions from a pathway that produces sustainability transitions in a circular city system.

As says in the literature review, "network knowledge" is another indicator of knowledge production. Amenta et al. (2019, p.14) explain that an ULL can collaborate to build a pathway "[…] based on the principles of circularity which […] constitute new networks of cooperation that can help overcome institutional lock-in situations". Consequently, network knowledge is an indicator of the knowledge productions pathway for sustainability transitions in a circular city system.

Another indicator of knowledge production brought from the literature review is "Contextualized knowledge." Puerari et al. (2018, p.14) affirm that the products, services, social connections, and/or knowledge produced in an ULL need to be adopted and shared by communities and citizens by turning on "[…] ambivalent role of contextualized knowledge and the implications for sustainability transitions" Puerari et al. (2018, p.14). Being evidence, Contextualized knowledge is a key indicator of the knowledge productions pathway for sustainability transitions in a circular city system.

Another indicator of knowledge production identified in the literature review is "monitoring use knowledge." Sharp & Salter (2017, p.1) affirm that ULL "[…] could be benefited from clearer agenda setting and continuous monitoring to feedback results". Monitoring use knowledge is an indicator of the knowledge productions pathway for

sustainability transitions in a circular city system. In summary, according to the literature, Knowledge Production involved various multidisciplinary indicators that work together to provide systematic solutions in context inside the ULL. Furthermore, it was identified as the major pathway for sustainability transition to an innovative city system from a circular economy perspective.

Policymaking was the second pathway. Inside this pathway, we identified three different indicators: References to a transformative agenda setting, policy instruments, and policy applications can be undertaken as a pathway for sustainability transitions to innovative systems of cities.

The first indicator that we classified in the literature review about policymaking is "References to a transformative agenda-setting." Frantzeskaki et al. (2018, p.1045) say that ULL "[…] can connect a sense of change (transformation) with a sense of place by co-creating new narratives of place […]". So also, Bulkeley et al. (2016, p.16). explain that an ULL considers "[…] as particular governance projects provide one means through which to conceptualise their role in transformative change". And Wright et al. (2018, p.327) explain that the ULL, "[…] sheds new light on the critical role played by government in facilitating and leading sustainability transitions". So, it means that the References to a transformative agenda setting is an indicator of policymaking, a pathway for sustainability transition to an innovative city system from a circular economy perspective.

Another indicator of policymaking identify in the literature review is "Policy instruments." Mukhtar-Landgren et al. (2019, p. 727), ULLs "[…] are strongly related and extensively used as policy instruments by municipalities", and Fratini et al. (2019, p.974) say that ULL has a "[..] research agenda that explores the relationship between the political and the epistemic domain of existing urban translations of circular economy across scales and places". As a result, Policy instruments work to develop policymaking as a pathway that produces sustainability transitions in a circular city system.

"Policy applications" is another indicator of policymaking identifies in the literature review. For example, in the narratives of Levenda (2018, p. 63; 2019, p1); the ULL developing opportunities to support the local government, private sector, academia, and communities addressing these efforts to systems like urban sustainability, renewable energy, and ecosystems of entrepreneurialism. in this sense, we can affirm that, according to the literature review, policymaking is a pathway for sustainability transition to innovative city system from a circular economy perspective.

Co-creation is the third pathway found as a pathway for sustainability transitions to an innovative system of cities. Inside this pathway, we identified two different indicators, such as Co-creation approaches and new narratives of cities. The first indicator that we

classified is "Co-creation approaches." Puerari et al. (2018, p.1) identified in the ULL "[…] distinct types of co-creation elements that relate to specific dynamics of participation, facilitation, and organization […]". Also, Amenta et al. (2019, p. 14) say that the ULL "in the co-creation approach […] every stakeholder is involved in the definition of EIS and strategies that aim at improving the quality of life […] based on the principles of circularity, is experimented and tested".

However, the ULL has been "[…] allowing for a more sustained process of co-exploration of the status quo, co-creation of knowledge, and co-production of solutions and strategies" (Arciniegas et al., 2019, p.49). Even though, Levenda (2019, p.1) says that the ULL has "[…] the potential of active co-production, and instead relies on the delegation of responsibility for action to a constrained assemblage of smart technologies and smart users". It means that smart technologies and smart users can construct new products or services for the city system. As a result, the co-creation approach is a fundamental indicator of the co-creation pathway of sustainability transitions in a circular city system.

The second indicator of Co-creation identified in the literature review is "New narratives of cities." New narratives of cities are committed to becoming listening institutions, creating authentic speeches and two-way relationships to gather local knowledge and aspirations to transform cities. Frantzeskaki et al. (2018, p. 1045) affirm that ULL can connect "[…] by co-creating new narratives of place, by co-producing knowledge on new practices […]".

Amenta & Van Timmeren (2018, p.21) say that the ULL "[…] have the potential to be the virtual and physical environments in which experimenting the collaborative co-creation process […] demonstrate the need for circular regeneration of wastescapes as an innovative process that can eventually lead to healthier cities with a higher quality of life". As an effect, new narratives of cities are an important indicator of the co-creation pathway for sustainability transitions in the circular city system. In summary, we can affirm that, according to the literature review, Co-creation is also a pathway for sustainability transition to an innovative city system from a circular economy perspective.

Geographical embeddedness is the fourth category that can be considered a pathway to become sustainability transitions to innovative city systems. Inside this pathway, we identified three different indicators: Geography for quality of life, integrated relational spaces, and a sustainable and desirable city system. The first indicator that we classified is "Geography for quality of life." According to Voytenko et al. (2016, p.1), ULLs "[…] are emerging as a form of collective urban governance and experimentation to address a range of sustainability challenges experienced in cities and urban areas and to capture opportunities created by urbanization".

Moreover, Amenta & Van Timmeren (2018, p.21) affirm that through ULL "[…] the spatial challenges related […] the need for circular regeneration of wastescapes as an innovative process that can eventually lead to healthier cities with a higher quality of life". Thus, to be planned in its spatial and social dimension, Geography for quality of life works in two directions – social and economic. As a result, Geography for quality of life is a fundamental indicator of the Geographical embeddedness pathway for sustainability transitions in a circular city system.

The second indicator of Geographical embeddedness identified in the literature review is "integrated relational spaces." Integrated relational spaces are composed of relations between objects. For example, Arciniegas et al. (2019, p.49) explain that ULL "[…] provides a relational space including stakeholders in a structured process in a specific location, spanning over a longer time period". And Dąbrowski et al. (2019, p. 59) say that ULL "[…] develop experimental solutions and regional strategies for circular economy […] investigate how the solutions changed as they "travelled" through the relational space […]. Consequently, integrated relational spaces are a fundamental indicator of the Geographical embeddedness pathway for sustainability transitions in a circular city system.

"Sustainable and desirable city systems" is the third indicator of Geographical embeddedness showed by literature. For example, Koop & Van Leeuwen (2017, p.385) say that ULL as a "[…] regional platforms of cities are needed to enhance city-to-city learning and to improve governance capacities necessary to accelerate effective and efficient transitions towards […]". Also, Fratini et al. (2019, p.974) affirm that "circular economy imaginaries can support transformative pathways for socially inclusive and environmentally desirable value creation in cities." This sustainable and desirable city system is a fundamental indicator of the Geographical embeddedness pathway for sustainability transitions in the circular city system. In short, it is understood that Geographical embeddedness is a pathway for sustainability transition to an innovative city system from a circular economy perspective.

Urban Transitions are considered as another pathway to became sustainability transitions to innovative city systems. Inside this pathway, we identified two different indicators, such as Environmental transitions and societal transitions. The first indicator that we classified is "Environmental transitions." Sharp & Salter (2017, p.1) affirm that ULL "[…] utilise the operational processes of transition management to support experiments […]" in city systems.

Additionally, Beecroft (2018, p.1) says that, the ULL "[…] focusses on one transition process rather than a multitude of interventions." Also, Amenta & Van Timmeren (2018, p.21) sustain that ULL "[…] have the potential to be the virtual and physical environments in which experimenting the collaborative co-creation process […]". And

Greer et al. (2020, p.1) say that ULLs "[…] facilitate the diffusion of […] settings that created a favourable environment". This result affirms that environmental transitions are a key indicator of urban transitions pathway for sustainability transitions in circular city systems.

The second indicator identified in the literature review is "societal transitions." As a structural change of city system, Schaepke et al. (2018, p.85) affirm that ULLs, "[…] provide an orientation on experimental and transdisciplinary research for societal transformations, and reveal the contributions of this type of research in supporting societal change". For this reason, societal transitions constitute an indicator of urban transitions pathway for sustainability transitions in the circular city system. Thus, urban transitions are a pathway for sustainability transition to innovative city system from circular economy perspective.

Networks of cooperation among institutions were identified as a pathway to became sustainability transitions to innovative city systems. Inside this pathway, we identified four indicators: problem-solving Arenas (lock-in situations), Knowledge integration strands, activating network partners, and niche and regime actors connect.

The first indicator identified in the literature review is "Problem-solving Arenas (lock-in situations)." Lock-in effect refers to a situation in which consumers are dependent on a single manufacturer or supplier for a specific service and cannot move to another vendor without substantial costs or inconvenience (Eurich & Burtscher, 2014). In an innovative city system, ULLs are seen "[…] as an institutional arena for discussions, can facilitate the relations among institutions, citizens, researchers, enterprises and other stakeholders which will eventually constitute new networks of cooperation that can help overcome institutional lock-in situations." (Amenta et al., 2019, p.14).

Dąbrowski et al. (2019, p.59) affirm that a ULL allows "develop experimental solutions and regional strategies for circular economy and better resource management. This unique setting offered […] an opportunity to […] investigate how the solutions changed as they "travelled" through the relational space of the networked living labs." Also, Koop & van Leeuwen (2017, p.385) say that the ULL permits "[…] learning alliances are needed as the time window to solve the global water governance crisis is narrow and rapidly closing". This is why problem-solving Arenas (lock-in situations) was identified as a fundamental indicator of Networks of cooperation among institutions pathway for sustainability transitions in a circular city system.

Another indicator identified is "Knowledge integration strands." Arciniegas et al. (2019, p.49) affirm that ULL has "[…] iterative engagement between stakeholders not only empowers them but also enables a more in-depth analysis for a better integration of various strands of knowledge". Von Wirth et al. (2019, p.229) say that activating

network partners is a key indicator in the ULL because the "[…] aim to support the diffusion of innovations and know-how developed within ULL to a broader context". To that Knowledge integration strands is an indicator of Networks of cooperation among institutions pathway for sustainability transitions in the circular city system.

Another indicator identified in the literature review is "Niche and regime actors connect." Greer et al. (2020, p.1) say that this interaction is possibly characterized by weak compatibility between niche and regime with few practices, rules, or guiding principles in common. The networks have emerged on the margins of the regime, both in response to the applied circular economy and their need to promote transformation in cities. Indeed, it turned up as an indicator of the Networks of cooperation among institutions pathway for circular city system. Thus, Networks of cooperation among institutions is a pathway for sustainability transition to an innovative city system from a circular economy perspective.

Culture change is another category identified that could become a pathway for sustainability transitions to innovative city systems. This pathway has to do with the concept of "ULLs to become transformative." Levenda (2019, p.1) affirm that ULL can "[…] reconfigure everyday activities and/or adopt new technologies". Menny et al. (2018, p.68) say that "user involvement plays a positive role in realizing the transformative potential of ULLs for sustainability, but governance structure, leadership and power distribution are also important factors for ULLs to become transformative."

Bulkeley et al. (2016, p. 16) explain that ULLs "[…] conceptualize their role in transformative change" through the governance in their projects. To Fratini et al. (2019, p. 974), the ULL "[…] explores the relationship between the political and the epistemic domain of existing urban translations of circular economy across scales and places, to support future empirical investigations of whether and how circular economy imaginaries can support transformative pathways for socially inclusive and environmentally desirable value creation in cities". So, it ended up, Culture change is a pathway for sustainability transition to an innovative city system from circular economy perspective.

Collaborative engagement is the last category considered a pathway to becoming sustainability transitions to innovative city systems. Inside this pathway, we identified two different indicators, such as Different user participation and actor connects. The first indicator identified in the literature review is "different user participation." Voytenko et al. (2016, p.1) say that "participation and user involvement" is a key characteristic of ULL. So, to that, different user participation is an indicator of collaborative engagement pathway for circular city system.

The second indicator identified in the literature review is "actors connects." Greer et al. (2020, p.1) affirm that "[…] actors connect, including actions taken to facilitate the diffusion of circular […] and settings that created a favourable environment". Indeed, it turned up as an indicator of a collaborative engagement pathway. Thus, collaborative engagement is a pathway for sustainability transition to an innovative city system from circular economy perspective.

In conclusion, knowledge production, policymaking, co-creation, geographical embeddedness, urban transitions, networks of cooperation among institutions, culture change, and collaborative engagement are the pathways found in this literature review study based on content analysis as potentials to achieve changes as innovative city system.

The triangulation analysis based on MCA and content analysis, we found support among their findings. For instance, in the MCA, we could observe concepts such as Co-creation, urban experimentation, stakeholder, experiments, local government, governance, technologies, real-world, city futures and systemic change, knowledge transfer, managing transition, spatial planning, territories, and urban planning. From the same perspective, from the content analysis of the articles emerged similar categories (pathways) such as: knowledge production, policymaking, co-creation, geographical embeddedness, urban transitions, networks of cooperation among institutions, culture change, and collaborative engagement. When compared the results found by two different technics, we can see a pattern, a trend. This means that all of them are related to some extent to the concepts of ST, CE, and ULLs.

CONCLUSION

In order to address the research question, we characterize how Urban Living Labs could become pathways for sustainability transitions to innovative city systems from a circular economy perspective. We did apply MCA and content analysis, through which we a going to triangulate this discussion. The pathways found in the literature review, such as Knowledge production, policymaking, co-creation, geographical embeddedness, urban transitions, networks of cooperation among institutions, culture change, and collaborative engagement, were evidenced through the three technics approaches applied and mentioned above.

For instance, the pathways found based on content analysis are also supported by the MCA evidence. There were similarities of concepts such as Co-creation, urban experimentation, stakeholder, experiments, local government, governance, technologies, real-world, city futures and systemic change, knowledge transfer, managing transition, spatial planning, territories, and urban planning. As one can see,

the pathways found in the literature review are significant sustainability transitions to introduce innovations in a city system supported by circular economy principles such as knowledge development, collaboration platform, business support schemes, regulatory frameworks, procurement and infrastructure, and fiscal framework (Prendeville, Cherim, & Bocken, 2018).

However, even though they are not the subject of this research, it is important to mention that smart cities and social innovation are valuable themes to future studies. Thus, an Urban Living Lab is a space where many actors come together to co-create, develop, and test products and services. Also, it has retained a stake in promoting the sustainable city system, facilitating sustainability transitions to an innovative city system from a circular economy perspective. In conclusion, according to this study, Urban Living Labs can become pathways for sustainability transitions to innovative city systems from a circular economy perspective.

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Research in Progress Paper

Investigating the emerging landscape and key enabling factors in creating the diversity of urban collaborative experimentations in Canada to accelerate sustainability transition; qualitative case studies from four major Canadian cities

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Abstract

Canadian Urban Living Labs (ULLs) are often created organically, forming diverse and distinct local models, networks, and methods of urban experimentation across the country. Although often labeled differently, many of these collaborative experimentations share some similar characteristics with ULLs. The research question for this paper is: *How is the diversity of the collaborative urban experimentations (ULLs) that focus on urban environmental sustainability in major Canadian cities and what are the main trends in the urban lab ecosystem?* This research investigate this question by studying 20 ULLs in a qualitative case study research from four major cities of Vancouver, Calgary, Toronto, and Montréal[1]. By conducting semi-structured interviews with the key informants of the labs as well as desk research from publicly available data on these organizations or labs, this research first provides a general evaluation of the current labs' landscape in Canada that focus on urban environmental sustainability through a strategic planning lens. Next, it describes some challenges and complexities to identify the key and critical factors that impact the diversity of ULLs in Canada, suggests a model that capture the multidimensional factors, and then categorizes those factors in four themes. Following these discussions, it demonstrates that the model and structure of these labs can be categorized in 4 main groups and 8 sub-categories using

[1] With one exception of a Living Lab model that is located outside of those four major cities. Since the model of Living Lab was only found in Québec, we included this lab as well.

various qualitative data. The research also suggests specifically considering the categorization of these labs based on their key methodological and theoretical drivers (4 groups) and the main types of outcomes in ULL organizations and labs (4 groups). Finally, it provides visualizations that illustrate the diversity of ULLs based on the top influential factors to explore the possibility of identifying the key trends and patterns in this variety using visualization.

Key words

ULLs diversity; ULLs ecosystem; Visualization; Categorizing urban experimentations; Key enablers; Trends; Evaluation

Introduction

In recent years, innovations in urban governance in various forms have become a key concept for accelerating urban systemic change and sustainability transition (Evans, Karvonen & Raven, 2016; Kuhlmann & Rip, 2014; Sengers, Wieczorek, & Raven, 2016). One specific type of experimental intervention that has gotten increasing attention recently around the world, are Urban Living Labs (ULLs) (Marvin et al., 2018; Evans, Karvonen, & Raven, 2016; Voytenko, McCormick, Evans, & Schliwa, 2016; Bulkeley et al., 2016). In Canada, there has been an increasing popularity for different types of collaborative experimentations, new lab partnerships, and co-creation models across the country, which predominantly focus on addressing complex social or institutional challenges (Radius, 2018; Cole, 2021). In spite of the growing recognition of these labs and their methodologies in addressing complex social problems, little research has been done with special focus on the diversity of these labs in the urban contexts and in regards to addressing environmental sustainability topics.

Canada is home to a diverse lab ecosystem. Canadian labs field has been increasingly popular since 2009. These labs are being established or originated from government, non-profit, for-profit and academic sectors, and, the largest sources of funding for Canadian labs are philanthropy, non-profit partners, and entrepreneurial activity (Radius, 2018).[2] This rapid and diverse proliferation demonstrates both the increasing recognition of labs, and also the relative immaturity of the field. Furthermore, this rapid propagation has been happening in diverse ways with a lack of connective infrastructure that would allow coordination or connection between these organizations. To date, there has been very little study on urban experimentation with focus on urban environmental sustainability (Cole, 2021; Westley & McGowan, 2017). There is also a gap in the literature to provide a broad and comprehensive picture about the variety, structural and methodological diversity or such organizations. These questions can guide the literature to understand the distinctions between the ULLs literature (Steen & Van Bueren, 2017; Chronéer, Ståhlbröst, & Habibipour, 2019) and these local models of experimentation in Canada. In this research, I explore the diversity and key trends in these labs and experimental methods.

To understand these emerging and often organic experiments, to communicate the results and impacts of the labs to both funding agencies and public or private organizations, and to evaluate the transformative capacity of these labs to address or accelerate sustainability transition, understanding the variety and major patterns in the landscape of ULLs is of high priority in ULL research in Canada. In this research, the

[2] Although there is no official study or network for these labs to date, especially in areas related to urban experimentation, in 2018 more that 130 active social innovation labs, a specific type of living labs, participated in the only conference to date (Radius, 2018). About 95% of these labs have been established between 2016 and 2018 and the number is rapidly growing across the country.

goal is to recognize the main factors that impact the diversity of ULLs and then show the main trends and patterns of ULL models and methods in Canada. However, due to the complex, evolving, temporary, and diverse nature of ULLs, the task of categorizing them through a comprehensive perspective is extremely complex and dependent on many known or unknown factors. This paper discusses the opportunities and challenges in this regard.

Literature Review

The literature shows a variety of approaches in classifying ULL typology. In one of the most comprehensive works about ULL typology, Bulkeley, et al. (2019) identify four ideal ULL dispositions focusing on the dynamic of control and contingency: (1) the trial, (2) the enclave, (3) the demonstration, and (4) the platform. Marvin et al. (2018) categorized ULLs in three groups: (1) Strategic, (2) Civic, and (3) Organic. Scholars have also identified more limited but diverse classification for ULLs. Fiúza (2017) identifies technology-driven, citizen-driven, and transition-driven types. Kronsell & Mukhtar-Landgren (2018) put German traditions in ULLs in front of Anglo-Saxon types. Juujärvi and Lund (2016) distinguish at least three types regarding the nature for ULLs: (1) ecosystem or networks of multiple stakeholders, (2) provide tools for enhancing and implementing public involvement, building relationships and sharing knowledge, (3) innovation management tools for building networks in urban development. Juujärvi and Pesso (2013) focus on the levels of engagement and identify: (1) technology-assisted research environment using different sensors and Internet of Things (IoT) deployments, (2) citizens as co-creators who contribute to designing and developing local services, and (3) a new kind of urban planning that uses novel processes and tools that are developed by actively engaging citizens to plan procedures and facilitate vision planning and increase mutual learning. Regarding the temporality of the ULLs, they also encompass a range of permanent, temporary or even uncertain projects (Ballon & Schuurman, 2015). Marvin & Silver (2018) present a typology built around the different forms of experimentation: lab logics, lab setting, lab activities, lab foci, and lab temporalities. Table 1 summarizes some of these classifications.

Table 1. Diversity of approaches to classify ULLs.

Type of classification and vision on ULL diversity	Main identifiers	Research study
Organization and initiation	Strategic, civic, organic	Marvin et al., 2018
Dynamic of control and contingency	Trial, enclave, demonstration, the platform	Bulkeley et al., 2019
Domain	Technology-assisted (IoT) research environment, citizen co-creation, novel type of urban planning	Juujärvi & Pesso, 2013
Area or aim of technological intervention	Ecosystem or network or stakeholders, tools for participation, networks and knowledge dissemination, innovation	Juujärvi & Lund, 2016

	management network in urban development	
Drivers	Technology-driven, citizen-driven, transition-driven	Fiúza, 2017
Area of origin	German, Anglo-Saxon	Kronsell & Mukhtar-Landgren, 2018
Temporality	Permanent, temporary, uncertain	Ballon & Schuurman, 2015
Impact between institutional boundary and geographical scale	Utilizer-driven, enabler-driven, provider-driven, user-driven	Schliwa & McCormick, 2018
General public partner	Citizen-driven, user-driven	Schliwa & McCormick, 2018

Gaps in the literature

The political, institutional and social contexts, in which these urban sustainability experimentations unfold and by which they are provoked, formed, or constrained, have received much less attention in ULL and transition literature. These gaps are partially because ULL literature has originally emerged from LL literature[3] (see Nevens et al., 2013). The diverse and fragmented nature of LL field, spanning across different disciplines and application domains, shows some general tendencies towards concentration on innovation networks or service co-creation (especially ICT development) topics and language in ULL literature as well (Juujärvi & Pesso, 2013, Schliwa & McCormick, 2018; Franz, 2015).[4] Despite such fragmentation, some clusters of scholars and publications can be identified with more focus on the variety of governance models, social and political connections, specific contextual factors, and forms of experimentations in ULLs (Evans et al., 2016; Kronsell et al., 2018; Voytenko et al., 2016; Bulkeley et al., 2019).

Research Methodology

The literature on urban experimentation often portrays urban collaborative experimentations (such as ULLs) as diverse, complex and multifaceted phenomenon (Nesti, 2018; Steen & Van Bueren, 2017). Due to their diversity and the various contexts in which urban labs can be applied, scholars argue that a case study analysis using qualitative exploratory research is the most appropriate method to provide a better understanding of these labs (Franz, Tausz, & Thiel, 2015; Chronéer, Ståhlbröst & Habibipour, 2019; Voytenko et al., 2016). Particularly case studies approach can be informative because of their explicit focus on context and dynamic interactions over time (Marshall & Rossman, 2014). I conveyed research using this approach.

[3] For instance, Nevens et al. (2013) note that their urban transition lab concept is inspired by the living lab concept and tailored to urban settings on a local level.

[4] For instance, terms such as user vs. citizen and centric vs. driven are often used interchangeably (Schliwa & McCormick, 2018).

Data collection

The data collection part of the research included a four-step investigation:

Step 1: Given the fact that in Canada there is no formal or informal active network or shared identity among the fast-growing number and diverse models of labs, the research started by creating a database of potential cases by surveying current organizations across Canada using internet sources and various keywords.[5]
Step 2: Using internet search, 98 cases from 4 main cities were identified with connections to urban sustainability issues or climate change topics.
Step 3: From that list, 46 labs were selected in the form of multi-project or permanent platforms and I excluded single projects or labs, partnerships and organizations that were one-off or not part of a larger scale initiative.
Step 4: Finally, the researcher conducted semi-structured interviews with open-ended questions with 26 key informants from 20 labs located in four main cities in Canada. During the interviews, snowball sampling also helped to identify some organizations or labs that were not known using the keywords.

Data analysis

After transcribing the interviews, the researcher conducted textual and software supported analysis for thematic ordering and coding of the interviews (Whicks, 2017; Merriam, 1998) using NVivo software. By means of both interview data as well as internet data from the websites, publications and documents available for each case, the research provides a classification of the labs to show their running time, partnership structure, leadership and ownership, evaluation, experimentation focus, funding sources, and participation/co-creation methods (parts of this data is included in Appendix A). This analysis followed the literature in ULLs with focus on their key characteristics (Steen & Van Bueren, 2017; Chronéer, Ståhlbröst, & Habibipour, 2019; Fiúza, 2017). Informed by the semi-structured interviews, the research also highlights some additional or emerging themes in these cases including initiation driving factors, main methodologies, geographical boundaries of impact, type of sustainability in projects, and number of lab cycles (parts of this data is included in Appendix B), and suggests revisiting common descriptions and classification of urban sustainability labs through a more inclusive lens. Based on these findings, the study identifis the diversity and key trends in these labs. Finally, I suggested visualizations depicting this diversity and trends.

[5] Keywords such as: living laboratory; urban lab; urban living lab; city lab; urban experiment; urban test-bed; urban transition labs; low carbon lab; sustainability lab; social innovation labs; and, social experimentation and technology.

Key Research Findings

Key enablers of ULLs and urban collaborative experimentations in Canadian cities

There are various driving factors for the growing popularity of urban labs in Canada. Urban experimentation supports the growing complexity, uncertainty, and systemic change in the urban environments (Karvonen, A., & Van Heur, 2014; Mukhtar-Landgren, Kronsell, Voytenko Palgan, & von Wirth, 2019). Systems thinking and complexity theory are two major theoretical motivating influencers for new partnerships and collaborations in labs. In addition, design thinking has also gained traction in the recent years in areas related to social and environmental problems, policy design and technological developments (van der Bijl-Brouwer & Malcolm, 2020; Roe, 2020; Rava, 2017). These methods and theories often support collaborative and systemic problem definition, institutional change, extraordinary partnerships, transparency, open processes, and non-linear and iterative project development and planning in uncertain, unpredictable and complex contexts (Van der Bijl-Brouwer, 2019; Mulgan, 2006; Brown & Wyatt, 2010).

Since 2009, systems thinking and social innovation have become exponentially popular in Canada. Started by new academic conversations on social enterprise and systems thinking (Westley, Zimmerman, & Patton, 2009; Meadows, 2008), conversations on social innovation (Westley, & McGowan, 2017; Westley, Antadze, Riddell, Robinson, & Geobey, 2014; Kieboom, 2014), and especially supported through initiatives such as Social Innovation Canada (SI Canada)[6], intellectual drivers are supporting the organic development of social innovation labs across the country and provide a source of knowledge share among lab practitioners. Although many of the examples among the case studies are not under this category, Social Innovation's theoretical and methodological foundations have created shared understanding and language[7] among lab practitioners and is noticeably dominating the lab conversations in Canada.

Various governmental, philanthropic, non-profit and academic organizations are supporting these new urban governance models. In Canada, a large number of these labs are either established at municipalities or have very close relations to the local governments. Furthermore, in Canada, academic research has entered the territory of real-world experimentations through specific models such as Campus as a Living Lab (CLL), CityStudio and various departmental design and policy studios in partnerships with governmental and non-governmental organizations or local communities. These models create both accountability and legitimacy for students, researchers and faculty

[6] https://sicanada.org/
[7] This language encompasses areas related to discussions such as developmental evaluation for complex lab evaluations (Patton, 2010; Gamble, 2008; Patton, 1994), distinctions between simple, complex and complicated social problems, emphasis on effective facilitation methods in complex issues, and connections to business models.

to conduct real-world experimentations.

Identifying the key patterns in the diversity of labs using SWOTs analysis:

Informed by the semi-structured interviews, Table 2 shows the preliminary analysis and a summary of this qualitative research findings in regards to the current state of the urban collaborative experimentations and ULLs in Canada through a strategic planning lens using Strengths and Weaknesses, Opportunities and Threats (SWOT) analysis (Gürel & Tat, 2017). This common strategic planning method of evaluation shows that despite the diversity of the types and models of the labs, there are general trends and patterns in the landscape of urban experimentation in Canada and certain factors are enabling or becoming barriers for large-scale transformative capacity of the labs. This general evaluation was an essential step before attempting to categorize labs in order to recognise common patterns and specificities of the labs. Moreover, to provides a more inclusive lens in defining and categorizing ULLs in Canada, it is imperative to first identify the key identified issues or possibilities, and then provide more local definitions and categorizations.

Table 2. Strengths and Weaknesses, Opportunities and Threats (SWOT) of urban collaborative experimentations (ULLs) with focus on environmental sustainability in four major Canadian cities.

Strengths	***Weaknesses***
Shared lab language, facilitation and evaluation methods from Social Innovation conversations and resources Theoretical and conceptual foundations are being developed and discussed Process evaluation (developmental evaluation) is being emphasized and discussed. Social innovation lab methodologies, design thinking and systems thinking are being used widely. **Existing clusters and networks for specific models** Stakeholder collaboration is being performed widely. University-municipality partnership models often have networks. **Existing funding mechanisms in specific areas** Housing complex issues (affordability, environmental sustainability, homelessness, food security) new developments and retrofits are some of the most common themes. **Diverse ecosystem of labs** The number of university-based or municipality-driven living labs as well as independent and	**Lack of long-term sustainability impact evaluation** Summative and impact evaluation of labs are unclear. Little emphasis on urban environmental sustainability. Weak connection to neighborhood and urban planning. Unclear impact on institutional transformation. Little sign of successful scaling and dissemination of results. Weak political recognition, legitimacy, support, power and agency in local governments for labs. Lack of clear definitions, network, and connections among sustainability focused labs **Lack of long-term financial sustainability** Findings are often project-based and long-term or mind-term funding is not available. **Lack of enough capacity** Lab practitioners are often over-burdened doing facilitation, design, and research together. Weak connection to academic research and students' involvement in many municipality-based on independent labs.

intermediary labs with diverse funding are growing.	Networks and resource sharing is not available for many isolated or new labs. **Weak or no community involvement or citizen co-creation** Lack of community participation, co-creation and involvement in the majority of projects with focus on environmental urban issues.
Opportunities	***Threats***
Capacity development Universities can offer infrastructure for creating co-creative spaces between the government, communities and researchers. Connecting intermediary organization (independent labs) can make a stronger network for sharing experiences and resources Labs can create a stronger platform as mediators between universities and governments by integrating research and real-world experiments in a more inclusive form with researchers. Universities can create a stronger connection between design and planning both in education and collaborative projects with governments. **Potential to connect to existing urban agendas and new sustainability initiatives** Creating strong connection to policy (diversity and inclusion, reconciliation, 2030 Agenda). Focusing on neighborhood scale and location-based developmental experiments. Connection of labs to the new paradigms or initiatives (such as Circular economy, Smart Cities and other technological innovation). **Existing international networks of Living Lab research** Connection to the existing international networks, research, and practices of ULLs around the world.	**Focus on short-term or single labs instead of lab portfolios and mid-term to long-term programs for large scale urban transition** Labs can only be limited to single projects because of the single grant mechanisms instead of longer-term grants and funding. There is also lack of enough emphasis on research and impact evaluation of the labs. **Focus on social issues with weak connections to urban planning, and environmental challenges** Labs can be separate from existing political and governmental structure and thus have less systemic or structural change and impact. **Best practice research methods instead of academic and profound research that directs innovation** Research design often is conducted by the lab facilitators and can insufficiently address complex issues due to the lack of time, resources or capacity. **Ignoring the importance of community co-creation by only focusing on stakeholder involvement** Labs can only focus on key stakeholder involvement and ignore user/tenant/community experience or knowledge due to their limited capacity, project requirements, or lab structure.

Discussion and Results

This section provides brief explanations about the importance and diversity of factors as well as some of the key challenges and uncertainties around categorizing ULLs in Canada.

Key factors in identifying the diversity of collaborative experimentations and partnership platforms in Canadian ULLs

This research attempts to show the patterns and trends for urban experimentation that have the potential to create large-scale urban transformation. To categorize these

organizations and labs, it reflects on various normative, relational and structural attributes such as the organization of the lab, types of experimentations and projects, types of co-creative approaches, involved actors and partners, theoretical foundations, methodological approaches, funding mechanisms, initiation and enabling factors, and types of outcomes. Some of these characteristics are listed in Appendices A to C by highlighting the intensity of focus using different color saturations.

Literature on urban experimentations and ULLs has provided various approaches to classify collaborative experimentations and more specifically ULL typologies (Ballon & Schuurman, 2015; Kronsell & Mukhtar-Landgren, 2018; Juujärvi and Pesso, 2013; Fiúza, 2017; Marvin & Silver, 2018; Bulkeley, et al., 2019). The results of this research are more in alignment with the previous research findings in regards to the importance of the driving factors (technology-driven, citizen-driven, transition-driven) (Fiúza, 2017), temporality (permanent, temporary, uncertain) (Ballon & Schuurman, 2015), and organization and initiation types (strategic, civic, organic) (Marvin et al., 2018) for the diversity of labs. However, this research shows that some key factors were more explicitly critical and formative in the direction of the labs and experimental approaches. The type and role of their leading and directing organization and its structure, the relationships and connections with their partners, and the underlying theory of change and methodological approaches in labs were among these factors. Although other factors, such as the type and sources of the funding, or the involvement of the general public (citizens) are also important to influence the nature and type of labs, these factors were either less conclusive and exceptional, or were widely shared between the majority of labs with very few exceptions compared to the key factors. As a result, they were not as critical as the other factors in demonstrating the variety and direction of the mainstream ULLs in Canada. Table 3 outlines these factors and the reasons behind the decision to exclude some of them as distinctive and critical causes.

Table 3. Key factors that impact the diversity and direction of Canadian urban sustainability innovation labs

Most critical factors in the diversity of ULLs in Canada	**Range of diversity**	**Less critical factors in the diversity of ULLs in Canada**	**Reason for being less critical**
Leading and directing organization	Local governments, universities (in the form of CLL and course-based labs), independent organizations or non-profit organizations	Design thinking methodologies used in the lab	They often use a variety of methods and experiment with different or new design thinking tools and approaches
Key partners, connections and relationships with them	Local governments, academia, non-profit organizations, private sector, general public	Type and model of funding agency	The majority of the labs either use one-off funding or grants or SEEDs funding. Funding agencies can be different for

			each project expect for research-based labs that often receive SEEDs funding as well
Theory of change, theoretical foundation, epistemological view on systemic change, or specific methodological approach	Systems thinking and design thinking, Social Innovation lab methods, none	Initiating actor or reason	Often a variety of personal reasons including past experiences, personal interest, lack of interest in conventional planning methods, familiarity with design thinking, and becoming familiar with lab methods through professional connections and networks
Role of local governments	Enable and provide funding for the lab, partner with the lab, key partner with academia to guide the direction of the projects	Scale of real-world experimentation, intervention or impact	The majority of labs encompassed a wide range of project scales. The exception was course-based labs that are often limited to 1 or 2 semesters for development and thus usually have limited scale of projects
Role of research institutions	Provide experimentation location, conduct research to guide experimentations, combine research and prototyping, educate and enable students to launch entrepreneurial projects	Stakeholder co-creation	Quality and type of co-creation depends on the project
Model and structure of the lab	Labs inside municipalities, campus or City labs for students and academic research, design studios or social entrepreneurship labs in universities, independent or intermediary organizations, Living Lab organization	General public involvement	Majority of labs did not involve the public. The expectations were youth-led or course-based labs
Political power and agency to create change	Depending on the role from consultation, facilitation and recommendation to full project development and implementation	Type of innovation (open vs. close)	The majority of labs were not fully supporting open innovation especially in areas closer to policy-making
Performance cycles	Single, multi-cycle, platform	Place-based experimentations	All labs were place-based

Partnership types	Municipality-academia-non-profit, Municipality-academia, academia, Municipality-non-profit, municipality-private sector, Municipality-academia-private sector, Non-profit	Type of urban sustainability topics to address	Often a range of topics. Few labs have a portfolio of research related to a special issue such as energy
Type of sustainability issues	Simple, complicated (technical and organizational), complex	Goal for scaling dissemination and replication	Although some people expressed their goal and intention for project scaling and replication, there was no sign of actual outcomes for that matter
Geographical location, networks and language	Francophonie labs vs. English labs, neighborhood, city, or provincial labs	Goals for creating knowledge and learning	The majority of the labs aim to create educational materials, distribute knowledge created in the labs or provide information about the results of the experimentations in the form of reports.
Driving discipline or area of civic, social or political activity	Science and research, policy, entrepreneurship, civic action, design, social enterprises, social R&D	-	-

General themes for key factor in identifying the diversity of ULLs:

Categorizing the diverse ULLs in based on attempts to identify key factors that shape their governance model and transformative capacities is a complex and daunting task. One reason for this is that the majority of these labs and organizations are new, and, therefore, not mature enough to provide enough historic and contextual data for an in-depth analysis of their direction or enablers over time. Furthermore, as they are in an exploratory phase, predicting their future direction based on their current state does not do just to these new organizations. Despite the flexible nature of their organizations in most cases, the diversity of the projects and the direction of projects are highly unforeseeable and dependent on various factors including available grants and funding as well as future urban challenges and desired intervention areas. Here this research provides the most common determining factors in regards to showing the general direction and trends in ULL varieties:

1. Relational, political and institutional factors:

In regards to the critical factors listed for categorization in Table 3, there are some items that need further elaboration. First of all, the role of local governments and research institutions in shaping the form of the lab seems to be one of the most impactful factors. A large number of the labs are located at municipalities, have strong connections with

the local governmental systems, or are parts of an academic program or initiative. These relationships and positions not only affect the direction and topics addressed in the labs, but also on the type of outcome and actors involved. For instance, labs located in academia often focus on the research, design and entrepreneurial projects with more flexibility in topics and the outcomes, while public sector innovation labs at municipalities often address some of the challenges present at municipalities or address systemic and internal barriers to address complex issues by involving staff or organizations that work with municipalities.

2. *Structural and local factors:*

Furthermore, based on various reasons, often public sector and academic labs have a relatively predetermined model or structure such as Campus as a Living Lab, Solutions labs, and City labs. Although these terms are not clearly defined, unlike the labs outside of these organizations, they imply some form of structure and focus area. For instance, Solution Labs often aim to address pressing and complex urban sustainability challenges driven by or in strong partnerships with municipalities, while City Lab or City-University partnerships often focus on complicated issues that need technical, social or technological experimentations and research within a limited project scope and scale. Last but not least, unlike ULL literature concentrating on quadruple helix models of public-private-people partnerships, Canadian labs often show public-non-profit or public-non-profit-private partnerships. The public includes both academia and local governments but in very exceptional examples, the focus of the lab projects are beyond the city and include provincial or even national scale of policy and planning.

3. *Performance and financial sustainability factors:*

In relations with the performance cycle, there are single cycle and multi-cycle labs, and platforms which often have a permanent physical space that is part of a larger organization. The nature of many lab projects is often viewed as temporary. Single cycle labs receive one-off grants and they include a single project or a portfolio of various projects under a single theme for a limited time. Since the focus of this research is on broader scale transformative potentials of the labs, although I acknowledge the existence of some one-off and single labs that are often strategic labs[8], this study focuses on the types and characteristics of the organizations that develop, initiate or guide civic and organic multi-cycle labs or lab platforms that are reproducible and scalable. However, the results show that the distinction between civic and organic labs can sometimes become blurred, especially in regards to policy labs inside academia that are driven by faculty.

[8] Such as the four smart city projects that won the Ministry of Infrastructure's Smart Cities Challenge in 2018.

4. Interpersonal, ideological, and individual factors:

In regards to the theory of change, theoretical foundations, epistemological views on systemic change, and methodological differences, the findings show these factors, while often missing from the ULL literature, are tremendously important in creating the direction of the labs, selecting the involved actors, setting the expectations about the outcomes, goals and aims for experimentations, and, utilizing tools and methods used in the experimentations. For instance, some directors mentioned their lack of interest in creating 'innovation' as it's used in more technological terms, while showed interest in generating systemic disruption and providing more inclusive environments for decision-making processes in cities as their goal.

Categorizing the model and structure of multi-cycle labs and platforms:

Based on the above-mentioned factors, as Appendix B shows, in a high-level categorization, this research suggests the following categorizations for urban sustainability innovation labs (ULLs) in Canada. The categorization comprises 4 main groups and 8 sub-categories for classifying these multi-cycle labs and platforms. In addition, 3 sub-categories are also divided into smaller clusters. Table 4 shows the results of these classifications.

Table 4. Model and structure of multi-cycle and platform urban sustainability innovation labs in Canada

Main groups	**Civic ULLs**			**Civic/Organic ULLs**	**Organic ULLs**	**Strategic ULLs**
	Labs inside municipalities	Campus or City labs for students and academic research		Design studios or social entrepreneurship labs in universities	Independent or intermediary organizations	Labs inside municipalities
Sub-categories and their smaller clusters	Solutions Labs	Campus as a Living Lab	Platform or building		Think-and-Do-Tanks	Smart City multi-cycle projects
			Multi-cycle organization			
	City Living Labs	City-university partnerships			Independent organizations	Platform or innovation district
						Multi-cycle organization
						Network and support organization
					Living Lab organization	Independent
						Inside academia

Categorizing ULLs using visualization:

Although quantitative data analysis commonly uses visualizations to gain clarity about complex data, exploratory data analysis for qualitative and multi-dimensional data often remains a challenge. However, research on evaluation suggests that visualization and creative techniques can be used for various types of evaluation to provide speed insight development for evaluation research (Handerson & Segal, 2013). This research explores an integration of visualization with qualitative data analysis in an exploratory approach to speed insight development and detect common patterns and trends. In addition to considering the critical factors in creating the diversity of labs discussed and listed above, the following factors were also considered in creating the visualizations for the diversity and landscape of ULLs in Canada:

i. *Model and structure of multi-cycle labs and platforms:* In Figure 1, the types of organizations are shown in squares coded in colors based on Table 3.
ii. *Categorizing labs and organizations based on the main theoretical and methodological factors:*

The research also classified the organizations and labs based on their key theories of change or methodologies they use. This classification is coded in four colors and the outline of each square encodes one of these main areas:

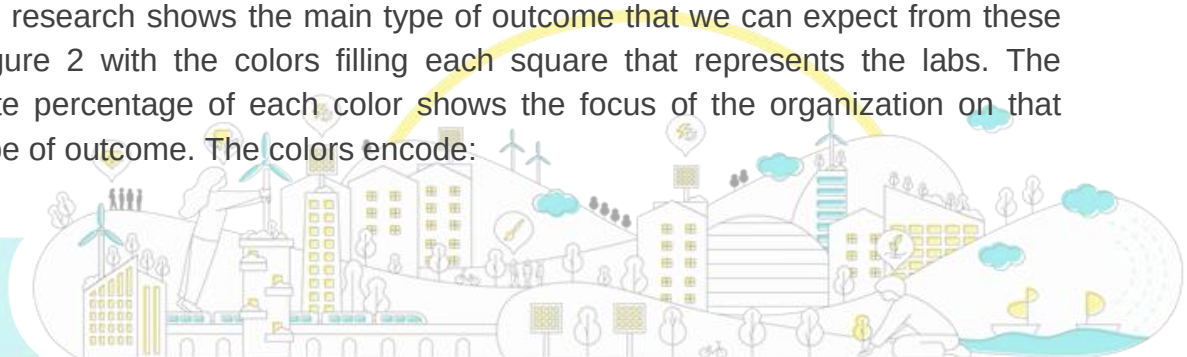
1) Design thinking and systems thinking
2) Scientific research methods
3) Systems thinking and Social Innovation facilitation/evaluation methods
4) No specific theory of change or methodology

iii. *Locating labs on the chart:*

In Figure 1, the organizations are placed on the charts based on their connection with governmental (X-axis) and non-governmental (Y-axis) organizations. This portrays the attachment or impact that the organizations may have on local, provincial and federal policy or institutional structure. It also depicts the closest connection to the other non-governmental organizations. The location of the squares on the chart illustrates the organization's relative connections to the governmental and non-governmental organizations considering various attributes that were discussed above as well as various qualitative data from interviews, reports, documents, and internet resources about labs.

iv. *Categorizing labs' outcomes:*

Finally, the research shows the main type of outcome that we can expect from these labs in Figure 2 with the colors filling each square that represents the labs. The approximate percentage of each color shows the focus of the organization on that specific type of outcome. The colors encode:



1) Policy recommendations
2) Science or engineering research reports or papers
3) Entrepreneurial projects
4) Network and support system

Figure 1. Visualizing the diversity of urban sustainability experimentations and labs in 4 Canadian cities considering the leading organizations, methodology and theoretical foundations.

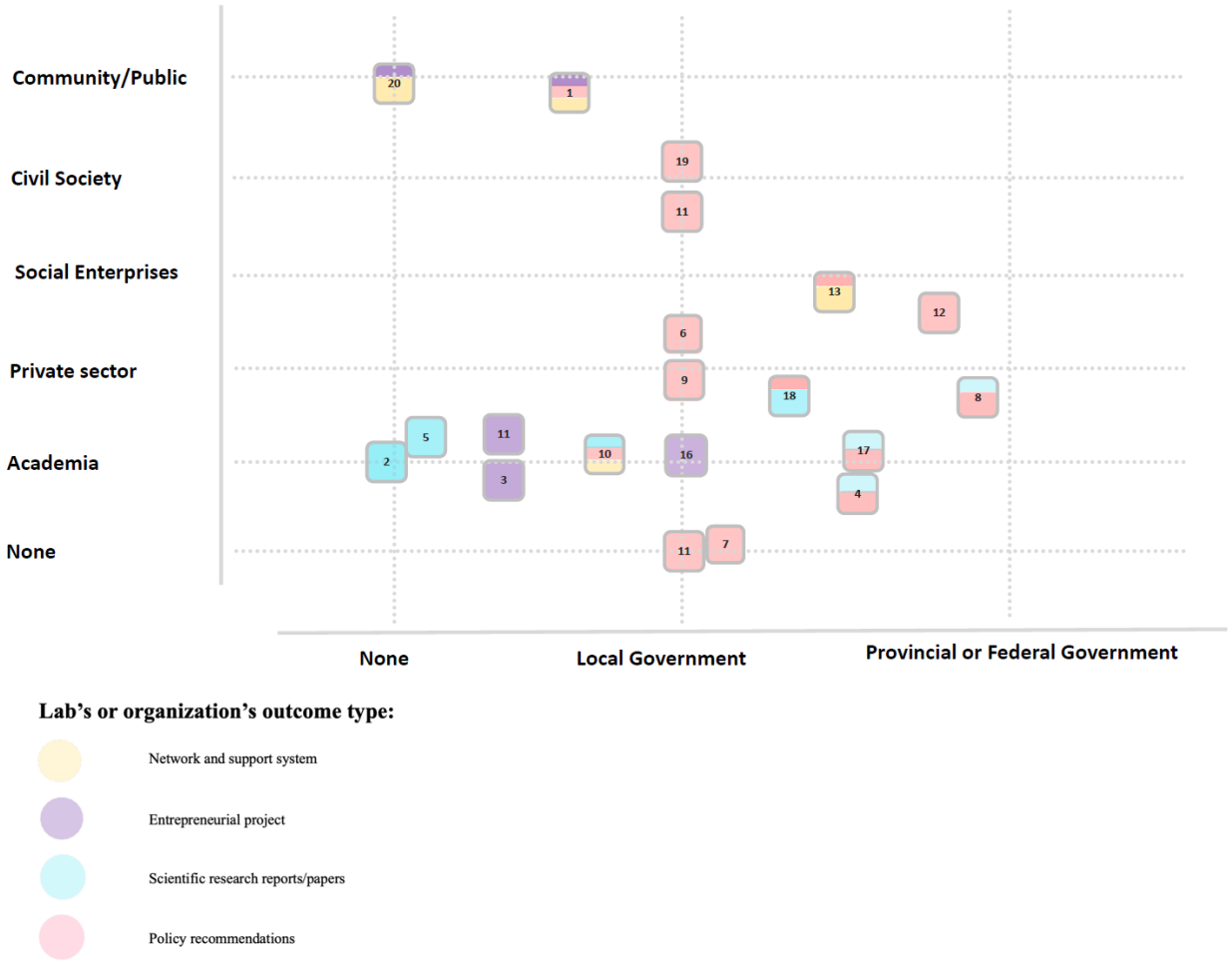


Figure 2. Visualizing the diversity of urban sustainability experimentations and labs in 4 Canadian cities considering the type of outcomes.

Conclusion

In this qualitative research, findings show that categorizing labs in a comprehensive and qualitative way is a complex task. In addition to the common identified classifications of ULLs, there are many underlying factors that create diversity of labs in Canada. These factors include but are not limited to: theoretical foundations and theories of change, visions on innovation and experimentation, methodological approaches, capacities, backgrounds of the leading actors, personal and organizational goals, funding sources and mechanisms, types and models of partnerships, previous experiences and connections, types of sustainability problems to address, aim for scaling and large-scale transition, focus on co-creation, type of research and academic involvement, political recognition, connections and networks, and outcome goals.

Despite the wide variety of labs and organizations leading them, both SWOT analysis and visualizing the diversity of urban experimentations in Canada show some trends and patterns in this landscape of ULLs. The majority of the labs are concentrated near

the local government column, or academia rows (Figure 1). However, the diversity, influence, and distribution of independent and mediatory organizations needs to be recognized and investigated as well. In the outcomes visualization (Figure 2), we can detect how the types of outcomes can be different in these experimentations while we observe some similarities between adjacent labs. For instance, labs located at municipalities often focus on policy recommendations. However, even with similarities in the structural model and types of relations for the ULLs, some labs do not share similar goals and desired outcomes.

In addition, comparing Figures 1 and 2 can also provide insights about the connections between the structure and outcomes of the labs. For instance, while creating an open innovation system for sharing the knowledge at a CLL might be a central objective, labs located at municipalities that often address complex and institutional issues, do not necessarily aim to create an open innovation model of lab and share the results. Considering the variety of lab objectives and goals make the typical definitions of ULLs more questionable as inclusive definitions. These complex factors lead to the question of whether, which and under what circumstances collaborative innovations lead to systemic change? Identifying various factors portraying the diversity of these labs also shows the importance of making ULL literature more inclusive in regards to the description of ULLs and key characteristics for them. It also suggests further exploration on the main barriers and benefits for creating more open and inclusive models with focus on active citizen co-creation and urban technology.

Finally, while the role and importance of the mediatory and independent labs are not particularly studied and is often underemphasized or overlooked in general lab conversations, their popularity and diversity in the recent years point to the importance of investigating the political accountability, power, agency, financial sustainability, and enabling factors of these labs as new forms of decentralized urban sustainability governance models. Our future research more precisely investigates these labs in specific case study projects.

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Appendices

The intensity of the colors in these tables show the relative level of focus of the lab on that characteristic from a qualitative perspective.

*Abbreviations:

G: Government; P: Private sector; A: Academia; NG: Non-governmental organization

SI: Social Innovation; ST: Systems Thinking; DT: Design Thinking

CX: Complex; C: Complicated; S: Simple

Appendix A

#	Lab Name	ULL key characteristics						
		Real-world Experimentation	Stakeholder co-creation	Citizen/ community co-creation	University/ research focus	Open innovation	Place-based	Partnership type
1	City Hive, Envirolab							G-NG
2	UBC Campus as a Living Lab							A
3	UBC dStudio							A
4	One Earth							G-NG
s	Transportation Futures							A-G-P
6	City of Vancouver Solutions Lab							G-P
7	Intelligent Futures							G
8	The Natural Step's Canada's Energy Futures Lab							G-P
9	Living Labs at The City of Calgary							G-P
10	Urban Alliance							A-G
11	CoLab							G
12	MaRS SC							G-P-(A)
13	Green Economy Canada (previously Sustainability CoLab)							P-G
14	Guelphlab							G
15	GreenHouse							A
16	CityLab Hamilton SIR							G-A
17	Cité-ID							A-G
18	Living Lab en innovation ouverte (LLiO)							G-P-A
19	Bridgewater, NS SC Challenge							G
20	Waterlution							NG

Appendix B

#	Lab Name	Other key characteristics						
		Main method/Theory of change	Types of urban sustainability issues	Political power and agency to change	Model and structure	Lab cycles	Scale of impact larger than city	Goal for scaling, dissemination, replication
1	City Hive, Envirolab	DT	C		Think and do tank – Independent organization	Multi-cycle		
2	UBC Campus as a Living Lab	-	C		CLL	Platform		
3	UBC dStudio	DT-ST-SI	S-C		Studio-Social Ent	Multi-cycle		
4	One Earth	-	CX		Think and do thank	Multi-cycle		
5	Transportation Futures	-	C		CLL	Multi-cycle		
6	City of Vancouver Solutions Lab	ST-SI	CX		Solutions lab – City	Multi-cycle		
7	Intelligent Futures	DT-ST	C-CX		Independent organization	Multi-cycle		
8	The Natural Step's Canada's Energy Futures Lab	ST-SI	CX		Independent organization	Multi-cycle		
9	Living Labs at The City of Calgary	-	S		CityLL	Multi-cycle		
10	Urban Alliance	-	C		City-University partnership	Multi-cycle		
11	CoLab	ST-SI	CX		Solutions lab - Government	Multi-cycle		
12	MaRS SC	ST-SI	C-CX		Solutions lab – Independent organization	Platform		
13	Green Economy Canada (previously Sustainability CoLab)	ST	C		Independent organization	Multi-cycle		
14	Guelphlab	SI	CX		Solutions lab - City	Multi-cycle		
15	GreenHouse	DT-SI	S-C		Studio-Social Ent	Platform		
16	CityLab Hamilton SIR		S-C		CityStudio	Multi-cycle		
17	Cité-ID	DT-ST	C-CX		Independent organization/ Academic research / LL	Multi-cycle		
18	Living Lab en innovation ouverte (LLiO)	DT-ST	C-CX		Independent organization / LL	Multi-cycle		
19	Bridgewater, NS SC Challenge	-	CX		Smart City	1 cycle		
20	Waterlution	DT	C		Independent organization	Multi-cycle		

Appendix C

Lab	Lab Name	Location	Area of Impact	Initiation Factor	Area of focus	Lab cycles	Leading organization
1	City Hive, Envirolab	BC	Metro Vancouver	Personal Interest	Youth empowerment	Multi-cycle	Independent
2	UBC Campus as a Living Lab	BC	UBC Vancouver campus	Faculty initiation	Research and innovation	Platform	University
3	UBC dStudio	BC	Vancouver	Faculty initiation	Design thinking and policy	Multi-cycle	University
4	One Earth	BC	Global	Personal Interest	Policy and research	Multi-cycle	Independent
5	Transportation Futures	BC	Metro Vancouver	Faculty initiation	Research and innovation	Multi-cycle	University
6	City of Vancouver Solutions Lab	BC	Vancouver	Personal interest	Facilitation and new internal partnerships	Multi-cycle	Government
7	Intelligent Futures	AB	AB	Personal Interest	Facilitation and planning	Multi-cycle	Independent organization
8	The Natural Step's Canada's Energy Futures Lab	AB	AB	Collective decision	Renewable energy	Multi-cycle	Independent organization
9	Living Labs at The City of Calgary	AB	Calgary	Government procurement for new technology	New urban technology procurement	Multi-cycle	Government
10	Urban Alliance	AB	Calgary	City university partnership	Research and innovation	Multi-cycle	University
11	CoLab	AB	Calgary	Personal interest	Facilitation and new internal partnerships	Multi-cycle	Government
12	MaRS SC	ON	ON, National	SC movement and personal interest	SC and energy policy	Platform	Independent organization
13	Green Economy Canada (previously Sustainability CoLab)	ON	AB	Personal interest in sustainability business support	Economic sustainability	Multi-cycle	Independent organization
14	Guelphlab	ON	Guelph	Internal complex issues	Facilitation and new internal partnerships	Multi-cycle	Government
15	GreenHouse	ON	Toronto	University program	Green entrepreneurship	Platform	University
16	CityLab Hamilton SIR	ON	Hamilton	City university partnership	Research and design	Multi-cycle	Government
17	Cité-ID	QC	Montreal	Faculty initiation	Research and policy	Multi-cycle	Independent organization
18	Living Lab en innovation ouverte (LLiO)	QC	QC	Personal interest and previous experiences	Research, design and policy	Multi-cycle	Independent organization
19	Bridgewater, NS SC Challenge	NS	Bridgewater	SC challenge	Energy	Single	Government
20	Waterlution	Canada	National	Personal interest	Water	Multi-cycle	Independent organization

Practitioners Presentation Paper

The key role of a Living Lab in creating a blockchain-based digital ecosystem to support local businesses

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Abstract

In the context of the Covid-related emergency, many cities were faced with the need to manage access to public spaces in compliance with security measures. In particular, ensuring the contact tracing of users. At the same time, the ongoing pandemic crisis has highlighted the need for a digital presence of small and medium-sized businesses in order to be reached virtually by their customers. However, not all businesses have been prepared for this digital challenge and they risk becoming disadvantaged and damaged by this new market situation.

In this context, the City of Lugano in Switzerland, has created the MyLugano app: a free and currently functioning app available to citizens and guests of Lugano for:

- booking and purchasing cultural, entertainment and sports events while ensuring contact tracing through the use of the app;
- a point-based loyalty system (LVGA points) based on the blockchain technology integrated in the app. The new loyalty system is dedicated to small and medium-sized businesses active in the sales sector of the City of Lugano (i.e.: businesses, cultural, sports, service and leisure activities, etc.), and users (citizens and tourists) who both receive LVGA points for every expense done using the app.

More info about the project: https://luganolivinglab.ch/en/projects/mylugano/

Key words

Living lab, urban lab, digital ecosystem, blockchain, local marketing, mobile app, public administration; pandemic crisis

The project

In the context of the Covid-related emergency, many cities during the first reopening after lockdown(s), were faced with the need to manage access to public spaces in compliance with security measures. In particular, ensuring the contact tracing of users (for example: access to municipal sports spaces, cultural activities, etc.). At the same time, the ongoing pandemic crisis has highlighted the need for a digital presence of small and medium-sized businesses in order to be reached virtually by their customers. However, not all businesses have been prepared for this digital challenge and they risk becoming disadvantaged and damaged by this new market situation.

The City of Lugano in Switzerland, has deployed several initiatives to support small and medium-sized businesses in the city. The case presented at the Digital Living Lab Days 2021 is a unique project in Switzerland, of a creation within a short time, of a city app managed by the municipal administration that has responded to these needs.
The case study presented is the MyLugano app: a free and currently functioning app available to citizens and guests of Lugano for:

- booking and purchasing cultural, entertainment and sports events in city facilities while ensuring contact tracing through the use of the app;
- a new point-based loyalty system (LVGA points) based on the blockchain technology integrated in the app. The new loyalty system is dedicated to small and medium-sized businesses active in the sales sector of the City of Lugano (i.e.: businesses, cultural, sports, service and leisure activities, etc.), and users (citizens) who both receive LVGA points for every expense done using the app.

So far MyLugano app can be considered a best practice for the innovative creation of a digital ecosystem using new technologies by a public administration. The app in fact manages, without the support of third parties, the city' contact tracing solution, provides a virtual place with the calendar of events in the city and the public places that require a reservation, and a space dedicated to shopping, with a free digital showcase for commercial partners.

The app is generating a promotion of shopping in the city in favor of the local merchants through the creation of an ad-hoc circuit using blockchain technology. MyLugano app has demonstrated also the need for coordination with the institutions: Swiss Financial Market Supervisory Authority (FINMA) and the Organismo di Autodisciplina dei Fiduciari del Cantone Ticino (OAD FCT), within the framework of the law against money laundering.

Moreover, MyLugano app has created an opportunity for local small and medium-sized businesses with a lack of resources or expertise, to increase their digital capabilities. In fact, the urban living lab of the City of Lugano (Lugano Living Lab) has coordinated the implementation of the digital support of the partners, collaborating in the development and management of their digitalization process.

Approach

L*3 played a key role in the implementation of the MyLugano app as facilitator and technological scouting and coordination at the four levels of the Living Labs model:

- Citizens: through the involvement of citizens in the testing phase of the app, using surveys and focus groups, collecting their requirements and feedback.
- Private sector: involvement of commercial partners including museums, stores, restaurants and bars, educational institutions and various services (e.g. hairdressers, music schools, IT...). The initiative is also supported by local associations related to the mentioned businesses.
- The City of Lugano has created a task force for a free support of business partners in their digital transformation, in order to promote the inclusion in the project of all small and medium-sized enterprises.
- Academia: the City of Lugano included local universities for in-depth studies on the economic, financial, and communication impact of the MyLugano app.
- Public government: through the internal coordination of the administrative divisions involved. As well as coordination with the Swiss Financial Market Supervisory Authority (FINMA) and the Organismo di Autodisciplina dei Fiduciari del Cantone Ticino (OAD FCT).

Furthermore, the approach can not be compared to other approaches as it represents an unique solution in Switzerland. Indeed, the use of blockchain for managing cashback and loyalty is still at the beginning. While for contact tracing functionality for booking events and public seats, several third-party services emerged in the market. These services offer similar features: attendee traceability standards and contactless check-in/out process. However, these services are paid-service for companies and institutions that need to use them, also the privacy policy system is not entirely managed by the institution.

Therefore MyLugano stands out for the creation of an app which manages contact tracing without the support of third parties. Moreover, an important aspect to consider in the development of such a project was the privacy policy and ethical approach. With MyLugano app no invasive profiling activities are carried out for marketing or advertising purposes, unlike what happens, for example, in all the loyalty circuits of

large chains or large retailers. Moreover, no data is processed in aggregate form, no data is exported or transmitted to third parties and all information remains strictly on Swiss territory and guarded by the City. The privacy policy is also written in a simple and intuitive way, to make perfectly clear the use that is made of the system and of the data entered, with maximum transparency and without being invasive.

Results/outcomes

MyLugano app is currently operating and it is possible to download it for free on mobile devices. Moreover, an informative website: my.lugano.ch is available.

Current data (June 2021):

- Users of MyLugano app: around 8'000, and counting
- Merchants included in the MyLugano app: 109, and counting
- Value in Swiss francs of the LVGA points currently circulating in the MyLugano app: about 300'000CHF
- Value in Swiss francs of the LVGA points already spent at the local merchants: about 80'000CHF

Therefore, MyLugano represents an important milestone in innovation at the City of Lugano in favour of the integration of technology in the life of the city community by creating an innovative digital ecosystem. However, an offline solution has also been conceived for those who are not familiar with technology (in order to avoid digital divide and not exclude anyone).

Several marketing and communication activities have been also carried out and are planned to ensure an understanding of the project to the citizenship:

- Social media: MyLugano; LuganoEventi, LuganoLivingLab. Only the account of MyLugano has generated 3’664 followers with an average of 1.3 posts per day that reach an average of 1’800 people (data updated: July 2021)
- Official website MyLugano.ch: 84,000 unique users, over half a million page views and 200’000 bookings made during the summer of 2020 (data updated: July 2021)
- Physical stands in the city and in the Lidos
- Information material and support for merchants and citizens/tourists
- Assistance at the city offices and online
- Poster campaigns on the territory (N° 2) and online (Adword)
- List of press releases and media coverage www.luganolivinglab.ch/it/projects/mylugano
- Tasks force of 3 people working on the territory to support merchants

- Earned media and Influencer Marketing: interviews on media/social media and creation of viral videos
- Partnership with companies and universities

Lessons learned/why is this presentation of interest for the public?

Public administration and academia: the project underlined the importance of a living lab for coordinating innovative projects involving citizens and administration. Lugano Living Lab (the urban lab of the City of Lugano in partnership with the local university USI – Università della Svizzera italiana) has played the crucial role of facilitator and coordinator of the implementation of the app. The lab also drove the strategic development of the app, making sure to value the Digital Strategy and Development Guidelines established by the City of Lugano. The lab also ensured internal training within the administration resources dedicated to maintain the app, while not burdening current services. At the same time, the lab dials with internal and external training and mentoring of private sector partners (e.g. merchants) involved in the project due to the new technologies used. Moreover, the lab is currently key when it comes to communicate with citizens, ensuring listening and dialogue in order to create a useful service for all.

Positive effects on the local economy: the City of Lugano allocated several economic contributions within the MyLugano app. For example: all fees collected for the granting (or renewal) of new MyLuganoCard were refunded to the users in the form of LVGApoints. Users also who virtualized their LuganoCard in the first phase of launching of the app received extra LVGApoints; bonus to employees in the form of LVGApoints, ecc.). These initiatives inject into the circuit of MyLugano an important cash (amounting to about half a million francs) in favor of users and the local economy.

The use of blockchain as an innovative solution for creating a digital ecosystem: the solution developed with the LVGApoints system is based on an innovative and cutting-edge technology: blockchain. Nowadays, blockchain is still little known and has a huge potential, especially in the context of institutions and public bodies. Therefore, the City of Lugano wanted to deepen the theme and proposes a solution that is unique in Switzerland. The LVGApoints system used for the MyLugano represents a digital complementary currency. Results of the first months of usages of the app are highly encouraging, as both the population and the merchants are seeing the value of having the LVGApoints. Points have indeed the potential to activate new spending habits. However, rigorous standards are required in this area to ensure high levels of security, so a qualified and trained workforce is required.

Acceptance of the project by the population and success of the initiative: MyLugano proved to be an exceptional success, becoming in a short time the reference platform for residents and tourists for the booking of events and public spaces with over 51’200 reservations and 115’045 accesses in the period June-December 2020. Following the launch of the new App (2021), MyLugano has become a tool for territorial marketing by entering into the circuit more than 300,000 CHF and generating revenues amounting to 130,000 CHF for the partners.

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Full Research Paper

Scaling the voice of older adults – reflections on a needed co-design infrastructure for healthy ageing smart communities

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Abstract

This paper investigates barriers that need to be overcome to support a co-design infrastructure for creating smart communities for healthy ageing. The paper further reviews current literature and best practice approaches more broadly and presents our research on wearable device use for walkability in cities as a case study. We highlight the needs for a bottom up approach supported by governments and city planners and breaking up silos between wearable technology development, service design and smart city development. The paper concludes with recommendations.

Key words

Smart cities, smart communities, wearable devices, co-design, healthy ageing

Background

A bottom up co-design approach to involve citizens through co-design has proven useful and establishes itself increasingly as recommended practice (e.g. Hoonhout, 2007; Sanders & Stappers, 2014). Alongside this, and in order to achieve a wider and deeper impact, these practices need to integrate with existing structures and effect some structural changes. In Australia, the Royal Commission into Aged Care Quality and Safety (2021) has demonstrated the need for integrating the voice of older adults into decision-making, research and innovation and product development. However, a present limitation outlined in a recent national survey with 4,562 older Australians (Orthia et al., 2021), shows that there are insufficient opportunities to be involved in innovating a new aged care system despite their interest:

"Seniors feel that opportunities for them to be involved in co-designing or managing the aged care system are currently minimal. For many, any chance to have input and voice their opinions would be highly valued" (p.9).

Considering that seniors are the primary consumers of the aged care system we can expect that participation in related service domains are even more scarce. This is compounded by the fact that there are major demographic transitions concerning the ageing of populations and rapid growth of urbanized communities.

In the present study, we have analysed our living lab research on healthy and active ageing in the smart city to suggest some potential avenues to increase the involvement in service design by older citizens.

Barriers and opportunities to achieving healthy ageing smart communities

Smart city approaches, in particular, mean using technology and better design to help make information more accessible and services more connected and tailored to support healthy ageing. A co-design infrastructure is one way in which this might be achieved with the participation of those who deliver services and those who use and need them. We reflect on the current barriers and opportunities to a co-design infrastructure supporting healthy ageing in smart cities.

Methodological approach

This study is part of a larger project building an evidence base across two streams of living lab research. Firstly, semi-structured interviews of independently living older adults who are using or have used consumer wearable device(s) to self-manage or self-monitor their health (Borda et al., 2020). Their experiences and aspirations towards health self-management in urban environments was analysed using motivational modelling (Miller et al., 2012; 2015) as the analysis framework.

A second stream focused on social prescribing supporting social connectedness in age-friendly communities (Pedell et al., 2020; 2021). Semi-structured interviews were conducted with a community health service provider. The resulting knowledge of their service ecosystem led to two co-design workshops with health practitioners and one client workshop. These were facilitated to understand the goals of the respective stakeholder groups and the user journey throughout the social prescribing service.

We extracted key themes from these two streams using reflective analysis with the motivations of the users serving as sensitizing concepts for the themes to evolve similar to content analysis (Patton, 2002). This method was chosen as it is particularly appropriate for unpacking the impact of complex interventions and how they work in different contexts. The thematic sections below were agreed by the authors as especially core to understanding the need for co-design to better involve older adults in an equitable partnership and improve their agency in service design. Several interventions and their impact are summarily described, followed by a case study which provides further context.

Top-down versus bottom-up approaches

Government bodies and public institutions, such as city councils and healthcare organisations, are increasingly making use of digital resources and ICT to engage citizens in smart service improvement ideas. Cities such as Vancouver (Canada) and Melbourne (Australia) have deployed citizen town hall platforms: Citizenlab Vancouver and Participate Melbourne. A growing number of smart cities have further established departments dedicated to service design for improving and innovating public services in participatory ways. For instance, New York City has launched the Service Design Studio at the Mayor's Office to support methodologies, such as co-design, that are often underused inside government.

Joining up different levels of government through co-design is becoming increasingly considered. Co-design as an approach lends itself to the design and delivery of services through equal partnership of stakeholders such as funders, service providers, been identified as an effective model for service design and delivery in community health services, for example.

Such approaches have been implemented by the Australian Government Department of Human Services (DHS) which partnered with the Municipal Association of Victoria (MAV) to produce a Co-Design Community Engagement prototype (DHS, 2012). The project explored how the Department can join with other levels of government and non-government organisations to deliver better services to the community and individuals, and how to test public engagement as a model for co-design of services at the strategic planning level. Among the engagement sessions, citizen groups included older Australians, migrants and refugees, youth and Indigenous.

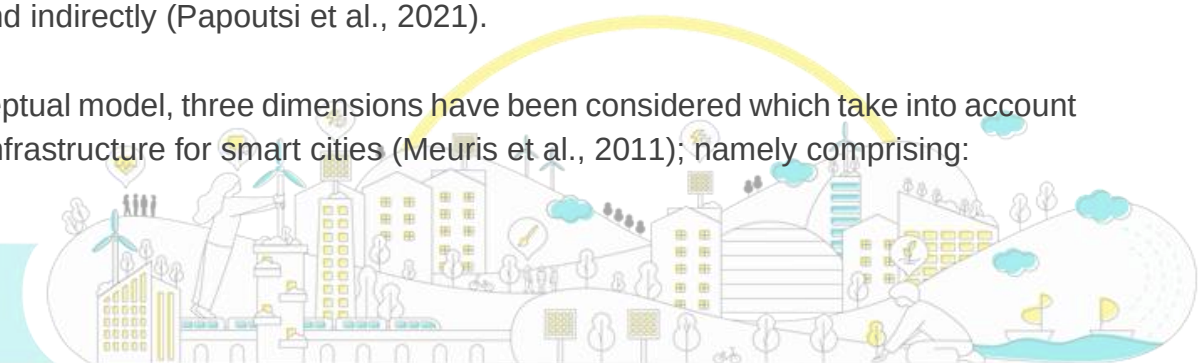
Extensive participation of older citizens, however, remains limited. This can be related to the fact that service tools and improvements remain predominantly designed using a top-down approach starting from the vision of the organisation or service rather than with citizens and/or from their more tailored needs (Wolff et al., 2020). The challenges can be further linked to multiple stakeholders, goals, perspectives and interests involved in service development. So, for instance, top–down policy activities whilst they have potentially wide impacts on service-related areas, they often take time, resources, and political will. Consequently, they can be less accessible to underserved communities, such as older citizens. Whereas the combination of a bottom–up approach, e.g. using citizen-engaged methods to advance local change, can fill in gaps of representation and localise impact.

This bottom-up approach is exemplified by methods like citizen science in which citizens can be involved in localised research and/or problem-solving, e.g. auditing the walkability of areas in their local neighbourhood or taking sensor readings to monitor air quality (Tuckett et al., 2018; Van Brussel & Huyse, 2018). The Our Voice citizen science program is one such bottom up initiative which specifically targets older adults as environmental change agents to improve their own health and well-being as well as that of their communities (Tuckett et al., 2018).

A co-design infrastructure can create pathways that allow stakeholders from both approaches to make constructive contributions and ideally emphasise engagement by those responsible for delivery of a service with those who may be current and/or potential users (Wolff et al., 2020; Carroll et al., 2021).

A shift is needed from co-designing with technology users to co-designing with patients as service users, and with healthcare staff as professionals. Good co-design needs to involve users, including those who engage with the technology-supported service both directly and indirectly (Papoutsi et al., 2021).

In a conceptual model, three dimensions have been considered which take into account such an infrastructure for smart cities (Meuris et al., 2011); namely comprising:



- *Horizontal co-design: learning and working with citizens and stakeholders across communities who may be based in neighbouring geographies or municipalities, or even in different countries with shared missions.*
- *Vertical co-design: working with citizens and stakeholders along service delivery chains, including improvement processes led by citizens.*
- *Intensity: undertaking appropriate levels of participation depending on what is needed, e.g. surveying or other data collection mechanisms, or collaboratively designing a solution.*

While such a three-dimensional model is very desirable to involve citizens along different matrices, there are other barriers that can prevent successful involvement. Particularly with the growth of smart city services, including smart healthcare, it is critical for older citizens to be included in their digital designs (Unertl et al., 2016; Papoutsi et al., 2021).

Breaking up silos between healthy ageing and smart city developments

The global trend of population ageing has brought great emphasis on 'healthy ageing', particularly developing strategies to ensure that older people enjoy life in their years, and not just extra years in their life (Carroll et al., 2021). Health Canada defined healthy ageing as 'a lifelong process of optimizing opportunities for improving and preserving health & physical, social & mental wellness, independence, quality of life and enhancing successful life-course transitions (Health Canada, 2001). A concurrent rise of an ageing population within cities is highlighting a certain urgency in adopting processes to support the parameters of healthy-ageing. Per the Organization for Economic Co-operation and Development (OECD, 2018), the population of older adults of 65 years and over is expected to climb to 25.1% in 2050 in its member states.

Not dissimilar to the goals of healthy-ageing, the movement towards creating "age-friendly" cities should ideally provide a supportive environment enabling residents to grow older actively within their families, neighbourhoods, and civic society and which presents opportunities for their participation in the community (Alley et al.,2017; Caro et al.,2016). The World Health organization (WHO) has led the development of the concept of Age-friendly Cities and an accompanying core set of indicators (WHO, 2015). For example, an age friendly city will feature core environmental aspects that consider both the accessible physical environment and the inclusive social environment, all of which impact the wellbeing and quality of life of an older person (Figure 1).

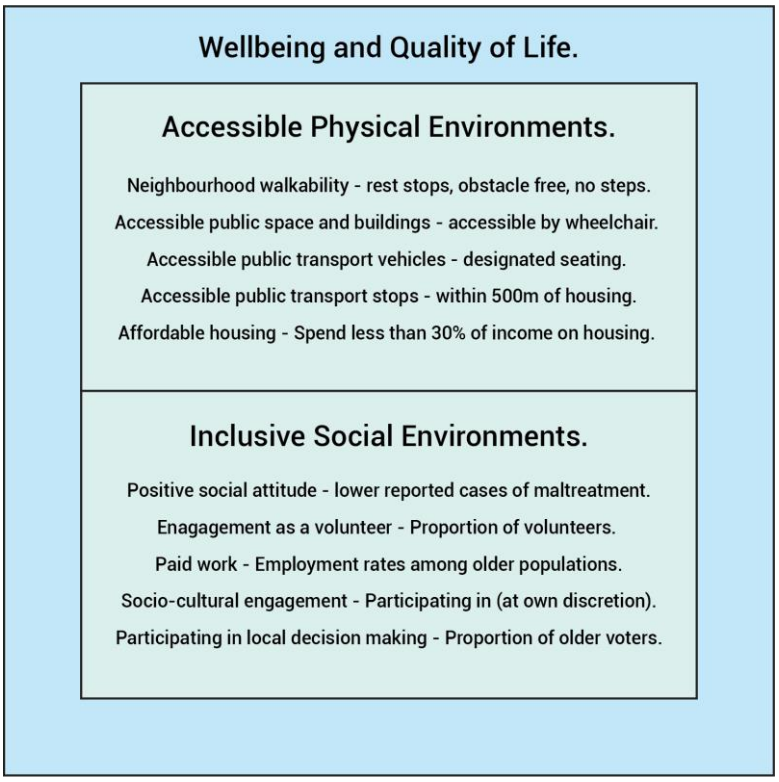


Figure 1: Wellbeing and Quality of Life in an age friendly city are determined by accessible physical environment and inclusive social environments.

A key thematic silo extracted from our aggregated research is the gap between healthy-ageing, as it may be supported through health self-management technology, for instance, wearable apps, and relevant smart city and community services information. Digital devices, such as mobile phones and activity trackers, are ubiquitous devices that potentially provide a way for older people to interact with smart city services, e.g. modes of transport, and which support their healthy ageing needs through apps and websites (Ek et al., 2018). If the design does not match with the lived experiences of the user, it is unlikely to be appropriated in daily practices (Carr et al., 2011; Davidson & Jensen, 2013; Borda et al., 2018; Ollevier et al., 2020; Pradhan et al., 2020).

Our data have shown that for the development of smart walkable cities we need to break the silos of wearable app development and trusted information on the environment. This means that app product development and city planning need to integrate in well-planned smart service development.

Opportunities for smart city services supported by smart apps and devices

The WHO Global Age-Friendly Cities guide outlines several key areas which define a smart city (WHO 2007), among which it should provide:

- Accessible public and private transport
- Opportunities for civic, cultural and educational engagement

- Barrier free spaces (both indoor and outdoor)
- Accessible and useful information for older adults

Accessible and useful information for older adults particularly highlights the need for technology development to better integrate health and information on the environment, but also embrace older adults as users of smart city and community services.

Many older adults use smart wearables, including mobile health technology, which holds significant potential for managing their health by providing tools to track, manage, and interpret personal health metrics, as well as providing access to environmental information relevant to their context (Borda et al., 2018; Pedell et al., 2021). Our research on healthy ageing and smart cities has highlighted specific opportunities for the design of successful services around walkability. Such services can ideally combine wearable technologies, health promotion, and city infrastructure.

Several cities have already been testing and implementing smart services promoting healthy routes, for example, the Smart City Active Mobile Phone Intervention (SCAMPI) study to promote physical activity through active transportation, including walking, in healthy adults in Stockholm (Ek et al., 2018). This study is a rare instance of a randomized controlled trial. More specifically targeted to seniors is the Smartwalk app trialled in Portugal which is part of a smart city system aiming to collect information about walk paths, relevant indicators about users' wellbeing such as heart rate and activity level, and contextual information about the environment and surroundings, e.g. weather, air quality (Bastos et al., 2019; Rocha et al., 2021).

A more widely implemented smart city app currently available in many countries is Blindsquare - a widely used accessible GPS-mobile app designed to help visually impaired individuals navigate cities through describing the environment, warning of intersections, providing directions and recommending places of interest. Such services could prove useful for older adults, for instance, filters in the app could be oriented to cater for specific environmental aspects such as rest areas, well-lit pathways, or the route with the fewest steps and gradients; thus providing tailored information for individual needs.

An example of a tailored app is The Slow Lane - a Dutch mobile app that enables older adults to control traffic lights to allow for longer crossing time. This interaction means that time is provided when needed so citizens with mobility issues need not worry to reach the other side safely.

An example of an international age-friendly community initiative taking place in Nottingham (UK), Greater Manchester (UK) and New York (USA) is the "Take a seat

campaign". This initiative aims to tackle issues of social isolation, to motivate older people to feel confident about leaving their homes and play an active part in their local communities. It does this by encouraging local businesses and community premises to join the campaign and offer people a chance to take a seat and 'catch their breath'. In Nottingham, 28 local areas joined the campaign since 2015 with shops, building societies, cafés, pubs, restaurants, hairdressers, travel agents and others participating.

Across these examples, a shared obstacle is the assumption of a certain level of access to digital technologies and digital literacy (Shin et al 2021) by older adults in order to participate more fully in these services. Similarly, there is only a variable involvement of older adults in the priority-setting and co-design of such smart app/smart city based services before they are implemented. This will have inevitable implications in subsequent adoption and/or scaling (Greenhalgh et al., 2017; Carroll et al., 2021). Early adoption steps will be important to be fostered, particularly if a peer or a mentoring network can be supported to shift behaviour change and gain adherence (Kononova et al., 2019). Various motivational parameters will have similar bearing on use and adoption which need to be considered in the wider design requirements.

Case Study: Design considerations supporting healthy ageing smart communities

Walking and older adults

According to a research study with 1128 older Australians living in Victoria walking becomes increasingly important as a form of exercise when people grow older (Garrard, 2013). In the 55-64 age group, nearly 40% walk for exercise, while no other form of exercise attracts more than 14% of that age group.

In order to put our research findings and recommendations into context, we start with a scenario which illustrates the needs and goals of older adults and the importance of them being involved in directly setting these goals and in co-designing the solutions.

Fiona (78 yrs) once loved walking along the Merri Creek trail (in Victoria, Australia) where she could hear the birds chirping and creek trickling water.
After her fall Fiona can only walk small distances at a time before needing rest. As Merri Creek does not have enough regular seating Fiona walks along the main street instead where rest spots are regular. She misses the calm sounds of the creek.

The environmental characteristics of an accessible physical environment are those for example, that have a proportion of streets that include pedestrian pathways for neighbourhood walkability, public spaces and buildings that are accessible by wheelchair, public transportation vehicles and stops that can be used by all people,

including those who have limitations in mobility, vision and hearing. Environments where older people report feeling respected within their communities, are offered opportunities for paid or volunteering work, can participate in socio-cultural activities, are involved in local political, economic and social decision making opportunities, and where information about social and health related services are available, are considered as social liveability indicators.

Creating an environment that is supportive of walking for seniors should include higher surface quality of infrastructure, such as footpaths and crossings, to help seniors avoid trips and falls, but also making digital information on these parameters open and accessible.

Wearables for healthy ageing

The use of smart health technologies is increasingly being considered as supporting interventions in dealing with the some of the challenges associated with urban ageing.

Among health technologies, the use of wearable devices in the support and management of independent older adults is becoming more widely advocated and a growing number of seniors are using wearable devices to self-monitor and manage their health (McMahon et al., 2016).

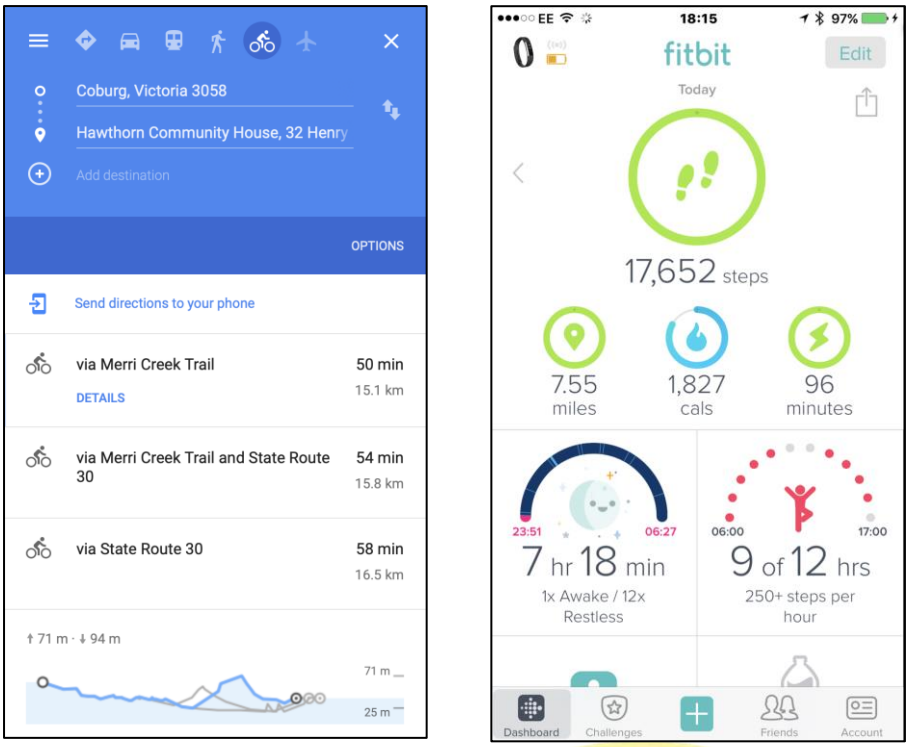


Figure 2. Silos are evident in digital information provision of health parameters and environmental information

In this context, we define wearable devices as those that can *be "worn or mated with human skin to continuously and closely monitor an individual's activities, without interrupting or limiting the user's motions''* (Haghi et al., 2017).

However, to maximize uptake of these devices, more research needs to take place to better understand the emotional goals of older adults when using this technology within their urban environment. By doing so, uptake and acceptance of wearable devices by older adults may increase, leading to enhanced wellbeing, and potential insights into framework development for the design of healthy ageing smart cities.

To complement findings from the published literature, which are based on large numbers of conducted surveys and often not a lot of detailed and individual information, our present recommendations are based on an in-depth analysis of semi-structured interviews with older citizens. As a data analysis mechanism, we applied three thematic frames to analyse transcripts focussing on emotional, quality and functional goals to account for the rich individual needs of older adults for walking in the smart city.

Emotions of older adults when using a wearable for health reasons

Emotions are a key factor in taking up technologies or not (Miller et al., 2015; Pedell et al., 2014). Hence if wearables shall support older adults in their ambition to walk in order to increase their health then technology developers as well as city planners need to understand these influencing emotions.

A strong theme amongst the different older adults using wearables was that they want to feel motivated. This would support them to achieve better goals in being more active and increase step counts.
"I think it's the motivation. I think it created this thing for me it was the motivation to make sure that pedometer showed a lot of steps at the end of the day".

Once a certain hurdle was taken there was an aim to feel confident with the ambition to increase the range of functions for wearable use managing their activities and health: *"Definitely not feeling confident. I simply used it to measure my steps and my sleep. That's all I'm doing".* This points to different levels of confidence, and equally to technology experience.

Such feelings go in conjunction with wanting to feel being up to date on modern technology use. *"I would recommend it to mature aged people like myself. I think you know it makes you feel to sort of up with a bit of modern technology".*

This means there is a desire to make use of the devices that other people are using or recommending for exercise and health. Older adults do not want devices that are simply

created for them as ‘senior devices’. There is the possibility to choose from many devices and platforms that are not further stigmatising older adults

Qualities of wearable technologies to monitor physical activity

When older adults use the wearables they consider supportive of their needs, they are more inclined to be feeling motivated and supported by the technology to do some walking:
“I just wanted to get a little bit more active. I work in an office, a sedentary job and I've found it encouraging me to get up from a desk and walk around to get my steps up”.
Some also wish for data to be shareable: *“And you know I'm looking for some kind of solution where I could have direct contact with my doctor whoever that is, and when I meet them, we have all the figures in front of us”.*

While this participant was really open to sharing, others wished for more privacy for their data - just for themselves or to be shared with close family members: *“Yeah it comes up in conversation occasionally. I might tell my husband. The two thousand steps alert went off before lunch today or it still hasn't gone off and its bed time or something like that”.*

It should be noted that some older adults are champions in their thinking and use of technologies are well ahead of the existing service structure: *“I come for a yearly update and then I can show the doctor all the data. You know, how much I slept, how my blood pressure develops, number of steps, number of calories. And I'm in a strange situation with this. I know more than the doctor does about certain things and so he's not really that happy when it comes to it”.*

Indeed, wearables are used to manage health on different levels and extent. Participants used them for managing weight and chronic pain. *“I've had a flare up of rheumatoid arthritis in the last month so I haven't been doing those things. So that means that the Fitbit and steps is sort of at the top of my aim each week”. They also used it to monitor activity as a preventative measure to increase their health and wellbeing on a general level: “It does give me reminders that I've been sitting down for too long.”*

Purposely we have started with the emotional and quality goals. Looking just at the functional goals, we would not have had the same rich understanding of the personal needs in supporting physical activity and health with the use of wearables.

Integrating wearable health technology for walking and the smart environment

Participant comments make it clear that we need to look at the wearable devices in their context of use, individual lives of older adults and the built environment. Only then can we overcome silos between environmental data and wearable generated health data.

"The minimum exercise I have every day is walking to the bus stop and I get off the bus a few stops early and walk up the back streets to the hospital".
And "…*it was an alarm that went off telling me you know you have to... And so when it comes to the number of steps, I still take them. But I had to get a dog to make sure that I did those numbers. … So, I took a dog; a living creature to help me make my steps".*

If we know that a person not only has a wearable device for motivation, but also has a dog, s/he might need information on routes where s/he can easily take a dog alongside him/her. Similarly, in the former example, the person walking to the hospital might need information where to rest or alternative routes that might bypass major roads and with more shaded areas.

Fiona has set a goal to walk 7000 steps each day. She is motivated to maintain her fitness and stay healthy.
No longer able to walk along Merri Creek her Fitbit charts a route using data from the council where rest spots fountains and shade are regular along another creek near her home. Fiona can continue to hear the sounds of birds and the trickling creek.

We suggest that design considerations are aligned with tailored recommendations combining wearable health data, preferences, and environmental parameters. Together, these factors can positively influence older adults' agency and liveability in the city, increasing their health and wellbeing (refer to Figure 3).

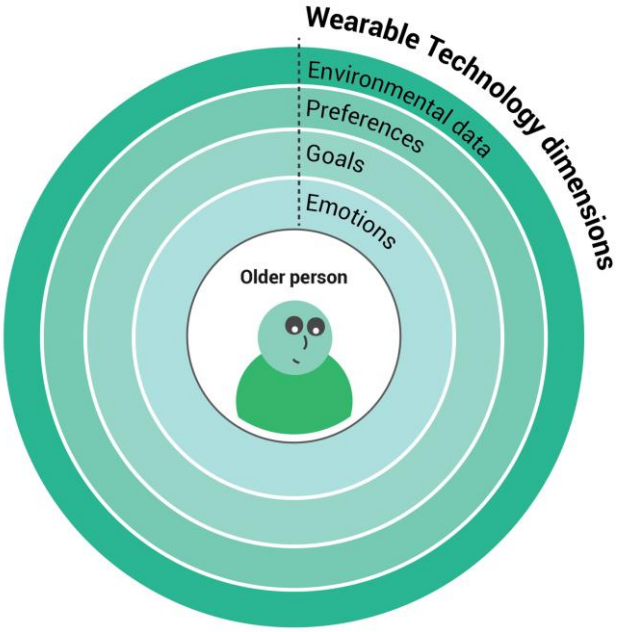


Figure 3: Integrating user preferences, goals and emotions for walking and the smart (urban) environment

Such convergences of healthy ageing, residing within cities, and age-friendliness, are further producing new modalities to better identify the challenges, for instance, the notion of "urban ageing" (Van Hoof et al., 2018), and how co-design can collaboratively address these modalities (Wolff et al., 2020).

Limitations

There are inevitable limitations to this vision of building a co-design infrastructure supporting older adults' participation in healthy ageing smart city design. Firstly, there is a defined limitation in the aggregated strands of our living lab research, focusing on older adults with higher digital literacy in non-CALD communities.

Cities rather than suburban and rural settings are more likely to be a testbed for smart systems due to the fact that larger municipalities have more resources to push age-friendly development. However, potentially these testbeds can also serve as an example for communities in regions and rural areas to become more adaptable for older adults.

A 'one size fits all' of co-design will not be adequate to fulfil different needs, and will need to be considered in context and be iteratively applied and evaluated. Specific co-design approaches to levels of participation needs are outside the scope of this synthesis.

Concluding Recommendations

Based on our living lab research, current literature, and best practice, we have identified several barriers and opportunities to build a successful co-design infrastructure to create healthy ageing smart cities.

Firstly, we need to link up top-down and bottom-up processes to provide avenues for co-design results. The consultation of older adults currently happens in pockets and needs to be reshaped into systematic citizen consultation. The three-dimensional (i.e. horizontal, vertical, intensity) co-design model (Meuris et al.,2011) offers potential pathways for knowledge on identified needs and preferences of older adults to flow towards service improvement, policy making and funding bodies. To realise more localised impact, however, in which smart neighbourhoods can enable older adults to live healthy and active lives, this is most successfully enabled through bottom-up approaches with top-down active support.

Secondly from a technology development point of view, we need to build a digital information layer which is easily accessible through devices. Instead of separating devices and apps for health and information acquisition on urban environments, devices need to better integrate health and city information. Such a layer requires a greater variety of filters for tailoring to a growing population of older adults with different physical and technical capabilities, including providing them with the ease to access information on different interests and preferences relevant to them. There needs to be a concurrent acknowledgement of early adopters among older adults in the take up of digital devices and innovative services which support their health self-management and well-being. Ideally, the design of such smart city services need to place older citizens at the centre, not only as recipients and users of those services, but as designers in the process. Living labs are uniquely positioned to support multi-stakeholder collaborations to advance these goals and to scale the voice of older adults.

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Full Research Paper

A closer look at the role of higher education in living labs: a scoping review

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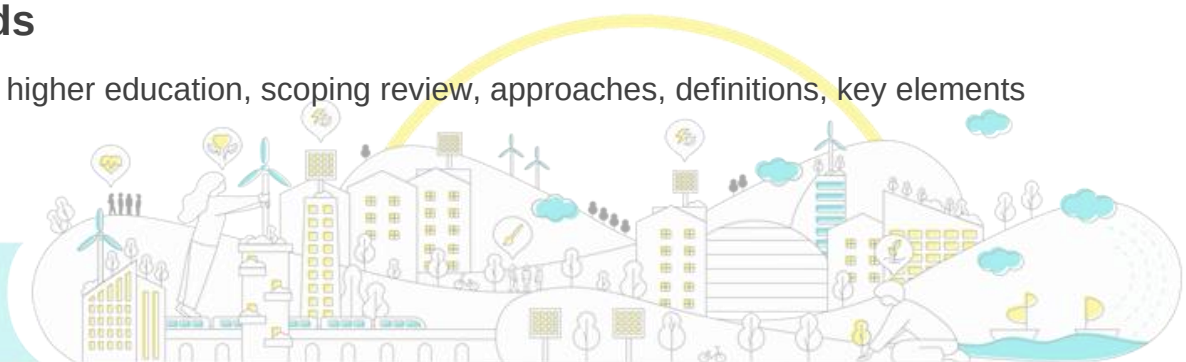
Abstract

As society changes fast, there is a need to educate professionals who contribute to innovation and complex adaptations in organizations. Companies, governmental bodies and other stakeholders seek collaboration on actual complex issues in living labs; user-centred, open innovation ecosystems based on co-creation and integration of research and innovation processes in real life settings. Living labs are recognized as educational environments to prepare students in higher education for future roles thus knowledge regarding the optimal embeddedness of higher education in living labs is of importance. The aim of this article is to explore the nature and extent of the scientific literature about living labs in which actors in higher education actively participate. A scoping review was conducted. Based on 21 articles, it can be concluded that the research on embedding higher education successfully in living labs is at an early stage. More detailed studies into aspects of the successful participation of higher education is recommended to gain knowledge about enhancing learning outcomes, and the effects of educational activities (including assessments) within living lab environments.

Key words

Living Lab, higher education, scoping review, approaches, definitions, key elements



Introduction

The world is changing fast and this is leading to complex societal challenges. These continuous changes affect the competences needed for professionals to contribute to innovation. Employers expect professionals to be lifelong learners and to constantly update their expertise in accordance with societal and professional demands. Complex societal challenges call for groups of collaborating experts with different backgrounds and contexts (1). Consequently, there is a need to educate professionals who think and work in an interdisciplinary fashion, who contribute to innovation, and who achieve complex adaptations in organizations. Higher education prepares a substantial group of professionals for 'real life', although it is questionable if traditional classroom courses prepare students sufficiently for the challenges of the future. According to Zitter, Hoeve and De Bruijn (2016), the traditional and scholarly approach of higher education is too limited, as it does not fit within the 'Zeitgeist' of the current era, it does not resonate with the preferences of students and it collides with the demands of professional practice (2). For example, in the Netherlands, Zuyd University of applied sciences will focus even more on developing students into professionals with skills that are relevant for the region. Integrating research into education and embedding education in practice are their main pillars (3).

Increasingly, companies, governmental bodies, civil societies and other stakeholders seek collaboration on actual complex issues in so-called living labs. This concept offers opportunities for higher education to work closely with professional practice with the emphasis on innovation research in 'real life'. In the literature, the concept of the living lab is increasingly gaining attention (4). The European Network of Living Labs (ENoLL) defines living labs as *"user-centred, open innovation ecosystems based on systematic user co-creation approach, integrating research and innovation processes in real life communities and settings*" (5). Real-life setting, co-creation, active user involvement, multi-stakeholder participation and multi-method approach are the five major elements of a living lab (5). According to ENoLL (2020), there is no single living lab methodology, all living labs combine and customize different user-centred, co-creation methodologies to best fit their purpose (multi-method approach). The building blocks exploration, experimentation and evaluation are performed in iterations, emphasizing the importance of getting to know the current state and designing possible future states of innovations, real-life testing and assessing the impact of the experiment by means of user-feedback (6).

Although the concept of living labs is emerging in the scientific literature and the number of living labs in different areas is increasing, there is still a lot to learn about how to run a living lab successfully. Several aspects of living labs have been the subject of study in recent years, e.g. studies into types of living labs or user roles within living labs (7).

In their systematic review, Schuurman et al. (2015) confirm the increasing number of papers about living labs since 2006, but the theory-based foundation of the concept is lagging behind the increasing number of experiences with living labs in practice around the world (4). A study into living labs in the Netherlands (8) highlights the potential value of living labs, though also indicates the early stage at which living labs are at the moment, and the need for further study.

As the concept of the living lab is gaining recognition as an innovative approach for higher education to prepare students for their future roles (8), knowledge regarding the embedding of higher education in living labs is lacking and of importance for success. Interdisciplinary collaboration poses challenges to all stakeholders involved, such as dealing with differences in professional language and professional culture (9), or shaping the involvement of users in the innovation process (10). Embedding higher education into living labs has its own challenges; these include merging the dynamics of education and the dynamics of the processes of innovation into the real-life setting, and matching the competences of students with required expertise in the field. Insight gained from reported experiences and lessons learned about how to incorporate higher education within living labs, how to facilitate students' learning in living labs and how to deal with the challenges it brings with it, could provide guidance for future living labs. The aim of this article is therefore *to explore the nature and extent of the scientific literature about living labs in which actors in higher education (i.e. students and lecturers) actively participate*. In order to retrieve this information a scoping review was conducted.

Methods

Study design

The literature on living labs was reviewed by means of a scoping review. In order to accumulate as much information as possible about the concept, the main focus was on relevance of articles. The five-stage approach of Arksey and O'Malley (2003) was used (11).

Identifying the research question

The following research question was formulated: 'What is known about the role of higher education in living labs in scientific literature and the factors that influence embeddedness of higher education in living labs?'

Sub questions part of this research question which will be answered are:

- What kind of studies are conducted regarding living labs that include higher education?

- How are living labs defined and which models and approaches are used as theoretical underpinnings of the living labs?
- What are features of living labs in which higher education participates?
- What are lessons learned regarding embeddedness of higher education in living labs?
- How is learning designed (e.g. learning outcomes, learning activities and assessment) in the living labs?

Identifying relevant studies

The search for this study included two concepts: 'learning environment' and 'living lab' (Figure 1). Using a literature discovery service from Ebsco Host 29 different databases were searched simultaneously (e.g. ScienceDirect, CINAHL, Psychology and Behavioral Sciences Collection, PsycARTICLES, Science Citation Index, IEEE Xplore Digital Library, Cochrane Database of Systematic Reviews, ERIC).

Search String

1. "learning environment OR education environment OR education OR student involvement";

AND

2. "living lab OR living labs OR living laboratory OR living laboratories"

Figure 1. Search string

The search was limited to publications in Dutch and English published between 2000 and June 2021. In addition to searching electronic databases, reference lists of relevant articles were checked.

Study selection

The selection of papers based on title was done independently by two reviewers (RvdH and RD). Papers with titles referring to both 'living labs' and 'education' were given a score of 2, papers with titles referring to 'living labs' or 'education' were scored with a 1, papers on topics that were not relevant to our study were scored with a 0. When the scores of the two reviewers together were >2, the abstracts were screened. The abstracts were screened by one reviewer (RvdH). Articles were included if both living labs and education were mentioned in the abstract. When the concept of living labs was not explicitly mentioned the article was not included, because this study specifically focused on environments which are called a living lab, other concepts may be partly comparable, but were not included because of the small nuances between the concepts. Where there was doubt the full text was screened, and the reviewer (RvdH) discussed inclusion of the sources with reviewer two (RD).

Charting the data

A descriptive summary of each study was created in a spreadsheet to map the citation information of the article, general article information (type of publication, number of living labs discussed, domain of the study, subject of innovation and aim of the study), the definitions, key elements and theoretical underpinnings of living labs used by the authors, information on the different features, lessons learned, and specific information about how learning is designed within the living labs. First, five articles were independently charted and discussed by two reviewers (RvdH and SB) and the results were discussed with researcher RD. Subsequently, one of the reviewers (RdvH) continued with the other 16 articles.

Collating summarizing and reporting the results

Initial reading and preliminary content analysis led to the main categories described to structure the findings. After creating the table, the results were summarized, reported and discussed by the authors in order to cluster results and draw conclusions.

Results

The search was performed on June 1st 2021 and resulted in 427 hits. After reading the titles, abstracts and full texts and correcting for duplicates, 21 full texts matching the inclusion criteria were included. Figure 2 shows the flow chart of the inclusion and exclusion process. Papers which were excluded did not meet the inclusion criteria during title or abstract screening because the topics 'living lab' and 'higher education' were not explicitly mentioned, as described in the Methods section.

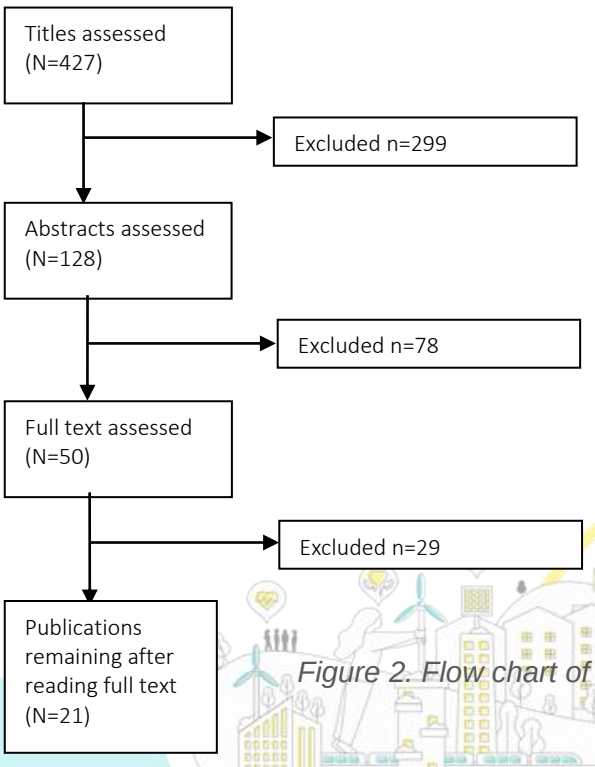


Figure 2. Flow chart of the inclusion and exclusion of articles

Table 1 (supplementary material[1]) gives an overview of all included articles. The first column shows the reference of the article (citation information). The second column provides general information about the type of study, the number of living labs involved in the study, the domain in which the living lab is situated, the subject of innovation and the aim of the study. The definition of living labs as described in the article is reported in the third column, often with additional key elements. The fourth column describes the theoretical underpinnings (models and/or approaches) towards living labs as reported in the articles. The features of the living lab; context of the living lab (environment), the stakeholders involved and also the roles and governance structure within the living lab are reported in the fifth column. Column six reports those lessons learned during the initiation, evaluation and sustainability of the living lab, including any success factors and challenges described in the papers. The seventh and last column shows specific information about aspects of education with the emphasis on learning outcomes, learning methods and types of assessment based on Biggs (12).

General article information

The articles included were published between 2007 and 2019. The living labs were situated in various domains including ICT, education, healthcare (occupational therapy, gerontology), industrial design, sustainability, service business development, engineering, tourism, ambient intelligence and architecture. For example, a living lab in architecture (13) focused on renewable energy and nearly zero energy buildings. An example from healthcare is a living lab to establish age-friendly services in co-creation with older adults (14).

Aims of the included studies ranged from evaluating the experiences of participants in living labs, exploring or developing the theoretical foundations of living labs or studying elements of living labs, e.g. knowledge management (15). Other aims included were designed serendipity and the financial sustainability of living labs. For example, Santally et al. (16) describe theoretical foundations to create a framework for a living lab focusing on classroom education of the future. Van den Berg et al. (14) studied the experiences of their living lab participants (older adults and undergraduate students) revealing the importance of equality and shared responsibility. Students are stakeholders in all studies. Education is explicitly mentioned as the aim of the study in eleven of the articles, e.g. Beecroft (17) describes the interrelations between real world labs and higher education using a social practice perspective.

The types of studies varied. Five articles are qualitative studies or evaluations of living labs, another five describe living lab cases/case studies, two are literature studies and the majority are knowledge syntheses (n=9). Where articles were a combination of type

[1] Supplementary material found in https://drive.google.com/file/d/1Ug5JQsrEMEU8xPhMQCckZAiYHx1JVPTf/view?usp=sharing

of study, e.g. a literature study combined with one or more case studies, the main type of study is reported in Table 1. The number of living labs described in each article varied from 1 to 5. However, most articles discussed one living lab, often containing several different projects or educational courses related to this single setting.

Definitions, key elements and theoretical underpinnings

Each of the articles defined living labs differently, although they often used similar wording in their description. For example, active user involvement is referred to as user-centred innovation, user-involvement, active participation or collaborative development. All of the five major elements as described by ENoLL frequently showed up: co-creation, real-life setting, multi-stakeholder participation, multi-method approach and active user involvement, together with the accompanying building blocks; exploration, experimentation and evaluation (6). Callaghan et al. (18) explain *co-creation* in living labs as input from users as co-creators utilized to research the context of ICT use (in this specific case), find new uses, and evaluate new solutions within their everyday contexts. Masseck (13) describes variation in *real-life settings* in architecture which can range from a small-scale knowledge dissemination and 'experience homes', up to a city platform for social innovation regarding sustainability, or a city itself with its buildings and inhabitants as a supporting ecosystem for user-centred innovation. The involvement of *multiple stakeholders* is highlighted by De Jager et al. (15) who describe a living lab as an 'innovation platform' that engages all stakeholders, such as end users, researchers, industrialists and policy makers at an earlier stage of the innovation process. Gualandi and Romme (19) explain that a living lab can contribute to every phase of the innovation process by orchestrating and coordinating the activities of exploration, co-creation, experimentation and evaluation. The living lab generates value to the entire supply chain and can explore and assess the environmental, social, and economic effects of the new products or services created and tested in the living lab.

Two of the most distinct differences in the definitions of living labs concern specific reference to research and to learning and education. Ten definitions explicitly include the element of research in their definition or key elements. An example of a definition explicitly mentioning research is the definition of Era & Landoni (20) used by Grove (10 pp 98) "*A Living Lab is a design research methodology aimed at co-creating innovation through the involvement of aware users in a real-life setting*." Additionally, the learning or educational aspect is described in six living lab definitions, e.g. in the definition of Jernsand (21) who describes living labs as spaces for open innovation, co-creation and experimentation in real-life settings with students. In their definition, Van den Berg et al. (14) describe "*In an educational setting, a living lab enables different stakeholders, including students, to learn how to work on user-driven innovation."*

Because the theoretical underpinnings could play an important role in the operationalisation of the living lab and therefore influence the role of higher education, we searched for the theoretical foundations or approaches of each living lab. One article did not mention a theoretical foundation (22). In the remaining twenty articles, a broad range of models were described as being used as theoretical argumentation to start a living lab in the first place. Most of these models or approaches focused on processes such as social interaction, pedagogics or design. Examples of these are activity theory (16), appreciative inquiry (18), design thinking (21), and service learning (23). Some used a very detailed description of the approach, while others only mentioned the model, but did not elaborate on the application details.

Living lab features

All articles described the contexts in which the living lab activities took place. Approximately half of the papers described living labs which were situated in a university department (n=9), sometimes combined with a virtual or web environment. Topics of the living labs located at university departments included the future of teaching (24), or sustainability (climate change and urban sustainability e.g. at the campus building (25). In these examples, there is a clear relationship visible between the topic of the living lab and the location, being a real-life environment close to users (in these cases students, lecturers and others). Other contexts in which living labs were situated are public spaces, community sites and cities (n=9). Subjects of these living labs included sustainable tourism (21), development of library services (26) and development of age-friendly services (14). Two articles described a digital/web context, without a physical component, e.g. a knowledge management application (15, 10). In one article, the living lab environment was labelled as a human machine interactive environment (27).

Many different stakeholders were involved in the living labs. Two articles described collaboration in the form of a Public-Private-People-Partnership (15, 16). Hence, diverse public and private actors are involved; these include: companies, industry, associations, students (differing study levels and differing study programmes), academics, teachers, researchers, policy makers, end users (e.g. older adults), citizens, service providers and healthcare organizations. The roles of stakeholders can differ during the processes of the living labs and the composition of stakeholders can be different in each of the phases (exploration, experimentation, evaluation).

Some articles explicated the roles of the stakeholders. For example students can play various roles including learner, peer observer, project leader, data collector, analyst and/or presenter. The roles of students can change over time (22). Lecturers often provided guidance, coaching and instruction, while end users were able to share their insights or function as mentors or trainers. Some articles emphasized the importance

of equality within the living labs (14, 21). Jernsand (2019) described ‘flat leadership’ as a teaching style employed in their living lab of sustainable tourism, in which lecturers are mentors who listen and advise rather than give directions (21).

Hardly any information is provided about the organization, or governance of living labs and conditions for the sustainability of living labs. In their article, Gualandi and Romme (19), address the financial sustainability of living labs by making suggestions for acquiring funding and creating value as these are important conditions for living labs to become financially sustainable.

Design of learning

Our main interest was to ascertain if articles addressed the contribution of education to the living lab, and if so, how they designed learning in the labs. Information on the following topics was searched for: learning outcomes of students and, where applicable, other stakeholders, if and how activities to enhance learning were described, and if and how articles reported on the assessment of learning in the living lab context. Fourteen of the 21 articles included specifically mention learning outcomes of students in their study. The learning outcomes described can be divided into the disciplines of generic learning outcomes and specific learning outcomes. Generic learning outcomes were usually more broadly formulated and concerned topics such as professional development, clinical reasoning through lived experiences, reflection (learning-by-interaction), self-regulation of learning, taking responsibility, learning from experience, self-assessment, social awareness, innovation and collaboration. Examples of discipline-specific outcomes were knowledge of and skills relevant to the development and implementation of age-friendly services (14), and specific sustainability development competences (13).

Learning and teaching activities were not described in detail, however, examples of activities presented in this way included fun learning using cartoons or story-telling cartoon movies (16). Another example is gaming-to-learn, in which learning by playing and serious gaming play an important role in the teaching and learning of the students (16). Doing research with others (not only students and teachers) rather than on others (14) are other examples of teaching and learning activities in the living lab. These include, developing creative innovations that answer the needs of the user, teams working on parallel projects of their own choice, and the observation and assessment of assignments during activities in the lab (22). Hummels and Vinke (9) connect the term individual curriculum to their living lab, giving students the opportunity to select their learning activities at the start of a semester, depending on their individual learning needs. Learn by doing, edutainment, using social media tools, placed-based learning, participatory methods and workshops are other examples of teaching and learning activities in the context of the living lab. Real-life environments, involvement of users

and co-creation are also essential elements in the aforementioned learning activities.

The assessment of learning was rarely discussed. Only three articles described the assessment of students within the living labs; the forms of assessment used were presentations, qualitative assessments during and after activities (reflection seminars, group discussions, course evaluations), progress reports, student blogs, future-driven self-assessment (focus on utilizing the programme of study to prepare students to develop sustainable self-assessment ability), exhibitions and show cases in which students present their work and coaches and fellow students act as peer reviewers (9). One article reported experiences regarding the assessment of learning in living labs; he concluded that 'there seems to be less competitive pressure' in assessments in the living lab context than in regular assessments in the curricula (28).

Lessons learned

The articles often addressed lessons learned (including success factors and challenges) regarding initiation, evaluation and sustainability of living labs. Generally, lessons learned concern processes in living labs, interaction in living labs and preconditions for successful living labs. Regarding the process, van den Berg et al. (14) found that there is a tension between what is beneficial for a user-driven living lab, and what is appropriate for an educational system with a focus on control and prediction; finding the right balance between 'freedom and frameworks' is a necessity. Furthermore, these authors learned about the value of investing time and effort in building relationships between co-creators. Hummels and Vinke (9) indicate that an attitude of lifelong learning among all the participants is essential, and creates the right environment in a living lab. According to Grove (10), designed serendipity (unexpectedness, insightfulness and value) is a success factor as it leads to useful findings and fits within a living lab approach which seeks to elicit unforeseen user ideas and behaviours to enhance product innovation.

Considering interaction in living labs, flat leadership and less competitive pressure amongst living lab participants will help to create a successful living lab (28). Using social media tools such as blogs, wikis, Really Simple Syndication (RSS) feeds, sharing content, tagging and social networking were experienced as stimulating to the success of a living lab (15).

Requirements for successful living labs include a supportive logistic infrastructure. Benson and Hansen (22) describe the importance of coping with logistical barriers, and the establishment of a community site willing and able to accommodate students during educational activities. Furthermore, closeness between stakeholders, e.g. firms and end-users, is a precondition for a successful living lab. Jernsand (21) found neutral places to be of significance for living labs as they reduce the risk of participants being

hampered by institutional ‘lock-in effects’ such as incorporated norms, cultures and working methods.

Discussion

The aim of this article was to explore the nature and extent of the scientific literature on living labs in which higher education (students and lecturers) actively participates. Potential results could guide higher education programmes and their networks in the setting up of sustainable and meaningful collaborations for innovative educational courses, both together with and in the real world. Living labs are a new phenomenon, and this study also shows that research into living labs with the active participation of higher education appears to be relatively new, as the majority of the papers have only been published recently, and the number of papers is limited. The *kind of studies* included were mainly descriptive and explorative in nature, reflecting the state of the art in living lab research. Schuurman et al. (4) also found the number of empirical, quantitative and comparative studies focusing on the added value of living labs somewhat limited. In our review, we found no studies that focused on the effects of learning in living labs.

Definitions of living labs generally do involve the main aspects of ENoLL; real-life setting, co-creation, active user involvement, multi-stakeholder participation and multi-method approach (5). This might imply that there is overall consensus about the core of living labs. Some articles added terms related to education and research to their definition, which, from the perspective of universities, appears to be a logical addition. The fact that most articles do not explicitly mention research as being associated with living labs might be related to existing perceptions about the process of innovation, i.e. that research is an inherent part of innovation. A similar assumption can be made about learning in living labs; one cannot innovate without learning. However, including students and teachers in living labs does call for active learning, and active learning is of importance for all stakeholders involved. Veeckman et al. (29) link living labs to "communities of interest" and "communities of practice" following the work of Wenger et al. (30). In these communities, stakeholders are informally connected by what they do together and by what they have learned through their mutual engagement in these activities (29). This perspective calls for discussion about incorporating learning as one of the core elements of future living lab definitions. Consequently, the attention to learning in real life contexts might impact the *theoretical underpinnings* of living labs. The available body of knowledge about communities (30) and hybrid learning environments (31) support the embeddedness of higher education in living labs. Wals, Lans and Kupper (32) define a hybrid learning environment as a social practice around ill-defined, authentic tasks or issues whose resolution requires transboundary learning. For example, the available knowledge on how to assess students in hybrid learning

environments. Zitter and Hoeve (2) emphasize the crucial role of participants from practice or business in the assessment of students.

The different *features* of the living lab were discussed for some labs in detail and others very minimal. Regarding the context, this study reveals that almost half of the living labs were situated at universities. This could well reflect the state of the art in the development of living labs in higher education, with universities themselves as the founders and organizers. It also provokes discussion about the real-life element of living labs. However, the topics of the living labs situated at universities are all linked to topics studied in this context, e.g. IT, sustainability and education, in which the users of the living lab are the users at the universities. From an educational perspective, the real-life element of living labs is the innovative aspect of living labs offering students experiences outside the classroom. In her comment about neutral places, Jernsand (21) emphasized the impact of the location on the success of living labs. Further research into the real-life aspect of the living lab, including its location, the intensity of interaction between students and users, and the learning experiences of students would be a useful line of further research. It is notable that this study found few results of research on the organization and governance of living labs involving higher education. One article concerning innovation networks (33) implies that collaboration in these networks requires clear and SMART goals from the beginning, as well as continuous management of the main elements of the network, and investment in information and communication technology to improve information sharing and formal coordination. In an article on innovation management (34), the authors stress the importance of a strategy to guide the approach that steers the innovation, the processes, the portfolio, and the projects in the innovation funnel, as well as leadership, resources, and the competences of staff. The lack of information ascertained by this study might relate to the locations of living labs at universities. Embedding higher education within living labs outside the university may lead to challenges other than embedding living labs in higher education institutions.

Different *lessons learned* regarding processes in living labs, interaction in living labs and requirements for successful living labs were found. Balance between freedom and frameworks is of importance. Furthermore, it is crucial to invest in relationships between co-creators. Less competition and flat leadership helps to create a successful environment. Moreover, a supportive logistic infrastructure and closeness between stakeholders is needed.

When focusing on *how learning is designed* in the living labs, a distinction was made between generic competences and specific competences. As expected, the specific competences differ between labs depending on the domain and subject studied there. Among the generic competences there are a lot of communalities, these include co-creation, cooperation, clinical reasoning and reflection, and learning from experience

and innovativeness. These competences match all key elements of living labs which according to ENoLL are real-life setting, co-creation, active user involvement, multi-stakeholder participation and multi-method approach (5). The learning activities in living labs which were identified seemed to be more innovative and interactive than the more classical learning activities. Only three papers reported on assessments in living labs. Although education was part of most research objectives in our study, none of the studies focused on the effects of educational activities in living labs on the competences of students.

Our aim was to explore the nature and extent of the scientific literature about living labs in which higher education (students and lecturers) actively participate. Although not scientific, there are other papers that discuss this subject, but they were not part of the selection, and therefore this review does not capture the full body of knowledge in this domain. Scientific studies that may possibly be relevant could be missed because of our selection of databases and use of search terms. Our search and selection specifically focused on articles addressing the concept of the living lab, as it seems to be an internationally accepted concept and other reviews of living labs have already been conducted. The finding that all articles referred to the same aspects of living labs (as described by ENoLL) supports the assumption that this review did capture the concept.

Conclusion

Based on this scoping review it can be concluded that research on embedding higher education in living labs is at an early stage. More detailed studies into the aspects of participation of higher education are recommended in order to gain knowledge about enhancing learning outcomes, and the effects of educational activities including assessments within the living lab environment.

In addition, there appears to be a lack of knowledge about conditions, organization and governance of living labs and further study would certainly be worthwhile. More emphasis on learning as being a crucial aspect of living labs may steer the research and those theoretical foundations that support the embeddedness of higher education in living labs.

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Conflicts of interest/Competing interests

Not applicable

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Full Research Paper

Human Factors in Living Lab Research

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Abstract

Human factors research is still in its infancy in healthcare and other fields but has the potential to allow organisations and living labs to assess and improve the quality of innovations while closely involving potential end users. Human Factors can be defined as a scientific discipline focusing on the interaction between individuals and systems with the goal of improving safety, performance, and user acceptability. Studies simulating challenging real-life circumstances in selected samples and using a multi-method approach can provide important insights for organisations and governments and allow for better and safer services for the end user. By combining existing theory and case examples, the current paper aims to situate human factors research and to help researchers determine when and how this methodology could be applied.

Key words

Human factors, methodology, living lab, safety, usability

Introduction

The discipline of human factors and its relevance for living labs

Human Factors can be defined as a scientific discipline focusing on the interaction between individuals and systems with the goal of improving safety, performance, and user acceptability (Bergman, 2012; Weir, Newham, & Bennie, 2020). The term 'systems' can refer to specific tools, technologies, or tasks; the general working environment; or in some cases even the social, political and economic climate (Weir et al., 2020). This broad scope and interest in the wider system distinguishes human factors from the related fields of ergonomics, usability, and user-centred design, although the terms are often used interchangeably (Norris, 2009). Human factors can be situated on the crossroads between engineering and psychology since it focuses both on the design of tools and environments, as well as on the cognitive and social functioning of users (Parker, 2015). While it was first used in safety critical industries such as defence and aviation, it has gained entry to a broader field of design and safety management in the past decade (Norris, 2009). In the meantime, the Systems Engineering Initiative for Patient Safety, a human factors framework specifically tailored to healthcare was even proposed (SEIPS & SEIPS 2.0; Holden et al., 2013). While research is generally concerned with outcomes, human factors research has a strong complementary focus on the process. For example, SEIPS 2.0 focusses on the work system, processes (physical, cognitive and social/behavioural), and outcomes (Holden et al., 2013). Instead of merely assessing whether a system improves efficiency or user outcomes, it is important that research also focuses on safety, ease of use, contextual fit, and implementation processes.

Human factors are of great interest to living labs since these innovation ecosystems aim to facilitate the development and optimization of innovative solutions and hold an intermediary position between the relevant stakeholders (e.g., citizens, regulatory agencies, professional organisations or developers). Although many definitions exist, the living lab approach can be seen as a methodology centred around the co-creation of innovations through end-user involvement and experimentation in real-life contexts (Ballon, Van Hoed, & Schuurman, 2018; Dell'Era & Landoni, 2014). Living Lab research generally follows an iterative cycle including exploration, co-creation, testing & evaluation, and implementation & upscaling (Ballon et al., 2018; Van Den Kieboom, Bongers, Mark, & Snaphaan, 2019). While actual human factors studies are situated in the testing phase, all four stages contribute to providing safe and user-friendly products. Figure 1 provides examples of information relevant to human factors than can be collected in the different phases of living lab research.

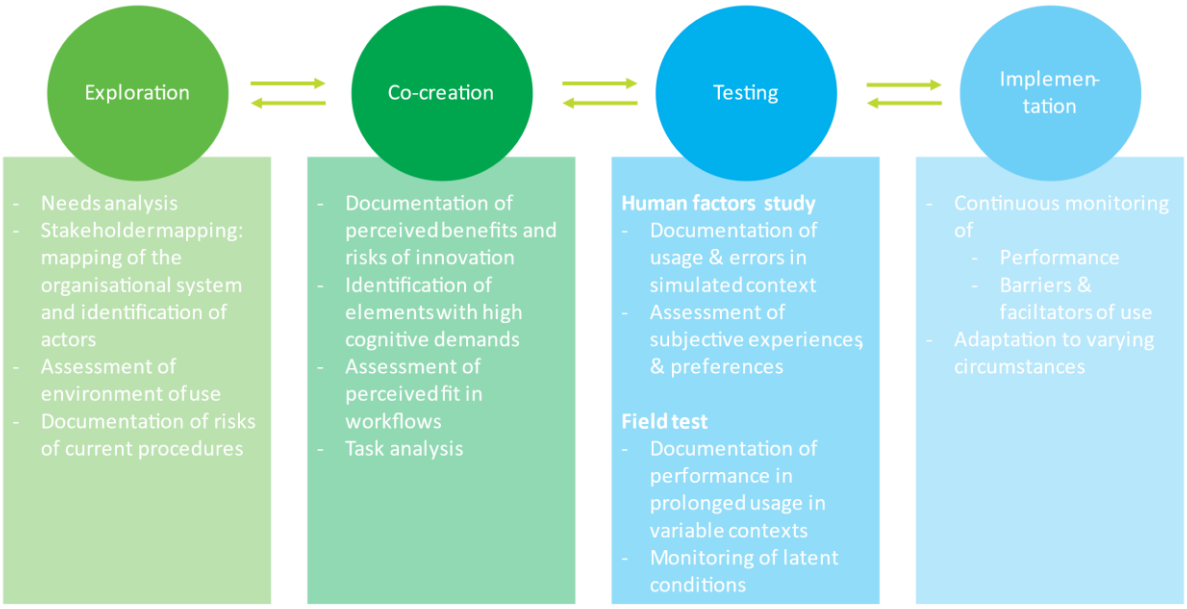

Figure 1. Overview of the different stages of living lab research and some according relevant exemplary focal points for data collection in relation to human factors.

To be able to design for safety, performance, and acceptability, it is paramount to collect ample information about the environment in which an innovation will be implemented. The *exploration phase* allows for the collection of information on physical, practical & organizational circumstances as well as current potential safety risks. Circumstances can refer to the actual working environment (e.g., amount of space, internet access) but also to the subjective experience of this context, such as cognitive demands (e.g., stimulus-rich/noisy environment influencing performance) (Norris, 2009). When *co-designing* an innovation in collaboration with the stakeholders, perceived risks, elements of high cognitive demand, and usability of the innovation should be taken into account. In addition, the fit with existing processes, workflows, and habits should be documented since this is key to maximizing appropriate and long-term usage. At this point in the cycle, it could be useful to include hierarchical task analysis, a widely used human factors technique that describes the investigated activity through a hierarchy of goals, sub-goals, operations, and plans (Stanton, 2017). Such a detailed analysis of the innovation can guide further design and the development of test protocols.

The *testing* phase requires field tests to gain insight into prolonged usage, usage in real contexts with varying in demands and circumstances, and latent conditions that are harder to identify in previous stages (Norris, 2009). However, Georges, Schuurman, Baccarne, and Coorevits (2015) also propose pre-field or usability trials depending on the functional maturity of the innovation. A lab-based *human factors study* can not only account for technical difficulties related to lower functional maturity, but also provides additional opportunities to document interactions and preferences. Finally, when an

innovation is *implemented* in the field, monitoring and documentation should continue, since societal needs, challenges, and contexts continue to evolve quickly and will ask for adaptation of the innovation.

Multiple stakeholders should be involved in all stages since the design of innovations is a dynamic process including continuous improvement and adaptation. The process is not linear in nature but allows to move flexibly across the stages in multiple iterations. The goal of living lab and human factors research is to provide innovations that are relevant, safe, reliable, and easy to use. Nevertheless, insights that are being collected can additionally be used to optimize procedures, shape supportive materials and training, or support other process and implementation factors.

Human factors studies

While exploration and co-creation provide insight into stakeholder perceptions and beliefs, methods such as human factors studies and live tests allow to move away from assumptions. Weir et al. (2020) observe a strong contrast between positive perceptions of technological innovation regarding safety versus the data on errors and other usability problems in actual implementation. Specific testing paradigms can be used to gain insight into human factors. In a human factors study, sometimes also referred to as a usability study, users are asked to interact with an innovation in simulated real-life circumstances (Bergman, 2012). Table 1 provides an overview of some prototypical characteristics of a human factors study. However, the design should always be tailored to the research questions and innovation of interest.

A human factors study *aims* to provide insight into actual interactions with innovations, and according usage problems or errors, in a challenging yet controlled situation that simulates real life. Having a diverse *sample* from the target population, including potentially vulnerable targets, allows organizations to design their innovations for their most vulnerable users (e.g., those with low digital literacy), which will promote safety and usability. Per condition or target population, a *sample size* of around 8 individuals is common and appears sufficient to detect the vast majority of usability problems (Bolle et al., 2016). However, the required sample size can differ depending on the richness of the dataset and on the data collection methods on which you rely. Using a lab-based simulated context allows to observe behaviours that occur widespread over time in or are difficult or unethical to evaluate in real life. For example, we can simulate that a patient has forgotten to take their medication and observe the resultant behaviour. Human factors studies can be designed to be very challenging and even maximize the likelihood of making errors. By providing a very stringent test of the innovation, rigorous safety precautions can be put in place before it is implemented in practice.

Table 1. Prototypical characteristics of a human factors study

	Human factors study
1. Goal	To provide insight into actual interactions with innovations in a challenging simulated context.
2. Sample	Recruitment of individuals from the targeted end-user population. Aim to recruit a diverse population in terms of demographics (e.g., age, gender, digital literacy) and especially target vulnerable individuals for whom usage might be challenging.
3. Sample size	About 8 participants per condition.
4. Design	One-to-one sessions in which the usage context is simulated by implementing instructions, materials, circumstances, and distractors in tasks as they would occur in real life. Additional inclusion of rare and challenging events helps to uncover potential hazards.
5. Data collection	Mixed method approach, which can include - observations (e.g., frequency and nature of usage errors and deviations from ideal use) - instantaneous self-report (e.g., think aloud protocol) - reflections regarding experiences and preferences (e.g., survey, interview) - validated human factors questionnaires (e.g., System Usability Scale; Brooke, 1986) - automatic data collection (e.g., mouse or eye tracking)

Reviews show that implemented *methodologies* greatly vary and can include observations, interviews, focus groups and questionnaires (Valdez, McGuire, & Rivera, 2017; Weir et al., 2020). Most studies implement multiple data collection methods. While the think aloud protocol is a hallmark human factors methodology, the number of studies implementing the think aloud paradigm or task analysis remains limited (Valdez et al., 2017; Weir et al., 2020). In the think aloud protocol, also known as verbal protocol analysis, participants are asked to perform a task and simultaneously verbally report everything that goes through their mind, unedited and without evaluation. This protocol provides insight into the cognitions and processes that underlie behaviour. Research generally shows that merely reporting thoughts does not influence the cognitive process, however asking about motivations (i.e., why individuals are performing actions) could interfere with the natural process since it requires interpretation (Güss, 2018). The think aloud data is recorded and subsequently undergoes qualitative analysis and coding to extract the themes relevant to the research questions. Inductive

qualitative analysis is preferred since it is difficult to capture the variability of thought processes relating to task interactions in a-priori models and codebooks. Triangulation, or combining several methods or sources of information, can improve trustworthiness of the findings so an approach combining thinking aloud data with observation checklists or survey and interview data is preferred (Aitken, Marshall, Elliott, & McKinley, 2011; Güss, 2018).

The results of human factors studies can help organizations formulate concrete suggestions to improve the design of innovations and services. However, the impact of these studies on the innovations under investigation is often insufficiently demonstrated or documented (Carayon, 2019; Weir et al., 2020). Maintaining good report of design and end-user iterations following human factors studies allows researchers and organizations to document the effects of their efforts and also monitor whether further optimizations are warranted.

Healthcare as an exemplary context

Human factors and user-centred design can have a particularly large impact in the field of healthcare, where medical and pharmaceutical dispensing errors for example cause serious, yet preventable, harm (Carayon & Hoonakker, 2019; Weir et al., 2020). Healthcare is a complex and dynamic field with many stakeholders (e.g., hospitals, pharmacies, patients, companies) whose needs and goals can be very dissimilar. Designing healthcare products, such as medication packaging, can therefore be challenging and benefit from several iterations of end-user involvement and research to optimize the design and implementation. In line with this, the UK National Health Services (NHS; Department of Health Human Factors Reference Group, 2012) and U.S. Food and Drug Administration (FDA) support and encourage the exploration of Human factors (U.S. Department of Health and Human Services, Food and Drug Administration, Center for Devices and Radiological Health, & Office of Device Evaluation U.S. Department of Health and Human Services, 2016). The following section will describe the design of four exemplary human factors studies from the field of healthcare.

Research design

While human factors studies have the same goal, implemented research designs can differ depending on the type of innovation, implementation context, or sample. Table 2 provides concrete examples of what a human factors study can look like, based on four healthcare innovation cases executed by our living lab. The human factors study components can be combined with other living lab services (e.g., co-creation), but these are not included in the table.

Table 2. Four case design examples in which human factors studies were implemented in living lab context

Case	Sample and study conditions	Study components
Case 1. Smart medication pack (with app component)	16 participants. Two conditions depending on the medication pack usage instructions.	*Accelerated-3-days paradigm* - Interacting with medication pack while being exposed to distracting conditions mimicking real life - Error simulation - Collection of video recordings for qualitative analysis and analysis of observational data with a codebook *Questionnaire* - Assessment of usability and preferences & comparison to alternative design
Case 2. Medication packaging (with mobile app component)	51 participants from three European countries. Two conditions depending on the medication wallet design.	*Accelerated-15- days paradigm* - Removing tablets from the pack based on users' comprehension of the instructions - Collection of observational data with a codebook *Think aloud paradigm* - Presentation of a used wallet with the instruction to reflect on whether a mistake was made and what the user should do - Collection of video recordings for qualitative analysis and analysis of observational data with a codebook *Questionnaire* - Assessment of comprehension of instruction & design preferences

Table 1 (continued). *Four case design examples in which human factors studies were implemented in living lab context*

Case	Sample and study conditions	Study components
Case 3. Visual design of medication packaging	Patients (N=93) and professionals (N = 92; pharmacists, nurses, general practitioners) from 6 countries around the world. Two conditions depending on medication stacking in cabinet.	*Medication retrieval task* - Performing 8 tasks concerning retrieving medication from a medicine cabinet with packs stacked according to a fixed pattern - Collection of video recordings for qualitative analysis and analysis of observational data with a codebook *Colour sorting task* - Sorting colours depending on danger & appropriateness for medication packs *Questionnaire* - Assessing task experiences - Osgood's semantic differential task (Osgood, Suci, & Tannenbaum, 1957) *Patient focus groups* - Evaluation of the design in terms of reliability & clarity - Assessment of current medication packaging management, current errors, and how packaging could improve these *Expert panels (professionals)* - Evaluation of the design in terms of reliability & clarity - Comparisons to other brands - Discussion of how packaging can support use and administration
Case 4. Web-based platform for education and disease management in neurological patients	9 neurology patients together with their informal caregivers	*Think aloud paradigm* - Presentation of several daily life situations in which the platform could be of use were presented and participants were asked to act accordingly and think aloud while doing so - Collection of observational data with a codebook *Questionnaire* - Assessment of usability and preferences

In the first case, participants were asked to go through 3 days of using the smart medication package multiple times per day. Two conditions were designed based on how the product could be implemented in practice, which only differed in their instructions. In the first condition participants only received a folder explaining how to use the smart medication packing, while the second condition received additional verbal instructions and a demonstration of tablet removal. Participants were subsequently asked to interact with the smart medication pack while performing normal daily activities, such as reading a newspaper article, watching a video clip (simulating watching television), and talking with someone. Their behaviour was observed and documented with the help of a codebook. In addition to naturalistic use, participants were also explicitly asked to make certain errors so they could experience and comment on the resulting sequence of events on the smart medication package and app. Observational data was supplemented with a self-report questionnaire on usability and user preferences.

The second case concerns a multi-country design in which two alternative packaging designs were compared. Similar to case 1, participants were asked to go through multiple days of removing tablets from the pack, while their interactions with the pack were observed. In a second task, they were presented with a used wallet and were asked to think aloud about whether any errors were made and what the user should do. Finally, a questionnaire provided further input on their experiences and preference.

The third and largest international study concerned the visual design of medication packaging. It consisted of a medication retrieval task with 2 conditions that varied in medication stacking, in which behaviours were observed using a codebook (a subsequent questionnaire also assessed their experiences in more depth). A colour sorting task was performed to assess possible cross-cultural differences in how colours are perceived and interpreted. In the questionnaire, participants were also presented with opposing word pairs (e.g., beautiful vs ugly, strong vs weak) based on Osgood's semantic differential (Osgood et al., 1957) to explore the connotative meaning of the design. The design was further discussed and evaluated in patient focus groups and expert panels.

In the fourth exemplary case, neurology patients interacted with a web-based platform while thinking aloud. After receiving a folder with instructions and their login details for the secure platform, they were presented with situations and questions that they could encounter in real life and for which they could use the platform. They performed the task together with an informal caregiver, as previous results from co-creation sessions showed that these older or disabled patients would often rely on their support network to help them use such a platform. Data collection consisted of observations as well as self-report data from a questionnaire.

Observing which aspects of product use led to usage errors in these cases, allowed the respective companies to optimize design. The results and reports of these four cases all had an impact on the design or implementation circumstances of these innovations. Documented changes following the human factors studies consist of making the choice between two competing design, changing the terminologies, selecting appropriate colours, or adapting usage instructions. Two included studies were performed in multiple countries, which can provide added value for the organizations as customs, perceptions, and opinions can vary across cultures (De Witte, Adriaensen, Broeckx, Van Der Auwera, & Van Daele, In press). Organizations often aim to launch their product internationally but need to make sure that designs are suitable for all end users.

Conclusion

Organizations are developing and upscaling new innovations and technologies at an unprecedented pace. However, it is important for these innovations to be adapted to the intended user and meet quality standards in terms of safety, performance, ease of use, and contextual fit. Human factors research in healthcare and other fields is still in its infancy, but allows organizations to properly assess these aspects of innovations and – if need be – improve their quality. Living labs can play a key role in making sure that innovations are safe, efficient, and designed with the user in mind. The current paper aimed to inform the field on how human factors methodologies can be designed and what role they can play in an iterative development cycle. While certain hallmark human factors techniques, tasks, and data collection methods exist, the design of a human factors study will nevertheless always remain a very individual and tailored process as innovations, circumstances and targeted end users vary. Study protocols using a multi-method approach to mimic stringent real-life circumstances and gain insight into error-prone processes can provide important insights for organizations and governments and will be responsible for better and safer services for the end user.

Future living lab research could benefit from a human factors perspective, but the methodology is currently still underused and understudied. There is therefore a need for more publications which do not only share study designs, but also document and report the short- and long-term impact of human factors research on (healthcare) innovations. Carayon and Hoonakker (2019, p. 72) state that “If we want human factors to be taken seriously into account, we should not be shouting from the sideline, but get actively involved in the design and implementation of health IT, and evaluate the impact of our human factors methods and principles on the technology in practice.”

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Research Session Tuesday

Tuesday, 7th September

15:30-17:00 CEST

Full Research Paper

Agroecology living labs: defining characteristics and key components of their successful orchestration

Authors

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MS in Sustainable Territorial Development

Abstract

The increasing concerns about the health, environmental and socio-economic challenges aggravated by the COVID-19 syndemic have necessitated the radical transformation of the current agriculture and food systems in Europe. In this regard, agroecology, and more specifically, agroecology living labs (LL) approach and principles, have been gaining momentum in Europe over the last decades. Being already reflected in recent European policy frameworks and initiatives, the concept of agroecology LL, however, is still blurry and has not been commonly accepted by policy-makers, practitioners and researchers. The present study aims to contribute to filling in this knowledge gap by understanding what may make agroecology LLs different from other types of LLs with respect to their aims, goals, activities, methods, stakeholders, as well as context and field-specific factors. Based on two agroecology LL «revelatory» case studies (Belgium, Hungary) supported by the evidence from other agriculture-related LLs (Serbia, Belgium) the paper sheds light on the roles and the associated skills that may be necessary for the successful orchestration and sustainability of an agroecology LL in the long-term perspective. Through establishing a dialogue with the existing academic and grey literature this work intends not only to share the research results but also to trigger further discussion and research on agroecology living labs, orchestrators and their skills.

Key words

Agroecology, Agroecology Transition, Living Lab, Orchestrators, Skills, Roles.

Introduction

Nowadays Europe is facing numerous sustainability challenges that have been seriously aggravated by the COVID-19 pandemic, or, more precisely, the syndemic that encompasses social, economic and environmental crises (Horton, 2020). The syndemic displayed the pitfalls of the current industrial agriculture model, with its corporate-controlled food systems, extractive patterns, monocultural production and other unsustainable practices that all together pose danger to the environmental and human well-being.

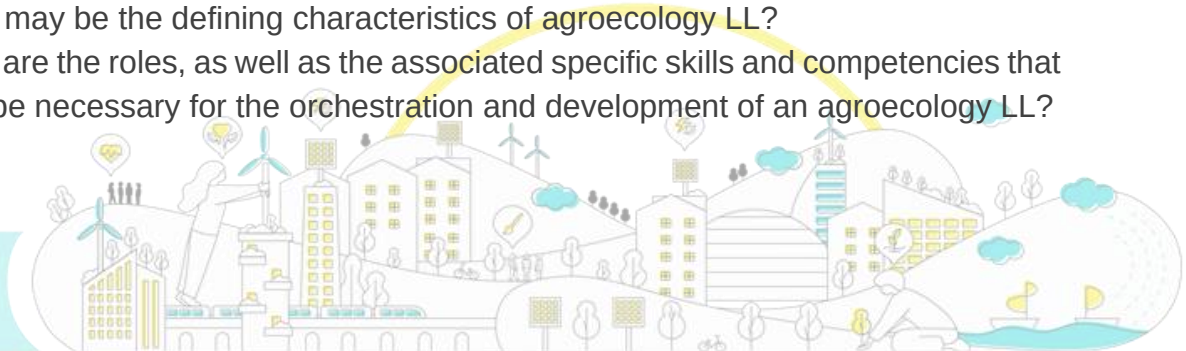
In this regard, agroecology is believed to pave the way towards a more resilient, sustainable, inclusive and healthy agricultural system ensuring interconnected benefits for both urban and rural territories (FAO, 2015). Among all initiatives and policy frameworks for dealing with the identified challenges and for promoting sustainable agriculture and farming practices in Europe, the most recent ones have put a particular focus on the potential of agroecology for agri-food systems' transition (European R&I partnership on agroecology living labs and research infrastructures, 2021). To enable such a transition, the European Commission (EC) has chosen a living lab (living laboratories, LL) approach as one of the key tools and leading principles for multi-stakeholder engagement, cooperation and solutions generation.

Although a LL approach has already indicated its effectiveness to address the challenges in many domains (Zavratnik et al., 2019), its application in the agroecology field seems novel. The lack of existing studies on agroecology living labs combined with the growing popularity of this concept entails the necessity to fill in a huge knowledge gap. This can start from the conceptualization and understanding of what may make agroecology LLs different from other types of living labs or related ecosystems. Moreover, the ambition of the current European policies to establish the network of agroecology living labs (e.g. the ALL-Ready project), makes it relevant to understand which skills, competencies, and expertise are required to create, manage and grow such innovative and complex ecosystems.

Thus, the present study aims to explore the specificities of agroecology LLs and to identify the possible roles and skills that may be necessary for their successful orchestration and sustainability in the long-term perspective.

To do this, the research was structured around two main research questions:

1. What may be the defining characteristics of agroecology LL?
2. What are the roles, as well as the associated specific skills and competencies that may be necessary for the orchestration and development of an agroecology LL?



The work focused on the two case studies of agroecology living labs based in Belgium and Hungary and was supported by the agroecology-related LL cases from Serbia and Belgium. The research was conducted in the frame of the masters' thesis of the Erasmus Mundus Joint Master Degree Program in Sustainable Territorial Development.

This paper is organized as follows. Section 2 presents the review of the most relevant academic literature, as well as the conceptual framework developed for the research. Next, Section 3 briefly describes the applied methodology and analysis methods. In Section 4 answers to the research questions are highlighted and discussed. Finally, Section 5 concludes and summarizes the paper's main points.

Theoretical and conceptual frameworks

Literature review

Agroecology and agroecology transition

The term «agroecology» that emerged in the 1930s (Wezel & Soldat, 2009) and stemmed from a fusion between agronomy and ecology (Moudry Jr et al., 2018), has been transformed and expanded over the last decades. Nowadays agroecology has embedded a threefold dimension that was reflected in the definition given by the Association of Agroecology Europe and that will be referred to in the present work: agroecology as a science, a practice and a social movement[1].

However, the term «agroecology» still takes diverse meanings in different parts of the world and even within the EU. This, consequently, leads to the different approaches, public policies, research and training activities in this field (Euro-EducATES, 2016). Yet, despite the multitude of definitions across countries, agroecology in Europe has begun to cohere into a continental network of researchers, students, practitioners and advocates (Wezel et. al, 2018). Agroecology is considered as the end goal in the continuous process of agroecological transition based on core principles (Altieri, 2018; HLPE, 2019), values and politics (Nyeleni 2015), as well as cultural, ecological or social elements (FAO, 2018).

While recognizing agroecology's multifunctional benefits and its potential, it is still necessary to understand how agroecology can provide the framework for organizing and transforming the entire agri-food system (Anderson et al., 2021). And here the transition process appears as a key concept. According to FAO, it is the gradual change that farmers implement to adapt and move from conventional systems towards an

[1] The full definition can be found here https://www.agroecology-europe.org/our-approach/our-understanding-of-agroecology/

agroecological system, and that needs to include different levels, such as social, environmental and economic changes. Additionally, the agroecological transition should incorporate context-specific practices and policies involving different stakeholders with strong commitment from all levels, farmers, consumers, agencies and policymakers (FAO, 2020). In this regard, LLs have emerged as one of the promising approaches for agroecology transition over the last decade. These ecosystems involve different stakeholders in the development of innovative solutions while taking into account the specificities of agri-food systems and their context (EC, 2020).

(Agroecology) Living Labs

Numerous reviews of the literature on living labs have been published over the past few years (Schuurman et al., 2015; Westerlund et al., 2018; McLoughlin and Prendergast, 2018) seeking to better define and study this concept that has been variously understood by different actors all over the world (Gamache et al., 2020).

Playing one of the most important roles in the establishment of Living Labs as a research method and a well-rooted business model (Zavratnik et al., 2019), the European Network of Living Labs (ENoLL) suggests their definition of Living Labs. The ENoLL's definition will be used in the present work as it mainly embraces the key principles and provides a comprehensive understanding of the concept[2].

Driven by the need to reach an agreement on the commonly accepted definition and explore the different applications of the living labs, researchers have been developing their various typologies (Schuurman, D. et al., 2013). The necessity to support the transition of territories towards healthier and more sustainable agri-food systems has led to greater attention to the specific Living Labs focused on agri-food and agroecology innovations and practices (e.g. Gamache et al., 2020).

The analysis of the most recent academic literature and agroecology-connected policies (both, within and outside the EU) revealed that there are three most relevant interconnected types of Living Labs (LL), i.e. rural LL, agroecosystem LL and agroecology LL.

One of the most comprehensive and deep research on Rural Living Labs was conducted by the LIVERUR project under Horizon 2020 aiming to support businesses, projects and initiatives in designing innovative business models in rural areas, moving

[2] According to ENoLL, Living Labs are defined as «user-centred, open innovation ecosystems based on systematic user co-creation approach, integrating research and innovation processes in real-life communities and settings. LLs are both practice-driven organizations that facilitate and foster open, collaborative innovation, as well as real-life environments or arenas where both open innovation and user innovation processes can be studied and subject to experiments and where new solutions are developed. LLs operate as intermediaries among citizens, research organizations, companies, cities and regions for joint value co-creation, rapid prototyping or validation to scale up innovation and businesses».

towards a Circular Economy and including all important stakeholders by following the Living Lab approach (CORDIS, 2020; LIVERUR-project website).

LIVERUR project identifies Living Labs as, on the one hand, ecosystems of open innovation, centred on the user, which often operate in a territorial context, integrating concurrent research and innovation processes within a public-private partnership, and, on the other hand, as innovative business models that are currently developing in rural areas. It gives special attention to the territorial context of Living Lab's rural environment and its specific objectives and ambitions that may affect the LL's success (LIVERUR-project website). A Rural Living Lab is considered to be different from an «ordinary» Living Lab, as it has to take into account the complexities of demographic challenges, consequences of population mobility, ageing of the rural population, climate change and its implications for the livelihoods of the rural population, etc. (Zavratnik et al., 2019). Consequently, another distinctive feature of the Rural LL is the need for multidisciplinary approaches to be applied to ensure their longevity and sustainability (Pérez-Trejo et al., 2010, pp. 243–245).

Another type of Living Labs, Agroecosystems Living Laboratories (ALL), has been nourished and developed mainly in Canada and the USA (among European countries, in France), following the formation of the international Agroecosystems Living Laboratories (ALL) working group in 2018 (ALL report, 2019; AAFC, 2020). The ALL working group defined ALL as «transdisciplinary approaches which involve farmers, scientists and other interested partners in the co-design, monitoring and evaluation of new and existing agricultural practices and technologies on working landscapes to improve their effectiveness and early adoption».

This definition is also based on the core principles of a LL and applies them to the specific context of agricultural research that makes it similar to the concept of Rural Living Lab and, as it will be shown later, of agroecology LL. Transdisciplinary approach, co-design and co-development with participants and monitoring, evaluation, and/or research on working landscapes, represent the three components in the core of the ALL analytical framework (McPhee, 2020). Their integration into the ALL activities is something that distinguishes ALL from more traditional research formulations and that is seen necessary to accelerate the adoption of agricultural practices and techniques (ALL report, 2019).

In the most recent article by Agriculture & Agri-food Canada and French research institution INRAE, the existing framework proposed for defining characteristics of a LL, in general, and an urban LL, in particular (Steen and Ellen van Bueren, 2017), was adopted for ALL to highlight the difference of ALL from other LL types. The results with the defining characteristics of ALL and the analysis of the unique nature of agroecosystem living labs were presented, particularly highlighting the high levels of

scientific research, long innovation cycles with high uncertainty due to external factors and the great number and diversity of stakeholders involved (McPhee et al., 2021). The authors distinguished the «Context» dimension as a crucial characteristic of ALLs meaning that the living lab's activities are implemented in «the real-life use context of the innovation». As it will be discussed later, this context characteristic, i.e. the LL's embeddedness in a territory or a space-bound place, is also an important aspect for understanding agroecology LL's and their role in enabling agroecological transition.

Thus, while rural and agroecosystem types of LLs have been already analyzed and studied, agroecology living labs' defining characteristics have not been greatly discussed in the academic literature so far. Although the concept was included in the European policy agenda, EC does not give a definition of Agroecology LL. Though being just in an infant stage of its development, the concept of Agroecology LL is promised to include the core principles of both approaches, i.e. agroecology and LLs, which makes it close and tightly related to the concepts of Rural, Sustainable and Agroecosystem Living Labs. Similar to these concepts, the link to the territory and community in which agroecology LLs are developed (place-based) is especially highlighted (EC, 2020).

Despite the growing interest of researchers in this topic, there is still the need to develop the benchmarking criteria, scope and overlaps of the highlighted LL concepts, especially in relation to the territories they operate. Focusing on the agroecology LLs, the present work contributes to filling in the existing research gaps not only by revealing an agroecology LL's specificities but also by trying to understand who and how can «orchestrate» them.

Living Labs' Orchestrators and their skills

As a co-creation and open innovation ecosystem at its core, an Agroecology LL requires conducting or «orchestrating» to ensure its stability and effectiveness in the long-term perspective in producing a desired positive effect (CCO, 2020).

Orchestration has already been actively discussed in the academic literature on the innovation ecosystems and networks, and numerous researchers have been proposing their definitions of the orchestration concept that could embrace the actions, value creation and goals behind it (e.g. Dhanaraj & Parkhe, 2006; Gausdal & Nilsen 2011; Verhoeven and Maritz, 2012; Äyväri & Spilling 2020). Claiming that despite the increasing use of the term, «orchestration» often remains «a metaphor without any specific meaning», Äyväri & Spilling (2020) suggested a new definition with regard to the special features of orchestrators' goals and tasks in the LL context. Based on the existing literature on innovation ecosystems' orchestration and the results of the case study analysis, they concluded that «orchestration refers to participatory and supportive

management practices in innovation ecosystems to enable multi-stakeholder co-creation, maximize the learning of all actors involved and finally to achieve the shared vision of the ecosystem». This definition implies the bottom-up approach for orchestrating a LL where it emerged as a dynamic activity and a constantly evolving practice. Moreover, orchestrating is not just managing, but rather curating, interpreting, facilitating, mediating, and building bridges between stakeholders (CCO, 2020).

The idea of the importance of specific individual skills and competencies for orchestrating Living labs has been echoed in many research works (e.g. Loades, 2018; Gago & Rubalcaba, 2020; Deming, 2017; Fuglsang and Hansen, 2019). They emphasized that orchestrating Living labs requires certain soft skills that go beyond traditional hard skills, such as language skills, technical or computer skills. These soft skills are important for the co-creation process (Tsey et al, 2018; Morris et al., 2019), being very specific for each particular activity, e.g. intuition, creativity, passion, motivation, responsibility and others that one acquires throughout the whole life (Gago & Rubalcaba, 2020). Apart from the distinction between soft and hard skills, different frameworks have been developed to shed the light on the skills and competencies necessary for orchestration. For example, Haselberger et al. (2012) categorized all identified soft skills into three groups, i.e. personal, social and content-reliant/methodological skills, while Äyväri, A., Hirvikoski, T. & Uitto, H. (2019) suggested another framework specifically for LL orchestrators skills, i.e. skills in building relationships, networks, and eco-systems, skills in maintaining them, as well as skills in executing living lab projects. This typology, the first one developed specifically for LL orchestration skills, will form a basis for the conceptual framework of the present paper to be discussed further.

Conceptual framework

To answer the first research question on the specificities of agroecology LLs, the framework for key elements of the Rural Living Lab suggested by LIVERUR, 2020 was used as a guideline and adopted for the analysis of agroecology LLs. This framework (Table 1) includes 5 main categories of characteristics to be explored for research on Rural LL and suggests questions to be answered within research, that also formed the basis for the survey (questionnaire) and interviews within the present work.

Table 1. The key elements of the Rural Living Lab. Source: LIVERUR, 2020

Key elements of the Rural Living Lab	Survey Part I-Part II
Identification of the Rural Living Lab	1) What is the Living Lab social constituency? Name and geographical location 2) What is the LL rural / agro-industrial constituency? 3) Who are the stakeholders of the Rural Living Lab? 4) What's the role of the different stakeholders? 5) What is the Rural Living Lab infrastructure? 6) What's the main focus of the Rural Living Lab?
How does the Rural Living Lab work?	7) What is the business model of the Rural Living Lab? What's the benefit of the Rural Living Lab? 8) How this benefit is generated (Product/Market Strategies)? 9) Earnings of the Rural Living Lab 10) How is the Rural Living Lab financed? 11) Who runs the Rural Living Lab? 12) What is the Living Lab legal entity and who are the owners? What is the legal framework of the Living Lab? 13) What is the governance structure of the Living Lab? 14) What are the approaches used to involve citizens in LL activities? Are community-like approaches used to enable self organized peer-to-peer LL stakeholders' interaction? 15) Duration of the Living Lab? 16) Openness? 17) Future perspectives of the Living Lab regarding..
Products/Services	18) Which products/services are offered within the Rural Living Lab? 19) What's the target market of the Rural Living Lab? (line of business) 20) Is the Rural Living Lab only Regional orientated or International orientated?
Rural Living Lab ICT Infrastructure	21) Are there any providers involved? Which one? 22) Which technologies are implemented in the Rural Living Lab? 23) How is the ICT infrastructure operated, maintained and developed? 24) Is the ICT infrastructure open to the different stakeholders?
Methods & Tools	25) Which Methods and Tools are used in the Rural Living Lab to integrate the end-user into the following product/service development process 26) In which process phases are the user involved? (front end (p-idea, p-concept) or in the back-end (p-development, market launch)' 27) Other Methods not mentioned 28) Which Methods are used to integrate the customer into the Rural Living Lab? 29) Does the Rural Living Lab use any Data preparation Tools (statistical Tools)? Which one? 30) Any smart ICT apps which could be interesting for the LIVERUR Community?

The choice of this framework is based on the fact that it reflects the main elements of LLs highlighted in the theoretical framework and covers other existing methodologies to analyze LLs, from both theoretical and practical perspectives, e.g. ENoLL application guidelines for evaluation of LLs (ENoLL application guidelines, 2021) or the one suggested by Kris Steen and van Bueren for Urban Living Labs (2017). The four-dimension framework (aims, activities, participants, and context) of Steen & van Bueren (2017) was also adopted in the recent research on the defining characteristics of agroecosystem LLs by McPhee and colleagues, 2021 that led to the idea of integrating its elements in the framework for the present research. The final version of the framework for the analysis of agroecology LLs' specificities represents the synthesis of the above-mentioned approaches and can be found in Table 2 below. Its components are related to different levels (such as the overall aim and objectives, contextual factors, actions etc.) that were supposed to help in grasping as many characteristics of agroecology LLs as possible to reflect then on their specificities from other LL types.

Table 2. The key elements to define agroecology living lab.

Key element	Survey / interview questions main points (examples)
Identification of the LL	*The LL history and «age»? The LL name and definition (type to be attached in the respondent's opinion)? The legal entity (NGO, private, public)? Bottom-up or to-down initiative? The main focus of the LL? What are the strengths, weaknesses of the LL in the local context? What are the pitfalls?*
Aims & goals	*What are the aims and goals? Why?*
Activities and approaches & methods	*What are the main activities? Which approaches are applied? Which unique methods are used? What are the specific ones for agroecology LL? Which products/services are offered within the LL? Is the LL only Regional orientated or International orientated?*
Stakeholders	*Who are the main stakeholders? What is their role? In which phases of the innovation/ co-creation process they are involved? How? What are the outcomes? Which difficulties you face in involving them? Why? How do you solve it?*
Context	*Geographical location? Specificities of the local context? The territory of the LL (scope)? What are the boundaries? The understanding of place-based approach within the LL? Opportunities/ threats of the local context with regard to agroecology transition*
How does the Rural Living Lab work?	*What is the business model if any? How the value is generated (Product/Market Strategies? How is the LL financed? Who runs the LL? What is the governance structure of the LL? Openness?*
The Living Lab ICT & Infrastructure	*Which technologies are implemented in the LL? Which infrastructure is there? How is the ICT infrastructure operated, maintained and developed? Is the ICT infrastructure open to the different stakeholders?*
The LL's role in the local context and future vision	*How do you see the role of the LL? Future perspectives of the Living Lab regarding agroecological transformation? Which factors are of the most importance for the LL's sustainability?*

LL's orchestrators are attributed with one or more roles that may be understood as «behaviours expected of parties in particular positions» (see Allen & van de Vliert, 1984 in Nyström et al., 2014). These roles are dynamic and negotiable between the actors, depending on the particular situation and the needs following the LL's goals (Nyström et al., 2014). Besides, an actor can perform several roles simultaneously or during different stages of joint activity (see e.g. Heikkinen et al. 2007). Moreover, the roles can be adopted, created and transformed by the actors themselves according to time and context. The different approaches to role theory confirm this idea suggesting that roles may also vary by the actors' conduct and rationale to act (see Nyström et al. 2014).

The roles, with the associated skills, identified in the three most recent studies (Nyström et al. 2014; Hirvikoski et al., 2018 and Äyväri, Jyrämä & Hirvikoski, 2018) served as a basis for the conceptual framework of the present research. It is worth mentioning that the framework proposed by Äyväri, A., Hirvikoski, T., Uitto, H. (2019) does not focus on any particular type of LLs and is general for living lab orchestration skills. However, as it was pointed out by Schuurman and colleagues (2016), it may be interesting to look at the impact of individual characteristics on the innovation processes and on the outcomes of the network. Therefore, in the frame of the present research, this idea inspired the consideration of different context-related and individual factors specific for agroecology LLs that could be important for the definition and sustainability of such LLs. The highlighted framework was adapted and enriched for the aims of the present work. The final graphical representation of the developed conceptual framework can be found below (Fig. 1).

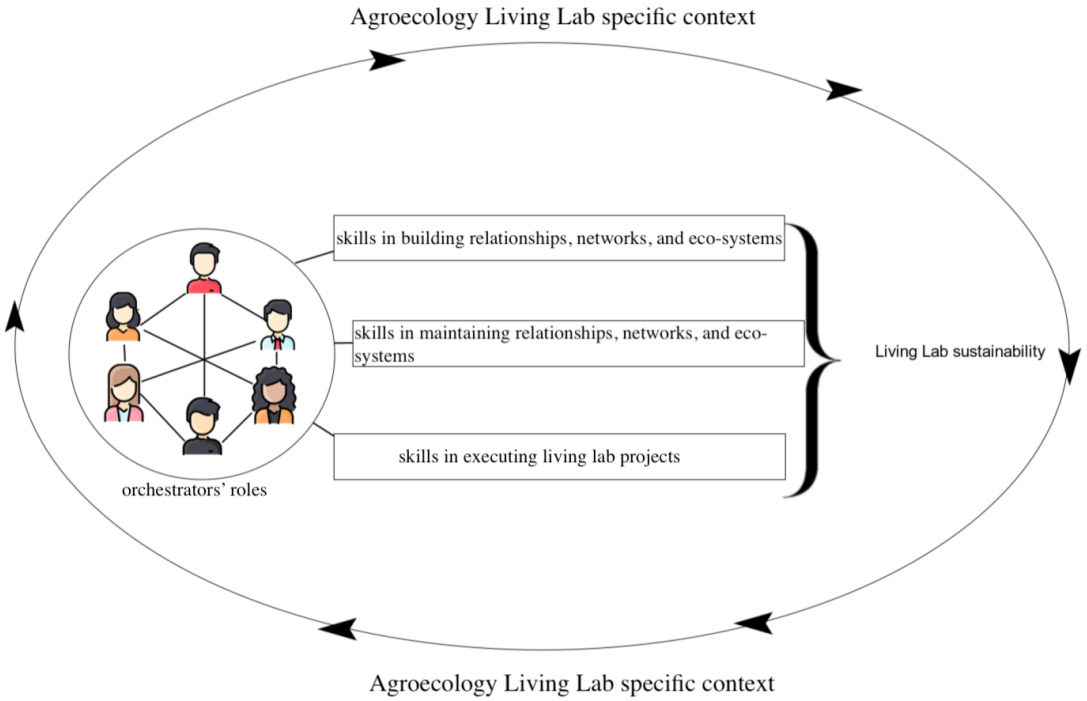


Figure 1. The conceptual framework.

Methodology

Living labs are usually studied through case studies (single or multiple) (Dekker, Franco-Contreras & Meijer, 2017) using mixed-method techniques, such as qualitative (e.g. interviews, focus groups) and quantitative (e.g. surveys) (Liedtke et al. 2012).

The two living labs from Belgium (ILVO's Agroecology and Organic Farming Living Lab, LLAEBIO) and Hungary (ÖMKi on-farm Living Lab) were selected, analyzed and viewed as guiding «revelatory» case studies following the logic for the multiple-case study procedure suggested by Yin, 2018. To reflect on possible specificities that may be attributed to the geographical, socio-economic, political and even cultural differences, the living labs were selected to meet the set of common elaborated criteria. According to them, the selected cases should:

1) be aligned with the ENoLL's definition of living labs as applied in this paper;
2) include agroecology (or agroecology transformation) among its aims, mission and vision, with relevance to the definition of agroecology applied in the work;
3) be located in the European countries, since the research is focusing on the European context within the current European agriculture and agroecology policy framework.
4) be active actors in establishing and promoting agroecology living lab and its network approach (particularly, be actively involved in the current European initiatives on agroecology transition, such as AE4EU, ALL-Ready, the ENoLL AOTF for Rural Living Labs or other projects).

5) be of different «age», i.e. at different stages of the LL development[3]
6) have different scopes and scales of implementation.

It is worth mentioning that both cases of LLs are ENoLL's partners that are actively involved in the ALL-Ready project aiming at the creation of the first European Agroecology Living Lab and Research Infrastructure Network, AgroEcoLLNet (EC, 2020). This makes it especially relevant and interesting to derive the lessons from them that could be then applied in the course of the ALL-Ready project realization. Both living labs play a remarkable role in their contexts in promoting and developing the agroecology approach, therefore, they are expected to be representative and have a good potential for learning from their experience.

Findings from these two cases were then enriched with the insights from the additional cases, such as PA4ALL BioSense Living Lab (Serbia) and Agrotopia Living Lab (Belgium) (both members of the ENoLL network), as well as from the relevant academic and grey literature.

The data from case studies were collected in the course of deep semi-structured interviews (via Skype) carried out in line with the guidelines by Patton (1990) and Yin (2018) between January 2021 and March 2021. In addition, some supplementary insights from other living labs' orchestrators were collected using the online survey in Google Forms.

The collected data were analyzed using a coding method and thematic analysis technique whereby all data and observation summaries could be categorized into themes (e.g. King, 2004; Miles & Huberman, 1994) to identify patterns and inter-relationships between different units of the analysis.

After the first readings of the interview transcripts, the preliminary codes were assigned to the data in order to describe the content. At this stage, the search for patterns, concepts, specificities of agroecology living labs was performed across the different interviews to extract significant elements and to attribute the codes into broader themes (some of the codes were overlapping while others needed to be split). The themes and codes were reviewed through a more detailed analysis to identify further specific categories within each theme. The next rounds of coding made it possible to summarize the findings that were then compared and cross-synthesized before discussing the final results.
The analysis of the agroecology living lab orchestrators' roles and skills was performed under the same logic. Following the conceptual framework, the coding technique was

[3] E.g. while ÖMKi on-farm Living Lab has more than almost 10-year experience, ILVO LL (LLAEBIO) is very young. This difference was expected to enable to see how the age of the LL can influence the set of its orchestrators' roles and necessary skills.

used to search for possible roles and their features through searching for words associated with previously identified roles, tasks and orchestrators' skills in the living lab. The findings were summarized for two living labs separately and accompanied by insights and discoveries from each particular case.

The insights from the supportive cases (based on the survey and the literature) were coded and analyzed in a similar way to the procedure applied to the two guiding case studies and following the proposed conceptual framework.

Every time, before delivering final results and presenting previously unknown specificities of agroecology living labs and their orchestrators' role and skills, the findings and interpretations were compared with the prior research results and existing literature. This was necessary to present empirical evidence in a due way and to allow a dialogue between data and theory (e.g. Eisenhardt & Graebner, 2007; Yin, 2018). Finally, the findings from all case studies (i.e., from Belgium, Hungary, and supporting ones) were considered together to contribute to the analysis and discussion part.

Cross-case analysis and Discussion

Answering the first research question

Table 3 synthesizes the defining characteristics of agroecology LLs revealed from the main case studies (LLAEBIO and ÖMKi on farm living lab).

Table 3. Defining characteristics of agroecology LLs.

Key element	Characteristics
Identification of the LL	• Incorporates 3-sided definition of agroecology (as a science, practice & movement) • Agroecology as the good direction, the process and the end goal • Integrates diverse types of knowledge • Broad scope and multi-dimensional nature (technological, socio-economic, political dimensions of agriculture) • Driven and supported by academic institutions • Long-term return and impact of the co-creation and innovation process
Aims and goals	• **Aimed** at enabling agroecology transition **Goals** may include • developing, learning and sharing existing and new knowledge • Promoting agroecology practices and expertise • Scaling up best practices • Bringing relevant stakeholders together in the domain of agroecology and organic farming • Trust building • Greater involvement of farmers (conventional and organic) into research and experimenting activities

Activities, approaches & methods	• Multi-dimensional scope of activities (research, on farm experimenting, tests, network building etc.) • Cover the whole agri-food value chain • Development of context-specific solutions • Formal, and especially, informal way of activities • Demonstration & showcasing on the spot • Activities may vary and evolve depending on projects • Research-based approach and strong cooperation with Academia • Bottom-up approaches • System thinking approach
Stakeholders	• Great diversity and high number of stakeholders, interests, visions • Farmers and academia cooperation as target groups • Emphasis on the young generation • Urban-rural stakeholder cooperation as opportunity and the future perspective • Ownership and trust issues among stakeholders
Context	• Strong context-specific and place-based nature • Located in the territories with historically established agri-food sector • Multi-level territorial boundaries defined by stakeholder network and cooperation opportunities • Gap between the Western & CEE region
How does the Rural Living Lab work?	• Strong team work and collective impact thinking approach • Multiple units of diverse expertise under the supervisor • Transdisciplinarity • Continuous reflective working process • Management and responsibility allocation depending on projects • Different dynamic roles and skills within one team
The Living Lab ICT & Infrastructure	• Supportive role of ICT innovations and related infrastructure • Open agriculture database and platforms for diverse agriculture and agri-food knowledge accumulation and sharing • Vulnerability of some key stakeholders to new technologies and innovations (e.g. conventional farmers)
The LL's role in the local context and future vision	• LL as an open meeting place, a forum for knowledge generation and sharing • Need for the increased adaptability • Ambition for scaling up from rural to urban areas • Agroecology is the future • Creation of the network for agroecology living labs and expansion of existing ones (ENoLL)

While it seems impossible to comment on all identified specific features in this paper, among the detected characteristics of the agroecology LLs presented in Table 3, particular attention can be given to some of them.

First of all, in line with the general ENoLL's interpretation of Living Labs (ENoLL 2021), the concept of agroecology living lab integrates several definitions that are already reported in academic literature. They refer to experimentation and knowledge-exchange platform (Pierson & Lievins, 2005), open innovation ecosystem using a multi-stakeholder, user-centred approach (e.g. ENoLL, 2021; U4IoT Consortium; 2017; Dutilleul et al., 2010), as well as specific references to research methodology and approach (Bergvall-Kåreborn et al., 2009). The incorporation of socio-economic, political and other sustainability pillars reinforces its multidimensional nature and aligns agroecology living labs with rural, agroecosystem and even urban living labs (e.g. Zavratnik et al., 2019; Westerlund et al., 2018; McPhee et al., 2021 and Steen et al., 2017). However, its particular focus on the threefold concept of agroecology and organic farming transition, together with enhanced involvement of farmers (conventional and organic) into research and experimenting activities, makes agroecology living labs different from other types.

Moreover, its strong emphasis on the innovative knowledge generation in agroecology, organic farming and agri-food domains within the whole food chain implies the inherent bottom-up approach. In its turn, it determines the specific for agroecology LL issues to deal with, particularly, trust-building, conflicts of interest, including the ownership and decision power allocation pitfalls.

What was found specific in the case studies is their existence and functioning on the multiple scales (basically, on two levels in the analyzed cases) going beyond just spatial or territorial boundaries. This echoes Gamache et al., 2020 study proposing the definition of a living lab's boundaries by «the network of actors that compose it», as well as the framework of Agroecology Territories suggested by Wezel et al. 2016. Particularly, the evidence from the present work's cases proves the idea that the agroecology LL's territory (or scope) should be perceived as a system of plural territories with «a strong common overlap» and multi-level territories peculiar to certain types of relevant stakeholders.

Following this idea, the systemic thinking approach evolved as another distinctive feature of an agroecology LL. Specifically, system thinking was mentioned as essential for dynamic stability and balanced actors' relationships within the network, as well as its efficient management.

The important finding on the place-based nature of agroecology living labs contributes to the discussion on a «family tree of place-based living labs» by Chris McPhee et al., 2021. Although the conducted analysis does not allow to place undoubtedly agroecology living labs within the typology of place-based living labs, it implies that they share some characteristics with agroecosystem living labs. This provides the space for further research on the living labs typologies and the implications of their complexity and overlaps.

The context-specific and place-based nature of the case study LLs can be connected with the identified gap between the Western and Central-Eastern European regions that influences the dynamics, scope and progress of agroecology LLs in their activities towards agroecological transition. Thus, the finding contributes to the discussion on this gap that was also analyzed in a detailed way by Varga & Drexler, 2020 who emphasized the necessity to deal with the agriculture and agri-food sector's challenges from different perspectives specific to the local context.

The present research revealed that ICT-related infrastructure (such as online platforms) in agroecology living labs plays a supportive, not a dominant role, and is used as a tool to facilitate and boost knowledge sharing and co-creation with various stakeholders. This may make it different from other types of LLs, such as precision or digital farming LLs, that are sometimes criticized for leading to the digital exclusion of conventional

farmers or their dependence on expensive innovative technologies (Gamache et al., 2020). This finding supports the idea of Caquet et al., 2020 who claimed that technological innovation is not the «engine of agroecological transition», but a major element contributing to supply increase, the efficiency of ecosystem services, knowledge management, as well as dealing with data scarcity on agroecological systems and those in transition.

Answering the second research question

The vast majority of the roles of the LL's orchestrators evolved in the course of the conducted analysis (e.g. Gatekeeper, Messenger, Builder, Coordinator etc.) correspond to those identified previously by researchers in the context of the role theory (e.g. Broderick, 1999; Nyström et al. 2014; Äyväri A., Jyrämä A., Hirvikoski T., 2018; Äyväri, A. & Spilling. K. 2020). The revealed importance of roles in facilitation, knowledge creation, communication and trust-building activities, as well as their temporality, multiplicity and dynamic nature echoes the findings of these authors providing the evidence specific to agroecology LL cases.

The orchestrators' roles detected in each agroecology LL and their connections with the previously discovered roles from the academic literature are captured in Table 4, Appendix 1.

Two new roles directly interconnected with each other were detected from the case studies, i.e. Researcher and Experimenter. The crucial role of the Researcher for the orchestration of an agroecology LL was stressed in all interviews and corresponds to the highlighted strong research-based nature of such LLs. It was found that Researchers are not only involved in the topic-specific projects or research activities but also form an integral part of the LL orchestrators' team. They bring their expertise and experience into the decision making, coordination, communication, networking and other processes of the agroecology LLs.

Experimenters, in their turn, are mainly responsible for real-life field experiments with farmers (and other relevant stakeholders) and their co-creative work with Researchers makes them complementary and related. However, its special focus on co-creation, knowledge sharing and learning with farmers enabled it to allocate it to a separate orchestrators' role.

It was revealed that almost all LL's orchestrators hold the role of Researcher apart from their other possible responsibilities (e.g. supervising, coordination etc.), and generally have a remarkable academic (scientific) background in agriculture or agroecology-related field.

This allowed unveiling some other findings, i.e. orchestrators' role multiplicity and their solid field-specific scientific background (i.e. in the agriculture and/or agroecology domain) as an important component of the agroecology LL orchestrator's profile. Moreover, the role multiplicity became clear when more than a dozen different roles were identified in each LL case. It was revealed that each orchestrator plays at least three different roles, while some roles (such as Facilitator or Trust, Network & co-creative relationships Builder or Decision-taker) are shared by several orchestrators.

The action- and the goals-based approaches to roles identified from the cases reflect the roles' dependence on «the situation and the needs that the network's goals require» (Biddle & Thomas, 1966; Herrmann, Jahnke, & Loser, 2004; Turner, 1988 all in Nyström et al. 2014). It also reflects their creation «through actions» and their high dynamics within a specific context (e.g. Heikkinen et al. 2007; Äyväri A., Jyrämä A. & Hirvikoski T., 2018). This context-specific nature of orchestrators' roles seems to be especially relevant for agroecology LLs. It is seen, for example, in the high diversity of different roles within each LL's team with their inherent research (scientific) dimension. However, such agroecology-connected academic and/ or professional background rooted in the orchestrators' roles may be necessary, but not sufficient for the agroecology LL orchestration. The latter requires the whole range of soft skills, as well as individual motivation to join and work in such an ecosystem.

The great importance of personal motivation in its interconnection with the roles and personal skills has been mentioned in several research works (e.g. Gago & Rubalcaba, 2020; Nyström et al. 2014). The analysis of all case studies confirmed this idea and revealed that in the case of agroecology LL the motivation to work in the agroecology-related field in general and to contribute to the nascent agroecology transition with a LL approach, in particular, is especially significant for the LL's success in the long-term perspective.

Most of the identified skills can be considered relevant «irrespective of the different living lab framework and environment» (e.g. see Gago & Rubalcaba, 2020). While the majority of soft skills from the cases mirrors the research findings of Äyväri, A., Hirvikoski, T. & Uitto, H. (2019) and Gago & Rubalcaba, 2020 (see Table 5) some new findings can be highlighted here.

For example, the collective impact and teamwork skills proved to be interconnected with the system and process thinking skills being necessary for the integration of the diverse knowledge and expertise and enabling the effective co-creation at different levels. The importance of pursuing the success «seen as jointly created and jointly benefitted» instead of individual one (Äyväri A., Jyrämä A., Hirvikoski T., 2018) emerged as a key to overcome challenges for successful LL's development and scale-up its outcomes. On the other hand, the lack of such skills among the LL's stakeholders

mentioned during some interviews may become an obstacle for the LL's activities and growth making cooperation and relationship building much more challenging. This may be also complicated when the skills are regarded on different process levels as it takes place in the Hungarian living lab and that is common for agroecology LLs. Therefore, the deeper analysis of such skills and their mutual influence at different process levels for all actors could be interesting for a better understanding of the agroecology LL orchestration within and beyond its network.

As to the learning skills of orchestrators crucial for co-creation processes (e.g. Fuglsang and Hansen, 2019; Gago & Rubalcaba, 2020), the present research complimented them with the continuous reflection and questioning skills, as well as «teaching and knowledge exchange» dimensions that may partially follow from a strong research-based nature of agroecology LLs.

The group of visioning skills (see Äyväri, A., Hirvikoski, T. & Uitto, H., 2019) was enriched with the positive thinking skills that evolved as the key for idea generation, scaling up of impact and strategic planning in the agroecology LLs.

The present analysis also showed that the skills necessary for the orchestration of an agroecology LL may vary not only on different «life stages» of the LL but also be context-specific. For example, the skills of working with multi-language stakeholders with different backgrounds were especially emphasized in the ÖMKi LL case, while for LLAEBIO (operating mainly in the Dutch and English- speaking environment) this issue was not considered among the main challenges. This difference may be attributed to the fact that ÖMKi LL is established not only at the national, but also at the whole CEE macro-region, or BioEast region (BioEast, 2021) level where language and cultural diversity can hinder stakeholders' co-creation and cooperation for agroecology transition. The analysis suggests that the «interpreters» skills can be of particular significance for trust-building and stronger co-creation among the agroecology LLs where the finding of the «common language» represents a real challenge.

Finally, flexibility and adaptability skills emerged as vital for all LLs. However, for agroecology LLs this may be connected not only with the necessity to adapt to the COVID-19 new realities but also to their specificities. The latter may include the broad scope and multi-dimensional, the place-based and multi-stakeholder nature, as well as ever-developing agroecology-related knowledge and innovative technologies. All this requires orchestrators' readiness and motivation to update constantly their expertise, be creative and proactive to ensure their LL's sustainability in the future.

Table 5. Agroecology LL orchestrators' skills.

	Skills in building relationships, networks, and eco-systems	Skills in maintaining relationships, networks, and eco-systems	Skills in executing living lab projects / multi-stakeholder innovation processes
Previously mentioned by Äyväri A., Hirvikoski T., Uitto H. 2019	• Visioning skills (similar to Entrepreneurial skills), including wishful thinking and open-mind • T-shaped innovators skills • Networking skills • Personal influencing and motivating skills • Brokering & bridging	• Communication skills • Negotiation skills (mediating, balancing, conflict solving) • Social skills (empathy, listening, creativity & innovation) • Coordination skills • Innovation and lateral thinking skills • Client-centric, service modification skills • Ability to manage time	• Project management skills • Facilitation skills Learning and knowledge co-creation skills • Research skills • Design skills • Evaluation skills • Commercialization and upscaling skills • Planning skills, human resource management skills • Skills related to funding and financial issues • Pedagogical skills • Learning and reflection skills
Identified additionally from the agroecology LL cases			• Critical thinking / questioning skills • Multi-task performing skills
	- Systems & process thinking skills - Acting in multilingual and multicultural environment skills - Positive thinking (as complement to Visioning skills) - Flexibility / adaptability skills (modify and regroup) - Filed-specific professional or scientific background, experience and skills, as well as personal motivation to bring about agroecology development - Collective impact & teamwork skills		

Conclusion

The conducted case study analysis enabled identification of some possible defining characteristics of agroecology living labs focusing on their definition, principles, the multi-level scope of activities, aims and goals as well as diverse stakeholders with regard to their territory and space-bound places. Together with the multi-dimensional (though research-based) and strong place-based nature of agroecology LLs it implies the diversity of roles necessary for such LLs' orchestration. Two new identified roles enriched the existing frameworks for the orchestrators' roles for the innovation networks, i.e. Researcher and Experimenter. Other roles were juxtaposed highlighting their specificity in the given LLs' contexts. The successful orchestration of agroecology LLs requires some specific skills that were categorized in accordance with the conceptual framework and analyzed through the lens of the agroecology LLs. Among them, system and reflective thinking, flexibility, communication, facilitation and network-building skills appeared to be some of the most important in agroecology living labs.

The limitations of the present research (e.g. the number of cases studies, geographical and time limits of the analysis) imply the possibility of further research on agroecology living labs and their orchestration to enable their development and application for agroecological transition in the years to come. For example, a deeper analysis of roles' transformation throughout different LL's life stages may be interesting, particularly for agroecology LLs that are just emerging as a separate type of LLs. Moreover, the

understanding of how to determine, develop and enhance the right set of skills necessary for successful and effective orchestrators of such LL's may be important for capacity building in this domain. Finally, the novelty of the agroecology living labs concept and relatively little coverage of its difference from other existing LL's types (e.g. agriculture, agroecosystem or precision agriculture LLs) leaves a lot of space for further analysis on the living lab's taxonomy and classification.

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Appendix 1

Table 4. Orchestrators' roles identified from the «revelatory» case studies.

Roles identified	ÖMKi	LLAEBIO	Definition / previously found in academic literature
Communications associate	✓		Similar to Webber (similar to relationship promoter), Advocate, Messenger. Found in Nyström et al., 2014 and Hirvikoski et al., 2018
Living lab manager	✓		Appeared as an umbrella role, encompassing the following role of Activist (see Äyväri A., Jyrämä A., Hirvikoski T., 2018) Producer, planner, Accessory provider (Nyström et al., 2014) Coordinator, Builder, Orchestrator (Nyström et al. 2014 and Hirvikoski et al., 2018)
Project manager	✓		Similar to Coordinator and Orchestrator roles (Found in Nyström et al., 2014, Hirvikoski et al., 2018), as well as Invisible hand (Äyväri A., Jyrämä A., Hirvikoski T., 2018). The specificity for OMKi LL – focus on project-management following from the project-based nature of the LL work
Tester	✓		Similar to Tester in Nyström et al. 2014
Evaluator	✓		Impact Assessor (Äyväri A., Jyrämä A., Hirvikoski T., 2018) similar to Evaluator (Hirvikoski et al., 2018).
Learning process supporter	✓		Similar to Explorer in Äyväri A., Jyrämä A., Hirvikoski T., 2018. Traces of Informant (Nyström et al. 2014)
Service or product marketer	✓		Traces of Cultural intermediary in Äyväri A., Jyrämä A., Hirvikoski T., 2018, Messenger in Nyström et al. 2014
Trust, network and co-operative relationships builder	✓	✓	Similar to Builder (Nyström et al., 2014, Hirvikoski et al., 2018) Activist and Invisible hand role (Äyväri A., Jyrämä A., Hirvikoski T., 2018)
Facilitator (moderator)	✓	✓	Similar to that in Nyström et al., 2014, and Äyväri A., Jyrämä A., Hirvikoski T., 2018
Explorer	✓	✓	Similar to Explorer in (Äyväri A., Jyrämä A., Hirvikoski T., 2018). Similar to Informant (Nyström et al. 2014)
Coordinator	✓	✓	Found also in Nyström et al., 2014, Hirvikoski et al., 2018 and Äyväri A., Jyrämä A., Hirvikoski T., 2018
Decision-taker	✓	✓	Traces of Instigator, Planner and Producer (in Nyström et al. 2014) with emphasis on supportive and cooperative nature of decisions
Idea generator	✓	✓	Similarities with Producer and Instigator (Nyström et al. 2014)
Gatekeeper		✓	Found in Nyström et al., 2014, Äyväri A., Jyrämä A., Hirvikoski T., 2018 and similar to the role of a promoter proposed by Gemünden et al. (2007) in Nyström et al. 2014
Supervisor		✓	Traces of Invisible hand, Coordinator / Contributor in Nyström et al. 2014
Messenger		✓	Similar to Messenger in Nyström et al. 2014
Contact and information disseminator		✓	Traces of Cultural intermediary in Äyväri A., Jyrämä A., Hirvikoski T., 2018 and Messenger /Advocate in Nyström et al. 2014 Traces of Promoter in Hirvikoski et al., 2018
Supporter		✓	Similar to the Contributor role in Nyström et al. 2014
Integrator		✓	Found in Nyström et al. 2014
Researcher	✓	✓	
Experimenter (within co-creation process)	✓	✓	Some traces of Activist (Äyväri A., Jyrämä A., Hirvikoski T., 2018) and Co-creator (Nyström et al., 2014)

Full Research Paper

Rural Living Lab: What is that and how is it shaped?

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Abstract

Digital transformation (DT) has received increasing attention in recent years. Despite this, most of the current studies focus on digital transformation in more advanced societies, particularly urban areas, and the concept has not been investigated enough within rural contexts. This study aims at exploring how a rural living lab (Rural LL) is shaped and how this approach can be designed to support digital transformation processes in rural context. In so doing, following a design science research methodology (DSRM), we have designed an artefact (i.e., Rural LL framework) which is an "instantiation" that supports user centric digitalization of rural areas. The designed framework is developed based on the key components of "traditional" and "urban" living labs, as well as empirical data which was collected within the context of the DigiBy project. The main constructs (key components) of this framework are: 1) rural context, 2) digitalization, 3) governance, control, and business mode, and 4) quintuple helix actors. We also offer an empirically derived definition of the rural living lab concept, followed by avenues for future research.

Key words

Digital transformation, Living Lab, Rural living lab, Components, Rural residents, User engagement.

Introduction

Nowadays, digital transformation (DT) is changing dynamics and how the society is shaped (Agarwal, 2020). DT can be understood as the “changes that the digital technology causes or influences in all aspects of human life” (Stolterman & Fors, 2004, p. 689). These changes are visible in different levels and scales, from organizational to societal levels, and from more modernized urban areas to less digitalized rural areas, in which DT happens in an uncontrolled real-life context and where humans are involved in their everyday use context (Bockshecker et al., 2018; Spagnoli et al., 2019). To date, most studies of the societal effects of digitalization and DT has been carried out in urban areas, and there is a lack of research on the effects of digitalization in rural areas (Rotz et al., 2019; Runardotter et al., 2020). Since digitalization of society has a huge (positive and negative) impact on human’s life, people have the moral and ethical right to be a part of DT processes also in rural areas, which is in line with “participatory design” approach (Bansler, 1989; Bjerknes and Bratteteig, 1995). Hence, this paper focuses on DT and innovation in rural areas, and their challenges. The study is supported by a living lab (LL) approach (Bagalkot, 2009; Schaffers et al., 2009; Schuurman, 2015) that has been introduced and proposed as an inclusive and sustainable approach involving various stakeholders, focusing on individuals in their role as citizens, inhabitants, end-users etc., are engaged throughout the DT process in their real-life setting (Bergvall-Kåreborn et al., 2009; Ståhlbröst, 2008). Accordingly, LLs can be seen as an approach for facilitating innovation processes, as they allow one to simultaneously focus on individuals, technologies, tasks and structures, and the interactions between different stakeholders (Schaffers et al., 2009). To date, much attention has been paid to urban areas as the context of LL activities, the so-called Urban LL (Chronéer et al., 2019; Steen and Bueren, 2017), e.g., the initial list of key components of the traditional LLs were further revised and modified for the context of Urban LL by Chronéer et al. (2019).

Though, few studies have examined the possibilities and potentials of LL activities in relation to rural areas and then mostly investigated e.g., one specific dimension such as business models for Rural LL (Schaffers et al., 2009), co-creation activities and actions in rural context (Bagalkot, 2009), and nature-based solutions and sustainability in rural contexts (Lupp et al., 2021; Zavratnik et al., 2019). None has investigated the overall construction of Rural LLs and their key components. In addition, most of the studies on Rural LLs are mainly focused on the context of innovation (Bagalkot, 2009; Rotz et al., 2019) in relation to the traditional rural activities such as farming and agriculture, hence, rarely investigated the overall structure and key constructs of a Rural LL.

The aim of the study is to explore how the LL approach could be designed to support innovation processes aimed to include a multitude of rural stakeholders in DT activities of rural areas by following the five key components of “traditional” LLs – namely, ICT and infrastructure; management; partners and users; research and approach (Bergvall-Kåreborn et al., 2009; Ståhlbröst, 2012). By adopting a design science research methodology (Gregor and Hevner, 2013; Peffers et al., 2007), the study outlines the differences that distinguishes a Rural LL and presents a framework for Rural LLs that contributes to the body of literature by identifying the key components (constructs) of a Rural LL, proposing a definition for Rural LL, as well as understanding the key differences between Rural LLs with traditional and Urban LLs.

Methodology

This study follows a design science research methodology (DSRM) (Hevner et al., 2004; Peffers et al., 2007). DSRM aims to create an artefact to solve generally ill-defined problems and enables working with socio-technical systems to understand and develop existing structures and processes in an iterative manner (Carlsson et al., 2011). Accordingly, DSRM is known as an appropriate approach that proposes solutions for specific problems in real life settings (Gregor and Hevner, 2013), that is one of the key principles of all LL activities (Bergvall-Kåreborn et al., 2009; Ståhlbröst, 2008). Also, DSRM supports the Rural LL framework design, which could be categorized as an “instantiation”, see (Hevner et al., 2004) as it is a “prototype” of a Rural LL approach and its components and supports user centric digitalization of rural areas. Also, Peffers’s (2007) DSRM was followed which consists of six steps namely, 1) problem definition; 2) development objectives; 3) artefact development; 4) demonstration; 5) evaluation and 6) communication.

The empirical data was collected within the context of “DigiBy” project. The purpose of the project was to, in collaboration with Luleå University of Technology, the Norrbotten Region and all Norrbotten municipalities, conduct pilot tests to increase awareness and the application of digitalization opportunities for service development in rural areas.

Thus far, the artefact has undergone three iterations of the DSRM process. The problem identification consisted of (1) exploring and using the theoretical background of the rural situation (Section 3.1) and LLs (Section 3.3), and (2) the use of focus groups and questionnaires about rural digital policies (Section 3.2). Two focus groups consisting of officials at regional and municipal level, discussed the rural-urban digital divide and explored what opportunities the participants felt they had to influence rural digital policies and the responsibility they felt to bring in the rural perspective into the policy process. These focus groups were conducted with semi-structured questions (Flick, 2014) and the results made it evident that there are two specific groups of

officials working with digitalization of rural areas at regional level in Sweden. Therefore, an online questionnaire was sent out to both these groups to ensure inclusion. In this questionnaire, the Critical Systems Heuristics (CSH), a philosophical framework to support reflective practice was used (Ulrich, 2000). The identified problem (end of Section 3.3) was used in identifying the development objectives (Section 4). The development objectives were based on previous studies of the key components of LLs and Urban LLs (Bergvall-Kåreborn et al., 2009; Chronéer et al., 2019; Ståhlbröst, 2008). The Rural LL framework was demonstrated in the projects 'Digiby' and 'Predictive Movement' with a focus on digitalization of rural areas. In these projects, evaluation interviews were conducted with each pilot leader (ten and three pilots respectively). The framework underwent a second design iteration to incorporate some suggested improvements. A second demonstration and evaluation were performed in an online workshop with open-ended questions, and through free and unstructured discussions. The participants had used the Rural LL in their planning and following up tests of digital services in the rural areas. These results (Section 5) were used in a third iteration. The demonstration and evaluation of the third iteration is the topic of a future research paper.

The Rural Situation

The first law of geography phrased by Tobler (1970), "everything is related to everything else, but near things are more related than distant things" provides an understanding of the difference between a city and a rural area. For example, policies and development for digitalization in cities build on a commercial view where commercial actors drive the development (e.g., the Neoliberal economic philosophy) (Grimes, 2003; Malecki, 2003). Commercial initiatives strive for profit, and one way to maintain profit is to let people living close to each other share the costs, hence, sparsely populated areas become non profitable and largely dependent on state support (Lindberg et al., 2021). This is problematic for rural areas, since areas with low profitability are dependent on society intervening with support opportunities ("Sverige helt uppkopplat 2025 - en bredbandsstrategi - Regeringen.se," n.d.). This requires collaboration that is not easily achieved between the state, commercial actors, and individuals (Cras et al., 2019; Salemink et al., 2017). As a result, actors in rural areas develop their own solutions like village associations, formed by the villages' residents themselves, to cope with e.g., the broadband expansion and digital services.

There exist good intentions, e.g., the EU directive 2014/61/EU that states that "all citizens as well as the private and public sectors must have the opportunity to be part of the digital economy". However, when e.g., there are differentiated prices for renting mobile mast space that are based on the height above ground (the higher up, the more expensive) and with supplements for protection against ice slides, rural areas become

the losers. This creates an injustice, in line with Miranda Fricker's (2010) concept of 'epistemic injustice', which adapts to the rural-urban context as well. In short, Fricker (2010) argues that those who are always considered to be wrong, whose beliefs are not taken seriously, will eventually not trust their knowledge themselves.

Rural challenges

A Community Resilience framework suggest that digital policy must take three factors into account to be resilient; Multi-scalar [governing collaboration], Normative [social and technological factors], and have an integrated approach to resilience (Roberts et al., 2017). Rural digital policies incorporate these factors at a local level, but the expectation of a commercial actor to drive the development is a barrier - corporate profitability are prioritized before individuals' needs and desires. A triple helix model for implementing digital services and connection in Swedish rural areas exists, but the public (rural residents), a fourth component in quadruple helix is missing in the policy development process (Lindberg et al., 2021).

For instance, in Sweden, 80 % of the citizens has a fiber connection to their home, but this coverage is unevenly distributed between urban and rural areas (48% in Swedish rural areas). In addition, surface coverage in Sweden for mobile broadband and mobile telephony is 82 % for 10 Mbit/s (2G/3G) and the Cellular Coverage index (CCI) show high inequality between rural and urban areas (Beek and Reje, 2020).

Views on the Rural Situation – as perceived by officials

This section describes the stories, as told by officials working with digitalization in rural areas, structured in the themes Distance and Collaboration.

Distance. Regional rural retail plans have an over-all vision that rural retail shall be available everywhere in Sweden. Everyone should have a grocery store within 10 km and a fuel station with in 20 km. These distances are impossible to achieve in sparsely populated areas with between 0,2-5 inhabitants per square km, which is common in the four most northern counties in Sweden. The officials indirectly relate to distance, when discussing difficulties of getting support to alternative techniques. For example, many believe that radio technology or 4G LTE would be a solution for connection in rural areas. In 2018 the Swedish Board of Agriculture, responsible for the broadband expansion, approved radio link as a Next Generation Access technology (approved for EU-funding). They have not yet approved 4G LTE.

Collaboration. The officials emphasize that collaboration is important from a rural retail perspective. Collaboration between relevant levels would provide a more transparent view of the situation and facilitate decision-making. In addition, collaboration is regarded as a prerequisite for increasing the service level in a rapidly changing society

with the argument that work should be evaluated based on how they collaborate, and how partners experience the situation. One official said: “This is done through a multi-level collaboration locally, municipally and regionally. I believe coordination and collaboration has important intrinsic values, but to increase the commitment, the subject matter must be meaningful in a broader context. Otherwise, cooperation will not become collaboration and co-creation."

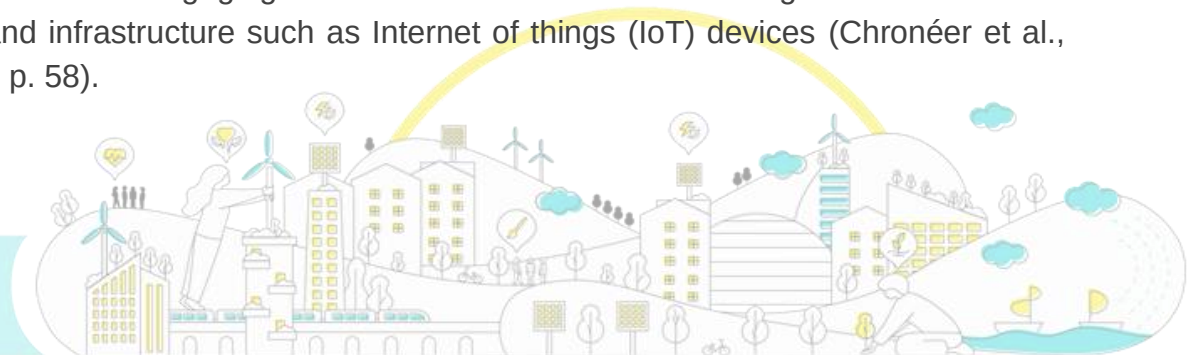
Living Labs and Rural Studies

The need for new approaches to engage various stakeholders and users (rural residents) in the DT process is growing (Evans and Karvonen, 2011). Considering the various consequences of digitalization on humans’ everyday lives (Baskerville et al., 2019; Bockshecker et al., 2018; Yoo, 2010), there are several reasons to involve humans such as empowerment, democracy (Boston College et al., 2014), acceptance and adoption of digital technologies (Moore, 2019; Padyab et al., 2020). LLs offer an approach to manage innovation activities (Leminen et al., 2012; Ståhlbröst, 2008). Accordingly, LLs facilitate DT, as they emphasize simultaneous focus on technologies, human, tasks and structures, and the interactions between them (Schaffers et al., 2009). LLs usually include five key components: ICT and infrastructure; management; partners and users; research and approach (Bergvall-Kåreborn et al., 2009; Ståhlbröst, 2012, 2008).

As DT is contextual and situational, different types of LLs have emerged to support innovation for e.g., energy efficiency, e-health, human centred AI, and Urban LLs (Chronéer et al., 2019). What distinguishes urban from traditional LLs is related to the context of innovation and stakeholder and user engagement, however the distinction between the two is not clear (Steen and Bueren, 2017).

To identify the key components of Urban LLs, (Chronéer et al., 2019) investigated the main differences between traditional and Urban LLs. They extended the five key components of traditional LLs and identified seven key components of Urban LLs, namely:

1) Governance models including management structure, politics, and policies.
2) Financing and business models.
3) Physical representation that takes place in a real-life setting in the city context.
4) An innovation to experiment with.
5) Partners and end-users (i.e., quadruple helix).
6) Approaches for engaging different stakeholders and collecting data.
7) ICT and infrastructure such as Internet of things (IoT) devices (Chronéer et al., 2019, p. 58).



Examples of studies that have investigated LLs in a rural context, are e.g., Guzman and colleagues (Guzman et al., 2008), who discuss Rural LLs as an approach for enabling user driven ICT-based innovation geared towards economic and social development in rural areas. Another example is Zavratnik et al., (2019), who evaluated LLs possible contributions to sustainable rural development and argue that the element of community and social change should be considered as a key element in enabling sustainable living. There has also been attempts to consider Rural LLs as an experimental milieu where various partners and rural residents develop, implement and evaluate solutions to address the problems that affect their environment (Fleet, 2020). Hence, to date there are no studies that have investigated the Rural LLs from the constructional perspective aiming to define its key components. This understanding is of central importance for three main reasons. First, the aim of a LL approach is to facilitate innovation in different contexts, thus the impact thereof needs to be traced and measured. Second, a framework is needed that supports and empowers stakeholders to innovate in rural areas (rural residents, companies, officials). Final, identification of key components will support the design of innovation activities in rural areas aiming to facilitate DT. Thus, we argue that a richer understanding of the Rural LL concept and its constructions is needed, which relies on experiences and empirical data from a real-life case of DT in a rural context, that is the project called 'DigiBy.'

Rural LL framework

To facilitate the processes of innovation and DT in rural areas we developed a framework to support our efforts in the DigiBy-project. To ensure that those involved in the project performed their activities in a similar way, we introduced a LL approach, based on the five key components of traditional LLs (Bergvall-Kåreborn et al., 2009; Ståhlbröst, 2008) and considering the key components from Urban LL (Chronéer et al., 2019). This resulted in a Rural LL framework since it is important to adjust the LL framework to the context. In this article, the endeavour is to adapt these key components (developed to support setting up a LL as an organisation or milieu in an urban context) to a rural context where the LL will be more flexible, time-limited and focused on supporting rural DT initiatives. Thus, the Rural LL framework is for piloting digital innovations in rural contexts, and it is not focusing on the innovation processes per se since there are key principles i.e., openness, realism, value creation, influence, and sustainability (Ståhlbröst, 2012) that should guide these processes in a LL context. As suggested in Peffers et al.'s (2007) DSRM, we design the Rural LL framework based on the above-mentioned studies of the key components of LLs and Urban LLs approach (Bergvall-Kåreborn et al., 2009; Chronéer et al., 2019; Ståhlbröst, 2008), as well as the empirical data gathered within the context of DigiBy-project. Considering the presented issues and complexities of DT in rural context, we ended up with the four overarching key components to support the design of Rural LLs, namely (see Fig. 1):

1) Rural context and the physical conditions
2) Governance and control (including methods for engagement and business model)
3) Quintuple Helix Approach
4) Digitalization (including innovation, ICT infrastructure)

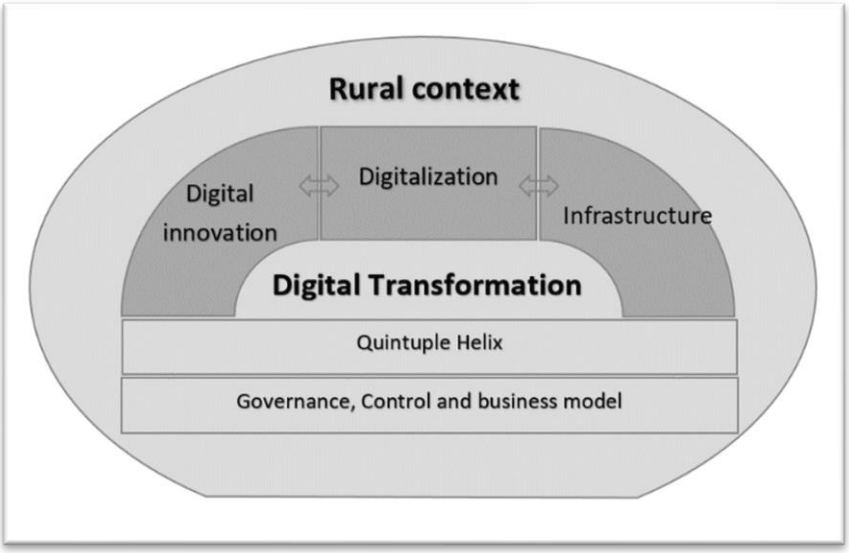


Figure 1. An overview of the developed Rural LL framework

Below, each of the key components in the Rural LL framework are explained in more detail.

Rural context

The rural context is a key component due to the importance to understand the specific nature of the context of DT. For instance, villages are dependent on governmental support while simultaneously being left to take care of matters themselves. Swedish digital policy follows the prevailing trend that digitalization of society should be carried out by commercial actors. However, in rural areas, with low profitability, low density of inhabitants; villages' residents initiate digital solutions themselves, e.g., associations arrange for digging down fiber cables. Situated conditions must be understood, such as who owns the place in which the innovation is to be implemented, plans for the areas (company establishment, new (updated) infrastructures, governmental decisions (e.g., exploitation plans, new natural reserves, changes in laws) and responsibility. In Rural LL activities, places and spaces that support organization of innovation activities is of utmost importance to understand and design for (Bergvall-Kåreborn et al., 2015) since all activities should take place in inhabitants' real life and support engagement, but there is lack of control over the situation and the DT process.

Digitalization

In Rural LLs, digitalization embraces more than merely digitalizing a business. It is about digitalization for inclusion and access to societal services. Digital innovation as a key component integrates both digital innovations that will be co-created by various stakeholders and rural residents, as well as the digital infrastructure (Verhoef et al., 2021). In Rural LLs, infrastructures are intertwined with the innovations that usually are in the fuzzy front-end stage. Here, digital infrastructure refers to the hardware, software, data (open or closed data), networks (e.g., 4G, 5G, fiber, Wi-Fi), as well as other IoT-solutions such as smart cameras, sensors in smart agriculture, and wearables.

Governance, control, and business model

One key component is the organization and management of a sustainable Rural LLs. This includes aspects as; the overall aim and objectives of Rural LLs, risk management and assessment, knowledge sharing with stakeholders and rural residents, and dissemination of the DT activities throughout the Rural LL lifetime. Regarding the business model, it should create, deliver, and capture values for all Rural LL stakeholders. As in Urban LLs, local governments and decision makers have a prominent role in the design of Rural LLs, e.g., to share experiences between different local initiatives so that learning and opportunities can emerge in other locations. For instance, in the DigiBy-project, officials with the role as rural developers shared our findings to different villages in their municipalities. Further, initiators of DT in the municipalities had contact with each other and the researchers. These rural developers have good local and people knowledge, i.e., they know the people running different rural initiatives, and they have ongoing communication with them.

The governance and control component focuses on governing and controlling LL activities, but it also supports knowledge sharing among the stakeholders involved in local initiatives and encourage active engagement between them and rural residents throughout the entire digital innovation processes. The FormIT methodology (Ståhlbröst, 2008) emphasizes the inclusion of external sources of knowledge and ideas in exploration, creation, implementation and evaluation of concepts, prototypes and innovations in real-life settings.

There is a need for multi-disciplinary approaches and various methods (e.g., brainstorming sessions, future workshops, gamification, heuristic evaluation, personas) and tools (Scholl and Kemp, 2016). User engagement in a LL context is an iterative process characterized by complex interplay between different phases and activities, including planning for engagement, realization of the planned activities in real-life setting, and reflecting upon the plans and actions aiming to sustain user engagement and commitment to use the innovation in their everyday use (Habibipour, 2020). In the rural context, being able to live and make business is of utmost importance. For

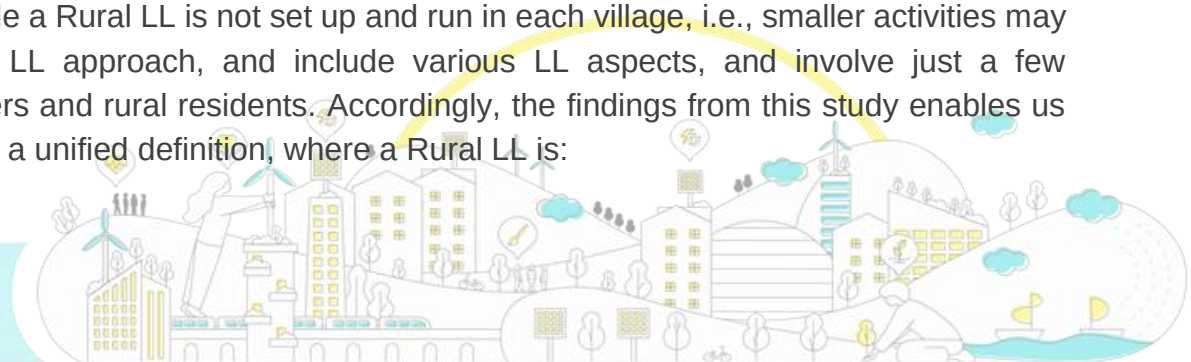
instance, an introduction of ICT can lead to the creation and development of new BMs areas (new potential revenue streams) and be an enabler of different types of innovations and thus businesses. In addition, ICT allow the creation of new networks and partnerships between local economic actors.

Quintuple Helix

All LL activities involve quadruple helix networks, i.e., public and private sectors, academic institutions, and citizens. However, it is natural in rural areas to be close to, dependent on and respectful of the environment and the natural resources, innovations need to embrace this context. Therefore, the quadruple helix of innovation should include this 'nature' (environment), as the fifth key actor in the DT process for rural areas, i.e., "Quintuple helix" of innovation (Carayannis et al., 2012), which means adding the helix (perspective) of "natural environments of society." This quintuple helix approach can also facilitate collaboration in Rural LLs and their DT processes, i.e., risks and workload can be divided among different partners. However, there is no formal partnership or dedicated leadership as is the case in Urban LLs. Therefore, identification of relevant stakeholders is one of the most challenging tasks (Zavratnik et al., 2019), and it should be carried out in the planning of the DT processes. Aspects such as stakeholders' motivation to contribute, their objectives as well as their engagement should be stated. Furthermore, the quintuple helix component should help Rural LL organizers to define the different roles of engaged partners including individual users (rural residents), and the degree of engagement. The partners might have passive roles such as affectee (Ståhlbröst and Holst, 2017), who are affected by, but will not influence the DT process, but also more active roles such as tester, experimenter, innovator, or lead participant.

Discussion and conclusion

In contrast to Urban LLs (Chronéer et al., 2019), Rural LLs do not consider LLs as an environment or a context. Instead, Rural LL is an approach that facilitates the processes of DT in rural areas where the identified key components will be a part of the overall innovation process, such as piloting and experimentation. Hence, in Rural LLs, smaller activities (e.g., pilots) will follow the LL approach and become an "instantiation" of LLs. In addition, in Rural LLs, the dimension of "time" plays an important role. For instance, in the urban context, the city is considered as an Urban LL and it is associated with a long-term and sustainable planning (Evans and Karvonen, 2011; Steen and Bueren, 2017), while a Rural LL is not set up and run in each village, i.e., smaller activities may follow the LL approach, and include various LL aspects, and involve just a few stakeholders and rural residents. Accordingly, the findings from this study enables us to propose a unified definition, where a Rural LL is:



“An approach that facilitates digital transformation processes in rural areas by engaging quintuple helix actors including rural residents and natural environments throughout the digitalization of society in real-life settings.”

When it comes to the methodological contribution, the use of Peffers’s (2007) DSRM provided several advantages when designing and evaluating the Rural LL framework. It provided a systematic and structured approach for 1) identifying the problem and objectives based on theory and empirical data, 2) developing guidelines and designing the Rural LL framework, and 3) identifying criteria in the demonstration and evaluation of the framework. The iterative nature of the DSRM also enabled multiple cycles of design and evaluation that improved the framework until it reached its full potential. This methodology also provided the ability to use other methodologies, including focus groups and questionnaires for problem identification, and interviews and online workshops for demonstration and evaluation. Overall, as our results revealed, the proposed Rural LL framework highlights some key differences between urban LLs and Rural LLs, as it can be seen in table 1.

In respect to the evaluation of the proposed Rural LL framework, rural residents saw the benefit of it on an overall level. The design of the framework was perceived as extensive and unmanageable for a practitioner, however they reasoned that the framework could be divided into parts and used separately for different target groups. According to the received feedback from officials in the workshop who work with policy processes for local development, the “framework” can support the structure of the work in a policy process. In different stages of the policy process, input from target groups can be collected, from politicians' visions to the individual's needs. The participants reasoned also that the “framework” could be used by the project management for planning and follow-up of individual projects. Thus, they also pointed at practical difficulties for using the framework in a project implementation phase that has an agile approach. On the other hand, the participants perceived the framework to be very communicative and useful as a basis for disseminating results and reporting findings (considering openness as one key principle in LL activities), e.g., using it as a guide for disseminating the results of successful LL projects. The framework could also support an increased understanding of how to carry out societal processes or projects with different stakeholders.

Table 1. The Rural LL and urban LL

	Urban LL	Rural LL
Nature and Philosophy	ULL is a context, which is usually associated with a physical setting	RLL is an approach that facilitates digital transformation
Scope of living lab (time-wise)	Long-term	Short-term
Innovation development phases	Planning, exploration, co-creation, experimentation, evaluation and adoption	One or multi phases of innovation development
ICT and digital innovations (maturity level)	ICT as a supportive tools (the focus is on NBS not digital transformation) – relatively mature technology	Digital innovations and ICT infrastructure are intertwined - immature technology
Governance level	More structured. The development plan is well established based on pre-defined steps.	Flexible, Rural LL objectives are defined based on the specific case (pilot)
Actors	Quadruple helix	Quintuple helix
Living lab vision	Future: Set up and run an urban living lab as an organization in the city context	Current: Facilitate DT process in the current situation

This study also opens several directions for future research. An interesting topic for future research is to study how a Rural LL can be seen as a “model” which describes a set of propositions or statements expressing relationships among constructs (here key components). For example, how different ways of governing and control might be affected by the rural context, or how actors (quintuple helix) and their engagement approach might differ, depending on the digital innovation type as well as the digital infrastructure in rural areas. Our hope is that the presented Rural LL framework and definition can be used as a starting point for facilitating and supporting DT processes in rural areas, by further iteration of design cycles and evaluations in the real-life context.

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Full Research Paper

Urban Living Labs and Transformative Changes: A qualitative study to the triadic relationship between financing, stakeholder roles and outcomes of Urban Living Labs on their impact creation in the city of Groningen, the Netherlands.

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Abstract

Urban Living Labs have become a popular instrument to find solutions to the pressing challenge that cities face: How can they combine economic prosperity, social cohesion, and environmental sustainability? While the normalisation of Urban Living Labs in cities is well evident to date, a lack of understanding in the nature and purpose of the empirical phenomenon leaves open many challenges yet to be overcome. One particular challenge is about their potential impact to contribute to transformative changes. By combining a retrospective literature review with a comparative case study to three Urban Living Labs in the city of Groningen, the Netherlands, this study explores how the triadic relationship between stakeholder roles, funding options and outcomes generated influences the impact creation of Urban Living Labs. The study confirms and adds to current theoretical positions taken about how to overcome issues regarding impact creation in terms of a shared ideology and reviewing the concept of agency and power. Also, it shows that opportunity lies within trust building among stakeholders in Urban Living Labs in order to enhance its potential in practise via five ways: redesigning funding programs, look out for new ways to access effectiveness, political empowerment of initiators, the level of abstract as facilitator in collaboration, and a clarification of the concept itself. Consequently, this study calls for further research into the underexplored potential of existing theoretical approaches and models about Urban Living Labs, into the workings of power dynamics in Urban Living Labs, and into its self-sustaining character, especially about social adoption and ownership of Urban Living

Labs as a self-sustaining governance system to guarantee continuity over time, and how to make them self-sustaining and less dependent on external funding streams, like municipal subsidies.

Key words

Urban Living Labs, Trust Building, Impact Creation, Stakeholder Roles, Outcomes, Funding Model.

Introduction

For several years, Urban Living Labs (ULLs) have risen up in cities. This, in response to a pressing challenge that cities face: How can cities provide economic prosperity and social cohesion while achieving environmental sustainability? (Marvin, Bulkeley, Mai, McCormick & Voytenko, 2018). Not only in practise but also in academia spheres, the concept increasingly gained interest (Hossain, Leminen & Westerlund, 2019; Schuurman, 2015).

Yet, despite ULLs and their experimentation are taking place in growing degree, their nature and purpose as an empirical phenomenon in not fully understood (Bulkeley et al., 2016), because the acceleration and normalisation of ULLs in practise proceeded much more rapid than the development of evidence and understanding in theory (Bulkeley et al., 2016; Marvin et al., 2018). As such, there is a lack of international comparison and systematic learning on how impacts can be scaled up to achieve transformative changes (Marvin et al., 2018) and how they effectively facilitate urban sustainability transitions (Evans & Karvonen, 2013; Nevens, Frantzeskaki, Gorissen & Loorbach, 2013). Such transitions are about changes in markets, policy, culture, technologies, and infrastructure as well as in human behaviours and practises (Bulkeley, Castán Broto, Hodson & Marvin, 2010; Frantzeskaki & Loorbach, 2010; Schaffers & Turkama, 2012; Voytenko, McCormick, Evans & Schliwa, 2016). A key point therein is to examine the role of (urban) experiments as a means to govern these transitions and in doing urban innovation and governance (Marvin et al., 2018) to gradually transform stable regimes (Kemp, Schot & Hoogma, 1998; Schot & Geels, 2008). Existing regimes or systems, namely, seem to be difficult to pry off because they are stabilised by processes that create path dependencies (Grin, Rotmans & Schot, 2010; Loorbach & Rotmans, 2010; Neef, Verweij, Gugerell & Moen, 2017). ULLs are one way to do so (Marvin et al., 2018; Schaffers & Turkama, 2012), because they are similar in view to transition management (Loorbach & Rotmans, 2010) and centre the use of experiments; less directed processes in which innovation or ideas are demonstrated, tested and experiences are gained (Bulkeley & Castán Broto, 2012; Kemp et al., 1998). The degree to which these experiments lead to regime transitions seem to depend on growing social networks, innovations, and learnings that they establish (Brown & Vergragt, 2008).

Existing research, however, mainly focusses on the aims and workings of ULLs instead of critically reviewing their implications (Bulkeley et al., 2016), essence (Hossain et al., 2019), or to what extent they shape new governance modes (Marvin et al., 2018). Some challenges in ULLs, therefore, link with temporality and unpredictable outcomes (Hossain et al., 2019), financial sustainability (Gualandi & Romme, 2019), scalability, diffusion, and impact (Puerari et al., 2018; von Wirth, Fuenfschilling, Frantzeskaki &

Coenen, 2018) and the redistribution of agency and risks (Burch, Graham & Mitchell, 2018; Loorbach & Rotmans, 2010; Smith & Raven, 2012).

This study addresses this research gap by focussing on how the relationship between funding, stakeholder roles and process outcomes in ULLs can contribute to transformative changes required to strive for urban sustainability. The main research question is **How can ULLs contribute to transformative changes in the urban environment and society by gaining a better understanding in the relationship between their funding, stakeholder roles and outcomes?** Tensions between these aspects have been observed years ago by, for example, Hodson, Evans and Schliwa (2018) in the UK, however, are still present in today's ULL practise (Scholl & de Kraker, 2021).

Theoretical Framework

Although the origin of the living lab (LL) movement can be traced back to the 60s and the foundation of the European Network of Living Labs in 2006 (Hossain et al., 2019), the emergence of ULLs started since the 2008 Global Economic Crisis. Since then, cities struggle to find solutions to faced challenged via three sets of issues: 1) there is no singular pathway towards urban sustainability (De Jong, Joss, Schraven, Zhan & Weijnen, 2015), 2) interest increased in the potential of experimentation in place-based contexts that may overcome rigidity in existing socio-technical systems based on private contexts (Almirall & Wareham, 2011; Chesbrough, 2006), and 3) various stakeholders, like research and technology institutions started to see the urban environment as a place to support local communities and grassroots initiatives to align with National innovation (Luque-Ayala & Marvin, 2015; Marvin et al., 2018; Paroutis, Bennet & Heracleous 2014). In fact, ULLs and parts of cities are positioned as a form of experimentations in a broader shift in the nature of urban governance (Bulkeley et al., 2016; Evans, Karvonen & Raven, 2017; McGuirk, Bulkeley & Dowling, 2014; Steen & van Bueren, 2017), and as such seem to be able to enhance learning about placed-based contexts to achieve changes in socio-technical and socio-ecological systems by continuously enrolling new sites or actors (Astbury & Bulkeley, 2018; Baccarne, Schuurman, Mechant & De Marez, 2014; Bulkeley et al., 2016; Liedtke, Welfens, Rohn & Nordmann, 2012; Marvin et al., 2018; Scholl & Kemp, 2016; Steenbergen & Frantzeskaki, 2018; Voytenko et al., 2016)

Meanwhile, defining ULLs has been an ongoing challenge, both in science and in practise. While Voytenko et al. (2016) argue that there is no universal ULL definition, Chronéer, Ståhlbröst and Habibipour (2019) in contrast developed a 'unified' definition. In general, two streams are identified. On the one hand, LL definitions that stem from open innovation theory and co-creation (see e.g., Leminen, 2013; Westerlund &

Leminen, 2011 or Westerlund, Leminen & Habib, 2018). On the other hand, ULL definitions stem from management transition and urban governance. ULLs are herein viewed as a governance model in which experimentation and learning are centred (See e.g. Bulkeley & Castán Broto, 2012 or Liedtke et al., 2012).

In this study, *''Urban living labs constitute a form of experimental governance whereby urban stakeholders develop and test new technologies, products, services and ways of living to produce innovative solutions to the challenges of climate change, resilience and urban sustainability''* (Bulkeley & Castán Broto, 2012 interpreted by Voytenko et al., 2016, p. 45-46), because it shows two aspects. First, ULLs constitute a form of experimental governance with urban stakeholders. Second, it underpins the focus on finding solutions to today's urban challenges and reaching urban sustainability. Both are relevant, because todays urban and societal challenges need collaborative efforts across sectors as well as between disciplines (Bulkeley et al., 2016; Evans, Jones, Karvonen, Millard & Wendler, 2015; Hossain et al., 2019; Marvin et al., 2018; Menny, Voytenko & McCormick, 2018; Voytenko et al., 2016).

Also, regarding typologies of ULLs discussion remains, since cases investigated differ and the criteria that form the basis of typologies are not widely agreed upon. Neef et al. (2017) for example differ between Product Oriented Labs and Urban Transition Labs based on the theoretical foundations of open and user innovation. Leminen, Westerlund and Nyström (2012), and Bondarenko, Schuurman and de Kinderen (2019) propose five types of ULLs based on the stakeholder who drives the activities: Enabler, Provider, Utilizer, User, and Researcher driven. Additionally, and used in this study, Marvin et al. (2018) empirically compared 50 ULLs across Europe and differentiate between three types of ULLs based on their geographical scale and urban dimension, see Table 1.

Table 1. Strategic, Civic and Organic ULL characteristics (Marvin et al., 2018 p. 8)

Characteristics	*Strategic*	*Civic*	*Organic*
Lead actors	Innovation agencies, national government, and corporate business	Municipal and local authorities, higher education and research institutes, local companies, and SME's	Civil society, communities, NGOs, and residents.
Urban imaginary	Urban as a testbed that can be replicated or generalised	Urban as a contingent and historically produced context	Urban understood in particular ways by local communities
Primary purpose	National innovation and technological priorities	Urban economic and employment priorities	Community social, economic, and environmental
Organisation form	Competitive (Urban selected site as a site for experimentation)	Developmental (Partnerships formed by local actors)	Micro / Single (Multiple forms of community organisation)

Funding type	One-off or competitive	Co-funding or partnership	Improvised, ranging from subsidies to investing voluntary time or (personal) resources
Analogue	National innovation	Urban technology policy	Grassroots innovation

Strategic ULLs contain larger scale technological development programmes developed by state intermediaries and involves private partners. They are often state sponsored including private investments in order to build local capacity and enhance the international competitive position. **Civic ULLs** involve municipal governments and local stakeholders. Their goal tends to have a strong local character and focus on particular urban priorities. Hence, co-funding is widely used in combination with private investments and National or European subsidies. **Organic ULLs** are focussed on specific local and contextual issues, like social needs or urban poverty, on community- and neighbourhood level and link with grassroots innovation literature in socio-technical innovation (Seyfang & Smith, 2007). The key actors are civil society and non-profit organisations who try to mobilise residents around projects.

ULLs are, indeed, associated with open innovation and user innovation (Hossain et al., 2019) which are both extremes of the user involvement spectrum (Leminen, 2013). Open innovation links with the idea that businesses cannot operate on their own and instead look for external resources to improve their developments (Chesbrough, 2006). User innovation highlights the necessity of passive and active roles of citizens in innovation processes (see e.g., Baccarne et al., 2014 or Bergvall-Kåreborn & Ståhlbröst, 2009). Both are needed to identify needs and ideas and validate and formalise learning outcomes (Menny et al., 2018). As such, many scientists tried to come up with stakeholder roles. Often referred to and used for typologies are the Enabler, Provider, Utilizer, User and Researcher roles (Bondarenko et al 2019; Schuurman, Baccarne, De Marez, Veeckman & Ballon, 2016; Leminen et al., 2012; Westerlund & Leminen, 2011). Enablers stand for organisations that make things happen and that support ULL activities in financial terms or other resources. Providers are development organisations that provide something to ULLs like knowledge or expertise. Public or private organisations that use ULLs as a strategic tool to develop their own business are Utilizers. Users reflect end-users of products or citizens in a specific place who are involved in ULL activities. Researchers are providers of knowledge as well as generators of new scientific knowledge in diverse fields, like urban policy.

Recently, The Funding Mix Framework (FMF, Figure 1) is set up by Gualandi and Romme (2019), who provide a first holistic view of the relationship between stakeholders, value creation and funding options. It consists of four funding methods:

Pay per service (PPS), Subsidies (SUB), Out of Network Funds (ONF), and **Cross Financing (CRF).** PPS is a revenue arising from services in ULLs, mostly given by private partners that seek economic value. SUB is often given by public partners in the strategic level of ULLs. ONF are equal to SUB, however, provided by partners not involved in the ULL constellation, like EU funding. CRF is about new ways of funding, such as renting out the physical space of ULLs.

Additionally, Gualandi and Romme (2019) argue that value created in ULLs can be economic, business, and public. The first is about tangible and measurable outcomes, like generated start-ups (Baccarne et al., 2014). The second is an extension of economic value, such as trainings provided. The third is about non-financial impacts of ULLs that following Baccarne et al. (2014) link with realizing policy goals. In these terms, public value is considered the most important in ULLs (Guzman et al., 2013) as they have a strong focus on social value creation and civic engagement (Baccarne et al., 2014). In fact, social acceptance of innovation and consumer practises seem crucial accelerators of sustainability transitions (Markard, Geels & Raven, 2020; Schaffer & Turkama, 2012; Stoeglehner, 2020), while these are the most difficult ones to measure such as urban safety, environmental awareness (Ståhlbröst, 2012) or the adoption of new practises (von Wirth et al., 2018).

Moreover, long-term funding is needed for long-term operation, knowledge accumulation, scalability and impact creation (Evans et al., 2015; Guzman et al., 2013; Veeckman, Schuurman, Leminen & Westerlund, 2013). Indeed, ULL outcomes and studies have focussed on incremental rather than radical outcomes (Hossain et al., 2019) since successful ULLs are inherently locally (Burch, Graham & Mitchell, 2018) and are viewed as the starting point for scalability and transformation at different scales (Astbury & Bulkeley, 2018). Despite, Mai (2018) shows that exact those small scale ULLs struggle hardest for appropriate funding. Thus, and still, business models remain underdeveloped and unsustainable, because they depend on public funding that require strict justification, project-based injections or funding from universities and regional development agencies (Schaffer & Turkama, 2012).

Impact-wise, von Wirth et al. (2018) show three ideal types of creating transformative changes in ULLs: **Embedding**, **Translating** and **Scaling**. The first is about the adoption and integration of an approach or outcome in existing local structures. The second is about elements of experiments or lessons learned being replicated and reproduced elsewhere. The third is about experiments becoming *''bigger in terms of content and remit''* (p. 233). Herein, transformative changes are viewed as the de-institutionalisation of existing socio-technical structures and new more sustainable ones being created, diffused, mainstreamed, and institutionalised again (von Wirth et al., 2018).

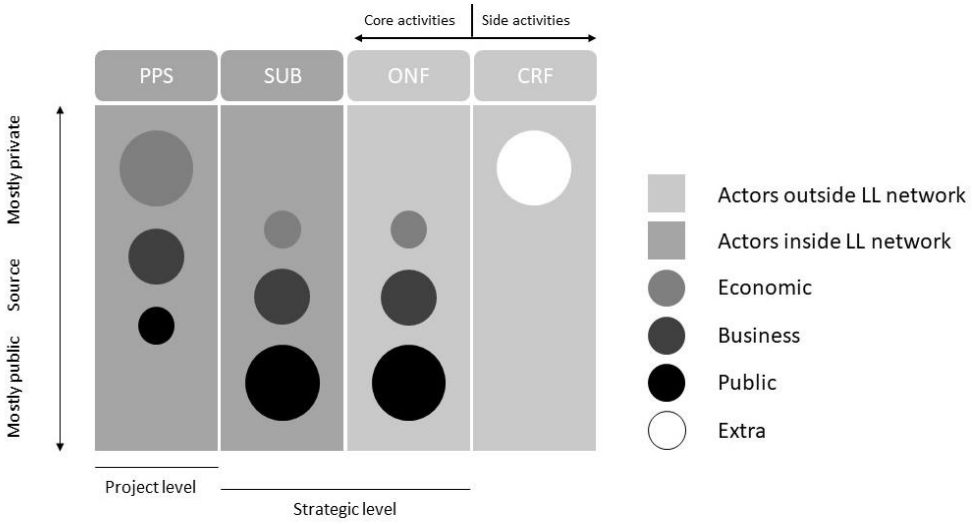

Figure 1: The Funding Mix Framework. Source: Gualandi and Romme (2019, p.6).

The current debate on solving the issue between funding, stakeholder roles and outcomes, provides two positions. First, researchers call for a shared ideology within ULLs in such a way that complementarity stands above competition between stakeholders. This is for example advocated by Gualandi and Romme (2019) who point to different funding options that should complement each other and Mangan et al. (2009) who hint to a common language as new discourse with shared perspectives. Second, debate is going on about agency and power of stakeholders involved and how this takes effect. For example, municipalities fear financial and political risks associated with experimentation and failure (Burch et al., 2018; Sharp & Raven, 2021). Indeed, Savini and Bertolini (2019) demonstrate that ULLs relate to the political dynamics of institutional stability and change. Besides, Burch et al. (2018) explain that ULLs flip traditional planning theory and practise by redistributing agency and power to non-traditional urban stakeholders, and Menny et al. (2018) introduce a cyclical process of redistributed power throughout different ULL phases as also mentioned by Steen and van Bueren (2017). It seems that opportunity lies in a change of mind-set towards shared ideologies and reviewing the concepts of agency and power.

Methodological notes

This study uses a qualitative research design and combines a manual retrospective literature review with a comparative case study analysis. Indeed, case studies are arguably the most used methodology in ULL research (Greve, Leminen, de Vita & Westerlund, 2020; see also the often cited paper by Eisenhardt (1989) within ULL literature). Yet, the method seems useful to gain a holistic overview of the context under study (Punch, 2013) and is particularly appropriate to collect data to study a novel phenomenon in an explorative manner (Yin, 2002) which is the case in ULL literature

since it is recent, quickly expanding and contains competing definitions (Di Stefano, Peteraf & Verona, 2010; Greve et al., 2020).

First, a retrospective literature review is held to understand the historical evolvement of ULLs and starts with two documents: *The Urban Living Labs: Experimenting with city futures* scientific reader from Marvin et al. (2018) and the academic paper *A systematic review of living lab literature* by Hossain et al. (2019) as both starting documents pay particular attention to (U)LLs in urban contexts and as means for sustainable development. Subsequently, the snowball method and pearl-growing method are applied to find additional relevant literature regarding the topic under study focussing on recognized authors and often mentioned key terms. The snowball method allowed for a relative fast and holistic exploration of the recent history of ULL literature and the identification of often mentioned key terms. The key terms (Urban Living Labs, Impact, Diffusion, Outcomes, Value, Stakeholder Roles, Funding Model, Financing) were then put in Google Scholar in the pearl-growing method for additional (and more recent) literature.

Second, a comparative case study (Punch, 2013) is conducted using semi-structured interviews to collect detailed data of cases by understanding and accessing stakeholder' perspectives of the situation and to explore the research question. Three cases are selected first by meeting **four general ULL criteria** and second by meeting **specific criteria to label cases as organic, civic or strategic ULL**. The criteria are assessed while reading in online policy documents, on their website, and about the mission, vision, and goals of the ULL. As far as general ULL criteria are concerned, the cases: 1) are geographically embedded in a particular location or place 2) must consist of urban stakeholders in the co-creation triple- or quadruple helix model 3) focus on urban sustainability, and 4) use experiments or test moments to generate knowledge or learn about urban sustainability.

Additionally, the specific criteria to label cases as organic, civic or strategic ULL are as follows. The strategic ULL 1) operates on city, regional or national scale 2) has involvement or a link to (national) innovation agencies or agreements 3) is financed by a lump sum in relatively short-term (although not necessary) 4) falls into a wider sustainability strategy, and 5) is competitive in nature. The civic ULL 1) operates within city scale 2) is focussed on local urban priorities, and 3) consists of a clear partnership between urban stakeholders that initiated the ULL. The organic ULL 1) is active on community- or neighbourhood level 2) is not initiated by governmental parties 3) focusses on specific local contextual issues that link with social needs or ideological values of the initiators, and 4) is a strategic niche (Seyfang and Smith, 2007).

In total, six interviews and one mail questionnaire have been conducted with eight interviewees in October and November 2019. The interviews lasted between 38 and 90

minutes and were taken at the work location of the interviewees, except for one in the Groninger city centre. The interviewees are governmental employees (2), governmental trainees who coordinated activities (2), civil initiators (2), a university employee (1), and a private sector person (1). The interviewees were chosen as they had leading positions in the ULL activities and projects. Prior to the interviews, interviewees received an interview guide and interview permission statement. The interview guide concerns an introduction to the research, its objectives, and questions asked. With the interview permission statement respondents were asked to agree on recording the interview and the use of information and data collected. Transcriptions were provided to the respondents for approval or changes regarding anonymity and answers given. The semi-structured interviews are transcribed manually and analysed by using the coding and memoing methodology (Punch, 2013; Miles, Huberman & Saldana, 2013). Analysis began with scoring out irrelevant information. Then, codes were attached to specific pieces of texts, resulting in 42 to 82 codes per interview. Next, all codes were clustered to find cross-connections between codes, clusters, and interviews. Alongside, the memoing technique (Punch, 2013) was used to put memos on different spots in the transcripts to move from the empirical to the conceptual level while analysing the data collected.

The case studies are located in the city of Groningen. It is the largest and youngest city in the north of the Netherlands. The surrounding rural areas, however, are entitled *krimpregio's* by the National government, meaning they face a declining population and related urban challenges. Moreover, Groningen is a typical student city with one in four being a student. The economy of the city has mainly been focussed on services and energy, such as the natural gas company GasUnie. Currently, focus is shifting to tourism, ICT, and energy and environment, like the Hydrogen Valley HEAVENN EU-project. Below, the cases are described.

Organic ULL: Stichting[1] *Paddepoel Energiek (SPE)*

SPE is a citizen initiative to improve energy neutrality in the neighbourhood Paddepoel, built in the 1960s, to show opportunities in typical old Dutch neighbourhoods and buildings. Not without success, since Paddepoel became partner in the EU-project Making City although it is often associated as a not-to-be-in neighbourhood. Their main aim was to create an energy neutral neighbourhood in 2035, both technically and socially. Also, everyone could join the initiative and learn from their energy coaches about energy production and consumption. Additionally, they collaborated with the municipality of Groningen, educational institutions and local businesses that develop, for example, solar panels. The period under study is roughly its stichting period from February 2016 until it stopped in October 2019.

[1] A *stichting* is a Dutch legal type of organisation that focusses on societal or social goals rather than monetary profit. It is obligated to form a board in a stichting while a supervisory board is not needed per se. A stichting is often funded by donations, loans or subsidies. A stichting does not have members or shareholders.

Civic ULL: Urban Gro Lab (UGL)

The UGL is a partnership of the municipal department of urban development and the Faculty of Spatial Sciences at the University of Groningen. They envisioned the city as ULL for high quality research that focussed on local socio-spatial challenges by bridging science and practise. Hereto, it tried to function as a source of knowledge and inspiration by collaborating with urban stakeholders and involving citizens. As such, it was run by a yearly changing full-time lab coordinator. The UGL existed for almost five years and was purposefully intended to be and function as an ULL for spatial research and innovation. The period under study is from November 2015 until it stopped in November 2018 corresponding with its last three years.

Strategic ULL: Welcoming International Talent (WIT)

The Gentlemen's Agreement 'Het Akkoord van Groningen' between the province of Groningen, the municipality of Groningen, the knowledge institutes in the city, and the University Medical Centre Groningen exists since 2005. It is a cross-party collaborative platform for joint coordination and decision-making that agreed upon envisioning a sustainable future for the city of Groningen as knowledge city by focussing on various themes, of which the focus in this study is laid on internationalization. The ULL aims to make Groningen 'stickier' by attracting, retaining, and integrating international residents and students better in the city while maintaining a high level of social cohesion and liveability to enhance the innovate capacity. The WIT finds it basis within wider sustainability strategies on EU, regional and city level. For example, the EU Cohesion Policy or the Next City Policy document. Also, it is a European Good Practise city in the URBACT Welcoming International Talent Transfer Network. The period under study is three years: from November 2016 (review moment Gentlemen's Agreement and local policies) until November 2019. The ULL is still active and functioning.

Comparative case study results

In all cases a core group is identified that is responsible for the funding and operation of the ULL (See blue contours in Figure 2; positioning of stakeholders in the figure is based on the theoretical description and its practical operation). In the SPE and WIT, this core group existed out of the Enabler and Utilizer stakeholder roles, whereas in the UGL the core group encompasses the Enabler, Provider and Research stakeholder roles because of the partnership between the municipality and the university. Municipalities are in all cases involved in the core group as Enabler, which is in line with Scholl and Kemp (2016) who observed that municipalities are often involved stakeholders in ULLs. In SPE and WIT, the Utilizers are involved as well because of the funding possibilities and expertise provision, which is already included in the UGL partnership. The researcher role in the SPE was rather absent as it was not focussed on generating new knowledge per se, while the UGL and WIT did.

Funding-wise, the SPE is mostly financed by PPS and SUB methods via the private businesses and the municipality corresponding the theoretical outcome aimed for. The UGL is financed by PPS and SUB methods as well, and both focus on public outcome value. The WIT is financed by all methods available and focuses on various outcomes. While it is acknowledged the FMF is not a static model, interestingly and notably is that PPS in the UGL, and PPS and SUB in WIT contrast to the theoretical model as provided by Gualandi and Romme (2019) since the PPS streams focussed on public outcomes, and the SUB obligated private outcomes. CRF is found to be complementary to other main funding streams aligning with the FMF. For example, payments by the housing association in SPE to inform and advice their tenants as side-activity. Moreover, WIT seems most eligible to receive ONF due to legitimation reasons as the geographical location they serve is bigger compared to organic or civic ULLs, and the potential impact created therewith. At the same time, however, their place-based embeddedness turns out to become less relevant (Mai, 2018).

Additionally, the interviewees mentioned university funding, political will and the role of civil servants as important in the funding provision for ULLs. Because of the Dutch educational system, universities seem to be limited in funding ‘experiments’ as their core task is doing scientific research. Thereby, political will is important for budgeting ULL projects in the coming years which was clearly mentioned in the WIT. Meanwhile, and because municipalities in the Netherlands are in a transition period as they get more responsibilities in light of the introduction of the new Environmental and Planning Act (2022), the role of civil servants is criticized by the interviewees. In general, they handle too strict justification criteria for subsidies provided, limiting the freedom of the ULL to ‘experiment’, especially in cases of SUB and ONF. These observations are in line with the SWOT-analysis of LLs given by Guzman et al. (2013) and the accountability discussion raised by Astbury and Bulkeley (2018).

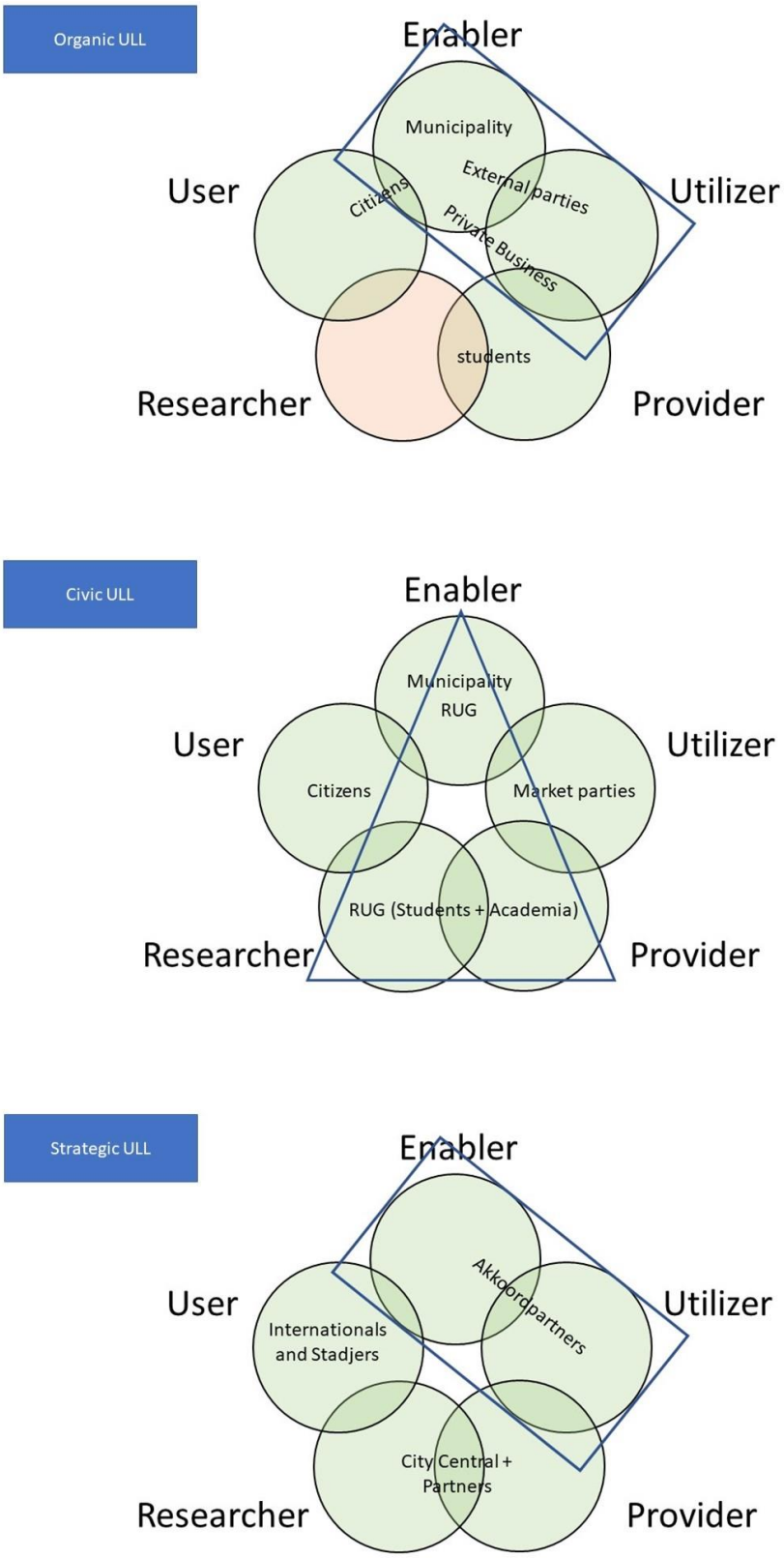

Figure 2: Theoretical stakeholder roles in the Organic, Civic and Strategic ULLs. Blue contour: Core group. Source: Authors.

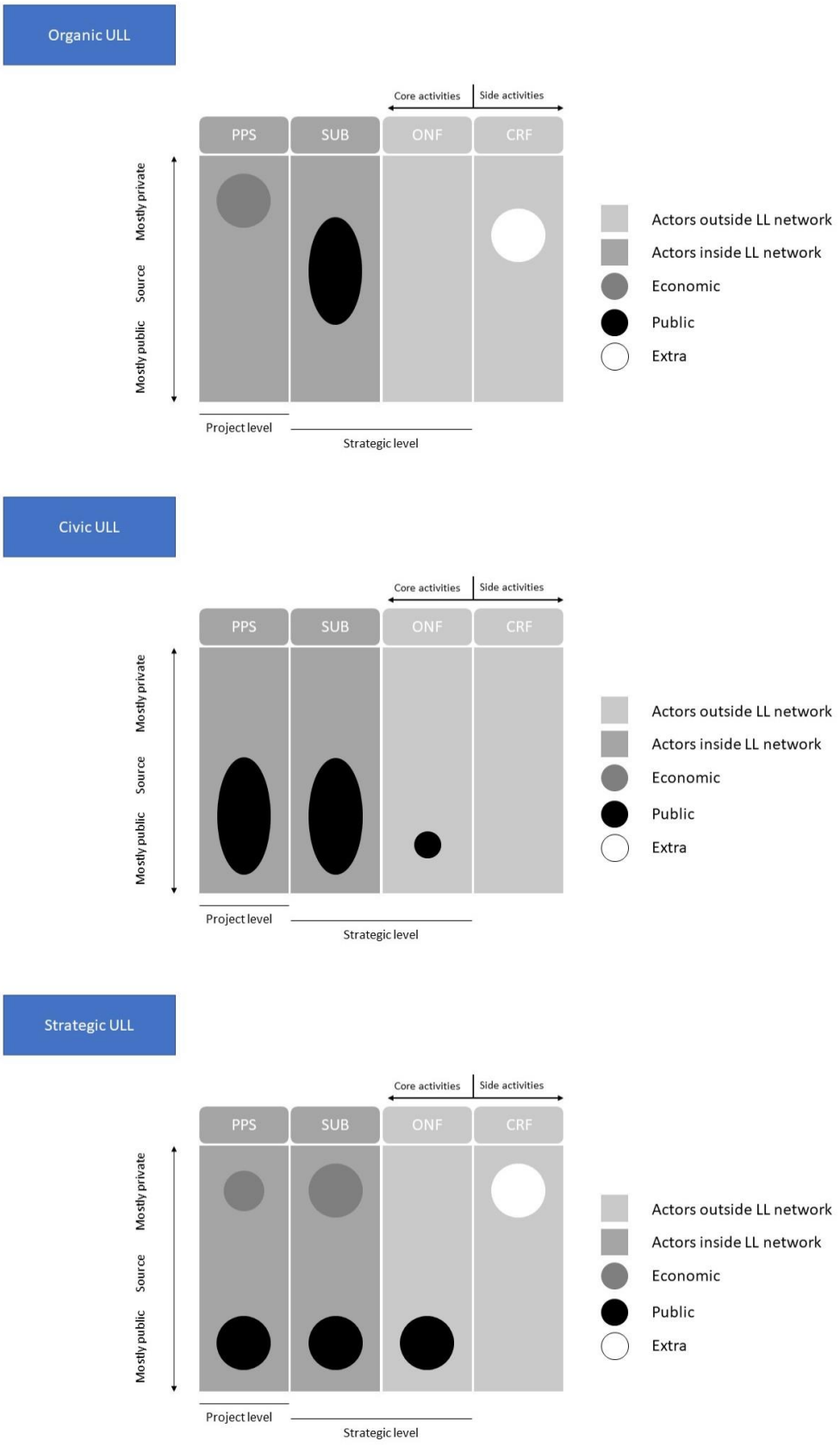

Figure 3: Theoretical funding model in the Organic, Civic and Strategic ULLs. Source: Authors, model based on Gualandi & Romme (2019).

Outcome-wise, **increased social networks and mutual learnings** were found in all cases and indicated as important by interviewees, whether or not focussed on in advance. These are clearly felt outcomes, though not directly measurable. In fact, Brown and Vergragt (2008) argued that both are of immense importance if ULLs want to contribute to regime transitions. Indeed, most value strived for in all the ULLs is of public value (See black circles in Figure 3) to aim for societal and urban improvements. In addition, and when economic value was pursued, this was done by private parties or for specific short-term services. Argued by the interviewees was that while some ULL experiments were seen as failures, they still brought outcomes that one might benefit from in the future or that potentially start wider transitions in provision systems regardless of the type of ULL.

Impact creation seems to depend on the interest of outsiders (at translating), the geographical scale the ULL is already active on (at scaling), and the available possibilities to embedding lessons in local structures or organisations (at embedding). The SPE scaled and translated outcomes, though not initiated by themselves. Rather, interest from outsiders (other neighbourhoods) and the obligation to become a stichting made them do so. The UGL embedded outcomes in local structures within its geographical focus. However, their impact remained sporadic due to a lack of long-term vision, but ranged from products created, experiences gained, networks built or improved education. The WIT embeds and translates lessons learned via either the integration of outcomes in local structures, like policy plans, or via the URBACT Network to other city contexts. Scaling was not observed, as the WIT already focused on (inter-)regional scale and ‘everyone’ in the Akkoord van Groningen.

Operational destruction

The SPE and UGL stopped prior and during this study because of the topic under study. Multiple causes were identified while analysing interviewee experiences and insights. Therefore, the operation is being described and discussed below.

In SPE, the municipality obligated the ULL to become a stichting in order to guarantee project funding. Therewith, SPE became more professional and legal administration was required, like setting up a board group or statutes. Because of the project-based funding, SPE spend a lot of time writing project proposals and guaranteeing funding, particularly municipal subsidy. Together with the voluntary character as citizen initiative, the organisational capacity was limited. Hence, follow-ups on projects were limited or absent. A great lesson learned, therefore, remained in the minds of involved actors according to the interviewees. To quantifiable these lessons the municipality connected SPE with a professional organisation (a business). Arguably, these two municipal decisions, obligating SPE to become a stichting and connecting it with the external business, were deadly to the ULL because of three reasons. First, internal discussion

between the board and others about the professionalization of SPE frustrated its operation. Second, legitimation and continuity were not guaranteed, since SPE did not have the organisational capacity to do so and formulate a long-term vision due to the project-based operation and funding. In fact, Voytenko et al. (2016) argues that a long-term strategic vision improves the ULL operation. Third, inhabitants preferred personal treatment, like visiting homes and getting to know each other, while the professional organisation worked counterproductive as they did not operate as such.

In the UGL, the yearly rotation of lab coordinators made it hard to operate structurally, both process and content-wise. Thereby, and similar to the SPE, a lack of organisational capacity limited evaluation and monitoring possibilities as lab coordinators operated solely. Moreover, a lack of institutional embeddedness frustrated in various ways the functioning of the UGL. One of them is the dis-alignment with internal municipal and political agendas for topics under study. Also, academic researchers may set their own research agenda, because of the academic freedom. Hence, participation and collaboration was only done when interests link with the UGL agenda, which could change yearly because of the install of a new lab coordinator who may change course. Again, it was argued by the interviewees that a long-term strategic vision contributes to knowledge accumulation and the institutional embeddedness of ULLs to manage and align expectations and objectives over years. Then, evaluation becomes more important and meaningful to reflect whether experiments were useful or not. Advocated by interviewees, especially those who organise activities, in-between successes and outcomes must be reflected, included, and celebrated to ensure motivation of stakeholders involved. Leminen, Rajahonka and Westerlund (2017) call these anchor points.

Conclusion and discussion

While ULLs in cities flourish faster than the development of an understanding of the nature of the concept, this study focussed on the triadic relationship between the stakeholder roles, funding model, and outcomes generated in relation to the potential of ULLs to contribute to transformative changes. The research question **How can ULLs contribute to transformative changes in the urban environment and society by gaining a better understanding in the relationship between their funding, stakeholder roles and outcomes?** was therefore centred. Historically, LLs and experimentation can alienate investment risks and provide new short-term insights for business development. Since the 2008 Global Economic crisis, ULLs emerged in the urban context to collectively learn about doing urban development; a long-term process in itself. While ULL practitioners and scientists are aware of the potentials inherent in the concept, the continuous search for limiting individual political and financial risks of urban stakeholders hinders to do so. This study shows that it is not individual aspects

themselves that improve impact creation, rather trust building among stakeholders seems necessary to overcome the hurdle to enhance the potency of ULLs to contribute to transformative changes.

Implications for practise

The main practical contribution of this study to ULL practise is the emphasis on trust building among stakeholders involved to overcome the issue presented above. Based on this study, five points seem to emerge for the ULL community: First, public grant providers on various political levels are challenged to rethink their selection criteria for subsidy approvals to guarantee strategic long-term funding in ULLs that can be complemented with project-based private investments. Second and consequently, new ways to measure effectiveness of ULL activities are needed to indicate successes and failures, both quantitative and qualitative and that allow for deviation on individual and collective level. In fact, this study shows that increased (social) networks and learnings accumulated must be integrated in evaluation criteria. Third, municipalities as often involved stakeholders are challenged to empower ULL initiators politically by reviewing the concept of agency and power, especially in organic and civic ULLs as those are active on topics that municipalities are already concerned with, like the energy transition. Fourth, ULL stakeholders should view the level of abstract in objectives as facilitator in collaboration by envisioning shared strategic goals while providing room for individual outcomes to ensure continuous momentum at all stakeholders. While the importance of these anchor points (Leminen et al., 2017) is acknowledged and recognized on operational level, it has yet to be incorporated on strategic level. Fifth, the ULL community must be aware for a fragmentation of views on the concept and think critically when one is needed to improve its applicability in practise. Recently, Greve et al. (2020) emphasised this as well by exploring the overall landscape of LL research and its potential areas of fragmentation and isolation.

Theoretical implications, limitations, and recommendations for further research

The theoretical contribution of this study is threefold. First, it follows up on Greve et al. (2020) who point to the opportunity for scholars to apply unused theoretical approaches in ULL literature. Hence, this study shows the importance of, for example, the FMF to be explored in practise and used in theory in order to improve funding models for ULLs that are still underdeveloped and unsustainable, and the application of the categorisation between organic, civic and strategic ULLs (Marvin et al., 2018) to be explored more extensively to understand the multitude of ULLs as a urban governance model to contribute to urban sustainability practises and transitions. We call for researchers to explore existing theoretical approaches more deeply, instead of (again) providing new approaches, categories or models to enrich our understanding of the applicability of ULLs in practise. A good example thereof is the recent study by Kalinauskaite et al. (2021) who developed further on the three-layer model once

provided by Schuurman (2015) but which is still underutilized as a conceptual model for the organisation of LLs and ULLs. Second, this study confirms and adds to the current theoretical debate about how to overcome the issue under study: a change in mind-set towards shared ideologies and reviewing agency and power. Hereto it considers to complement shared ideologies with individual wishes and needs, and the concept of power with the concept of justification as it was observed that a constant pressure to safeguard and legitimise expenditures creates power dynamics in ULLs between stakeholders involved. In this line of thought, we call for more research into the power dynamics in ULLs, especially in terms of political power, such as studies like Savini & Bertolini (2019) to improve understanding into just power relations among (non-)traditional urban stakeholders involved in ULLs. Third, and based on the results from this study, we call for further research into the self-sustaining character of ULLs. More specifically, 1) to investigate appropriate ways to embed ULLs in local context needs, problems, and potentials to improve social adoption and ownership of ULLs as a self-sustaining governance system to guarantee continuity over time, especially regarding organic and civic ULLs, and 2) to investigate how ULLs can be self-sustained financially in order to make them less dependent on subsidies and therewith certain consequences observed in the case study.

It is always important to recognize limitations of a study. First, this study is limited to the city of Groningen as context and the investigation of three ULLs indicated as organic, civic and strategic ULL. Further research should also focus on different contexts as well as comparison between similar types of ULLs within and between different contexts. For example, the exploration of organic ULLs within one city context or between city and rural environments. Second, one should note the limited amount of interviews held that form the base of this study. More experiences from a multitude of people and disciplines should be collected to enrich the understanding of the topic under study. Third, we connect with Greve et al. (2020) to start using more diverse as well as quantitative research methods in ULL literature, besides the often used and in this study applied case study methodology. For example, discourse analysis or ethnographic research designs may help us as researchers to analyse and experience how (spoken) agency and power is orchestrated in ULL daily practises and thus its contribution to transformative changes for urban sustainability.

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Practitioners Presentation Paper

Socially-oriented urban living labs in post-industrial cities: challenges and lessons learned

Authors

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Abstract

In the context of the European project A Place To Be-Come, the University of Liège has the mission to support the implementation of citizen spaces in a disadvantaged neighbourhood of Seraing. The purpose of these spaces is to be led by the inhabitants and local associations in order to contribute to the urban and social regeneration of the neighbourhood.

This work presents the pertinence of ULLs in post-industrial cities going through a physical and social metamorphosis, then the expected objectives of the project and finally the first observations, results and lessons learned.

Key words

Socially-oriented ULLs; European project; Post-industrial cities regeneration; Citizen participation; Model of governance

Problem statement

Fragile populations are often excluded from urban regeneration processes in post-industrial cities. To tackle this issue and better consider the social and cultural needs of fragile populations, effective tools are developed, including Urban Living Labs (ULLs). Whereas the ULLs approach seems to have potential for empowering fragile populations through active participation in urban redevelopment, little attention has been provided to the lessons learned from innovative processes, especially within socially-oriented Urban Living Labs.

Approach

In the post-industrial city of Seraing (Belgium), the city center has been undergoing an important physical regeneration process since 2005. However, the local population is still facing numerous social difficulties (e.g. 45% of unemployment), barely solved by these newly built infrastructures. Considering this, developing an ULL approach could connect citizens, local associations and services around activities that would contribute to the urban and social regeneration of the neighbourhood.

For this reason, as part of the UIA European project A Place to Be-Come, aimed at fighting against local poverty and social exclusion in the city center of Seraing, the LEMA (University of Liège) has been developing two socially-oriented ULLs with local stakeholders.

During the renovation process of these ULLs, LEMA organized regular meetings with local associations and representatives of the municipal administration in order to stimulate co-creation and facilitate co-management of these two social ULLs. For the moment, only institutional and associative actors are involved in the process, but it is planned to include the inhabitants of the neighbourhood in the management of the spaces at a second step.

The process is in progress and will be achieved by the end of 2022. At the moment, one of the space is used to organise citizen workshops to co-create urban projects with the inhabitants. It is also used by project stakeholders for professional formation of unemployed inhabitants for the maintenance of parks in the neighbourhood.

Outcomes

In this framework, the LEMA has identified two main challenges in the development of this methodology.

Firstly, in Seraing, the main model of governance focuses on centralized powers and hierarchy so that directly involving inhabitants has been very challenging. Therefore, in order to include citizens in the ULLs process, the LEMA mainly tackles association beneficiaries. Besides, representatives of local associations and municipal actors expect one actor to take the lead in the management of the ULLs and remain reluctant towards a co-management process. In brief, to enable citizens to be actors of their living environment, the ULLS can be an opportunity to start a mindset shift (notably of trust) at various power levels.

Secondly, a few years ago, the municipality delegated the economic development to an autonomous municipality-controlled company, which coordinates the European project. This complexifies the project by generating unnecessary exchanges between the two structures, which jeopardize the communication towards all the actors involved, including the citizens. The ULLs offer a real opportunity to federate people around a same target and place, hence allowing the citizens' developed initiatives to be articulated to other scales and actors, including public authorities.

Lessons learned and main interest

The main lessons learned so far are that: (i) to initiate ULLs based on co-creation, effective support of institutions and local associations towards change is essential, in the context of a centralized governance model, and (ii) ULLs have the potential to enhance communication between institutions, even if deeply fragmented, and enable the empowerment, not only of local citizens but also of local associations. These case study lessons may help foster the emergence of socially-oriented ULLs in supportive conditions, within other urban regeneration contexts.

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Practitioners Presentation Paper

Maker City – Culture & Creativity in Times of Disruptive Change

Authors

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Abstract

Makerspaces can be spaces for exploration, collaboration and equity, but are often exclusive as they are attached to Universities, or regarded as the domain of predominately white, middleclass men who are focussed on the technology and how it works rather than who uses it and what they might choose to do. We look at how through a social action and creative technology programme, co-created with young people we can create a more equitable environment to make long term change in communities and beyond.

Key words

Making, Makerspaces, Collaboration, Equity

Main problem statement

Living Lab present a case study about how we are undertaking collaborative research with UCL (University College of London) and young people around how makerspaces can be more equitable. We recognise that there is often not enough space for young people to explore their creativity in schools, so we have created an informal learning programme called Maker City which has a particular focus on working with young people from marginalised communities having social action at the heart of the programme using making and digital technologies. We look at how through co-creation with young people, and being able to listen and adapt to the types of learning and approaches they want to work within, we can provide a space for creative thinking and differing pedagogies than they are used to at school. It is also an opportunity to support them around exploring future creative careers using STEAM and making. Makerspaces are described as informal sites, designed for collaboration, making and hands on learning. Despite makerspaces and the maker movement trying to encompass democracy and accessibility they often reflect the white, middle class, male demographic, however makerspaces have the potential to build communities, empower people and become equitable spaces for a bright future.

Methods / approach

We have been working with local young people and a network of educators passionate about creativity in the curriculum and have been delivering Maker City for 3 years. We have worked with over 300 young people, in 9 different schools, in our Makerspace-KWMC: The Factory and online during COVID-19. Through this approach, we have explored makerspaces and what equity really means. We have taken our mobile making equipment such as laser cutters, vinyl cutters, 3D printers and digital embroidery machines into different settings and through an open approach to trial and error, we have worked with young people to evolve the programme putting them at the centre to make sure they have ownership of the content.

We have been working with UCL to explore how Maker Spaces can become more equitable for young people nationally, collaborating with our young participants who have taken part in ethnographic studies and shared their findings. By training young people how to research and providing them with equipment; such as voice recorders, cameras and tablets we have given them the tools that they need to research and contribute. We have also worked with our partners, MadLab and Institute of Making to share findings with each other. By supporting young people to be researchers, and not just the researched, we have found that the data is far richer for us to build on.

Another method that we use throughout, is providing a space for young people to see failure as a positive, not a negative. We embed prototyping and iteration in all of our activities, supporting young people in makerspaces to develop their skills through exploration. One young person said “Practice makes progress”, rather than perfect, which encompasses our approach in Maker City.

We centralise youth voice throughout these programmes by supporting them to find their creative spark and aim to enable young people from the age of 10 upwards to get involved in and think about STEM (Science, Technology, Engineering and Maths), Creative Technology and Social Action in an inspiring and inventive way. We make sure that we are using evaluation methods in all of the sessions that we run to ensure that young people have plenty of opportunities to feedback on the programme, session or activities. Some evaluation methods we use are peer to peer interviews, comment boxes, head, heart and feet (which is about what you learnt, what you loved, what you want to move forward in next time).

We found that young people are attracted to Maker City because of the development of their creativity and imagination, (so we are really talking STEAM not STEM). We use a focus on social action as a core element of the programme to encourage young people to develop their ideas and products based around what they care about, and the needs or issues in their local communities, Bristol and beyond.

Through COVID-19, we continued to run Maker City online, although we weren’t in a physical makerspace, we used our approach of creating a space for young people to explore problem solving, trial and error and designing products with social action campaigns in mind. We found that young people still came every week to the sessions to explore, learn new things and have a space to develop their creative skills.

Results / outcomes

We will share the activities and outcomes of the Maker City programme:

- Describing how the programme has been codesigned by young people with creativity at the centre, the products and social action campaigns that have been developed as well as the response to COVID-19, moving a maker space online.
- Explaining how we use creativity throughout our programme to challenge young people to rethink the way that they learn, encouraging trial and error and failing, using methods of prototyping
- Sharing learning on how to create more equitable makerspaces for young people
- We will share examples of how young people have gained new skills in design and coding

- Sharing findings about how young people believe in order to create an equitable makerspace environment you need to consider what inclusion really means. We cannot have just a physically inclusive space, but it needs to have considerations around gender, race and mental health.
- You can't have a truly inclusive space if you are not equitable. Considerations around intersectionality, such as pronouns, we must be thinking about access and inclusion together.
- Sharing findings about how creativity and technology aren't mutually exclusive, they aren't two different sets of tools but young people often do not have space or time within traditional education settings to use both.

Lessons learned and why is this presentation of interest for the public

Our lessons learnt so far look at how opening up maker spaces and different ways for young people to be creative and provide useful insights for ways in which Living Labs can develop more inclusive practices, important to ENoLL in its role as a network with fosters research and innovation within communities.

Our key learnings are that a maker space is a mindset above what the equipment or kit actually is. As much as the physical space is important, it is the culture that is set up within a maker space that makes it successful and equitable. Young people need to feel heard, supported whilst also being challenged and inspired.

In traditional maker spaces, youth voice is often absent, however once you include them into the programme design and you realise that the things that they care about are the things that makes them stay. For example, embedding social action into our making programme has engaged young people with the making equipment. Also, when you encourage youth voice to help shape what the makerspace environment should look and feel like, they will provide new ideas about how to make the makerspace more equitable and inclusive and we create a richer environment for all of us.

Practitioners Presentation Paper

ReThink ReMake ReCycle – participatory science communication

Authors

Lorraine Hudson, Fiona Dowling, Penny Evans, Zoe Banks Gross, Luke Sweeney and Josephine Gyasi

Knowle West Media Centre

Abstract

Participatory approaches such as citizen science offer the potential to open up research to society, yet the majority of people participating are affluent and well educated. We present a case study from the EU funded ParCos project where Bristol Living Lab collaborated with people typically underrepresented in science - those who face social economic disadvantage and Black, Asian and other minority ethnic communities. Working with families we explored issues of citizen empowerment in conducting and communicating science by collecting and using data to address issues of importance to them, using arts-based approaches. We designed an activity called 'ReThink ReMake ReCycle', which investigated the scale and impact of common household waste materials by unpicking the data behind what we waste. We followed a process of online social learning (workshops) and hands on making to explore sustainable solutions and alternatives and tell stories using the data collected. The lessons learnt include practical ways to increase the diversity of people involved in citizen science and to ensure participation is meaningful and adjusted to different ways of thinking, learning and living. We describe creative ways of working with communities to generate new forms of knowledge production. We also reflect on issues such as equity, power, exploitation and commitment to engagement that provide useful insights for ways in which Living Labs can develop more inclusive practices.

Key words

Citizen science, data, engagement, inclusive, participatory, waste

Main problem statement

ENoLL defines a Living Lab as a user-centred, open innovation ecosystem based on systematic user co-creation approach, integrating research and innovation processes in real life communities and settings. Historically, science and innovation opportunities have only been available to a minority of the population. Participatory approaches such as citizen science offer the potential to open up research to society, for it to become more inclusive and to provide greater opportunities for the public to engage in science. Yet the majority of people participating in citizen science are well educated (Haklay, 2018), and in the UK two thirds of people participating in out-of-school science activities are affluent and from the White ethnic majority (Ipsos MORI, 2014, cited in Dawson, 2017). Finding ways of engaging less privileged participants is an important goal if we genuinely want to move towards involving all of society. We present a case study from the EU funded ParCos (Participatory Science Communication) project where Bristol Living Lab collaborated with families in South Bristol, in area that ranks highly in the indices of deprivation in England and where there are high levels of child poverty.

Methods / approach

Working with families we have explored issues of citizen empowerment in conducting and communicating science by collecting and using data to address issues of importance to them, using arts-based approaches. We designed a programme 'ReThink ReMake ReCycle' (RRR) working with 22 households (34 adults and 14 children). The aim was to investigate the scale and impact of common household waste materials, such as paper and plastics, by unpicking the data behind what we waste. We followed a process of online social learning (workshops) and hands on making to explore sustainable solutions and alternatives. Working together to tell stories using the data collected and communicate what was learnt (participatory science stories).

Results / outcomes

We will share the activities and outcomes of ReThink ReMake Recycle:

- Describing how we engaged and collaborated with families who experience socio-economic disadvantage and come from diverse backgrounds
- Explaining an integrated approach to collecting research ethics and equalities data, to better understand who engaged in the project and empower participants
- Sharing learning on how we developed a blended citizen science approach (online learning with at home hands-on making) using arts-based approaches to engage communities around waste and the circular economy during COVID-19

Lessons learned and why is this presentation of interest for the public

Our lessons learnt focus on practical ways to increase the diversity of people involved in citizen science by designing simple tools to measure who takes part and approaches to participation that are meaningful and adjusted to different ways of thinking, learning and living. We describe creative ways of working with communities to generate new forms of knowledge production with a focus on waste and the circular economy.

We reflect on issues such as equity, power, exploitation and commitment to engagement that provide useful insights for ways in which Living Labs can develop more inclusive practices, important to ENoLL in its role as a network with fosters research and innovation within communities.

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Research Session Wednesday

Wednesday, 8th September

15:30-17:00 CEST

Research in Progress Paper

Orchestrating creative chaos: the role and key competencies of living lab managers & their team

Authors

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Abstract

Launching a new Living Lab (LL) is a challenge and identifying the right manager and team are key to enable it to develop sustainable activities. Although there is a large body of literature on the challenges and barriers faced by LL as well as their governance model, there is a gap as to which specific competencies a LL manager and their team require as individuals. The aim of this research is to dive very concretely into the roles and key competencies the members of such team should have or develop, hoping that such pointers would help developing structures recruit the right profiles. Given the limited literature on LL managers competencies, description of innovation brokers and LL stakeholders roles were analysed to find similarities and narrow them down to four roles – “Initiator and keeper of the strategy”, “Doer and value creator”, “Relationship creator and communicator” and “Business developer” - and their corresponding competences.

Eight semi-structured qualitative interviews were conducted with experts from the field; LL managers or team members that confirmed the relevance of the four profiles. The preliminary results underline the importance of soft skills in comparison to hard skills as well as intercultural team management. To further develop this research a quantitative survey will be conducted to test the framework.

Key words

Living Lab, governance, management, competencies, interdisciplinarity

Introduction

As the authors understand it

> *A Living Lab (LL) is an innovation intermediary, which orchestrates an ecosystem of actors in a specific region. Its goal is to co-design products and services in an iterative way, with key stakeholders in a public-private-people partnership and in a real-life setting. One of the outcomes of this co-design process is the co-creation of social value (benefit). To achieve its objectives, the Living Lab mobilizes existing innovation tools or develops new innovation tools.* (Mastelic, 2019, p. 56)

An ecosystem is by definition intangible, relying entirely on the engagement and inputs of its actors and stakeholders. In the LL approach the human component is doubly important as not only the output of the process depends on the commitment of the participants but the process itself is centred on the comprehension of the needs of real-life users.

Setting up a LL therefore requires to carefully select who will embody and lead it as well as a support team with complementary skills. It is a challenge the authors faced in their practice. They turned to the scientific literature for recommendations and although an existing large body of literature on the challenges and barriers faced by LL as well as their governance model, there is a gap as to which specific competencies a LL manager and their team require as individuals.

This led to the following research question: beyond general governance models, what are the key competencies common to LL managers and their team that support the success of their structure?

Theoretical Background

The literature on LL and innovation networks is quite recent and so far it mostly concentrated on the challenges which LL managers face to set them up (Brønnum & Møller, 2013; Nguyen & Marques, 2018) rather than the concrete competencies they should have. The topic of the specific role of LL manager, of governance and operational management is little addressed (Pikkarainen, Ervasti, Hurmelinna-Laukkanen, & Nätti, 2017). This might be because “the activities within user-driven LL are quite informally organized” (Leminen, Westerlund and Nyström, 2012 in Georges and Guilbert 2017:55). The same authors suggest that facilitators (or LL manager) often come from the public sector. They do not actively participate in the activities of the LL but they help finance the innovation initiatives. Other authors diverge with this opinion: some articles underline the importance to centralise management and initiatives to be led by one voluntary and visionary person (Nyström 2014 in Kopp, Haider, and Müller-

Christ 2018; Steen and van Bueren 2017), other authors focus more on the role played by the team members (Dubé et al., 2013; Pikkarainen et al., 2017) and the fact that roles are changing. They can overlap (role multiplicity), be exchanged (role ambidextry) and evolve over time (role temporality) (Nyström, Leminen, Westerlund, & Kortelainen, 2014). The two aspects however may not be incompatible: a visionary LL manager surrounded by an interdisciplinary team.

As Schuurman (2015, p. 185) underlined, there are three level of LL analysis : “meta” being a constellation of LL (stakeholders ecosystem (quadruple helix model and infrastructure), “meso” being the LL project portfolio and “macro” being the LL methodologies and tools. Within this framework, this study focuses on the meso level, with the LL manager being the interface with the meta level as well as being involved and supervising the projects on which their team has to deliver.

To develop a framework to enable the confrontation of assumptions to the experience of LL managers and team in the field and given the lack of detailed and operational descriptions focused on the role of LL manager, archetypes of roles were built based on the work of different authors describing the role of nets managers (Heikkinen, Mainela, Still, & Tähtinen, 2007), of network innovation facilitators (Pikkarainen et al., 2017), of stakeholders in sustainability-oriented innovation (Goodman, Korsunova, & Halme, 2017) as well as to some extend the innovation personas (Kelley, 2005). From this compared analysis, four profiles were described. See Table 1 for the description with reference to existing literature in the last column. The work of Nystrom (2014) that develops on Heikinnen research (2007), as well as Juujärvi & Pesso (2013) contributed indirectly to the framework.

Methodology

This research in progress follows an action research method design (Eisenhardt, 1989; Yin, 2015) and the data collection will be done in two parts. First, qualitative data was collected through a literature review and semi-directed interviews with experts from the field.

A framework was developed based on those elements and the results are discussed in the present article. Quantitative data will be collected in the second part of the research to validate and further refine the framework and will be the subject of a second article. A framework of 4 roles of LL managers (Table 1) was elaborated based on the literature review described in the previous section, with a focus on the meso (projects) level as well as the managerial experience of the authors. Semi-structured qualitative interviews were conducted with 8 different actors who had in common a strong entrepreneurial mindset and occupied roles of LL or innovation network managers.

They were selected to report on the experience of a variety of structures with different maturity level, thematic and regional contexts in Europe and Quebec, Canada. As these interviews underlined the importance of intercultural management skills, an intercultural management researcher was consulted.

Table 1. Framework describing the four roles of LL managers. Table by the authors

Role	Description	Other denomination in literature
Initiator and keeper of the strategy	- initiates the network - decides which partners become members of the LL - makes sure the vision is maintained - breaks down silos - has the decision power because they have access to the resources - defines priorities - distributes tasks - motivates people to work together by understanding their needs	Webber and gatekeeper (Heikinnen), Facilitator, leader, architect, gatekeeper, auctioneer (Pikkaraien) Stimulator (Goodman) Collaborator, Caregiver and Director (Kelley)
Doer and value creator	- participates in project development - plans and carries tasks - creates value and solves problems - organises the tests and collects feedback from users - it can also be someone less active on a daily basis but that shares one's knowledge and brings external ideas (advisor)	Producer and Planner (Heikinnen), Developer and promoter (Pikkaraien), Broker/mediator, concept refiner and initiator (Goodman), Hurdler, Experimenter and Cross Pollinisator (Kelley)
Relationship creator and Communicator	- takes care of project documentation - communicates the LL to different outside publics (popularisation, information, storytelling, brand promotion) - it can also be someone who is not directly involved in the project development but offers support services such as providing a workspace, good working conditions.	Advocate and Facilitator (Heikinnen), Conductor (Pikkaraien), Impact Extender, legitimator, Educator and context enabler (Goodman), Experience Architect, Storyteller, Anthropologist and site designer (Kelley)
Business developer	This role is necessary when the LL has self-financing goals. - takes care of fundraising and business development activities - understands the needs of the market and the industry - presents effectively the added value of the LL approach - shows good negotiation skills	This role was not explicitly described in the literature but was identified through the authors experience as well as the interviews. The profile that tends towards this role could be Kelley's The Caregiver.

Results

Framework of the 4 roles of LL managers

When presented with the 4 profiles framework, interviewees did not feel that any profile or role was missing from those presented - three respondents indicated that either one single person would exploit skills from the 4 different roles to different degrees at different stages of the LL development process (rarer) or the roles would be filled by different team members who can be involved to different degrees at different times. Some respondents indicated that in their experience there may be overlaps between the different roles (e.g. between the LL initiator and the business developer).

As illustration, the LLIO, a Living Lab focused on open innovation based in the province of Quebec in Canada, can count on a wide variety of profiles: from academics to designers, administrative and task-oriented people to specialist in recreology (the science of leisure). Even the leadership of the lab is shared between two individuals with complementary mindsets: one person is more disruptive and focused on divergence (stronger business developer traits) whereas the other is more structured and focused on convergence (stronger relationship and value creator traits).

The LL managers interviewed in Switzerland (Geneva, Neuchâtel, Lausanne and Valais) which are younger than the LLIO reported being led by individuals with an entrepreneurial mindset and with profiles mixing stronger initiator and business developer traits. They like to surround themselves with people more at ease with communication and operational skills when projects require it or as the LL grows.

It is certain that such a clear definition between the profiles is not representative of the variety of individuals, but it has the merit of making LL managers aware of the different roles they will have to embody or the skills profiles they will have to surround themselves with.

LL manager competencies in details

The interviews confirmed the relevance of this analysis in which the interviewees could identify themselves and their team members. They provided more insights as their way to manage a LL, which competencies to look in a LL manager. Instead of giving us a set of hard skills and techniques, they underlined the importance of soft skills and qualities such as:

- entrepreneurial mindset, sense of autonomy and initiative;
- ability to adapt your language to the person you are speaking to;
- ability to network and ease to speak to a broad array of people;
- ability to convince, obtain mandates, without adopting an excessively commercial approach;

- acceptance of not having the control over the process, adaptability, flexibility;
- to adopt a humble position, to practice humility like in systemic coaching.

Of course, knowing design thinking and the LL techniques is a must but they can be learnt quite easily compared to soft skills and interpersonal skills that are more difficult to train and are critical in the success of the co-creation processes centred around the understanding of human behaviour. Along the same lines, it appears that LL managers with a social and business background fare better than those with a technical background.

Business sensitivity which may not be the strongest trait of academics or people working in public institutions to which LL often stems for is however crucial for the sustainability of the structure. This was strongly underlined by Prof. Dimitri Schuurman which shares his experience from supporting the development of different LL structures with participants of ENOLL virtual learning lab course. It was also the assessment made by a Swiss LL which had to review its governance because they prioritized the importance of social traits in the LL manager they hired compared to business development traits and this choice was threatening the survival of the LL.

As long as they have a broad understanding of the domain and are able to understand the needs of the client, they are able to build trust even if they do not have the technical expertise. In this case, having a broad network to be able to bring in complementary expertise when needed is key. The ability to convince and to sell is another key element of LL managers at the head of structure with a self-financing objective and it further support the case of having a manager with a business background.

Discussion

This framework, which intends to be further tested and developed, offers complementary approach and more operational insights to the existing literature. Its goal is to help institutions willing to develop a LL to better understand which qualities and skills they should look for in a future LL manager and their team or for existing teams to look with a fresh eye at their members skills to make sure that the different roles are adequately represented according to the LL objectives to guarantee its sustainability in the long run. The focus appears to be more on the soft skills of the managers and their broad network and understanding of the domain rather than a set of technical skills and state-of-the- art expertise. As this research shows, given the extensive list of abilities and skills sought in a LL manager, there is more probability that these roles would be filled by more than one person, suggesting the need to budget accordingly to ensure the presence and availability of the right people with the right competencies.

This diversity of profiles and collaborations links to related disciplines such as change management as well as intercultural team management that are found more often in LL settings than in traditional companies or collaborations.

To pursuit this research the authors intend to collect quantitative data during the Open Living Lab Days to validate the framework with more LL managers or adapt it as it can be perceived as a little too rigid or stereotypical and it may not fit every kind of LL depending on its focus or domain. It will be extremely interesting to get more insights with the participants coming from a variety of backgrounds. The second objective is to further the application of intercultural and change management to the LL teams. The results will be used to propose a Full Research Paper and a training module for the Virtual Learning Lab to make existing or aspiring LL managers more aware of the variety of skills required in a LL team and give them tools to help them build balanced teams.

Conclusion

This article aims to bring scientific and managerial insight to the roles and skills LL managers and team should ideally have. Four roles were defined based on a literature review and qualitative interviews with field experts. Those roles are “Initiator and keeper of the strategy”, “Doer and value creator”, “Relationship creator and communicator” and “Business developer”. There might be overlaps in-between roles and they could be either found at diverse degrees in a single person or in different team members with complementary roles. The importance of the roles may vary with the objective (mandate or research driven) and the maturity level of the LL.

This study also underlined the importance of soft skills over a specific set of skills or technical expertise. Entrepreneurial mindset, adaptability, empathy, ability to network and sell as well a humble position were noted as key by the interviewees. While all these qualities are hard to find in a single person, LL are more often led by a team with complementary competences. LL being interdisciplinary by definition, this opens the way to further research in connection with change management and intercultural team management.

Authors intend to collect more data through a quantitative survey to further test and refine the framework as well as explore the link to the specific skills of intercultural team management in a LL setting.

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Full Research Paper

Motivational modelling: Bridging design and entrepreneurial activity to create business values

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Abstract

Emotions and the quality of service design are increasingly recognised as vital parts of the entrepreneurship journey and its success. They are important for the development of value propositions and aligned experiences that support customer acquisition and retention. This paper introduces a motivational goal modelling approach incorporating a do/be/feel method. The approach constitutes a straightforward way of capturing functional, quality, and emotional components diagrammatically on a single page. The method enables the inclusion of key stakeholders giving them a strong voice through co-design. We investigate how the modelling approach creates value to the design of services and business decision making. We found combining business-oriented methods and motivational modelling has the potential to improve adoption by customers. The goal models also constitute high level representations that act as a common guiding artefact between internal and external stakeholders.

Key words

Motivational models; entrepreneurship; goals; value propositions; service design, emotions, design-led innovation

Introduction

In the first section of the paper the importance of entrepreneurship in the context of the global economy is established, which is then linked to the role of living labs and design. Establishing a business model and attractive value propositions are critical to developing a successful business. There is an overview of tools to develop such business models and value propositions, focusing on the importance of feelings and the role of design. Within this frame the do/be/feel/method and motivational goal modelling is introduced as a possible bridge between design, strategy, and business model generation.

Entrepreneurship: Building a business

Entrepreneurship is increasingly seen as a core approach to economic development. There are 50 million new start-ups established each year according to the 2016-2017 GEM study (Le and Suh, 2019). Other authors estimate the figure to be at least double that number (Innmind, 2020). The global genome report 2020 states that the “start-up economy remains large, creating nearly $3 trillion in value, a figure on par with the GDP of a G7 economy” (Herrmann et al., 2020 p 23). Start-up activity is likely to accelerate as governments seek to support entrepreneurial activity as part of the recovery process in a post COVID-19 world.
Design is recognised as a core capability for producing innovation competitive advantage at national levels. The 2011 Design for Growth & Prosperity report by the European Commission suggests innovation design "can be understood as a distinctive, competitive advantage" (Thomson and Koskinen, 2012, p 38). In Australia, the National Cultural Policy Creative Australia recognises design thinking as "a ubiquitous capability for innovation" (2013). Stevens and Moultrie (2011) demonstrate design contributions to strategy formulation and implementation, based on a wide review of literature.

Innovation can also be described as the profitable leverage of ideas. It can be a new product, a new brand extension, a new service, or increasingly with the advent of the networked age, a new business model. Entrepreneurs then are also innovators combining business models, services, and products, established or new, in novel ways to gain a competitive advantage.

Living labs are important actors in the entrepreneurial ecosystem, with many living labs having an entrepreneurial focus. More generally, living labs are interested in the improvement of people’s lives. Tools that can aid adoption and communication between multiple stakeholders in organisations may aid many living lab projects.

Tools for entrepreneurship

Osterwalder and Pigneur (2010) propose that businesses are not created 'fully formed', i.e. with functioning production and marketing departments. Rather founders have to seek out a viable business model. They developed a Business Model Canvas (BMC) which consists of making 'hypotheses' about core business attributes and 'testing' them with the 'market' i.e., people who might actually want to buy these products or services. Value propositions are central and "… create value for a Customer Segment through a distinct mix of elements catering to that segment's needs. Values may be quantitative (e.g. price, speed of service) or qualitative (e.g. design, customer experience)" (Osterwalder and Pigneur, 2010). There are now variants of the BMC such as the Social Enterprise Canvas (Sparviero, 2019) and Service Logic Canvas (Ojasalo and Ojasalo, 2019), that have similar iterative approaches to business model development.

Vargo and Lusch (2004) propose 'service-dominant-logic' (SDL) as a mindset for organisation purpose and nature. In this model, service is the fundamental unit of exchange. The locus of value creation is moved from inside the firms to one that sits amongst the firm, customer and other actors. Frameworks developed within the living lab community have moved the locus of value creation even further towards the customer (Äyväri and Jyrämä, 2017). Value is defined as the phenomenological experience of the customer (Vargo et al., 2009). Customer experience includes the emotional response resulting from engaging with the service processes. Le and Suh (2019) developed a theory of value propositions from a customer perspective for internet start-ups. Their theory includes constructs of economy, efficiency, speed, customisation, community, emotion and trust which need a deep understanding.

Narrative is considered "an essential component of an entrepreneur's toolkit" (Martens, Jennings, and Jennings, 2007 p1107). Martens et al (2007) demonstrate the positive influence of narratives on businesses in regards to identity and risk management. Wuillaume et al (2019) further demonstrate how the role of emotions in their narratives positively affect outcome. Both positive and negative emotions out-performed neutral descriptions. Stories must reflect in the real world how the organisation functions both internally and externally in its interactions with the outside world. The functions of the organisation must be matched with qualities and emotions that are evoked in the story. Narratives and the emotional content are an important connection to the "affectivity" value proposition, the expectation of the interactions with the business and gained business resources.

Despite the evidence that emotional value propositions are an important part of continued use of a service, functional attributes tend to be emphasised during development. Lehner and Simlinger (2019) demonstrated this effect for FinTech start-ups. Noting the literature emphasis focused on functional attributes, "there is a clear

gap where the literature theory does not embrace the wider causal chain of functional, emotional and societal value propositions of digital service providers." (p280). Examining the constructs of emotion and community for start-ups in the 1990s, 2000s and 2010s for the construct of emotion, the sub-value of 'enjoyment and playfulness' increased from less than 10% to over 60%, with a similar result for community. Emotions, whether directed towards a whole community or the individual, are a key component of the overall value proposition for internet start-ups.

There is an emotional element as to whether people adopt a technology or service and use it consistently as discussed by Mendoza et al (2013). Only a product used on an ongoing basis will contribute true value to their users. Thus, increasingly business objectives and value propositions of innovative services and products need to be centered around customer emotions. Design can play an important role to support these objectives. We can conclude that non-functional value propositions are a key element of both developing a business model and an ongoing part of the final business outcome.

Design and Business Model Innovation

Research suggests that there are similarities between design and business model development approaches (Geissdoerfer, Bocken, and Hultink 2016). Geissdoerfer et al (2016) propose the use of design thinking to enhance value mapping activities within a generic business model development framework. Rau et al (2017) integrated service design to develop value propositions for a commodities company. Ojasalo and Ojasalo (2019) developed a service design canvas to bridge the gap between SDL views of value and service design methods. As design has expanded to co-design, the discipline has moved beyond empathy to giving users an actual voice in the design process and more fully incorporate contexts that are relevant to participants. Co-design is a creative process which describes an array of activities used in the design of products, services and systems which involve key stakeholders, collaborating on a shared problem or goal (Detienne, Baker, and Burkhardt 2012). Co-design improves knowledge of customer needs and quickens validation of ideas or concepts (Roser et al., 2009).

In this paper we emphasise service design. We follow Hsu's (2009) definition of service design as the "co-creation of value between service systems (customers, providers, etc.) and service systems resources (the dynamic configurations of people, technology, organizations, and shared information) connected internally and externally by value propositions."

The challenge is to bring the business and design processes together in practice. According to Prendeville & Bocken (2017), while the value for stakeholders in the value chain is emphasised, the value of service design to sustainable business is still often

overlooked. Hence their work brings together service design and sustainable business model innovation by presenting the synergies between these two domains. One element shared is goal-orientation creating value for business and value for customers respectively (Prendeville & Bocken, 2017). We anticipate that our suggested goal modelling approach is promising in articulating the goals that will add value for both.

For design to support entrepreneurial activities the role of designers is to help others to come up with good designs (Manzini, 2015). Successful service co-creation involves designers translating intangible experiences into tangible forms, through design representations such as personas and customer journey maps (Yu and Sangiorgi, 2017). Hsu aims to address the challenges to scale co-creation activities: “Population-oriented cocreation seeks scaling cocreation with a scope up to the population of its elements (customers, providers, systems, and resources).” (2009 p12).

Motivational goal modelling (MGM) is a co-creation technique that can be used to construct meaning for diverse stakeholders around a design or idea (Burrows et al., 2019). The models help articulate the ambiguous nature of social concepts, and value proposition generation. The “Do Be Feel” (do/be/feel) approach is a particular co-creation approach to help develop motivational goal models (Sterling, Pedell, & Oates, 2020).

Motivational goal modelling and the do/be/feel approach

The do/be/feel method was originally conceived for technology developments and has proven successful in that capacity (Taveter et al., 2019). The modelling includes emotional elements alongside functional and quality requirements. It has subsequently been generalised to non-technical design solutions, and also been used for community goal development. Here we describe the overall process and the process adaptations for generalised business contexts.

Do/be/feel method

The do/be/feel method has two initial stages:

1) do/be/feel goal elicitation
2) model development

The first stage includes a brainstorming session to elicit the core elements that are the basis for building a motivational goal model with any number of participants. At the brainstorming stage, four lists are created labelled, who, do, be, and feel.

- Who, being the stakeholders in the value ecosystem
- Do, represents the functional elements i.e. what should the business/service/product do
- Be, the qualities of the solution or services

- Feel, how stakeholders should feel, or what emotions should arise or in some cases should be avoided

The emphasis is on the key business activities that create the core service and value propositions for clients and partner organisations. In other words, a company may need an accounting function or partner organisation to run, but unless this was part of its value proposition to clients it would not be shown. This allows attention to focus on the core business services that represent its primary value propositions. The session generates the functional, quality and emotional requirements of the service solution. Despite its simplicity, diverse ideas can be captured quickly. It is interactive and results in detailed discussions about value propositions. During sessions stories are often collated to support the model. It is an efficient method of eliciting these requirements, usually taking 30 minutes. Once the lists have stabilised the model development stage starts.

The model is presented as a hierarchical diagram of the goals of a system at a high-level of abstraction. The data is input into the model as separate lists. With the stakeholders the lists are categorised as hierarchies i.e., several sub-functions might serve a high order functional goal. Based on these hierarchies the software will render an initial model using the notation containing several shapes, specifically parallelograms, hearts, people, and clouds (see Figure 1).

Figure 1. Symbols used in MGM (Marshall, 2018)

The functional elements (parallelograms) are expressed as nodes in the tree. The roles (stakeholders, person icon), quality (cloud), and feel (heart) goals are placed at an appropriate level in the hierarchy. The default is to leave them near the root of the tree. The model is refined until a single page representation that captures the functions, stakeholders, emotions and qualities at the core of the business is achieved. In the model below, for case study 2, all the qualities (be) such as ‘secure’ and ‘scalable’ apply throughout the system and are shown at the top level. Similarly, the feelings ‘intuitive’ and ‘comfortable’ are applied to the whole system whereas ‘reliable’ and ‘trustworthy’ are extra desired feelings relating to the ‘procure’, ‘streamline’ functionality.

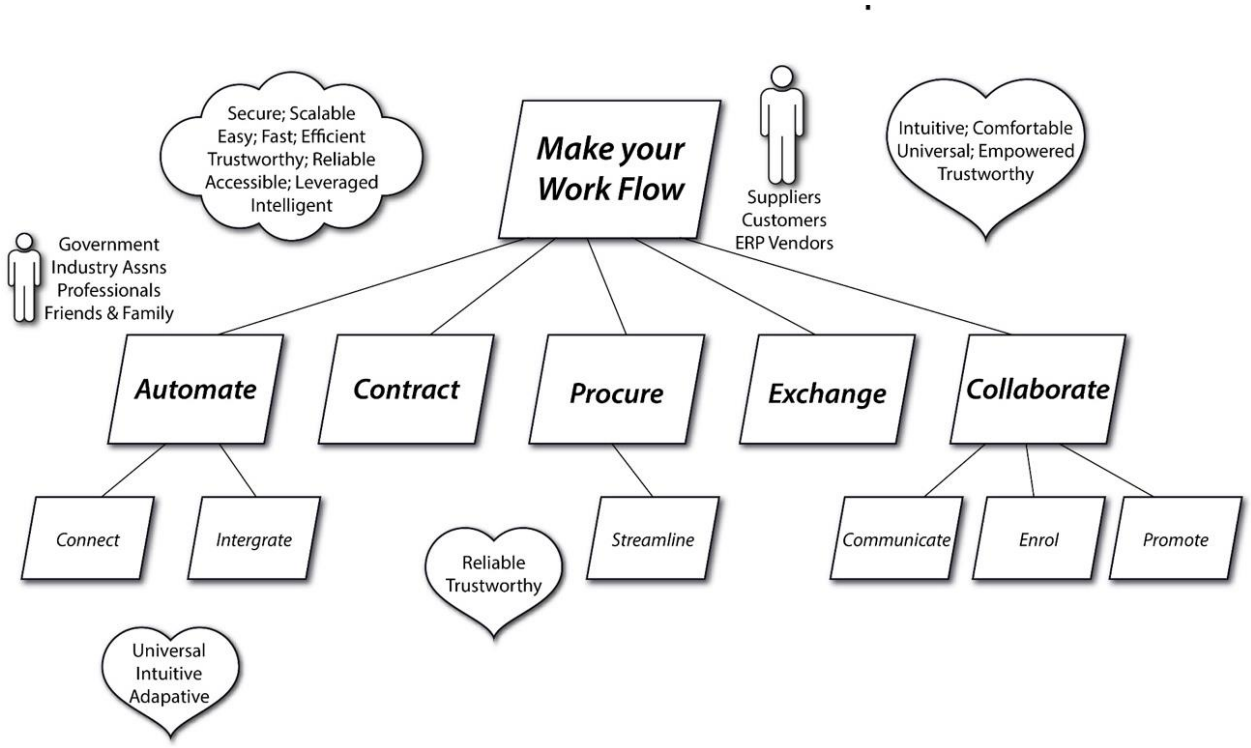

Figure 2. Motivational Model for Case Study 2

Developing the initial model represents the second stage of the process. From this point the model can be used and refined in different ways such as:

- Communication of value propositions to other stakeholders
- Detailed value proposition and service development
- Validation sessions with partners
- Co-creation / validation with business
- Informing other design activities such as branding
- Supporting information for software or product development

The cases studies show how motivational models have been used in some of these ways.

Methodology: Case study research

Our study chose qualitative case study research methodology to provide a richer story about the added value of applying MGM by entrepreneurs in their design of services. It is important for our research that the strength of qualitative research can focus on the complexity of naturally occurring contexts in businesses with their diverse stakeholders and business narratives. The main qualitative research approach applied in this research consists of case studies using interviews and document analysis as data gathering techniques.

We consider case study research especially suitable for investigating the utility of MGM to activate, enable, sustain, and scale business by influencing the design of services. Firstly, it supports a focus on details within complex phenomena, such as the design with its multiple challenges and activities. Case studies help connect to the micro-level of studying the effects of design and the actions of individual designers in detail. Thus, they allow us to investigate design processes and specific details at the same time (e.g. Neuman, 2005).

Secondly, as researchers, we do not have a lot of control over complex activities such as design. Design is a creative and flexible process, and relevant behaviours cannot be manipulated. The case study method allows us, to retain the holistic and meaningful characteristics of real design processes. The case studies enable us to investigate the use of the models in conjunction with other design and business tools such as personas, user journeys and BCM in their “natural context” (Zonabend, 1992 p278) of service development, looking at what people do.

Finally, case studies are likely “to produce or fill gaps in theory” (Walton, 1992). Yin (2003) recommends that a framework for the study be created prior to data collection. Descriptive cases and explanatory cases require that investigators begin with at least a descriptive theory, being important because generalisation is made to theory and not to populations. Multiple cases strengthen the results by replicating the pattern-matching, thus increasing confidence in the robustness of the theory (Yin, 2003).

Hence, as a basis we used MGM as theoretical framework with the assumption that, MGM creates value in design and business decision making in entrepreneurial settings toward experiences that will increase adoption of services. MGM builds a framework for approaching designers and entrepreneurs in the different case studies and systematises data collection and analysis. A further objective is to create a useful intervention in design processes, formulated as a method informed by practitioners and theory.

Methods

Data Collection

We used semi-structured interviews with representatives of each of the organisations involved investigating how:

- MGM was used in the business,
- its added value for entrepreneurial decision making and design,
- its use in activating, enabling, scaling and sustaining the business activity through adoption.

We also reviewed documents presented including the goal models themselves, some of which are shown, others were commercial in confidence and their role written up in the cases.

Data Analysis

The transcribed interviews as well as the documents were analysed applying content analysis. Content analysis enables researchers to go through a large volume of gathered data, from identifying key themes to emerging patterns in the design and business processes. Patton (2014) suggests that “content analysis is used to refer to any qualitative data reduction and sense-making effort that takes a volume of qualitative material and attempts to identify core consistencies and meanings” (453). Themes were extracted and categorised according to the perceived value of the different goal categories with a focus on emotional goals.

To enhance the credibility of the qualitative data analysis and ensure a high-level of commonality for the interpretations made, several researchers (the authors of the paper) analysed the data (investigator triangulation) (Guion, Diekl, & McDonald 2011) and themes were confirmed when shared by all analysing researchers. The project included four case studies of which two only are presented here due to word restrictions.

Case Studies

These case studies have been anonymised at the request of the participants.

Case Study 1

In this case, we interviewed a leader in the design and innovation team. We were also shown documentation such as the goal model, user journeys and personas.
This business is a disability support service provider with services in foster care, aged care and mental health. In 2019 they took over several supported independent living homes from the Australian government, a new venture within the company. While there were 'problems' with the independent living homes, there was little understanding about what they were. The innovation team were given an example of the problems as brief, "Sometimes you have three people in the disability home living together. One person with a disability isn't allowed to open the pantry and get food, while another person is allowed to open the pantry. Consequently, the pantry always remains locked, and that then affects the person's choice and control", along with a stated desire to use technology as a solution mechanism.

The project applied the MGM approach, with a focus on the feelings of people who lived in the homes, capturing illustrative stories. A second follow-up workshop was

conducted with carers (staff), support workers as other key actors in the system. The process revealed the complex dynamic between the housing, relationships between the residents, workers and the housing design. It also surfaced the residents' history that led to these feelings; in one example, a resident displayed aggressive behaviour that upset another resident, "… he makes me scared. My dad used to shout too and scare me." The created goal model helped the team to "really get a sense of who we were designing for" and capture some contextual history. It also "helped us define the brief and take a wider view of the design space … it's not only the technology, it's the layout of the house, it's also the staff".

The model informed the service design as elements were integrated into design processes, including user journey maps and personas. The specificity of the stories collected in the process made a significant difference to the design teams. In the independent living example capturing the stories and quotes alongside the goals helped develop a specific persona, rather than a generalised template "can define more appropriately what technology can do […] allowed us to hone in a little more".

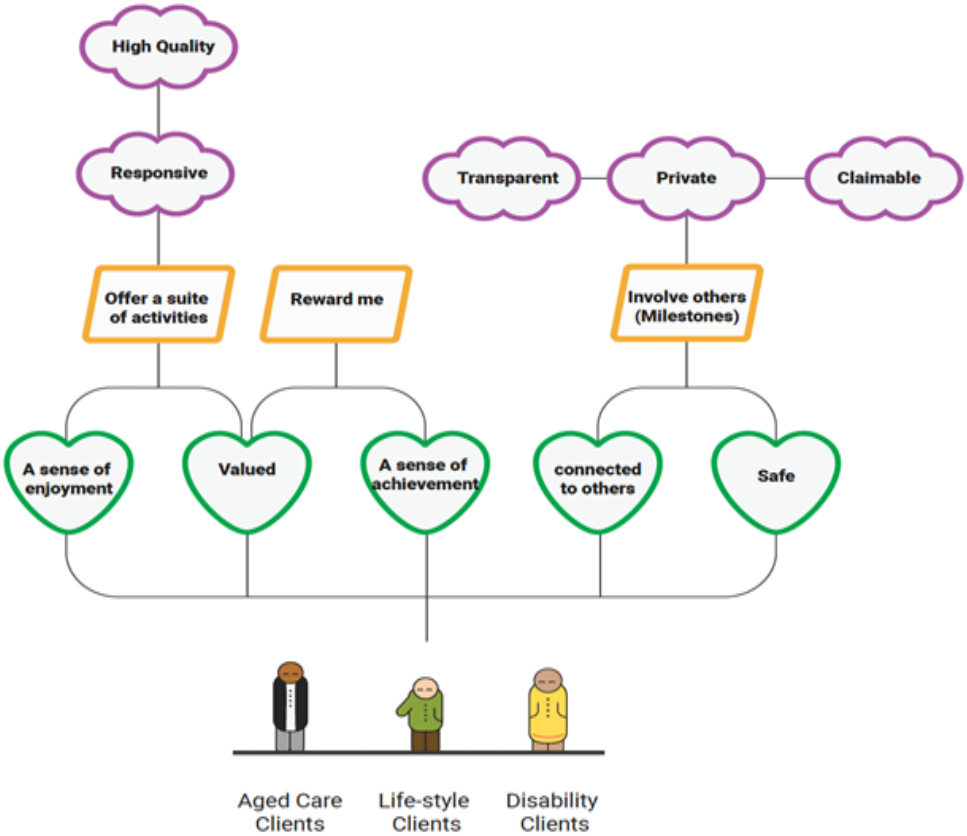

Figure 3 – Motivational Goal Model for a Cooking Course

Integration of the model into the journey maps enabled a similar specificity of emotions alongside the functions. "The users' feelings weren't just categorised as good, bad or average; they had a specificity of context and emotion, paired with actual quotes". It helped the design team and decision-makers focus on "what's at the core of using a product or engaging service. It is to make us feel a different way to the way we were."

Developing goal models with clients for a cooking course, they discovered that they wanted a sense of achievement and of being valued for completing course modules. A reward function was added to the system, which was not in the original design. Adding a function that provided a sense of acknowledgement and achievement enhanced the users' felt experience, as illustrated in Figure 3.

The goal model is also a common starting point for multiple levels of design: "we might have digital designers, content designers, or service designers, and it is more efficient to communicate to them the functional aspects." Subsequently the design team's language has changed to include emotions: "… now <anonymised> says we need to make people feel 'heard'". It has also brought a more expansive view of design and design for adoption beyond technology. The whole socio-technical system, "the invisible feeling or this invisible part of the service design that you can't 'design in' as a physical product but an interaction," was considered. This insight led to the inclusion of vouchers to allow support workers to have a dinner with clients and their families enabling the team toto design for the experience of the staff member rather than just design the functions. "I consider it an important tool in the toolbox, every new project has had an element of motivational goal modelling" and "it's worked so well because people's emotions come first as the basis for design".

The organisation is now using the MGM technique within its existing ventures. It is a high-level common touchpoint for decision-makers, "the people that give money and say a project should go ahead are always disconnected from what happens on the ground. Goal modelling is so good to demonstrate why this project and why this avenue" and "what MGM has done for our organisation it's been able to identify those really, really important stories that you wouldn't get if you just sat down and said what are functional aspects of this service or this product. You get it paired with what is at the core of being what a human is".

The organisation didn't use a BMC or similar for the new venture; however, they performed a detailed analysis of profitability and found that where MGM had been applied, the services are viable and profitable. The first use of the model was an enabler within the new venture.

The broader use is now in helping the business to scale, by expanding its service and sustaining through improved service to existing customers, and "get CEO and Directors to understand what services are making people feel and why we are losing customers or why they aren't joining us or how we can make their experience better". Understanding the impact the services had on the quality of life, through emotions, has changed business investment decisions and the way services are designed.

We found in Case Study 1 that motivational goal modelling influences business decision

making from a bottom-up approach and has become part of the corporate ‘language’. The goal model approach helped, enable new services and scale and sustain existing services in the business. The model was both used as a design tool on its own and integrated into other design approaches. The model influenced both decisions and service designs through the inclusion of emotions.

Case Study 2

We interviewed the CEO and reviewed business artefacts such as a trust framework. The model (see Figure 2) was created in 2018 to help the organisation develop a single page description of their new service offering of a "universally connected commerce platform that allows people and organisations to connect, automate and trade, while seamlessly collaborating through trusted relationships”. The platform can be considered as both a "social networking" platform and an "Ecommerce" platform, or a "Social eCommerce" platform that facilitates connected marketplaces. The aim is to build the trusted connected economy of systems to connect with other, more complex, systems in the future such as a smart city.

Case study 2 uses MGM in several ways. An overall business model has been iterated and refined through time. There are subsidiary, more detailed, models associated with the development of individual products.

At a strategic level, MGM is used as an ongoing reference point for business strategy and development. Looking at the functions and experiences, the management team uses MGM to decide the optimal pathway for product development, based on user data, the product set complementing the model. MGM changed business decision processes by focusing on experiences and qualities, rather than solely on functions. However, as the process focuses on functions, it was explained that a key role is seen in helping develop to marry the intentions of the platform with the actual customer experience. As the CEO expressed: “The MGM is unpacking a serpent with lots of tentacles, bridging the gap between intention and experience.”

The management team decided to use MGM in preference to the BMC they had developed, as they felt that the BMC was “locked in time" and static because of the high effort to update it. MGM was more dynamic, and the model updated as a living document. The use was described as an artefact of “strategic culture, - a lived practice baked into our organisational practice”. The model was important for not getting “bogged down in detail and stalled in meetings” and to remind people “what we are here to do and how”. The model also helped reveal subtle distinctions such as “feeling trustworthy versus being trustworthy” that are both core components of their value proposition to customers. Functional goals were updated to ’connect’, ‘collaborate’, ‘trade’ and ‘own’ accounting for language clients use.

Each product development also has its own more detailed functional goal model. They noted the technical team could get focused on the function details and workflow design. The MGM provides a "benchmark experience" alongside the functional goals, and is also used alongside workflow and integrated into story boards/use cases having human aspects explicitly included. The experiences are “informally measured through reactions to software, intangible reactions such as excitement or the sense of that’s not what we wanted.” Depending on the reaction, the software may be redeveloped. It allows technology people to listen to a different goal and story and benchmark against that experience. It was also emphasised that the model helped non-technical people to participate with their views and experience allowing them input to design more easily as they can "defend the experience" rather than focus on the technical approach in how they want the platform to be and how they want to feel about it.

MGM was considered a design tool, but it was not just perceived as such, but also for scoping. "You can't design without MGM, it became a practice of engaging clients by thinking about what they do and the experience they want". According to the CEO it is “at the requirements’ stage when scoping ‘what are we going to do’ and when you ask the clients then they tell you what they want from an MGM point of view. That is their language.” Hence it "bridges between design tools", "scoping", "communications" and "strategic planning" tools. The current use supports sustaining and scaling initiatives.

Discussion and conclusion

We investigated how MGM adds value to design and business decision making in entrepreneurial settings toward experiences that will increase adoption of services. Both case studies show direct links between the use of the MGM and design activities. The model was used directly in that elements of the goal model were included in other design approaches (user journeys, personas, understanding the user experience) and influenced language and culture of the innovation and software development teams. In all cases the goals created greater awareness of, and focus on emotional aspects, of design, and explicitly stated the relationship of the overall design solution and services with the experience of the stakeholders involved.

Business decisions were similarly influenced through bottom-up and top-down approaches. Case study 1 showed that the goal model influenced business decisions, including not only which services to invest in, but also how to tackle problems and needs of clients. The decisions increased considerations of emotions (e.g., incident management and support services) allowing a wider view of the service design space (e.g. whole of house design and social dynamics). Case study 2 shows a top-down approach where the CEO and management team are using the model to influence culture, product development, priority decisions, and overall strategy. In this case study,

there is a direct link between financial projections and the model as the means, through adoption by clients based on their experience

Our research showed that both business theories of value creation and design, especially service design, has had a trajectory towards user emotions and overall experiences which was linked to adoption of services. There is early evidence to support the link between motivation modelling and adoption of services, but further research will be needed to explore this relationship.

MGM has been perceived as a design tool, as well as something that reaches beyond design activities. Design is an activity that often involves many stakeholders to develop meaningful services. The goal models were successfully used in all case studies as shared communication artefacts between stakeholders, internal and external. Similar use has been reported by Paay et al. (2009) who described goal models as information vessels between different stakeholders in a design project. MGM offered a high-level of representing and discussing overall user and other stakeholder goals. Models served as communication artefact between designers, top management, and other groups for understanding and decision making. For designers. the models are a place to represent complex client goals including the importance of emotions. For management, they are a starting point to discuss the meaning of motivations for developing novel services for the company. As they are suitable to record the activities, experiences and emotions of users in the light of the business goals, we see them as being a specific kind of boundary object (Star, 1989) between the stakeholders.

In their framework of designs strategic contributions Stevens and Moultrie (2011 p495) state that strategic design based on “the premise that design disciplines need to be considered in toto, and the strategic contributions identified are not specifically related to single design disciplines.” Of the nine elements in their framework, motivational goals modelling contributed across seven of them, including all the elements of the strategic vision.

We suggest that MGM can serve as a design approach that acts in this capacity bridging between design, business strategy and culture. While we have focused on the entrepreneurship case studies, the use of MGMs as boundary objects are likely to be applicable to living ab activities outside of entrepreneurship, and potentially to the design of the lab itself.

We conducted our research across five different businesses of which we have described the two that are most representative. However, this is still a limited number of case studies which are currently available, at later stages of entrepreneurial activity. Further research would investigate a comprehensive set of start-ups across a broader spectrum of stages in their development.

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Full Research Paper

The added value of cross-border living lab services for the health market: insights from the CrossCare project

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Abstract

Companies and organisations in the healthcare field are very interested in gaining insight into the market of neighbouring countries as the silver economy gains importance. By scaling up their innovation across borders, they can reach a bigger market. CrossCare is an EU-funded Interreg (Flanders – Netherlands) project in which six living labs from Belgium and the Netherlands collaborated between 2016 to 2021 to stimulate, transform and accelerate health innovations in close collaboration with end users and stakeholders. Participating companies received tailored cross-border living lab services and this empirical paper explores the added value of these cross-border living lab services for the health market. Objectives and interests of companies participating in CrossCare were monitored prior to receiving cross-border living lab services and follow-up assessments provided insight into the extent to which objectives were met and which services provided companies with the greatest benefit. Companies had high expectations, which living labs were able to meet, regarding cross-border market insights, comprehension of the innovation domain, improved user acceptance and experience, product-market fit, and improved end-user insights. The current study shows that companies can benefit from living lab services and encourages further cross-border health ecosystems and collaboration.

Key words

cross-border research, living lab, impact measurement, living lab services, health innovations

Introduction

Health challenges & innovation

Many countries, including Belgium and the Netherlands, are facing similar challenges regarding demographic evolutions that are leading to an increased need for care (Draudviliene et al., 2021). The European Union (2018) estimates that the 'Silver Economy' (the market related to aging and the population of over 50 years old) will lead to the development of many new products and services in the area of health, care, and technology and will contribute 5.7 trillion EUR to Europe's economy by 2025. However, the development of innovative products also holds financial risks and requires reaching a sufficiently large market needs for sustainability**.** Draudviliene et al. (2021) emphasize the need to create new ecosystems within Europe that can consist of neighbouring regions and include national and regional stakeholders, such as policy makers, medicine, industry, and science. Flanders (in Belgium) and the southern part of the Netherlands are facing similar challenges and share a common language so innovations could in theory easily be transferred between contexts, leading to a bigger market. However, cross-cultural differences as well as differences in the organizational context of health service delivery can hamper the uptake of healthcare innovations (De Witte et al., 2019). Product launches regularly fail due to innovations not meeting end-user needs or not fitting into existing services, processes, and business models.

Living labs, and more specifically cross-border living lab collaboration, can help develop new health-related ecosystems which can contribute to tackling these challenges. Ballon, Van Hoed, & Schuurman (2018) define the concept of living labs as referring to "the involvement of multiple stakeholders, including users, in the exploration, co-creation and evaluation of (usually ICT-related) innovations within a realistic setting". A living lab can guide developers of care innovations to create new or improved care concepts, services, processes, and products together with end users and test them in practice. In such open innovation, the end user is not only at the centre of health innovation evaluation but is also a key partner in the development and adjustment of healthcare innovations. Interviews with SMEs also show that they believe living labs can help them with testing, validation, and internationalisation of their services (Lepik & Krigul, 2021). The CrossCare project is an international living lab collaboration in which empirical data was collected that can help assess whether living labs can indeed support organisations to develop and launch products for the international health market.

The CrossCare project

CrossCare is an EU-funded Interreg (Flanders – Netherlands) project in which six living labs from Belgium (Happy Aging, InnovAGE, LiCalab) and the Netherlands (Proeftuin Slimmer Leven, CIC, EIZT) collaborated between 2016 to 2021 to stimulate, transform and accelerate health innovations. The project supported cross-border collaboration and knowledge exchange between entrepreneurs/companies, end users, knowledge institutions, and healthcare organisations. Partnering living labs demonstrated complementary expertise on e.g., care technology, care processes, or living at home so that tailored expertise and networks could be provided to the field. The living labs offered a menu of services, detailed in Table 1. Within the context of this project, 44 companies or organisations collaborated in 30 innovation trajectories centred around a product or service. Participants of the project, selected through five waves of open calls, received tailored cross-border living lab services provided by one Flemish and one Dutch living lab to help them design or improve their health innovations. Innovations of the fifth wave specifically focused on care challenges that were first launched by consortia of healthcare partners to which companies were added later through an open call. The fifth wave started in February 2020 as an extension of the CrossCare project and was not included in the current data collection.

Table 1. Menu of services provided by the living labs

Service	Description
Access to the health ecosystem	Living labs can provide access to the health ecosystem and for example organise interviews with care experts or care organisations about business models, willingness to pay, legislation, etc. This makes it possible to develop partnerships throughout the care and value chain, so that developed innovations suit existing flows and can be implemented more quickly.
Access to a carefully selected panel for data collection	A living lab panel is an extensive collection of users who co-create products or services with developers and who test them during their everyday activities in their home or work environment. Users can be healthy citizens, patients, elderly, informal caregivers, doctors, nurses, care experts, etc..

Co-creation sessions	Innovations are developed in iterative group sessions together with the end users and are checked against the users' needs. The living labs are specialized in generating user feedback through various methodologies.
Live tests	The care innovation is tested for a number of weeks or months. During this test, the living labs generate user feedback that can be used to adjust and retest the developments. The live tests not only allow to collect direct feedback from users, they can also facilitate observation, monitoring and analysis of behaviour in users' natural living or working environment.
Business model advice	Living labs can offer support in designing business models through stakeholder analysis and go-to-market definition. Sessions are organized with key stakeholders: health insurers, municipalities and healthcare purchasers among others.
Project and data management	The living labs have specialized staff for the recruitment of the test panel, assessment and follow-up of the test population in function of the care innovation project, organization of co-creation sessions and live tests, etc. Procedures around privacy and data management are also included.
Specific expertise in care innovations	The living labs have thematic expertise regarding the field of health & care and can share their knowledge and insights.

Aims

Previous research has suggested that living labs can provide developers with new insights and allow them to test product-market fit, which can lead to positive economic effects (Ballon et al., 2018)**.** Although impact evaluation of living lab projects is challenging due to difficulties in determining causation, outcome selection and isolation, and methodological challenges (Ballon et al., 2018), it is an important endeavour to determine the relevance and preferences relating different living lab activities. The current study aimed to investigate the added value of cross-border living lab services. Objectives and interests of companies participating in CrossCare were monitored prior to receiving cross-border living lab services and follow-up assessments provided insight into the extent to which objectives were met and which services provided companies with the greatest benefit.

Methods

Sample

The current study included 24 healthcare innovation companies who participated in the first four waves of the CrossCare project. These companies were selected during four open calls for participation in the CrossCare project after an elaborate selection process (Figure 1). Companies could submit a short innovation proposal to CrossCare to receive funding and living lab services for the development of a new product, service, or concept. Project partners screened the submissions relating to the social relevance, innovative value of the product/service, economic added value to the companies, technical and commercial feasibility, and potential benefits from living lab services in CrossCare. After screening the short proposals, one Flemish and one Dutch living lab were selected to support companies to write a full project proposal. On demo day, the feedback of step 1 was discussed and additional guidance to design a full innovation proposal was provided and continued after demo day. Full proposals were submitted six weeks after initial selection. Proposals were screened for admissibility based on predefined rules and criteria (e.g., involvement of at least 1 SME, financial aspects). An independent expert jury ranked eligible projects based on: (1) the relevance of the innovation project (e.g., expected economic and/or social added value, technical and commercial feasibility), (2) quality of execution (e.g., quality of the work plan, competencies of partners), and (3) other criteria (e.g., TRL level 5-8). The CrossCare steering committee subsequently selected the best proposals.

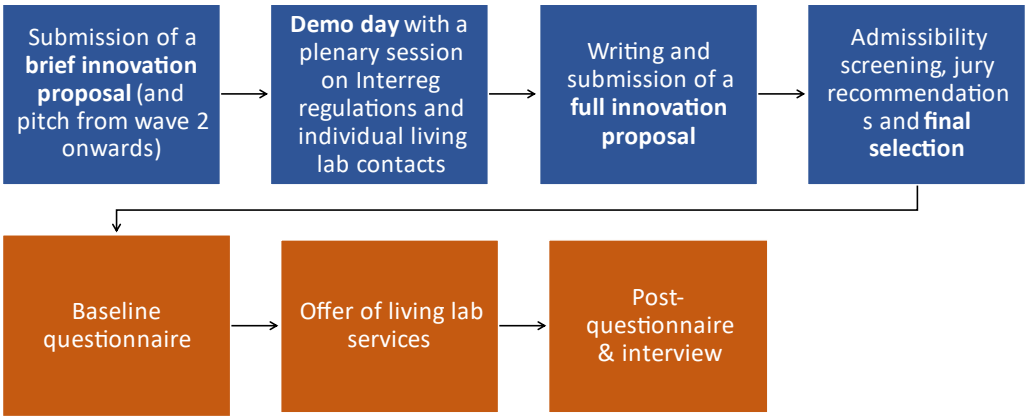

Figure 1. Selection process for CrossCare projects (top row) and the experimental procedure of the current study for selected proposals (bottom row).

In total, 179 applications from companies and organisations in Flanders and The Netherlands were submitted to CrossCare. Two to nine proposals were funded per call, leading to a total of 30 innovation projects that were selected and launched. Each project included at least one company (SME) and could additionally include one or more healthcare organisations as partners. For the current study, all companies participating in the first four waves of the project received an invitation for participation, resulting in 24 companies completing the baseline survey and 20 companies completing the post-survey with additional follow-up through a telephone interview. All participants provided informed consent.

Data collection and analysis

A *baseline survey* was completed before living lab services were initiated and focused on (1) background information and attitudes of the organisation, (2) expectations regarding the cross-border living lab services, and (3) the objectives of the innovation project. A second survey was completed after the innovation project was closed and all living lab services were delivered. This *post-survey* focused on measuring the impact of the cross-border living lab services on user/business insights and development of the innovation. Specifically, it concerned the evaluation of expectations, perceived added value of the cross-border living lab services, and which objectives the company was able to realise through the CrossCare innovation trajectory. Questionnaires consisted mostly of scale and multiple-choice questions and were presented through Qualtrics online survey software. To gain more in-depth information about attitudes and experiences of the companies, semi-structured interviews were conducted over the phone to further clarify the survey outcomes and to obtain more elaborated insights in the cross-border living lab services that provided the greatest benefit. The two online measurement surveys were inspired by previous impact measurement surveys of living labs developed by Van Hoed (Ballon et al., 2018). The surveys and topic guide for semi-structured in-depth interviews were iteratively developed and adjusted to the context of cross-border living labs with feedback from the six CrossCare living labs and experts.

All data were collected between 2016 and 2020. Survey responses were combined and analysed through descriptive statistics. Thematic analyses were conducted on questionnaire responses. Quotes from the interviews are used to illustrate the findings.

Results

Participating companies and organisations

The current study included 24 companies, 13 Flemish SME's and 11 Dutch SME's, which were developing innovations in the large healthcare domain. These were digital self-management tools (medication adherence, chronic obstructive pulmonary disease, mental health and drug rehabilitation, multiple sclerosis), self-testing devices and platforms (self-testing for sexually transmitted diseases, lithium self-test for patients with bipolar disorder), medical products (ostomy aid, fixation of percutaneous drainage catheters, intradermal injection devices), medical diagnostics (internet-connected uroflowmetry in home environment, sleep apnea diagnostic device), ergonomic aids and care/wellbeing devices (for patients with low back pain, tremor, dementia, incontinence), lifestyle prevention services (physical activity support for elderly), health monitoring with wearables (fall prevention), hospital-oriented innovations (inflatables for proning procedure during surgery, mobile oxygen therapy, head mounted digital 3D loupe), and digital communication tools between care professionals and patients/citizens. At both sides of the border, tailored co-creation sessions and live tests were carried out with patients, care professionals, elderly people and informal carers. In some cases, business model sessions or interviews with stakeholders (health insurers, municipalities and healthcare purchasers, among others) have also been held. The living lab projects took place in the home environment, hospitals, and care settings (e.g., elderly care, home care, care institutions for disabled individuals). Half of the companies (*n*=12/24) already had *some first experiences in cross-border markets* before participating in the CrossCare project and almost all of them (*n*=23/24) had *a strong suspicion of cultural differences between the home market and the cross-border market*.

Most companies (*n*=21/24) indicated at baseline measurement that they had already acquired a good understanding of *end-user needs and problems* in their home market, while a minority (*n*=6/24) of the companies indicated that they had good insights in *end-user needs and problems* in the cross-border market. With regard to *insights in the business model and ecosystem*, more than half of the companies (*n*=15/24) reported good insights in the home market, and only a minority of the companies (*n*=4/24) reported having already good insights in the cross-border market.

Expectations and key objectives regarding cross-border living lab services

Companies' expectations and needs regarding cross-border living lab services were collected through the online baseline survey before the start of the innovation projects.

During this assessment, companies were asked to indicate to what extent they expected to realize certain objectives through their CrossCare innovation project, based on an extensive list of 31 possible objectives.

A better understanding of the cross-border market is listed as a key objective by the participating companies (Table 2). All of them (*n*=20/20) expect to better understand the cross-border market and half of them (*n*=10/20) assigned this the highest possible score. Interest in the home market is lower, but still three quarters of the companies (*n*=16/20) expected to better understand the home market.

Table 2. Objectives of participating companies before their innovation project was started and the extent to which these objectives were reached at projection completion. Only companies who completed both assessments are included in this table (N=20).

	Baseline measurement[a]		**Post-measurement[b]**	
	Interested companies (N) [c]	Mean (SD)	Companies that realised objective (N) [c]	Mean (SD)
1. Better understanding of cross-border market	20	4.50 (0.50)	13	3.55 (1.16)
2. Improving knowledge and competences regarding innovation domain	20	4.50 (0.50)	15	4.05 (0.83)
3. Improving user acceptance and user experience of the innovation	20	4.35 (0.48)	17	4.25 (1.04)
4. Testing product market-fit	19	4.50 (0.59)	16	4.10 (0.94)
5. Involving users and gaining external opinions about the innovation	19	4.35 (0.57)	18	4.15 (0.73)
6. Improving the product and its value proposition	19	4.30 (0.90)	14	3.65 (1.01)
7. Improving awareness about the position and added value of the company in the home market and cross-border market	19	4.30 (0.56)	18	4.00 (0.63)
8. Entering new market(s)	18	4.25 (0.62)	9	3.00 (1.22)

9. Accelerating the innovation process	18	4.15 (0.57)	13	3.75 (0.77)
10. Better understanding of the home market	16	4.20 (0.75)	15	4.05 (1.07)

Notes. [a] *5-point likert scale: 1 we do certainly not expect to realize this objective; 2 we do not expect to realize this objective; 3 neutral; 4 we do expect to realize this objective; 5 we certainly do expect to realize this objective;* [b] *5-point likert scale: 1 we certainly did not realize this objective; 2 we partially realized this objective; 3 neutral; 4 we have largely realized this objective; 5 we certainly realized this objective;* [c] *Defined as a scale score of 4 or above.*

At the end of the innovation projects, the companies were asked to complete the post-measurement survey and to participate in an in-depth phone interview to further clarify whether the expectations and objectives for participation in the CrossCare project were fulfilled and to learn which services provided them with the greatest benefit. High mean scores in Table 2 indicate that most objectives were realised. Companies' expectations concerning improved cross-border market understanding were most often met: 65% of the companies (*n*=13/20) were able to largely or certainly realize this objective. Also, 20% of the companies (*n*=4/20) partially reached this objective. One company stated that they were certainly not able to realize a better understanding of the cross-border market due to the limited number of cross-border activities that were performed during its innovation project. This company experienced big challenges with battery life and its innovation was evaluated as being too immature for real-life testing, as first user tests frustrated the end users.

Through their participation in CrossCare, companies learned about the differences in the care systems of Belgium and the Netherlands and how the innovation and/or business model had to be adapted in order to meet user and stakeholders' needs in both countries. The questionnaire findings were further supported by the interviews. A company developing a medical diagnostic innovation learned that their technology is used in a different way in both countries.

> *"Care systems in Belgium and The Netherlands differ a lot. We learned that this has a huge impact in the daily implementation of our innovation. In the Netherlands, they work with a care budget and gathering as much symptom information as possible in the beginning is important in order to start care from there. In Belgium, where there is a performance-based paying system, the data collection via our application needs to start later. Through our participation in CrossCare we were able to identify a different added value and way of working of our product in both countries. Our product can address these different needs. It's the same product, but via the software the user can choose different options in the settings. We also learned that there is a huge difference in how we need to implement the logistics around our innovation."*

An ergonomics company experienced added value from the stakeholder input they received from the living labs.

> *"Our cross-border market insights have strongly evolved. We learned who our key stakeholders are. The living lab organized brainstorms with them and we learned who our competitors are and what they do. We had a few co-creation sessions with possible cross-border clients like hospitals and care centers. We learned a lot."*

A company developing a self-testing product (suitable for postal delivery) learned that its one size fits all approach did not match the reality and business models need customization for each new cross-border market.

> *"An important insight is that we now know that we should not have any presuppositions when we take our innovation to other countries. Everything depends on cultural and postal regulations. Our total business model has been adjusted by those insights. We thought we could go for a one size fits all approach, but nothing could be further from the truth. Much more customization is needed."*

Through cross-border living lab services from CrossCare, the majority of the companies (n=15/20) gained new insights, knowledge and competences in the innovation domain (state of art). Additionally, the cross-border services made a convincing contribution to improved user acceptance and experience of the companies' innovations. A total of 85% of the companies (n=17/20) was able to improve the user acceptance and user experience of its innovation. CrossCare supported the further development of the innovation for almost all of the participating companies. Ranging from the full development of the product's hardware to countless iterations in the product's software. Feedback was not limited to improving the product, user-friendliness and comfort, but also - for example - the role that a healthcare professional can play or cannot play in the daily practise.

The objective 'entering new markets' was realized by only half of the interested companies (n=9/18). Although this objective received the lowest mean score and was less realized than other objectives, it is important to nuance that we might not expect companies to enter new markets shortly after completion of their innovation trajectory. While the other objectives are short-term goals, market entering can be categorized as an objective on the mid-long-term.

Cross-border living lab services

Companies were asked to rank a list of 10 cross-border living lab services from high interest/priority to low interest/priority. Based on the responses, Figure 2 ranks the services according to how interesting companies perceive them to be. Companies most

importantly expect expertise and support from the CrossCare living labs in selecting and recruiting the desired test persons (rank *M* = 1.70, *SD* = 1.58). In addition, services offering support in developing and testing the innovation together with end users via co-creation sessions or via live testing is also perceived as a service with very high interest/priority (rank *M* = 2.15, *SD* = 0.79). Furthermore, the companies expect to receive services improving their knowledge about the legal framework of their innovation (for example relevant regulations, reimbursement modalities, etc.; rank *M* = 4.75, *SD* = 1.95). Business expertise and coaching in the health market are also of interest (rank *M* = 5.50, *SD* = 2.91). Closing the top 5 services, companies show interest to receive services offering scientific expertise (rank *M* = 6.20, *SD* = 2.04) and access to (physical) infrastructure (rank *M* = 6.20, *SD* = 2.44).

After completion of their CrossCare trajectory, the top two services companies were most interested in were indeed also most valued (Figure 2). In terms of living lab services, the selection and recruitment of desired test persons and all associated expertise, methodologies and contacts were most valued by the companies (rank *M* = 1.95, *SD* = 2.11). A company developing a medical diagnostic service was able to continue to work with their end users after CrossCare.

> *"The living labs brought us into contact with very interesting parties. Our company still has very good contact with clinicians in both countries, our test users have become also our customers."*

Baseline priority ranking		Added value ranking	
1	Expertise and support in selecting and recruiting the desired test persons	1	Expertise and support in selecting and recruiting the desired test persons
2	Support in developing and testing the innovation together with end users via co-creation or live testing	2	Support in developing and testing the innovation together with end -users via co-creation or live testing
3	Knowledge transfer with regard to the legal framework of the innovation	↑ 3	Act as a bridge builder / matchmaker
4	Business expertise and coaching	↑ 4	Methodological support during structured and iterative innovation process
5	Access to specific scientific expertise	5	Access to specific scientific expertise
6	Access to (physical) infrastructure	6	Access to (physical) infrastructure
7	Act as a bridge builder/ matchmaker	↓ 7	Business expertise and coaching
8	Methodological support during structured and iterative innovation process	↓ 8	Knowledge transfer with regard to the legal framework of the innovation
9	Organize/ facilitate networking opportunities	9	Organize / facilitate networking opportunities
10	Prototyping support	10	Prototyping support

Figure 2. Ranking of services from high to low interest/priority before the start of the living lab project and ranking of living lab services from high to low added value after completion of the living lab project.

Recruitment of end-users at both sides of the border offered added value for a company developing an ergonomic aid.

> *"We were able to receive feedback from end-users recruited by 5 living labs (3 Flemish and 2 Dutch living labs). It was proposed by the living labs to collaborate in end-user recruitment to reach more end-users. That way, we gained insights in bigger and more variated user groups. We found small, but interesting cultural differences."*

Additionally, services providing support in the development and testing of the innovation with end-users via co-creation or live testing were highly appreciated (rank *M* = 2.30, *SD* = 1.42). A company developing a self-testing innovation appreciated the methodological expertise of the living labs.

> *"We are especially grateful to the living labs' methodological support in terms of user testing. They knew exactly how to ask questions the right way in order to get the most out of the tests. They were able to gather much richer insights from our target group than we as a company could."*

End-user interaction was experienced as going smoothly by a company developing an ergonomic aid.

> *"As a company, we were present during the co-creation sessions as an observer. Then you notice the knowledge, skills and techniques to involve elderly people in need of care in innovation research. All interactions with end-users went smoothly."*

A company developing a health monitoring innovation was able to successfully launch its second version of the product.

> *"Thanks to all the user insights, we learned that our initial innovation wasn't ready yet for market launch. We improved our innovation based on user feedback. A potential failure and early end of our innovation has been avoided."*

While the service of being a bridge builder or matchmaker was perceived of lower interest during the baseline survey, this service received a ranking indicative of a high added value during the post-measurement (rank *M* = 4.60, *SD* = 2.60). Companies felt supported by the living labs in establishing contacts with the care sector, care professionals, and potential clients. After completion of their innovation project, companies also valued the living labs' methodological support during the iterative innovation process more (rank *M* = 5.70, *SD* = 2.41). Companies appreciated being supported with a structured innovation approach.

On the other, some services were valued less or missed during the cross-border living lab services. Knowledge transfer with regard to the legal framework of the innovation was perceived of high priority during the baseline survey. During post-measurement,

this service did not appear to have the expected added value (rank *M* = 6.90, *SD* = 1.95). Some companies (*n*=4/20) indicated that they were lacking knowledge and support from the living labs in their preparation for a clinical study (e.g., medical-ethical approval), the registration of the study, and typical other regulatory aspects (e.g. CE-marking, reimbursement procedures). One company mentioned during the phone interview that they were hesitating to continue collaborating with living labs in their follow-up trajectory due to a lack of regulatory expertise. Therefore, they are researching the added value of a clinical research organisation, which offers elaborated services concerning regulatory affairs. Business expertise and coaching was also valued less after completion of the project (rank *M* = 6.70, *SD* = 2.33).

Despite networking opportunities not being perceived as service of high interest, nor high added value after completion of the project, some companies (n=2/20) suggested the idea to organize sessions in which companies that participated in CrossCare innovation projects can share their experiences and exchange knowledge about market insights, business models, regulatory affairs, etc.

Discussion

Current health challenges, for example relating to an aging population, are not restricted by national borders but appear similar across Europe. Therefore, the international launch of health innovations can hold great benefits both for countries and their populations as well as for companies targeting this market. While Schaffers & Turkama (2012) envisioned that living labs could accelerate the development and acceptance of innovations through cross-border collaboration, they noticed that Living labs did not appear ready for this role at that time (due to e.g., insufficient integrating in regional innovation ecosystems). The sheer number of applications for the current cross-border project as well as the questionnaire results indicate that companies and organisations in the healthcare field are very interested in gaining insight into the market of neighbouring countries. Companies interested in cross-border living lab services have very high expectations regarding cross-border market insights, comprehension of the innovation domain, improved user acceptance and experience, product-market fit, and improved end-user insights. Importantly, and in contrast to Schaffers & Turkama (2012), living labs were also able to meet the expectations of the companies, who for example learned about the differences in the care systems of Belgium and the Netherlands and how the innovation and/or business model had to be adapted in order to meet user and stakeholders' needs in both countries.

The current study can also provide insight into which living lab services companies are seeking. In line with Lepik and Krigul (2021), companies assign high priority at baseline and experience high added value at post-test of living lab services entailing end-user

selection and recruitment as well as support in designing appropriate studies to collect their insights in relation to the innovations. Some companies did not feel sufficiently supported in the legal area. On the other hand, the role of living labs as bridge builders, providing access to other actors in the care ecosystem, was appreciated more strongly after the living lab services were received as compared to what companies estimated beforehand. Previous research has emphasized the relevance of innovation intermediaries for open innovation (Grotenhuis, 2017; Katzy, Turgut, Holzmann, & Sailer, 2013).

These findings are in line with Ballon et al. (2018) who also show beneficial effects of living lab services, e.g., in terms of product-market fit, but extend these findings to an international context. However, several limitations should be taken into account when interpreting these results. Since there was no control group, it cannot be excluded that factors outside of the project contributed to the observed changes. However, the questionnaire did ask specifically whether changes occurred 'due to the CrossCare project' to try to minimalize the impact of external parameters. The current study included a small sample of 24 companies from a specific European cross-border area, limiting generalizability. Future research should extend the current findings and include longitudinal data as well as objective metrics (e.g., increase in cross-border users or revenue).

Conclusion

Although companies have high expectancies from cross-border living lab services, living labs are able to deliver services that create added value for the companies. Companies strongly value targeted end-user recruitment services and support in testing the innovation with end users. These services are, therefore, an important strength of cross-border living lab services. Additionally, the roles of matchmaker and expert in iterative development trajectories and methodologies prove especially useful at project completion. The current study shows that companies can benefit from living lab services and encourages further cross-border health ecosystems and collaboration. Taken together, living labs have the potential to help companies develop products that can address actual health needs beyond borders.

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Practitioners Presentation Paper

Enhancing Collaborative Innovation - Case Healthy Liveable Neighbourhoods

Authors

Annamaria Rossi & Kaisa Spilling

Abstract

Cities around the globe are challenged by rapid urbanization and climate change. In the Nordic countries, the challenges will be distinct for their location, climate conditions and social structure. To mitigate and adapt to these challenges, solutions supporting green, inclusive and healthy urban life should be explored together. This paper presents the role of facilitation of collaborative innovation in the Nordic context. With an agile piloting programme the aim is to identify and share best solutions for greener and healthier neighbourhoods and scale up best practices across regions. In the Nordic Healthy Cities project the collaborative innovation approach has supported sharing insights and finding synergies between cities and companies, and strengthened their role as a platform for creating and testing new innovations.

Key words

Collaborative Innovation, Agile Piloting, Green Infrastructure, Urban Health

Introduction

The Nordic Healthy Cities (2020-2022), a collaboration project run by the Nordic Smart City Network addresses different challenges related to wellbeing in the densifying cities [1]. The Healthy Liveable Neighbourhoods piloting programme, one of the activities within the project, brought five Nordic cities together in a collaborative innovation process to seek solutions to be piloted in an agile piloting program, utilizing three Nordic neighbourhoods as urban living labs. Forum Virium Helsinki has been facilitating co-creation and piloting in the different phases of the process to maximize the learning of the cities, companies and other stakeholders engaged in the process.

Approach & Methods

In the collaborative innovation approach, the cities serve as platforms for improving citizens' everyday life and creating new innovations by experimenting and implementing new technologies and services, and promoting collaboration between public and private sectors [2]. In the Healthy Liveable Neighbourhoods piloting programme, the cities were seeking solutions on green infrastructure, foodscapes and citizen participation to answer the health challenges caused by urbanization and climate change.

The agile piloting programme provides a model for quick experimentation of new solutions and services in a real-world environment and serves as a boundary object for collaboration between the cities [3]. The process facilitated by Forum Virium enables learnings throughout the process and parallelly supports the cities facilitating their pilots.

First, the five partner cities, Helsinki, Vantaa, Stavanger, Kristiansand and Copenhagen, were brought together to share insights regarding the topics and learnings from their own cities. The focus for the piloting challenges were then defined together through a facilitated co-creation process engaging the partner cities and wider, finding synergies to serve both the cities providing the labs for experimentation and the interests of the follower cities. Three topics were introduced through an open call: participative planning of green infrastructure, urban farming solutions and local food production and consumption. As a result, three pilots were selected to be implemented in three local neighbourhoods of Helsinki, Vantaa and Stavanger together with the residents.

A virtual kick off event brought the cities and piloting teams together. An experimentation canvas adopted from healthcare [4] to urban lab context was used as a tool to create common understanding, identify essential stakeholders, and most importantly, set goals for the pilot. A common process enables sharing of insights and

experiences throughout the piloting programme.

Results and lessons learned

As results so far, three pilots were selected to be run in Smart Kalasatama Urban lab in Helsinki, Hakunila neighbourhood in Vantaa, and Storhaug district in Stavanger. The case provides an example of how the piloting programme serves as a boundary object for collaborative innovation.

Utilizing cities as urban labs for experimentation is an effective way to support collaborative innovation, experiment together with the citizens and find best practices and solutions together for the increasing urban challenges. Programme format with several cities opens more possibilities for the companies as well as possibilities for cities to follow the interesting pilots and adopt the learnings.

Synergies on the process and solutions between the cities have emerged already. In the fall at the end of the piloting period, a design sprint will be run together to emphasize learnings between cities and to enable the participation of city experts from the different Nordic cities.

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Practitioner Presentation Paper

Children and Young People's Mental Health Services Referral Innovation. Co-design and validation methodology

Authors

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Abstract

Children and young people's mental health services (CYPMHS) at Liverpool and Sefton Clinical Commissioning Groups referrals were paper-based. Paper-based referrals are inefficient and generate delays between appointments, which affect negatively on children and young people's mental health outcomes. Under a pilot-scale project funded by NHS England and with initial support from NHSX, Alder Hey Children's NHS Foundation Trust co-created with partner agencies the "CYP as One" to improve and digitally innovate the current mental health services provided to children and young people across Liverpool and Sefton region. "CYP as One" was created to improve the user flow for the children, young people, families and carers, as well as make the process easier and better for the teams that support them. This paper provides a reflective and critical analysis of the "CYP as One" platform co-creation and validation methodology. The innovation platform was launched in May 2021 and, currently, the authors are gathering real-world data on the innovation platform usage to validate the innovation claimed health and economic outcomes. It is anticipated that "CYP as One" will improve experience, communication and access to information from the young people themselves, their families and wider stakeholders. In addition, there is an expectation of reduced waiting times and "did not attend" cancellations and other benefits identified through costs and clinical time.

Keywords

Children and young people's mental health services (CYPMHS); Health Innovation; Living Lab; Real-world Validation; eHealth

Introduction

Problem: Children and young people's mental health services (CYPMHS) at Liverpool and Sefton Clinical Commissioning Groups referrals were paper-based. Paper-based referrals are inefficient and generate delays between appointments, which affect negatively on children and young people's (CYP) mental health outcomes.

Solution: Under a pilot-scale project funded by NHS England and with initial support from NHSX, Alder Hey Children's NHS Foundation Trust co-created with partner agencies the "CYP as One" to improve and digitally innovate the current mental health services provided to children and young people across Liverpool and Sefton region. The "CYP as One" project created a web-based platform (hereafter innovation) for a single data entry point for referral and appointment bookings which can be accessed and updated by all relevant agencies thus avoiding duplication and multiple data entries. Lastly, the platform provides access to the resources that children, young people and their families have said would be beneficial on the co-design phase. This has resulted in a fundamental change to how the referral system is structured, for what it is believed to be extremely beneficial for child, young people, their families but also all that are involved.

Aim: "CYP as One" was created to improve the user flow for the children and young people as well as make the process easier and better for the teams that support them.

Methodology: This paper provided a reflective and critical analysis of the "CYP as One" platform co-creation and validation methodology. The innovation was launched in May 2021 and, currently, the authors are gathering real-world data on the innovation usage to validate the innovation claimed health and economic outcomes.

Background Evidence

As the Children's Commissioner, Anne Longfield, pointed out in her recent report "Access to support remains the biggest issue for children's mental health services" (Childrens Commissioner, 2020, p2). This view is founded on research (Childrens Commissioner,2018) about the difficulties faced by CYP in accessing CYPMHS services. The main findings of that research revealed that

- Of more than 338,000 children referred to CAMHS in the study year, less than a third (31%) received treatment within the year.
- Another 37% were not accepted into treatment or discharged after an assessment appointment, and 32% were still on waiting lists at the end of the year.

- Less than 3% of children in England accessed CAMHS in the study year, a small fraction of those who need help.

This evidence points to an unmet need for CYP compounded by difficulties in accessing services. And while the situation is improving over recent years, there are still barriers to access. One of these hurdles is the complexity of the current CYPMHS referral systems across the country, some of which are cumbersome and multi-layered. Streamlining and simplifying this point of access through integrated digital technology would be a helpful addition to ensure that CYP receive the help they need. As Anne Longfield also comments “getting through that front door is an ordeal for too many”.

Methodology

There is an increasing drive to develop innovative and cost-effective strategies that focus on improving the quality of care. These innovative approaches will only work effectively if they meet real needs. Bearing this in mind, the Centre for Collaborative Innovation in Dementia works in partnership with stakeholders provides an open environment in which to innovate and validate potential solutions to the real-life challenges of the health and social systems (Smith, 2015; Smith & Simkhada, 2019). The Centre for Collaborative Innovation in Dementia is an accredited health Living Lab – the European Network of Living Labs (ENoLL).

The innovation was co-designed using a living lab approach led by the Alder Hey Children’s foundation trust and it will be validated by the Centre for Collaborative Innovation in Dementia using an innovative methodology entitle real-world validation (RWV).

Living Lab – innovation co-creation

“CYP as One” was co-created utilising a user-centred, research design methodology, putting the children and young people, as well as their families, at the forefront of the project. Twenty-six children and young people, thirty-one parents, and thirty-two health professionals formed the Open Innovation group.

Participants were recruited following response to a call via social media or by invitation at planned forum events. Additionally, already established workshops and focus groups were contacted and invited to participate. Further information and consent forms were sent to interested participants.

The project started at the end of January 2020, and the innovation was launched in May 2021. The innovation went through five iterations, which are described in detail

below. The launched product was iteration number six.

The original deliverables of the project were:

- Scoped digital front door concept for the CAMHS Partnership Offer to improve access to information and services available.
- Development of single or connected platforms & digital engagement tools from pre-referral to post-treatment, ensuring cross-communication for the single patient.
- Prototype digital referrals from partners and self-referral – via a single platform.
- Enable Digital signposting and referrals to social prescribing, resources for self-help and/or wider CAMHS Partnership.
- Digital patient appointment booking, allowing SPA staff and patients to book appointments with at least 1 service provider partner as well as patients to quickly (re)book an appointment.

The co-creation process can be divided as follows:

Paper prototype (iteration 1)

Drop-in sessions with Alder Hey Clinicians (5) and Bernardo's staff (2) to validate if what was needed was clinically necessary. The co-design team aimed to also involved children and young people and their families. However, this phase coincides with the COVID-19 pandemic and it was decided to delay these groups involvement. Testing conducted between 13-19th March 2020.

NHS Prototype version 1 (iteration 2)

Interviews conducted with GP's (2) and partner organisation staff members (2). From these interviews, it became apparent that there were fundamental issues with the prototype that needed changing. Testing conducted between 8th and 15th April 2020.

NHS Prototype version 2 (iteration 3)

Interviews conducted with health professionals (2), parents (6) and CYP (2). Interviews conducted between 12th May and 7th July 2020. The team put a lot of time and resources to engage further with CYP and their families, however, engagement during the pandemic was hard to reach, which is a limitation acknowledged throughout the co-creation process.

Mindwave version 1 (iteration 4)

Two workshops conducted with CYP with five participants on the 1st November 2020, and six participants on the 18th November 2020. Two workshops conducted with parents with six participants on the 11th November 2020, and seven participants on the

17th November 2020. In total, eleven CYP and twelve parents were consulted on the co-design of iteration 4.

Mindwave version 2 (iteration 5)

Two focus groups were conducted with health professionals with twelve participants on the 16th February and nine participants on the 17th February 2021. Further, two focus groups were conducted with parents with twelve participants on the 22nd February, and seven on the 24th February 2021. Last but not least, three focus groups were conducted with CYP with six participants on the 17th February, five participants on the 22nd February, and two participants on the 24th February 2021. In total, twenty-one health professionals, nineteen parents, and thirteen CYP were consulted on the co-design of iteration 5.

Real-world Validation – innovation validation

RWV is an innovative methodology that uses real-world data (e.g. data captured by mobile devices or wearables usage) to determine, in a non-controlled environment (in the real-world), the effectiveness, and the outcomes to patients, staff and the health economy, of health innovation (Ganga, 2021). The value of real-world systematised information has been gradually recognised by health research more broadly. Real-World Data (RWD) is being increasingly used to the understanding of health innovations. When captured and analysed, RWD produces the Real-World Evidence (RWE) that underpins the economic case for innovative intervention in the health and social care systems. Why use this methodology to validate “CYP as One”? The use of computers, mobile devices, wearables, and other biosensors gather and store huge amounts of health-related data has been rapidly accelerating. This data holds the potential to facilitate the understanding of the real-life impact of an innovation.
The innovation real-world validation will comprise three work packages (WP) across 7 months:

WP 1 – RESEARCH ETHICS AND GOVERNANCE
Establishing the project governance, including gaining ethical approval, and recruitment of a research assistant.

WP 2 – REAL-WORLD VALIDATION
2.1 Rapid literature review – a rapid, non-systematic literature review using standardised resources (PubMed, MEDLINE etc.) - explore existing health agency and service user data sharing arrangements, particularly those in the UK.
2.2 Real-world validation

i. **Project aim** –validate the "CYP as One" data platform.
ii. **Innovation's value proposition** – effectiveness measures and health outcomes against which the innovation's impact will be measured.

iii. **Data capture and analysis** – Real-World Evidence (RWE) of the innovation on pre-defined outcomes. 20 service users and 20 service providers will be recruited to the project.
iv. **In-market validation protocol design**.

WP 3 – Dissemination
3.1 Project reporting –during month 6 when findings and recommendations will be proposed
3.2. Journal article drafting –share the methodology, findings and conclusions of the health via a 3* journal article (e.g. BMJ Innovation).

Concluding remarks

It is anticipated that "CYP as One" will improve experience, communication and access to information from the young people themselves, their families and wider stakeholders. Benefits to flow from this work are

- one streamlined referral pathway for users for multiple mental health services over the Liverpool and Sefton area so they do not have to give the same information to lots of different services.
- ability to track referral so that the CYP, family or professional is aware of where their referral is up to
- decreasing administrative time for staff in the mental health services teams to allow more time to be spent supporting direct patient care
- reduced errors in transcription of referral details due to automation
- improved referral experience by referrer
- improved access to mental health services and support

In addition, there is an expectation of reduced waiting times and "was not bought" cancellations and other benefits identified through costs and clinical time. These benefits are to be validated by the implementation of the RWV protocol presented in the previous section.

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Research in Progress Paper

Daycare@Home: developing an innovative sustainable digital community daycare intervention

Authors

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Abstract

The closure of daycare services during the COVID-19 pandemic resulted in greater use of digital technology to facilitate social engagement with and between older people. To date, there has been little evaluation of this form of digital response to the pandemic. If effective, digital solutions for engaging with community groups remotely may represent an emergent solution to unequal regional daycare service access for older people. Using a qualitative research approach, this paper evaluates the acceptability of the *Daycare@Home* project currently providing daycare activities in Ireland, using an online delivery model. Evidence from this evaluation will inform further development of innovative digital solutions to enable better and smarter social connectivity options for community-dwelling older people.

Key words

Community daycare; digital intervention; ageing; wellbeing

Introduction

Daycare service participation increases quality of life[1]. However, previous research also suggests that those who attend community daycare are more likely to have higher levels of frailty as well as impairment in all domains of the instrumental activities of daily living (IADL)[2]. The provision of organised opportunities for older people to socialise, share a meal, engage in activities, hobbies or games together in local community daycare centres, are to be found in most communities in Ireland, as elsewhere.

From March 2020, government COVID-19 guidelines directed older people to 'cocoon' (to stay at home and avoid contact with others outside the home). The closure of community daycare services further restricted the social engagement opportunities for older people, especially those already less likely to be socially active. Indeed, older people living alone, and those with chronic conditions, or who required assistance with IADLS, have experienced the greatest negative impacts from COVID-19 restrictions including increased loneliness and depression[3].

Mental health and social ties have been associated with resilience in older people[4], but maintaining resilience is more difficult for those with chronic health conditions or limitations of function, such as IADL impairments[5]. During the COVID-19 pandemic, many community organisations shifted their focus from facilitating social engagement to meeting IADL needs, by providing assistance with shopping, collecting prescriptions and providing meals. However, those guiding COVID-19 service responses also urged providers to take into account the health benefits, for older people, of sustaining social connections[3,6]. Efforts to maintain social connection with older service users included the implementation or increase of telephone or video conference calls by community-based organisations[7].

Personal resilience will not be sufficient to ensure recovery from the COVID-19 pandemic, therefore, Chen[8] proposes that 'strong resilience of communities' will be necessary and points to the potential for digital technologies and web-based services to continue, as fundamental components of reshaped service delivery for and with older people. However, there has been little examination of how remotely delivered interventions maintained pre-pandemic social engagement with and by older people; nor on how such interventions might be adapted to a post-pandemic environment[9].

Drogheda Community Services Trust (DCST) - a client-focused community daycare charity in Ireland - recognised that the circumstances prompting consideration of remote service delivery also presented an opportunity to develop and test a sustainable online daycare service offering. An online service, offered in parallel to on-site services, could also extend the reach of community daycare to rural areas currently underserved

by daycare services. It is accepted as a core principle among living labs that innovative, effective, and sustainable community solutions are most likely to occur where synergistic multi-stakeholder partnerships are fostered and nurtured, in environments based on trust, where power, ideas and resources are shared[10]. This research examines the experiences of community stakeholders during the real world iterative, multi-stakeholder, collaborative development of *Daycare@Home* an online community daycare intervention.

Research Purpose

Prior to development of *Daycare@Home*, DCST conducted a survey to evaluate receptiveness among its members. Findings from this survey, completed by all members (n=81, 100%), are currently pending publication, but 69% of respondents expressed willingness to engage with the daycare digitally, if supported to do so. The *Daycare@Home* pilot project had the dual purpose of maintaining immediate social connection with service members while developing and evaluating a sustainable delivery model for an online daycare service. Findings from this study will inform the next steps in the development of *Daycare@Home* as well as transferring knowledge to local and regional organisations and actors on the delivery of online social connection solutions using digital technologies.

Technology

Production of the activities is undertaken on-site at the daycare premises, using a smartphone camera, a clip-on condenser microphone, laptop and a large mobile interactive whiteboard screen. As expected, access to digital devices and internet services remained a barrier to participation for many, with only 20% of service users reporting access to devices or the internet by September 2020. A range of tablet devices (n=20) were secured for distribution to service users, to access *Daycare@Home*. The service facilitators received training on setting up the tablets and on supporting older people to engage digitally. Paper training manuals were also created, and iteratively updated by the service facilitation team - as user support needs were identified. Telephone support was also available to assist with tablet set up.

Online Delivery

When service members were first surveyed about their willingness to participate in the *Daycare@Home* pilot study (Sept 2020), the service was offering two remotely delivered classes (gardening and mindfulness), with support from the local adult education service. Twelve months later, online activities were being offered, via Zoom, across three days weekly including: gardening, art and crafts, religious services, quizzes, chair exercises and mindfulness classes. The Zoom link to each activity was

sent by email, either directly to the service user or to a family member facilitating remote access to the activity.

Daycare@Home continued to be offered in parallel to telephone support calls, meal delivery and shopping supports put in place at the beginning of the pandemic. In June 2021, the daycare returned to limited in-person daycare service delivery, offering one day weekly of on-site daycare to each member. This limited on-site attendance, in line with government guidelines, provided an opportunity to trial the simultaneous delivery of on-site and online daycare. As service members gradually returned to on-site activities, a blended service delivery format was tested, with online service users joining on-site activities remotely.

Method

A multi-stakeholder Research Advisory Committee (RAC) guided the project from the outset. The mixed methods research approach includes interviews with service users, focus groups with family members and service facilitators as well as the design and testing of a digital skills survey for digital engagement facilitators in the community, such as community service staff and volunteers. Experiences with use and delivery of *Daycare@Home* were explored, along with the potential for engagement past the COVID-19 pandemic.

Thematic analysis, including the six stages outlined by Braun & Clarke (2006), will be undertaken using NVivo software. Findings outlined in this paper present initial descriptive data analysis, from familiarisation with the data and the development of initial codes and broad themes, from qualitative service user interviews (n=5) and a focus group with service facilitators (n=4). Approval to conduct this research was granted by the School of Health and Science Research Ethics Committee at Dundalk Institute of Technology, Ireland.

Findings

Service members reported particularly enjoying the ‘fun’ experienced while engaging with *Daycare@Home*. In particular, enjoyment of conversational ‘banter’ with other service users was highlighted, even where online participants were not previously known to each other. Service users were surprised, not only at being able to use the technology, but also at having so much fun, enjoying the activities in the online context and at finding themselves looking forward to the *Daycare@Home* activities:

'I'd miss talking to all these ladies' (Female, 84 years).

'I look forward to it after dinner. Rush up the dinner and tidy up, get ready to sit down and see who's in and who's not in' (Female, 83 years).

For members who joined the daycare during the COVID-19 closure of services, those who would have previously been reluctant to join the daycare reported their online experience would encourage them to become regular members. Reluctance to join daycare services was often due to a perception that the services were for 'old' people, with respondents not identifying themselves as 'old'. Central to this reconsideration of daycare services were the experiences of having unexpected fun, meeting new people and discovering that the interaction was 'normal':

'…what would you say, down to earth people, just talking normal among themselves and talking about their gardens or…telling the rest of us all these bits and pieces' (Female, 84 years).

'We would have a bit of banter, yes…and have a bit of fun and a few jokes and that…and another thing is you are talking to people and you are having a bit of fun and you are keeping up with the local [news]' (Male, 96 years).

Service facilitators were surprised by the level of enjoyment by service users. However, supporting and facilitating *Daycare@Home* required additional resources, including new digital skills, the need for possible workarounds to address visual or hearing impairments, and additional time to support service users to connect and use the online technology. The blended daycare required delivery of both formats simultaneously by the same staff. Yet, despite the challenges, service facilitators and users both noted benefits to the blended approach. Service facilitators were enthusiastic about the *Daycare@Home* project and recognised the blended delivery of activities as encouraging non-*Daycare@Home* users to consider participating online, for the days they were unable to attend the on-site daycare:

'So, if you are on a day that you are not [on-site] there, you still have contact with them [daycare service]. You know. No, I think like that…Tuesday, Wednesday and Friday now, we have a Zoom meeting and I am [on-site] there Thursday so you have the whole week…' (Male, 96 years).

One benefit of the blended delivery, for service facilitators, was the ability to provide in-person device set-up support to service users while they were on-site. Other advantages included: saving travel and scheduling time to visit the user at home for technical troubleshooting; there were more people available on-site to provide immediate support and address issues a colleague might be unable to resolve; and

communication in-person was easier without the interference of the online technology medium.

Conclusion

Technical challenges remain ongoing for all stakeholders as the *Daycare@Home* pilot continues. Nonetheless, all concurred that the blended service offered an enjoyable and acceptable daycare delivery format. Because those participating in-person could also see and engage with those linking to the activities remotely, and vice-versa, service members began discovering positive potential for technology in their lives as well as that online digital engagement might be both feasible and an acceptable tool for social engagement. Initial findings suggest online daycare has value for stakeholders, especially those with limited daycare access, but further examination of the sustainability of an online or blended delivery model is required. Fieldwork and data analysis are ongoing on this project with additional findings to be disseminated in due course.

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Research Session Thursday

Thursday, 9th September

15:30-17:00 CEST

Practitioners Presentation Paper

Living Lab as the Cluster of Innovating, Valorising and Internationalising the Higher Education Sector: the living lab collaboration between Korean and Dutch universities

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Abstract

The collaboration of university initiative living lab projects between Korea and the Netherlands has been raised to the level of most important innovation. The development of the living lab shifted from the international ties of education and research to the national agenda for the future of higher education and conversion and diversion towards a circular and sustainable economy. Especially, the Linc+ project, which is funded by the Korean Ministry of Education to accelerate academic-industrial collaboration, launched the Korea universities' living lab network, comprising over 43 universities, and strengthened the international co-creation platform with Dutch universities through living lab projects, such as serious game design, smart ageing, and social innovation. The mutual collaboration has benefited the creation of spaces for talents, quality education and research, ambitions for internationalisation, and led to the higher impact of living lab projects contributing to the solution of future societal problems. This paper will demonstrate the successful procedure of the living lab collaborations between Dutch and Korean universities, and the solidarity of the diverse strategies behind the multiple stakeholders, including government institutes, policy makers, universities, local authorities, coordinators, facilitators and connectors. The key factors of this international collaboration are based on the segmentation of the living lab sectors for clear vision and interests, targeting future-oriented needs, developing online platform and maintaining its continuity after the pandemic era.

Key words

transnational living lab, higher education living lab, international collaboration, national agenda for enhancing higher education, academic-industries collaboration, integrating co-creation to international living lab collaboration, social innovation and living lab projects

Three pillars for a macro-level living lab

The structure of the frame of a living lab can be divided into macro-meso-micro levels according to the size and working process of the living labs. The collaboration between Dutch and Korean universities and other stakeholders launched living lab projects 10 years ago, supported by the initiative and implementation of policy makers and ministerial agents in the field of science, national research funds and higher education. The benefit of the macro approach to shaping the living lab ecosystem as an open innovation platform is to create creativity and an autonomous environment for the emerging market, and the balanced and future-oriented goals for the R&D projects, as well as the enhancement of quality in the higher education sector and research for measuring future global changes. This paper demonstrates the passage of the macro-level living lab implement, which contributes to the positive effects of living lab projects between different societies, highlighting the teamwork of diverse partners and participants and the allocation of different roles to them.

The role of higher education is important in the living lab system by providing the cutting-edge knowledge for prioritizing end-users' needs in the process of developing new products and services, and cultivating the ability and knowledge for the next generation through open innovation resources. Above all, it becomes important to have experiences from the real-life learning environment, including the users' needs, industries' dilemmas, and societal challenges. Additionally, the shift to a sustainable society and circular economy system requires various experimental approaches for finding alternative and radical changes, which can be achieved from the engagement of diverse stakeholders from a public-private partnership. Finally, building the resilience after the pandemic era should be combined with the awareness of the value of diversity and inclusion. The graft of the living lab concept onto education and research of higher education has been evaluated as a positive means, because the importance of co-designing and co-working in a living lab ecosystem could meet the needs of the times.

In addition to the advantages of employing the living lab process in the educational content of higher education, the problem-solving approach can be combined with the practice for the next phase of globalization out of the traditional way of international collaborations in universities' level through exchange student programmes and scholarships. The discussions and research for launching living labs between different societies and culture encourage thinking both globally and locally, resulting in meaningful consequences that take into account future activities for contributing to a better future together through the living lab practice. As the global policy institutes make a particular point of emphasizing, the ideas for a better future should be considered from both perspectives, global and local, and the new criteria of higher education, such as fluency of ideas, creative thinking, complex problem-solving, social and emotional skills, could be achieved through living lab collaborations with international partners.

Nuffic, a ministerial agent for internationalising Dutch higher education in the world since 1952, had advocated the value of living lab collaboration with international partners, using its network in Brazil, Indonesia, China, Mexico and Korea. The main missions for connecting Dutch students and professors with diverse markets and cultures focused on finding opportunities in global emerging markets, cultivating student entrepreneurship, as well as making capacity-building in third countries for achieving SDGs. Especially, living lab based curricula with international universities were geared toward the national economic agenda, such as water, energy, healthcare and creative economies. In order to help find the living lab issues and partners, Nuffic Neso offices collect up-to-date information about the opportunities and requests from the local authorities, building a mutual trust relationship with a broad range of education institutions, relevant government ministries, regional and local governments, research institutions, scholarship providers, international organisations and the business sector. The themes of living lab projects with international universities were differentiated to reflect the diverse agendas and task forces of countries: Brazil (bio-based living lab), Indonesia (logistics, water problem, tourism), China (e-commerce, supply chain), Korea (creative industries, smart ageing care).

On the initiative of the Science and Technology Policy Institute (STEPI), Korea recently became the leading country operating many living lab projects. This was made possible by a socially innovative approach to improve society and technology system and working attitudes to collaboration and solidarity, which used to be based on a one-way top-down style of governance, specialist-focused research projects and economic growth centred around industry innovation. Some leading living lab projects, such as smart city, smart aging, sustainable society and technology system transformation, are collaborating with other international partners. Another recent development to reflect the beneficial aspects of the living lab concept is that the Korean university living lab network was launched in 2019 as a subsidiary organisation of the Linc+ project, which is one of biggest recipients of government funding for cooperation between academia and industries, and close discussion and co-working with Dutch universities and organisations, which have a different context of adopting the living lab concept as a useful tool for problem-solving learning and valorising the international collaboration strategies as well as the enhancement of international classes.

The macro-level of living lab strategies in both the Dutch and Korean contexts were indispensable for creating the driving force of an advanced educational environment, which should be integrated with the innovation agenda for a circular economy and sustainable development. The structure of the living lab project between Dutch and Korean higher education institutions is a key factor for clustering the three main objectives: valorising the method and goals of education, leading innovation, and providing the practicality of internationalising the mind-set of students.

The history of living lab collaborations between the Dutch and Korean higher education sector

The reason behind the success of the two countries' living lab collaboration in the higher education sector was the mutual needs for enhancing the stage of living labs to the level of most important innovation. There have been four layers in the development of the living lab concept during last 10 years. First, Dutch universities tried to find a new way of collaborating with Korean universities in applying the concept of the living lab in 2012. The role of government agencies like Nuffic, which opened a branch office in Seoul, was important for finding partner universities in view of the market needs and updated information about the opportunities and future strategies of Korean universities. The first roundtable has been held for introducing the value and innovativeness of a new model of international cooperation based on a real-life learning environment and multiple stakeholders' participation in Korean society. The first trial for living lab initiatives involved a search in creative industries sectors, with an educational and serious game being chosen for the main theme, with the Living Lab Game Jam Project being launched and led by the HKU University of Arts in Utrecht. The main activities resulted from the continuation as the Living Lab Game Jam Project with POSTECH the main partner of the living lab project, with reciprocal visits and a hackaton for creating prototypes of serious games. The most noticeable outcome of this first living lab collaboration is that the partners were able to ensure its continuity, and the living lab activities have been contributing to solve the societal challenges based on the association with the end-users, patients, and consumers from the market research stage, such special games for stimulating the cognitive activity of people with dementia, improving the daily habit for healthy food consumption, increasing well-being in of life. The partners and participants of the serious game living lab have been augmented from other countries, like Japan and China, and the final game designs have been presented as a successful living lab example to EU policy lab, local and regional authorities.

Dutch Prime Minister Mark Rutte's visit to Korea in 2016 served as a momentum for accelerating cooperation through an interdisciplinary approach of different fields of studies. It was the second phase of Dutch–Korean living lab collaboration, launching the 'Smart Ageing' living lab project, the collaboration between Fontys Academy for Creative Industries, Windesheim University of Applied Sciences, and Konkuk University have been accelerating various solutions for improving the well-being of seniors, care for elderly people, involving a dynamic combination of trend-watching, design thinking, gerontology and IT & ICT. Nuffic Neso Korea has initiated a multisectoral collaboration and cooperation in community care. The living lab concept has allowed us to explore different ways of cooperating, including training, manpower exchange, and joint project planning. Korean and Dutch students and academic staff of universities from Korea and the Netherlands work closely together through the smart ageing living lab project,

increasingly using the skills of the future. In order to make a real environment for co-working with end-users, diverse partners involved to the living lab project, including the social innovation centre of Seoul Metropolitan City, policy makers and facilitators of city labs, the experts of Dutch and Korean elderly care home, IT & ICT related companies, and civil service departments. Constructing the virtuous circulation between mutual parties is crucial for the implementation of a successful meso-level living lab collaboration.

In the third phase, Dutch and Korean living lab collaboration focused on valorising the living lab strategies for future models of the internationalisation of Dutch higher education and gearing the living lab with additional diversity and sustainability. First of all, it increased in size in 2019 by bringing in the participant ministries, policy-making institutes, more than 10 Korean universities, provincial innovation centres, companies, embassies, and Korean national newspapers and broadcasters. The object was to enhance the quality and deepen the co-work system, which could result from the balanced cooperation between macro-level living lab frame and meso-level living lab activities. This could be brought about by the initiatives of STEPI and Nuffic Neso Korea, so that an official forum of STEPI's KNoLL (Korean Network of Living Labs) presented the smart ageing living lab project as the exemplar of international cooperation, along with the Korean 'Smart Ageing' Living Lab delegation to the Netherlands in 2019.

The highlight of the recent development is that Neso Korea connected Dutch universities to the Korean Universities' Network of Living Lab. For instance, it was empowered by the serial collaborative events and delegation visits, such as Dutch Universities' participation in the launch of the Korean Universities Living Lab Network, and the official roundtable of the Dutch–Korean Universities living lab network in January 2020. After the outbreak of corona, the living lab collaboration was smoothly migrated to an online basis, and the discussions during the pandemic era included how to share the societal movement in the post-corona, widening accesses between Dutch and Korean universities, shifting the main themes towards inclusion, diversities, and resilience. The successful procedure could be borne from the core characteristics of macro-level strategies and leadership: segmentation of the living lab sectors, targeting the future-oriented needs, innovating higher education by facilitating the living lab projects, and by developing online platforms and maintaining their continuity.

The innovative outcomes of the living lab collaboration

The Dutch–Korean network of living labs has contributed to the internationalisation of higher education sector by providing students with new opportunities for learning from different countries, which is the ideal path for sharing values, work ethic and ambitions. For enhancing the quality of education could be achieved by prioritising the method of solving problems for the curriculum design of Dutch and Korean universities. Additionally, living lab projects were directly linked to the eco-system of innovation: providing the meaningful way to contribute to society, encouraging the confidence of working together, endless support for continuing the sustainable relationship, and the responsible and unique position in stimulating the qualified networking, ideas, and fast action plans for preparing for the next step. These three pillars (innovation, valorisation, internationalisation) of living lab collaboration functioned as an anchor for innovation in the co-work circumstances.

Further detailed results of the first set-up living lab in the field of serious game can be found when it became the showcase for food security and sustainability in Europe presented to European policymakers, showing the collaboration between HKU University of Arts Utrecht, Utrecht University and POSTECH. During the 10 years from launching the collaboration, Dutch universities had focused on the educational and research aspects of living labs at the beginning, later shifting towards the development of students' skills and capacity which will be connected to the creation of the new market for individual career and the circular economy for a nation.

The smart ageing living lab project became the highlight of re-framing the structure and goals of the Korean higher education sector, such as the Program for Industrial Needs-Matched Education (PRIME) and the Industry-University Cooperation (LINC+) projected by the Ministry of Education and the National Research Foundation of Korea, because the process of living lab collaborations with Dutch universities was paralleled with the main goals of gaining university autonomy, internal and external coordination, and financial support for innovative renewal. As the result of the progression of living lab collaborations, the curricula of academic major reflect the living lab elements, and the budgeting plan for higher education could engage thoroughly for providing the benefits of living lab methodologies in clustering innovation, valorisation, and internationalisation. At the same time, the experimental and innovative approach to elderly care in an ageing society could be united with regional development as well as international cooperation using the principal theories and leading actors to apply the transition model for the future.

Challenges of international living lab projects

While the axis of Dutch and Korean living lab collaboration centres around the academic and research network, it is necessary to broaden the scope of the mutual collaboration. In particular, the dynamics from industrial partners are vital for scaling up the productivity of living lab projects. Due to the different market structures between two countries, it is difficult for the bottom-up approach of meso or micro level living labs to be fully applied for the traditional R&D pursuits of a large-scale business oriented economy like Korea. However, real-life experiments are practicable for small or middle-scale business for the balanced development of a regional area, and the creative ideas of living lab participants and the field test of inventive solutions should be considered for regional and central strategies.

Providing a favourable climate for the execution of advanced living labs should be applied to living lab participants, groups, and institutions, using incentives for professors' further research, students' diploma, partner companies, otherwise each participant faces an unsustainable situation for concentrating on living lab projects in a mid-term of 3 or 4 years, for example. Through this incentive system, living lab practitioners aim to elevate their mutual goals with high motivation, which will result in finding the shortcut to be an influential project measured by high-level governance parties.

The main challenge for living lab participants for an international project is to gain the know-how for building common ground to create harmonious relations among stakeholders, for a complex set of criteria coming from multiple parties has obstacles that have to become overcome to everyone's satisfaction. Similar to the coordination of diverse opinions, it is not easy to meet individual and specific interests and needs throughout the project. For that reason, the role of facilitators and coordinators is indispensable for organising the multistage discussions, managing the shared goals, and negotiating diverse needs and differing views on the living lab activities and plans. Professional facilitators and living lab leaders should be fostered and supported by all participating bodies, so that the efficiency of actual management can lead a successful process.

Conclusion

Living lab methods provide the future-oriented collaboration for the macro-level of a national agenda for valorising higher education and for the root-based bottom-up approach of connecting universities and local stakeholders as well as end users. It could yield the innovation practice for university students, also the importance of the well-designed structure of diverse stakeholders for leading to a successful international living lab project.

There are key factors for creating organisational dynamics in binding different cultural contexts into a co-creation platform through living lab activities. First, it is important to divide into relevant sectors that can integrate the national resources and taskforce, and the local authorities' interests, and the future goal of higher education sector all together. Secondly, monitoring for the establishment of the future-oriented needs in diverse living lab actors is fundamental for the efficient connection of the triangular relations of policy, local needs, and experts. Lastly, the international living lab project should be oriented on the basis of trust-relations and shared value for contributing to the future needs of society, which can provide the motive for developing the flexible structure in the age of resilience and maintaining its continuity to co-create the future through living lab projects.

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Practitioners Presentation Paper

Co-Creation During COVID: Lessons and Unexpected Benefits of a Sudden Shift to Co-Creation in Virtual Environments

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Abstract

Lockdowns and travel restrictions due to the COVID-19 pandemic prompted a sudden and widespread shift to working in virtual environments. This shift posed substantial challenges to living labs that depended on in-person co-creation workshops to bring together users and other partners to drive the innovation process. Within Agriculture and Agri-Food Canada's Living Laboratories Initiative, these challenges were particularly acute given the unique characteristics of agroecosystem living labs, including the remote locations of users (farmers), a frequent lack of reliable internet access in rural areas, and the time pressures of impending and immoveable deadlines imposed by the growing season. This presentation will share the experiences and adaptations that were made to living lab co-creation approaches in response to a global crises. Examples of solutions used across the network and in the launch of the new program included direct translations of in-person workshop formats to virtual environments, in-situ Zoom hosting on mobile devices in farmer's fields, and hybrid events where limited in-person gatherings were allowed. The lessons learned in this context will be of interest to others who need to adapt their processes in response to unique new challenges. However, this experience also demonstrates how the crisis forced process improvements whose benefits extend beyond the crisis itself and revealed additional benefits and solutions to pre-existing challenges.

Key words

agriculture, agroecosystem living labs, co-creation, workshops, virtual, COVID

Problem statement(s)

For many, when the world changed in 2020 in response to the threat posed by the COVID-19 pandemic, lockdowns and travel restrictions prompted a sudden and widespread shift to working in virtual environments. This shift posed substantial challenges to living labs that depended on in-person co-creation workshops to bring together users and other partners to drive the innovation process. Within Agriculture and Agri-Food Canada's Living Laboratories Initiative (https://www.agr.gc.ca/livinglab), these challenges were particularly acute given the unique characteristics of agroecosystem living labs [1], including the remote locations of users (farmers), a frequent lack of reliable internet access in rural areas, and the time pressures of impending and immoveable deadlines imposed by the growing season. The pandemic also posed an additional problem because it coincided with the launch of a new program of living labs – Agricultural Climate Solutions (https://www.agr.gc.ca/agriculturalclimatesolutions) – that traditionally would include in-person information sessions and workshops with potential partners across the country.

Methods/approach

Although each of the four living labs in this network follows a common framework and approach, there are differences in their partnership structures, objectives, and geographies that required different approaches to solving the challenge of continuing co-creating processes despite the COVID-19 pandemic. Examples of solutions used across the network and in the launch of the new program included direct translations of in-person workshop formats to virtual environments, in-situ Zoom hosting on mobile devices in farmer's fields, and hybrid events where limited in-person gatherings were allowed.

Results/outcomes

The results of the new approaches to co-creation revealed expected challenges associated with the shift from in-person to virtual interactions, such as technological limitations, uneven internet access, and altered personal interactions, which were not entirely possible to overcome but did not entirely inhibit progress. Moreover, there were unexpected benefits of these virtual interactions that offered some solutions to pre-existing challenges, such as users and partners that were widely distributed geographically and substantial travel demands across the network. Specific solutions were developed that will continue to provide benefits even after in-person meetings because possible again, but also the crisis unlocked the creative potential of participants and the realization of how different forms and formats of co-creation can

increase the efficiency and effectiveness of living lab processes.

Lessons learned

This experience demonstrates adaptations that were made to living lab co-creation approaches in response to a global crises. The lessons learned in this context are of interest to others who need to adapt their processes in response to unique challenges. However, this experience also demonstrates how the crisis forced process improvements whose benefits extend beyond the crisis itself and revealed additional benefits and solutions to pre-existing challenges.

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Full Research Paper

Co-creating a Living Lab for Sustainable Community Engagement

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Abstract

This study will propose the co-creation of living labs as a method for fostering a sustainable and proactive community of participants based on the idea of relational community engagement. The site of the research is a user-driven living lab called ‘Oyamachi Living Lab’, which is based on community development activities in a residential area of Tokyo. We will verify its effectiveness through action research that creates opportunities for residents to participate in research and co-production before its opening.

Key words

Urban Living Lab, Co-creation, Resident involvement, Community Engagement, Oyamachi Living Lab

Introduction

Co-creation and community are key concepts for living labs. As advocated in the Quadruple Helix Model, the involvement and collaboration of various stakeholders is essential (Compagnucci, Spigarelli, Coelho, & Duarte, 2021). However, the involvement and sustained proactive participation of citizens, which is a necessary precondition, is a common challenge to many living labs (Hossain & Leminen, 2019). The methodology has not yet been established, especially in terms of sustainable transitions in the region rather than service development （Von Wirth, Fuenfschilling, Frantzeskaki, & Coenen, 2019）. There are few useful insights on how to effectively engage diverse citizens (Akasaka & Nakatani, 2021). In urban living labs, that address specific local issues, particularly, citizens are also stakeholders, and their continuous participation in the living lab is desirable, rather than one-time participation in individual projects. Therefore, building the sustained engagement of participants is an important factor in the success of living labs.

Community engagement is a process of interaction and trust-building within a community, mainly by non-profit organisations, to achieve social outcomes through the voluntary cooperation of participants and collaborations with the community. Community engagement can be short-term or ongoing (Johnston & Lane, 2018). Engagement, which has been dealt with in the context of living labs and co-creation with users, has been analysed from the short-term episodic community engagement aspects (Andersen, Danholt, Halskov, Hansen, & Lauritsen, 2015; Habibipour, 2021). However, for sustainable living lab operations, a relational community engagement that maintains and expands everyday connections are important. According to Johnston and Lane (2018), episodic community engagement builds on the social capital generated from relational community engagements. This idea can also be applied to living labs.

Objectives of the study

The purpose of this research was to propose the co-creation of living labs with local residents as a method for fostering a sustainable and proactive community of participants. The case in point is the Oyamachi Living Lab, which was established by Tokyo City University in collaboration with a local community action group, the Oyamachi Project (2017-). This co-creation is a process of community engagement, which is the first step in building a sustainable relationship between local residents and the Living Lab. It is an attempt to establish a Living Lab based on the Living Lab approach, in which citizens participate in the creation process itself, rather than inviting citizens after the Lab is established. Previous research shows that leadership as

orchestration, such as setting the theme, creating the ecosystem, and opportunities for participation is important for the setup of living labs (Mori & Sakakura, 2019). In contrast, this study empirically explores how fostering social capital contributes to the promotion of sustained and proactive participation by involving participants in the establishment process, and the key points of this process.

Research subject

History of Oyamachi Project

The Oyamachi Project is a local community activity in the Oyamadai area, involving a variety of people, including local residents, elementary and junior high schools, stores, and universities. The Oyamadai area is a residential area located in the southern part of Setagaya Ward, Tokyo. It is characterised by a shopping street running north-south and a quiet residential area laid out in a grid pattern around Oyamadai Station on the Tokyu Oimachi Line, which opened in 1930. The Setagaya Campus of Tokyo City University is located to the south of the town. The Oyamachi Project was formed in 2017, with "learning" and "connection" as keywords. It has held workshops at elementary schools and exchange events in the shopping district, creating social capital and spontaneous activities that have not existed in the area's history (Sakakura, 2021).

Figure 1. Workshop at Oyamadai elementary school

Figure 2. Hokoten project

Background of the Oyamachi Living Lab

The Oyamachi Living Lab, based on the community of the Oyamachi Project, is organised and prepared by the Well-Being Living Lab Research Unit, a research project of the Tokyo City University Research Institute. Based on the results of the "Development and Dissemination of Information Technology Guidelines for Promoting Japanese-style Well-being" Project (JST/RISTEX), a university research unit was established to create a place for daily dialogue and development in technology to realise the well-being of the community. In October 2020, the Oyamachi Living Lab Preparatory Room was set up in the shopping district and started to be used on an

experimental basis. In October 2020, we decided to renovate the store of Yuta Takano, a representative of the Oyamachi Project, and set up a community café and living lab. The Oyamachi Living Lab is a user-driven project (Leminen, Westerlund, & Nyström, 2012). In Japan, there are living labs such as Tamapla LL, Kamakura LL, and Sunaba, which were established manually by companies, local governments, and universities, but there are very few community-based labs. Labs set up by organisations seem to have the problem of making participants passive, making it difficult to initiate open innovations for multiple stakeholders.

Research Methods

In this study, we designed and established a living lab with the participation of local residents. The specific procedure is to first make a list of local stakeholders from various fields and generations who are willing to commit to the living lab, and conduct interviews to identify its local characteristics and needs. The interview data were then coded and structured, and a concept and vision for a living lab suitable for Oyamadai was established. A workshop was held with the participation of local residents, including interviewees, to examine these concepts and discuss an implementation plan. Furthermore, participatory designs such as space and activity design were carried out multiple times, and the existing stores in the area were renovated and completed through DIY.

The effectiveness of the implementation was verified from data obtained through questionnaires and interviews with participants and participant observations. These data were examined from the perspective of how participants' relationships and commitments change and how proactive actions occurred after the establishment of the lab.

	2020				2021				
	May.	Jun.~Aug.	Sep.~Nov.	Dec.~Feb.	Mar.	Apr.~Sep.	Aug.~Sep.	Oct.	Nov.~
Stages of the Process	Research and Preparation				Invitation	Co-production		Establish	Operation
Activities	Listing of Stakeholders	Interview	Qualitative Data Analysis, Structuring	Developing a Vision	Vision Workshop	Design Action Plans	Renovation Pilot Implementation	Opening Event	Participant Activities, Design Projects
Details of implementation	Made a list of stakeholders who should be involved in Oyamachi Living Lab.	Conducted in-depth interviews with 33 people in four fields: education, local economy, medical welfare, and environment.	Coded and structured the interview transcripts. Extracted the 13 values of Oyamadai.	Based on the results of the data analysis, we brainstormed the ideal form and function of an LL that is unique to Oyamadai.	A workshop was held with about 50 local residents and stakeholders, including interviewees, to discuss the vision.	Several workshops were held to specificly discuss the design of the renovation and activities after the opening.	Conduct a DIY workshop on renovation with participants. Try out and practice the activities.	Plan and produce an opening event with participants and invite local residents and stakeholders.	Open the café space for participants' activities. Work with participants on design projects.。
Participation opportunities		●			●	● ●	● ● ●	●	● ● ● ●
Participant experience		Talk about their thoughts and hopes of the community, their awareness of the issues, and their own feelings and activities.			Listen to the results of the interview and the plans for the LL. Talk with other participants about their vision of LL.	Think about specific activities and space design for LL with other participants.	Try to formulate our own ideas. Create something together with other participants.	Organize an opening event together. Explain the lab to other residents.	Visit the lab often. Sometimes participate in design projects. The lab becomes their place to live.
Goals and degree of commitment		Forming a connection			Understanding and empathy, Interaction among participants	Continuing Participation, Envisioning Together	Action, Building Together	Role Acquisition, Ownership	Proactive Activities, Sustained commitment

Figure 3. Diagram of the co-creation process

Implementation: Co-creation process of Oyamachi Living Lab

Identification of Stakeholders

To establish a Living Lab, it is important to collaborate with a variety of local residents and organisations. In this project, we created a list of 10 participants from each of the four fields of education, local economy, local welfare, and environment, and asked them to be interviewed. This methodology builds relationships with diverse stakeholders and intentionally creates social capital.

Interviews and Structuring

Although the purpose of the interviews was to investigate the community's characteristics and needs, we conducted in-depth interviews with the residents of Oyamadai about their most important values, issues in different fields, and their expectations from the Living Lab. This allowed us to listen not only to superficial local issues but also to personal consciousness and intentions. We interviewed 33 people and conducted a qualitative data analysis of the interview data. This was organised into 486 codes and 98 categories, and 13 values that Oyamadai wanted to keep were extracted. The procedure was as follows. First, transcripts of the interviews were prepared and coded line by line. Then, the codes with common content were merged to form categories (middle items). Finally, we combined them and extracted 13 items. This work was carried out using the cloud-based software Mural.

Figure 4. Interviews with residents

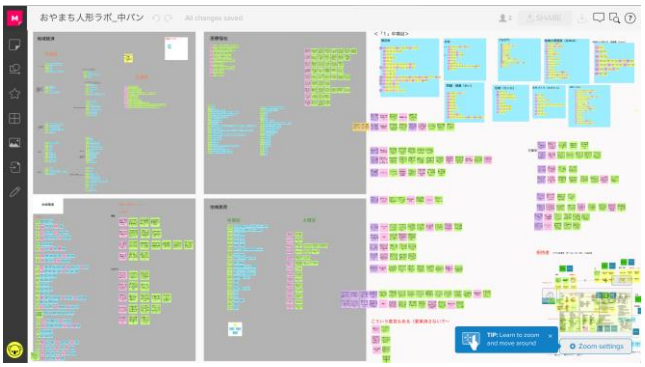

Figure 5. Qualitative data analysis using Mural

Table.1 The 13 values that Oyamadai wanted to keep

1 We decide what it's worth ourselves. Some people can understand it.
2 Positive and compassionate acceptance of everyone.
3 The spirit of building the town with our own hands is inherited.
4 The size of the shopping area is just right. We respect each other.
5 Not just a place to live, but a place to live well. It can make your life better.
6 There are no landmarks, but the scenery is somewhat Oyamadai-like.
7 A cluster of various things in a residential area.
8 We want to create a common history of events and old connections.
9 The shopping street is a meeting place.
10 A natural scene for children to play in the town.
11 Feel happy to be connected with others. A town where it is easy to connect with others.
12 Everyone can express themselves. Everyone can be challenging.
13 We want to keep the perfect harmony of this town for the future.

Vision and Workshop Tool Design

Based on these values, we established a concept and vision for the Living Lab that felt appropriate for Oyamadai and compiled it into a vision book. This was also the tool used in the workshops. To conceive these functional images, a workshop was originally planned to be held with the participation of local residents, but because of the COVID-19 pandemic it had to be cancelled. Instead, we held a brainstorming session with the core members of the Oyamachi project and the students. Based on the concept of ‘gathering, overflowing, and starting to play’, 20 functional images were organised. Some of the ideas are different from the usual Living Labs, such as a café, a place for community activities, and an open entrance for the shopping street.

Figure 6. Workshop tools

Figure 7. Visionary diagram of the Oyamachi Living Lab

OYAMACHI WAYA-WAYA Co-creation Workshop

On 13 March 2021, a workshop was held to encourage participants to be proactively involved in the process of the living lab. To this end, the workshop was structured to deepen the understanding of the Living Lab and allow participants to talk about their mutual expectations and consider the plan together. There were approximately 50 participants, including the interviewees. Because most of the participants lived in the neighbourhood, we divided them into four groups of three or four people at each of the four venues in the shopping district. The venues were connected online. The activities of each group's work were designed based on their common interests and the balance of their residential locations.

Although many of the participants had never met each other before, we first built trust within each group through telling stories about their deep-seated passions. This was followed by a dialogue on the analysis and vision for the lab, based on the interview results to promote understanding. During this session, participants chose one of the 13 values that they could agree on and talked about their specific experiences pertaining to it. This process helped them understand each other and share an implicit intellectual awareness of the town. Finally, the groups presented their ideas for the activities they wished would be conducted at the Oyamachi Living Lab. Through this workshop, many attractive design projects and community activities were proposed.

Figure 8, 9. Scenes from the workshop

Results and Considerations of the process

An online questionnaire was sent to the workshop participants, and 27 participants responded. All participants felt that the time they spent on the workshop was meaningful, and 96% said they would like to participate in future activities. Many said that they had encounters that would lead to future involvement and that they became fonder of the community by listening to other people's thoughts. Some said that they would like to invite their friends and acquaintances to participate in subsequent activities, which seems to have promoted an understanding of and empathy for the Living Lab and fostered a desire for continued involvement.

At this point, it seems that these workshops were an effective process for a relational community engagement that not only identified needs and built consensus, but also led to sustained commitment.

Conclusion

A The Oyamachi Living Lab was scheduled to open in October 2021. After the workshop mentioned above, a second workshop was held on May 18th to discuss the renovation plan. The process of continuous co-creation with participants is still happening at the time this paper was written. Additionally, the interest in living labs is growing, and preparations for joint research with local companies and institutions are underway. These include a community building at a cooperative house, a service-learning class at Oyamadai Junior High School, and a lifestyle study of remote workers. This research co-creates a living lab through a process of relational community engagement to foster a sustainable and proactive community of participants. This action research has shown that user-driven living labs can be established by inviting local people to participate in a research and collaborative co-process opening. It can be said to be one of the ways in which living labs are established from the bottom up.

No all conclusions have been drawn yet, but as a current consideration, the co-creation of a living lab, which takes the same form as a design project carried out there, can be effective as a process of relational community engagement. The concept of the living lab and its patterns of use can be created together with the participants. Upon completing the lab, we hope to report further details in a subsequent paper.

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Research in Progress Paper

Towards an XAI alignment workshop: a practice-oriented, multi-stakeholder approach for human-centred AI explanations

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Abstract

The field of Explainable AI (XAI) aims to find ways to create understandable and transparent AI systems to promote fairness, prevent bias and to make dealing with the systems easier. In our research we expand upon the existing approaches from a living labs and human-centred-design perspective. We present the XAI alignment workshop and its train-the-trainer concept as the first step of a holistic development methodology for context-specific explainable AI. Our aim is twofold: we focus (1) on how to create and embed AI explanations in a human context and (2) on how to support practitioners in doing so, since most systems that will affect the lives of people are created by professionals within a business context. To bridge the gap between research and practice, we are developing the workshop through case studies, and we created the train-the-trainer concept to try to empower practitioners to take ownership over the materials and build a more context-specific, inclusive and transparent way of working within their AI projects.

Key words

Explainable AI; Trustworthy AI; Human-centred design; Research-practice gap; Fairness

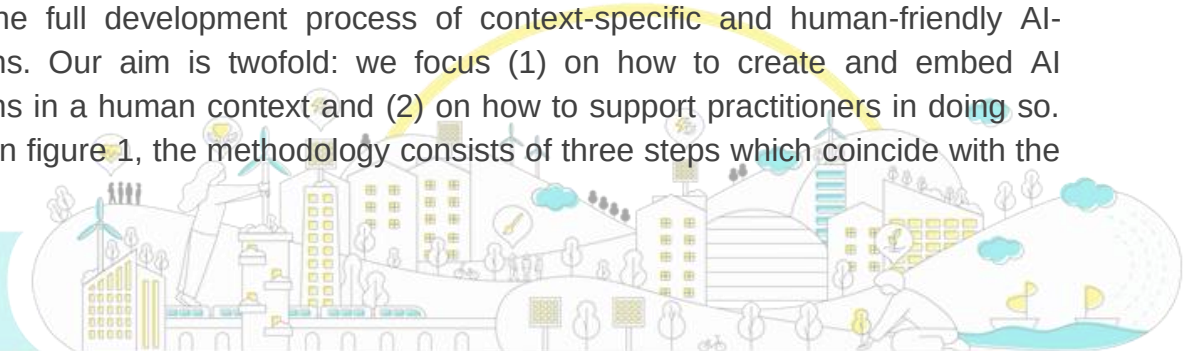
Introduction

As the application of Artificial Intelligent (AI) and specifically Machine Learning (ML) is growing, it has become clear that the hidden nature of AI systems poses several problems to the implementation in real-life situations where it affects human decisions and its fairness, accountability, and trustworthiness (Floridi, 2019; Cath et al., 2018). To ensure AI systems will be understandable and transparent, research into Explainable AI (XAI) has increased in recent years (Arrieta et al., 2020; Vilone & Longo, 2020; Morley et al., 2019). The aim is that people are better able to work together with the AI systems and bias can more easily be detected in an early stage. While studying the existing research in Explainable AI (van Leeuwen et al., 2021), we noticed three things:

1. There is more attention for the building and testing phases of the development process in XAI and less for design and evaluation of XAI in its use-context (van Leeuwen et al., 2021; Morley et al., 2019).
2. Most approaches aim to assist technical developers to understand their own systems and require an expert understanding of data science. These approaches often do not tackle how or why a system can be explained to different types of people involved in the system (van Leeuwen et al., 2021; Abdul et al., 2018).
3. There is a disconnect between research and practice. The techniques developed in academia often lack appeal to practitioners: they are hard to read, difficult to access, often not actionable and don't take the business context in which they will be used into account (Colusso et al., 2017).

This narrow focus on the technical and academic aspects of explainable AI is not sufficient to develop truly trustworthy, inclusive, and transparent AI systems and reveals a need for more contributions on how to design context-specific AI-explanations in practice. Our research, therefore, aims to find a way to support practitioners in creating AI explanations that are designed and developed for the human context in which they will be deployed. Within AI, we target specifically the development of digital systems built around ML models, since these are increasingly present in real-life services while being harder to understand and more difficult to design transparently.

As an answer to these observations, we are combining different tools and heuristics from human-centred design and living lab approaches in a XAI methodology that supports the full development process of context-specific and human-friendly AI-explanations. Our aim is twofold: we focus (1) on how to create and embed AI explanations in a human context and (2) on how to support practitioners in doing so. As shown in figure 1, the methodology consists of three steps which coincide with the



development process: ‘understand & align’, ‘explore & create’ and ‘evaluate & implement’. We have developed the ‘XAI alignment workshop’ to address the first step. In the workshop, we bring together the development team to define the requirements for an envisioned system with increased trust and fairness in system outcomes. Using a train-the-trainer format of the workshop we empower participants to take ownership over the workshop materials for sustainable implementation in their current practice.

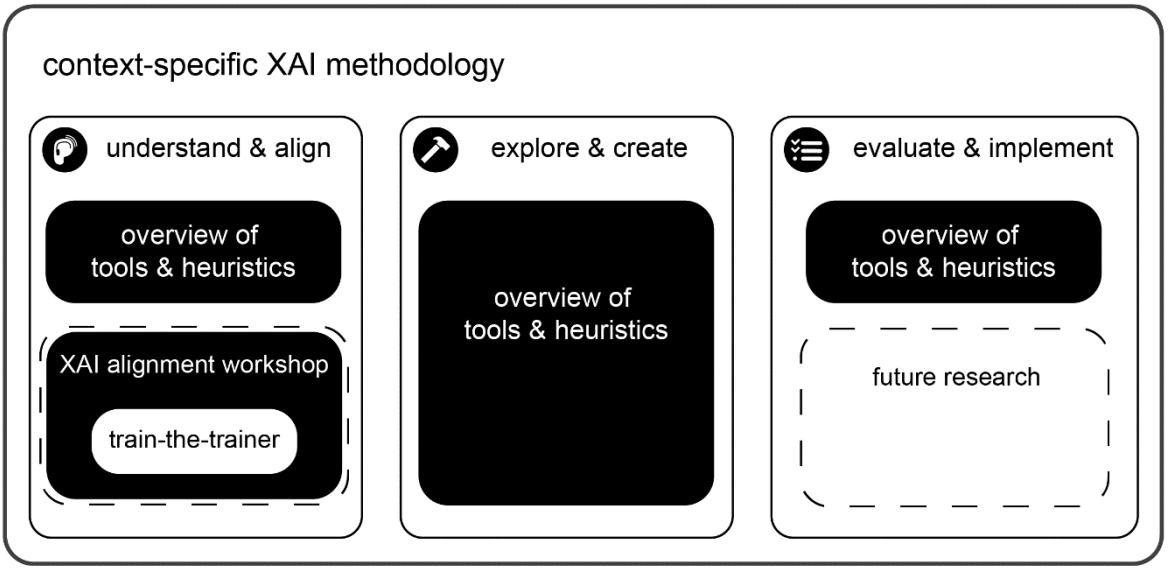


Figure 1. overview XAI methodology

Most AI systems that will affect the daily lives of people are not created in the academic sphere, but by professionals in a business context. The implementation of the workshop into a business context forms an integral part of connecting research and practice. Therefore, we aimed to create a workshop that appeals to the reality of creating AI systems in practice in two ways. First, the design process of the workshop followed an iterative process in which we have fine-tuned the workshop step by step in collaboration with practitioners through case studies and, second, through creating a ‘train-the-trainer’ workshop we aim to make this implementation into organisations easier. The focus of this paper is the workshop-in-progress and our ideas on how we intent to train others to use and implement the workshop in their practice.

Background ‘understand & align’ step

The ‘understand & align’ step aims to investigate the context around the (future) AI system. In this step, we bring together an interdisciplinary development team, from data scientists to business owners, to build and define their understanding of the system-to-be and the people involved. The result of this step is the definition of the explainability requirements based on the needs of potential different user groups of the AI system.

Doing this step early in the process with the diverse development team helps to create a clear vision for the system and to prevent the implementation of implicit assumptions into the system design in all phases of the process. An interdisciplinary team engaging in this step increases the value of this step by increasing the diversity of views and points of alignment or conflict considered. The more different voices are present throughout the process the more likely it is that biases and opportunities are discovered from the start (D'Ignazio & Klein, 2020). Alternatively, by noticing the lack of diversity of the team, one becomes aware that other voices should be consulted during the process (van Leeuwen et al., 2020). Therefore, it is important to involve future users and communities who will be affected by the system to listen to their needs. Empathizing with different stories helps to prevent the implementation of (biased) assumptions into the system design (Senova, 2017; Steen et al., 2007).

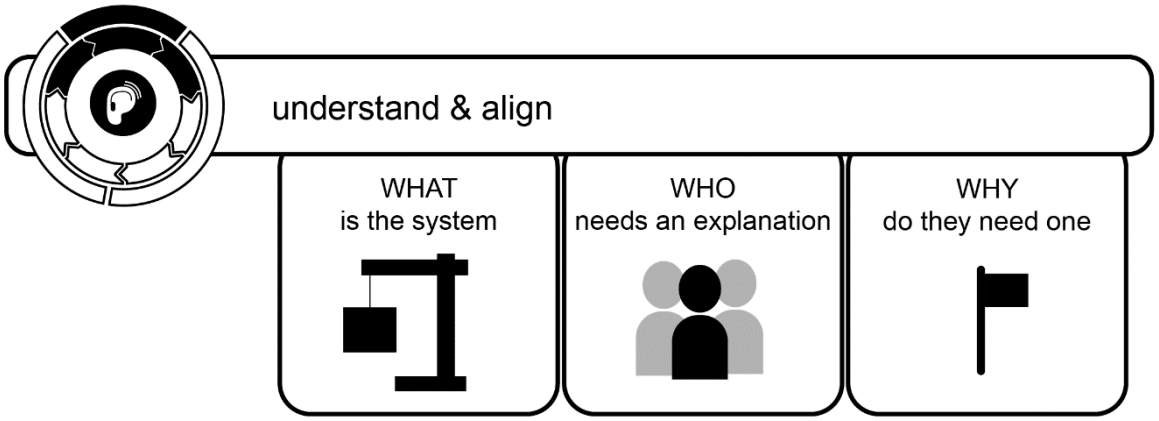


Figure 2. overview of 'understand & align' step

The method follows the XAI taxonomy in human-agent systems of Rosenfeld & Richardson (2019). They have defined the fundamental questions about the WHAT, WHO and WHY of explainability that are the base of the 'understand & align' step (figure 2):

- WHAT: What is the aim of the system, what does it do and what does it consist of?
- WHO: Who are the users of the system that need an explanation? Include all the stakeholders involved with the system, including the communities that might be (indirectly) affected.
- WHY: What are the reasons for explaining the system process, its predictions, or recommendations? Different reasons influence the type of explanation you need. An in-depth reflection is also needed to determine how an explanation can help to create a better impact on people and society.

To support practitioners in answering these fundamental questions of Rosenfeld & Richardson (2019) during the 'understand & align' step, we have developed the 'XAI alignment workshop'.

XAI alignment workshop

The XAI alignment workshop is a co-creative workshop in which the full and diverse development team comes together, preferably with representatives of the main users. Through the different exercises they will discuss and reflect upon their perspective on the system and try to build an aligned understanding of its goals and the people involved in and affected by the system. The workshop follows the three questions of WHAT, WHO and WHY about the technical, social, and ethical parts of the AI-application.

Methodology of creating the workshop

There are not many tools readily available that focus on context-specific explainability in the early phase of the development process (Van Leeuwen et al., 2021). We mapped a few different tools for this step, however, the tools range substantially in practical usefulness. We have combined and adapted three of the existing tools in such a way to be suitable for practice and to fit our specific focus on explainability. The tools that informed the set-up of the workshop are:

- The Artificial Intelligence Impact Assessment (AIIA), developed by the Dutch national think tank ECP Platform for the Information Provision, is a structured method to clearly map out the (social) benefits of an AI application (ECP, 2018). Attention is also paid to analysing the reliability, safety, and transparency of the AI system.
- ML Lifecycle Canvas (Zhou et al., 2020) was designed to assist novice designers at the start of their design process for a user experience empowered with Machine Learning.
- A component of designing new technologies is imagining the impact they will have on the world. To facilitate this Artefact created the Tarot Cards of Tech (Artefact group, 2017). These cards can be used during team meetings to perform an informal impact assessment and ideation.

Through the case studies, we have iteratively reformulated, added or removed (parts of) exercises, questions, and templates to better suit the purpose and participants of the XAI alignment workshop.

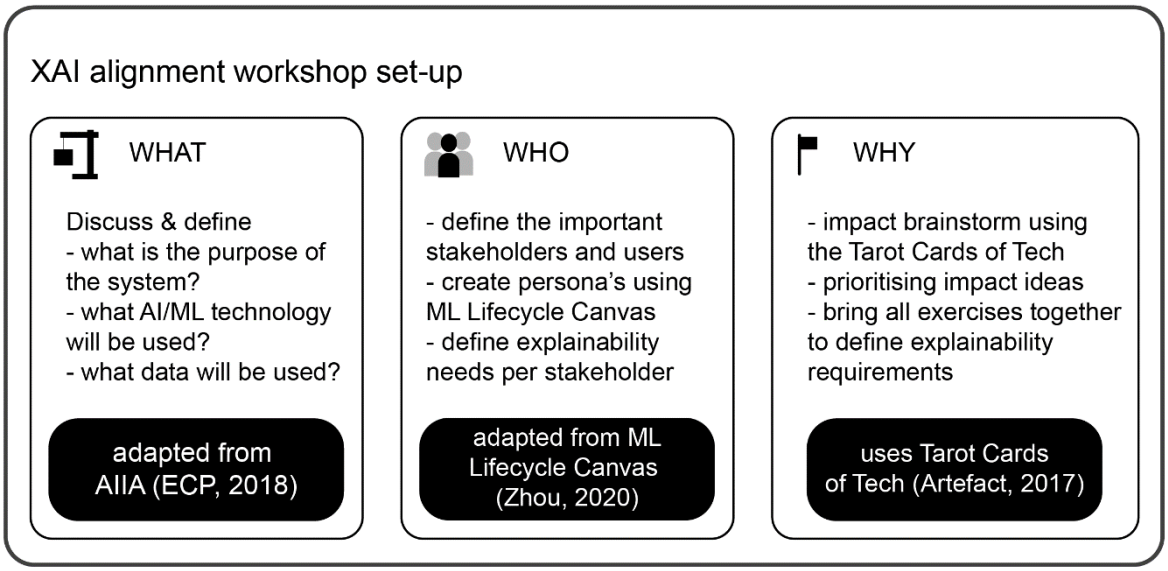


Figure 3. overview workshop set-up

Set-up of the workshop

The topic of the workshop is a specific and real AI-project on which the team is working and should be done preferably at the start of the project. An overview of the workshop set-up can be found in figure 3. In the first exercise we will discuss the WHAT to map out the technology and its context following several questions based on the second step of the Artificial Intelligence Impact Assessment tool (ECP, 2018). Afterwards, in the WHO section, the participants are asked to create the persona's based on a few common stakeholders, such as developers and marketing, using the adapted persona cards from the ML Lifecycle Canvas (Zhou et al., 2020). The participants use these personas to brainstorm and reflect upon the explainability needs in smaller groups.

In the third exercise, we will individually brainstorm different impact ideas using the Tarot Cards of Tech (Artefact group, 2017) to determine the WHY of explainability. Finally, the created explainability needs and ideas will be used to define requirements for improved explainability in the AI-application.

Train-the-trainer workshop

The reason to go one step further with a train-the-trainer workshop is to ensure participants are not only inspired but can also take the workshop home for implementation into their own living labs and organisations. During this workshop we will guide the participants through the workshop set-up, to give them the ability to learn more about the background and the tools to facilitate the workshop on their own. The workshop uses a use case that consists of a technology that is familiar to most of the participants. The use case needs to be general so that the participants, who are not themselves owner of the technology, are able to work with it. We also provide pre-filled

templates of the AIIA and persona cards to have more time discussing the background and implementation of the workshop.

Conclusion

We have presented the need for more practical and context-specific approaches for creating explainable AI systems and the methodology and workshop-in-progress that is our answer to this need. The XAI alignment workshop offers a practical tool for practitioners to discuss and develop context-specific AI systems and explanations. The practical implication is that it should become simpler for organisations to create AI systems that are transparent and beneficial to human and society. In addition, the train-the-trainer concept offers a new way to bridge the gap between research and practice by empowering practitioners to implement the workshop into their practice in their own way, making it more likely to stick on the long-term. Even though it proved highly beneficial to have the different stakeholders who will work on the project discuss the WHAT, WHO and WHY of the AI-project together, a limitation of the workshop is that it might be hard to gather a full team on a structural basis. We are currently looking for solutions together with participants from the previous case studies. In future case studies, we plan to explore the needs of practitioners more in-depth and test the train-the-trainer concept further.

In addition, we are also working on the ‘evaluation & implementation’ step of the XAI methodology (see figure 1) by mapping the existing scales and tools for evaluation. From a human-centred perspective, the evaluation of the explanation is just as important to ensure the system works correctly and benefits the people working with it and affected by it. We will bring the learnings of the XAI alignment workshop into the evaluation step as well. The workshop will, thus, act as a steppingstone for bringing more context-specific explainable AI methodologies into practice along the complete development process.

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Full Research Paper

The Urban Living Lab as tool for introducing circularity in the everyday life of vulnerable neighbourhoods: Case study Kerkrade-West, the Netherlands

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Abstract

The United Nations Sustainable Development Goals are a global framework towards a better world in 2030 including provision of basic human needs and tackling complex societal challenges that require sustainability transitions and changes in current socio-technical systems. One particular challenge is an urban circular economy transition that is currently mainly explored from a sectoral and technological point of view, leaving behind the socio-spatial and socio-cultural perspective. This study, therefore, explores the role of ULLs and the introduction of sustainability concepts in a socially vulnerable neighbourhood and its public space in Kerkrade-West, the Netherlands. Vulnerability refers to a mix of physical, socio-economic, and cultural challenges that weigh on the overall quality of life in a neighbourhood where inhabitants are concerned about everyday livelihood rather than sustainability practices. A three-year urban design workshop cycle with local urban stakeholders, citizens and students addresses the urban circular economy transition by combining urban design with socio-historic neighbourhood structures and the introduction of sustainability concepts in public space. As such, the workshop cycle provides three lessons to contribute to the urban circular transition: 1) lower the threshold of the circularity concept by introducing it in public space rather than framing it as a private and business concept only. 2) ULLs provide a tool to combine and bridge global sustainability concepts with everyday livelihood in vulnerable neighbourhoods by proper embeddedness in local context and dialogue with inhabitants. 3) The social value of circularity (and other sustainability concepts) are a tactic for neighbourhood revitalization that builds upon and improves local socio-spatial values. To conclude, we argue that the challenges to transition

towards more circular economy models is mainly a social-cultural one, and requires a shift in the way we explore, disseminate and integrate circular practises as well as perceive notions such as ‘circularity’ in urban development and the daily lives of citizens, especially in vulnerable neighbourhoods.

Key words

Urban Living Labs, Vulnerable Neighbourhoods, Urban Circular Economy, Neighbourhood revitalization.

Introduction

The Sustainable Development Goals (SDGs) as set in the United Nations Sustainable Development Summit in New York in 2015 set the base for a global framework towards a more sustainable world. Therein, 17 SDGs provide a rather holistic perspective for a sustainable world in 2030. These targets range from basic human needs, like no poverty (SDG1) or clean water and sanitation (SDG6) to complex and world challenges that the urban environment encounters, like sustainable cities and communities (SDG11) or climate action (SDG13). According to Thacker et al. (2019) widespread diffusion of technological innovations and new infrastructures is essential for the achievement of many SDGs.

''Sustainability transitions are fundamental changes in socio-technical systems such as energy, food or transport that aim to address grand challenges in a way that meets the needs of the present without compromising the ability of future generations to meet their own needs'' (Markard, Geels & Raven, 2020, p.1). Also in the urban sphere, sustainability transitions are about changes in markets, policy, culture, technologies, infrastructure as well as in human behaviours and practices (Bulkeley, Castán Broto, Hodson & Marvin, 2010; Frantzeskaki & Loorbach, 2010; Schaffers & Turkama, 2012; Voytenko, McCormick, Evans & Schliwa, 2016). However, progress in achieving the SDGs has been rather limited, because of the rigidity of existing systems (Sachs et al., 2019), such as in governance, finance, and the energy transition. Existing regimes or systems, namely, seem to be difficult to pry off because they are stabilized by processes that create path dependencies and entrapments (Grin, Rotmans & Schot, 2010). The other reason for this slow process is the diverse geographic context and their needs on regional and local level. Hence, the need to identify the geographical level sustainability challenges and transition changes are expected to occur. Our argument is based on 5 years of experience in ULL set ups in Kerkrade and Maastricht in the Netherlands and on literature that confirms the success of community initiatives and small-scale design interventions which are related to small scale interventions on public space level and its proven impacts on urban vitality (Mouratidis and Poortinga, 2020). Indeed, Anderson, Ruggeri, Steemers and Huppert (2016), provide evidence from Manchester (UK) that community-led physical improvements to public space increases urban vitality and the sense of community at the local level. Their research was conducted on micro-level, about a small plot of land in ownership of the municipality. As such, there is a knowledge gap regarding the effects on meso-level, between plots and neighbourhoods.

Following Markard et al. (2020) sustainability challenges are global, while transition changes happen on national or local level since on these levels innovations and interactions between policymakers, firms, consumers, and civil society organizations

are situated and understood by those involved. On this scale, strategic niche management or experimentation is one mean to govern transitions to gradually transform current regimes to tackle sustainability challenges (Kemp, Schot & Hoogma, 1998). Urban Living Labs (ULLs) seem one way to do so regarding urban governance and planning (Marvin, Bulkeley, Mai, McCormick & Voytenko, 2018; Schaffers & Turkama, 2012), because they are similar in view to transition management (Loorbach & Rotmans, 2010) and centre the use of experiments; viewed as less directed processes in which innovation or ideas are demonstrated, tested and experiences are gained (Bulkeley & Castán Broto, 2012; Kemp et al., 1998). Growing social networks, innovations and learnings established are thought crucial as outcomes for niches and experiments to lead to regime transitions (Brown and Vergragt, 2008).

The circular economy (CE) or circularity is one particular challenge investigated in this study. Apparently, there is incongruence about CE between policy and citizen understanding (Repo, Anttonen, Mykkänen & Lammi, 2018). Indeed, In the daily life of (non-expert) citizens and urban stakeholders CE remains one-dimensional and unclear to what extent it affects daily lives beyond recycling and frugality in the household (Korhonen, Honkasalo & Seppälä, 2018). There appears to be a focus on ecological and economic perspectives, while the social perspectives remain unexplored (Cuomo, Ravazzi, Savini & Bertolini, 2020); especially in socially vulnerable neighbourhoods in which inhabitants already face problems of poverty, unemployment, or a lack of social cohesion (Van de Weijer & Blezer, 2021), and therefore are concerned with everyday livelihood rather than sustainability practices. Therefore, this study is based on 3 years ULL in Kerkrade-West and explores the research gap highlighted in the previous section; namely the role of ULLs in fostering sustainability and CE concepts in a socially vulnerable neighbourhood. Consequently, enhancing the understanding on the CE and processes needed to facilitate this transition from a socio-spatial and socio-cultural perspective.

Conceptual framework

ULLs are an emerging approach across European cities to tackle their urban challenges. It brings together citizens, policymakers, businesses, and educational institutions and researchers to collectively find solutions in real-life environments in which urban problems are encountered. As such, they are both practice-driven organizations that facilitate and foster open collaborative innovation, as well as in-situ environments or arenas where both open and user innovation processes can be studied and are subject to experiments or interventions wherein new solutions are developed.

In theory, discussion continuous about a definition of ULLs. Voytenko et al. (2016) explain that there is no universal definition of ULLs since they are formed by various

stakeholders, focus on different goals, and form different partnerships. More recently, Chronéer, Ståhlbröst and Habibipour (2019) developed a unified definition of ULLs. However, and in general, one can assume that the core idea of ULLs is that urban sites can provide a learning arena within which the co-creation of innovation can be pursued between research organizations, public institutions, private sectors, and community actors (Liedtke, Welfens, Rohn & Nordmann, 2012).

While operating as such, the outcomes of ULLs can be tangible, intangible, or diverse in innovation, being incremental or radical according to Hossain, Leminen and Westerlund (2019). Thereby, most studies have focussed on incremental rather than radical outcomes (Hossain et al., 2019), which is not surprising because successful ULLs are inherently local (Burch, Graham & Mitchell, 2018) and are viewed as the starting point for scalability and transformation at different scales (Astbury & Bulkeley, 2018; Seyfang & Smith, 2007). Additionally, Gualandi and Romme (2019) argue that value created in ULLs can be economic, business and public in nature. The first is about tangible and measurable outcomes, like product and service development. The second is an extension of economic value, such as trainings provided. The third is about non-financial impacts of ULLs that following Baccarne, Schuurman, Merchant and De Marez (2014) also link with realizing policy goals, and arguably including CE purposes as well. In these terms, public value is considered the most important in ULLs as they have a strong focus on social value creation and civic engagement (Baccarne et al., 2014). Yet, at the same time, these are the most difficult ones to measure such as urban safety, environmental awareness (Ståhlbröst, 2012) or adoption of new practises (Von Wirth, Fuenfschilling, Frantzeskaki and Coenen, 2018).

Indeed, demonstrating the long-term value of ULLs is one of their threats (Guzman, del Carpio, Colomo-Palacios and de Diego, 2013), because of the societal acceptance of innovations (Gualandi & Romme, 2019; Schaffer & Turkama, 2012). In fact, social acceptance of innovation and adopting new consumer practises are crucial accelerators of sustainability transitions (Stoeglehner, 2020; Markard et al., 2020), while at the same time remaining one of the main challenges (Markard et al., 2020); highlighting the importance of the social dimension in for example the CE adoption and transition besides the current limited focus in practise to ecological or economic perspectives. Altogether, outcomes in ULLs should apply to individuals as well as collective groups and should include both economic and public outcomes to start *''transformative innovation''* (Den Ouden, 2011, p.13) for the de-institutionalisation of existing socio-technical structures and new more sustainable ones being created, diffused, mainstreamed, and institutionalised again (Von Wirth et al., 2018).

Currently, CE aspects are mostly explored from a technical fix and flows of material goods perspective, i.e. the typical re-making of products or services. For example, in the resilient city or smart city concepts that focus on those resources important for the

re-production and protection of cities or making material flows more efficient and flexible, respectively (Marvin et al., 2018). Meanwhile, the World Cities Report 2020 'The value of Sustainable Urbanization' views the CE approach as a systematic approach to economic development that is regenerative rather than linear in which a vision is offered to mutually reinforce economic and environmental value, leaving out a social dimension (UN-Habitat, 2020). Also, it argues urban stakeholders should take the CE approach more seriously over traditional make-take-waste models.

While viewing ULLs and circular practices in the rural contexts, Zavratnik, Superina and Stojmenova Duh (2019) argue that CE values should be the base for ULLs to establish new ecosystems that enables synergies among urban stakeholders involved. They view the CE approach as outlined in the Global Resources Outlook 2019 report (UN Environment Programme, 2019): *''The Circular Economy is one in which the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste is minimized. This is in contrast to a linear economy, which is based on the extract, make, and dispose model of production and consumption'' (p.23).* Again, limiting the view on a social dimension. In fact, there is a need for new sensible development methods that consider social, cultural, and natural aspects to ensure future wellbeing and attractiveness as a place to live in, and the ULL establishes such an approach that is based upon local resources and enhances the potentials for social innovation and social change (Zavratnik et al., 2019). This way, ULLs do not only aim to improve the economic welfare of the local or regional communities, but above all the social and environmental welfare as well aligning with everyday livelihood. Indeed, societal transformation in EU Policy takes on a deeply spatial dimension since innovation is the driving force for achieving social and territorial cohesion instead of sector policy improvements only (De Bonis, Concilio, Leanza, Marsh & Trapani, 2014). Consequently, ULLs seem suitable *''to promote territorial innovation as a shared objective in the public interest, capable of generating initiatives that both increase the yield on territorial capital and increase citizen well-being and quality of life as a result of engaging all stakeholders in co-designed innovation processes of value creation''* (De Bonis et al., 2014, p.264). A similar view is the third generation of living labs that '*'portrays different modes of collaborative innovation, where different stakeholders and particularly users have crucial roles in innovation on platforms''* (Leminen, Rajahonka & Westerlund, 2017, p.22) in which city and neighbourhood contexts can be seen as socio-technical platforms (Westerlund, Leminen & Habib, 2018) that focus on social impact rather than technical or business innovation only.

In a moment of socio-economical and urban transition processes taking place in many Europe neighbourhoods, social bonds among neighbours are under stress and in many communities a sense of community is severely lacking (European Union, 2011). This lack of interaction is clearly manifested in the use or under use of public spaces (Jacobs, 1994). In fact, public spaces have been crucial elements of vital

neighbourhoods and to human daily lives and interactions since the old Greek concept of Polis and Agora as the Agora was an open public space used for many human interactions and set the base of Athens democracy (Sennet, 2018). It is also argued to be a truly public space where goods and ideas were freely traded (Montgomery, 2014). The essence of public space as the smallest urban spatial unit is an important catalyser for people's exchange, reminiscent the urban history and cultures well as arouses people's sense of identity and belonging (Ramlee, Omar, Yunus & Samadi, 2015). Revitalizing public spaces refers to design and program those places more inclusive and better useable to enhance life quality of citizens in their neighbourhoods (Van de Weijer & Blezer, 2021). As such, opportunity lies in including circularity aspects as public spaces are reused and become embedded in local resource cycles as well as historic human activity and interaction cycles.

In the specific case of the Netherlands, the declining position of public space can undermine social inclusion duo to privatization, reduced mobility and accessibility, fear and insecurity. This issue has been highlighted by recent studies and reports conducted by Dutch public institutes (see e.g., Sint, Mackenbach & Bosma, 2015). They state that the control of people experiences over their environment is an important element of well-being. For example, when people cannot reach facilities like shops or the theatre independently, they feel less safe on the street. Besides, demographic changes and the development of people working outside their community has resulted in a decrease of interaction between people within the city and especially within public space, facilities, and infrastructures, such as squares or playgrounds (Vermeij & Steenbekkers, 2015; Steenbekkers and Vermeij, 2013). Another study in 43 deprived Dutch neighbourhoods highlights the interconnection between insecurity and population structure change on the accessibility, connectedness, vitality, social inclusion, and identity of neighbourhood and public spaces (van Nes & López, 2013). In fact, a common challenge in the Dutch context (See e.g., Nabielek, Hamers & Evers, 2016 or Derksen, 2014).

Methodological notes

For three consecutive years, from 2016 until 2018 (See table 1) Zuyd University of Applied Sciences organized a one week workshop in the neighbourhood Kerkrade-West in the Netherlands (See Figure 1). The workshop series brought together multicultural and international groups of students of several faculties and disciplines, such as architecture, built environment, urban design and occupational therapy and brought them in contact with local residents and urban stakeholders, like the municipality or Housing Association. The workshop cycle was focused on projecting transformative concepts in public space in Kerkrade-West and geared at connecting experts and non-experts. To do so, students were instructed to study and analyse the

current and historic socio-cultural environment and (under)use of public spaces, as well as to re-design and realize them to enhance use of public space and to identify feasible patterns of use, paying particular attention to the physical, cultural, and social identities that define the place and support its ongoing evolution. To guide the student actions and to ensure work and results would be useful for the interest of the main three stakeholders involved (the community, municipality, and Zuyd University of Applied Sciences), i.e., accelerating sustainability transitions related to the local context, indicative questions were provided. For example, *''What new spatial identity can be developed?''* or *''What obstacles and barriers (both social and spatial) keep these spaces from being transformed?''*. Regarding the acceleration of sustainability transitions, the main interest concerned: 1) For the community, how to deal with the effects of demographic shrinkage, neighbourhood restructuring and improving the relationship between them and the municipality. 2) For the municipality, how to do urban planning in the foresaw of the new Dutch Environment and Planning Act (2022) and how to prepare citizens for a proactive and responsible role in their communities. 3) For Zuyd University of Applied Sciences, how to educate and prepare student about current complex planning practices in the urban environment. Given its focus on applied research, programming, furbishing, and maintaining public space under conditions of demographic shrinkage was centred. This resulted in drawings, maps, schemes, collages, and other artistic impressions that provided tactical-urbanism-like (Lydon, Garcia & Duany, 2015) small-scale interventions for local public spaces. Hence, the social aspects in the neighbourhood were placed central including a shared notion of circularity on neighbourhood level to improve the physical environment. As such, Kerkrade-West was positioned as the real-life environment in a ULL setting in order to enhance general quality of life of citizens by introducing circularity aspects in their daily urban environment. Three specific public space locations were investigated: Akerstraat, Heiveldplein (in Kaalheide), and Gracht (See Figure 2).

Figure 2. Kerkrade-West location in the Netherland. Source: Organization.

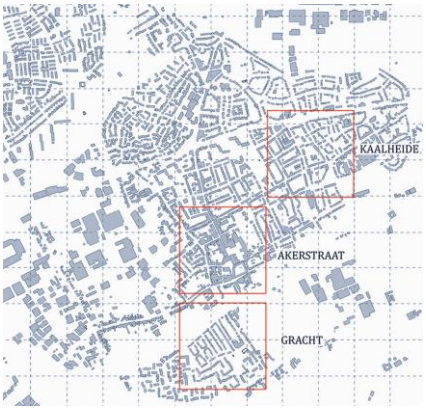

Figure 3. Location of the three project locations in the Kerkrade-West area. Source: Organization.

Table 1. Overview table of the workshop series.

Year	2016	2017	2018
# Participants (students)	50 students	65 students	65 students
Institutes	Zuyd University of Applied Sciences, KU Leuven, Breda Universities, Municipality, neighbourhood platform.	Zuyd University of Applied Sciences, KU Leuven, PXL Hasselt, Breda Universities, Municipality, neighbourhood platform.	Zuyd University of Applied Sciences, KU Leuven, PXL Hasselt, Breda Universities, BTU Berlin, Municipality, Stadsregio Parkstad, neighbourhood platform.
Locations	Akerstraat, Heiveldplein and Gracht.	Akerstraat, Heiveldplein and Gracht.	Akerstraat, Heiveldplein and Gracht.
Outcomes	Design scenarios, no further follow up actions.	Design scenarios, no further follow up actions.	Design scenarios that were the core of a follow up creative session with the local community in Gracht that ended up with detailed designs for physical intervention. The intentions were to implement the final design, however, due to finance issues the project was not implemented.

Akerstraat is a central street surrounded by shops on plinth level and apartments above. The street is developed from the 20s onwards and crosses the district in south-north direction. Despite its central location, Akerstraat is a symbol of decay in Kerkrade-West including intense car traffic, many parking spaces, vacant lots, and negative sentiments, such as a shabby and unsafe street, to local history as mine colony. Also, local entrepreneurs were negatively affected by the development of a commercial centre, Carboonplein; a similar designed square that hosts the weekly market (see Figure 3).

Figure 4. Akerstraat and Carboonplein in Kerkrade-West. Source: Organization.

Heiveldplein was highlighted as an underused public space by students investigating the Kaalheide area in 2016. Subsequently, Heiveldplein was centred in later workshops. It is a triangular square surrounded by 2-storey terraced houses and 3-storey apartment blocks; typical Dutch housing stock from the late 50s. Moreover, it was previously used as parking lot for a former football stadium that today only is used as training facility. Since 2009, the housing stock has been renovated and considered a great example on how to deal with consequences of a shrinking population. However, the Heiveldplein was not addressed in this process leaving it rather empty public space.

Figure 5. Heiveldplein in Kerkrade-West. Source: Organization.

Gracht is a neighbourhood with low-rise housing from the 60s-80s period and two high rise apartment flats from the 70s, owned by the local Housing Association. Some of the housing typologies are typical of the late 70s experiments in Dutch urban design and architecture for social housing. However, public spaces in Gracht are indicated as 'left-over' spaces in between housing stock or demolition activities. For example, the local church was demolished in 2012, leaving behind an unused empty field. Thereby, Gracht is isolated from other neighbourhoods in Kerkrade-West and lies in-between the railway track and industrial site that once served the Willem Sophia coal mine before closure in the 70s, and the Parkstad Ring Road completed in 2019.

Figure 6. Gracht in Kerkrade-West. Source: Organization.

The workshop cycle is evaluated by organizing a focus group discussion with Zuyd University of Applied Sciences, the municipality, and residents of the corresponding project locations in February 2020.

Figure 7. Workshop discussion between students, citizens and local stakeholders. Source: Organization.

Results

First and foremost, the involvement of students had according to participants a positive effect on the engagement of residents in the project locations. The students had a rather privileged position towards the local community and the municipality because of their neutrality in terms of connection to political and personal agendas. In general, residents were more willing to engage themselves with students, both Dutch and international ones, than with 'institutional' employees. They mentioned that students are open to local community needs, ambitions, and problems. As a result, the community felt that students managed to think critical on local affairs as well as went beyond conventional ways of working, even if proposed solution did not always fit in with the underlying issues or social mechanism. Indeed, students were in a learning process themselves and were invited to bring in their own insights, thoughts, and inspirations as well. Also, the attention given to the project locations contributed to the self-consciousness and self-esteem in the community and neighbourhood to appreciate current, historic, and social values rather than continuously emphasizing things that are less well.

Second, it was noticed that residents obtained a deeper understanding of sustainable building concepts and lifestyles in the urban environment as student involvement (via urban designs, drawings etc.) made sustainable concern less abstract. Consequently, residents got more used to implement environmental measures in their own environment. On the contrary, it is reported that participants could have had a 'soft' welcome including a strong role for social work students rather than directly focusing on urban design solutions with aforementioned disciplines. In such trajectory, it is expected to engage a more diverse group of residents and to find out the actual and precise concerns of the local community.

The dialogue among the municipality, local businesses, the community, and students tackled relevant issues to bother play makers and local contextual needs and challenges. These needs, challenges and themes also touched the importance of including energy and CE transitions as main ambitions for the region of Limburg that need to be translated in the local context of Kerkrade-West.

With regards to circularity, participants confirmed the high appreciation for projects that involve CE concepts and ideologies to bring back perspective to this vulnerable neighbourhood. Reviving these public spaces and, typically, cities involve branding techniques that are applied as a panacea across the world. However, several student groups succeeded in implementing concise and fitting CE strategies in their proposals, building on the genius loci which surfaces in their analyses of local opportunities, threats, and narratives. Two projects illustrate this.

Vintage Boulevard

This proposal gives Kerkrade-West a new identity by rebranding it as the centre for recycled, sustainable vintage fashion. The concept combines the circular economy concept that links with the vintage hype in the Netherlands and tackles the socio-economic challenges of the region. The vacant stores along the Akerstraat are transformed into spaces for workshops that teaches people how to design and recycles clothes, furniture, and accessories. It capitalizes on the existing second-hand stores in the street, but also drawing their activity into the street to enhance vibrancy. It tries to soften the sharp edges between inside workshops and street life, via mobile pop-up shops added in front of the stores. These pop-up stores not only allow the activities from inside to spill over to the public realm, but also forces traffic to slow down and making public space more pedestrian friendly.

Recognizing the importance of the parking lots for the local entrepreneurs, the daily interventions in this concept aim to integrate parking space and food- and entertainment trucks according to community needs. Also, it is organized and managed by a community committee that engages residents in the neighbourhood. During weekends, the space is transformed into a place for street experience; a large pedestrian square that gives the area an iconic atmosphere with the church as focal point. Overall, there are 3 main zones in the proposed square: the seating area, the street performance corner, and the central vintage market. The market, being the largest event in the vintage centre of Kerkrade(-West), aims from strategic point of view to attract not only local people from the Netherlands but also from Belgium and Germany, just across the border. Thus, the circular aspects of the project start from the economic opportunities in the vintage product and refurbishing market towards recycling public spaces by giving them diverse and flexible functions along seasons and weekdays. Consequently, aligning with community needs, challenges and themes of vitality and social inclusion.

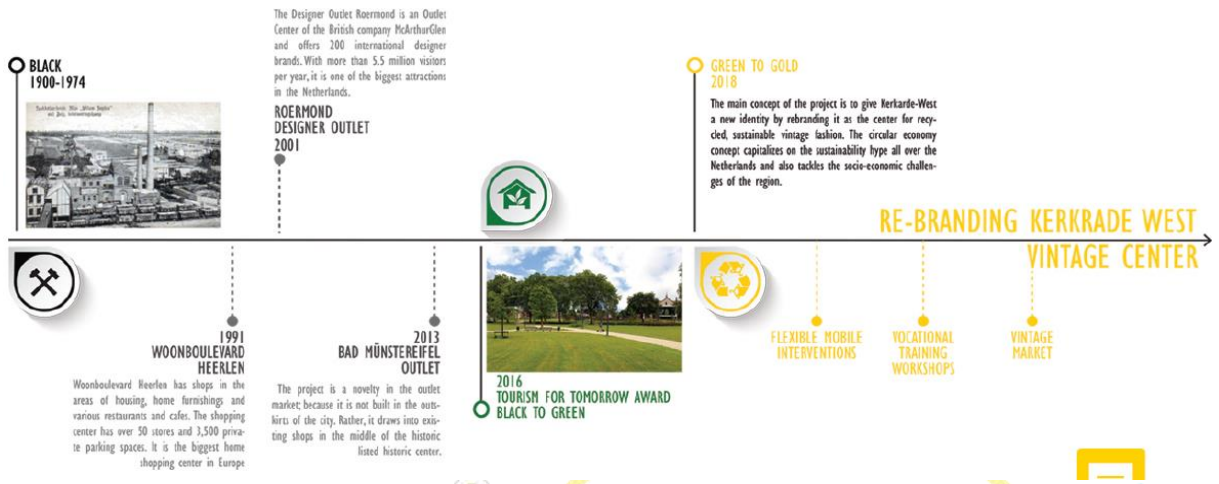

Figure 8. Vintage Boulevard project. Source: Student group.

Figure 9 (continuation). Vintage Boulevard project. Source: Student group.

Bricks filling for social platforms

This proposal aims to redesign and adapt the Akerstraat to particular desires of three social groups: elderly, youth, and families with young children. The concept investigates how these social groups feel by using certain places, what effect certain interventions may have on the location itself, the façade, the street, and its connection to other street elements. Also, it contributes to social interaction and meeting outdoors. As such, the project mainly focusses on the lack of social cohesion in the neighbourhood by creating opportunities for vibrant street life where people can express themselves and experience public space. To do so, the concept uses (refurbished) modular units that are moveable along the Akerstraat in order to allow for learned adaptation by stakeholders involved during different stages of the project implementation, based on user feedback. This way, it is possible to find out what kind of elements suits certain parts of the Akerstraat best, based on the needs and wishes of these social groups. Also, economic opportunity and vacancy can be tackled by ensuring modular units are placed in front of those spots to grow into the empty buildings. Thus, the circular concept materializes in creating modular units with flexible uses and location that give them a sustained role in public space that adapts to the local community needs in time and space.

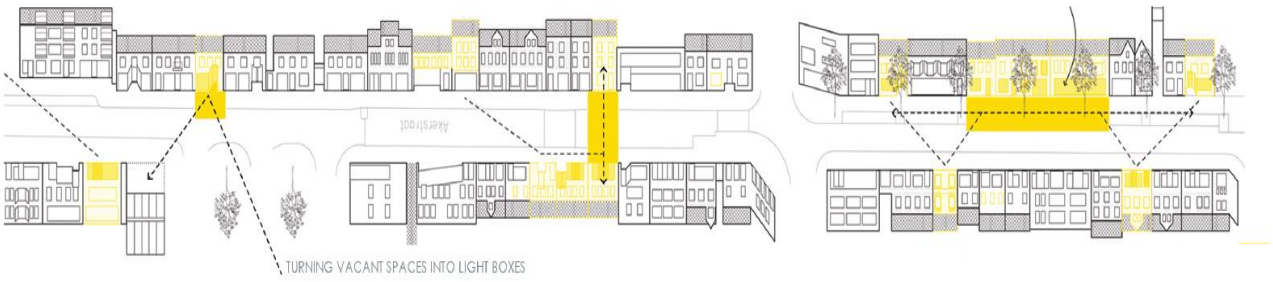

Figure 10. Ground floor plan with the urban voids filled in with new functions. Source: Student group.

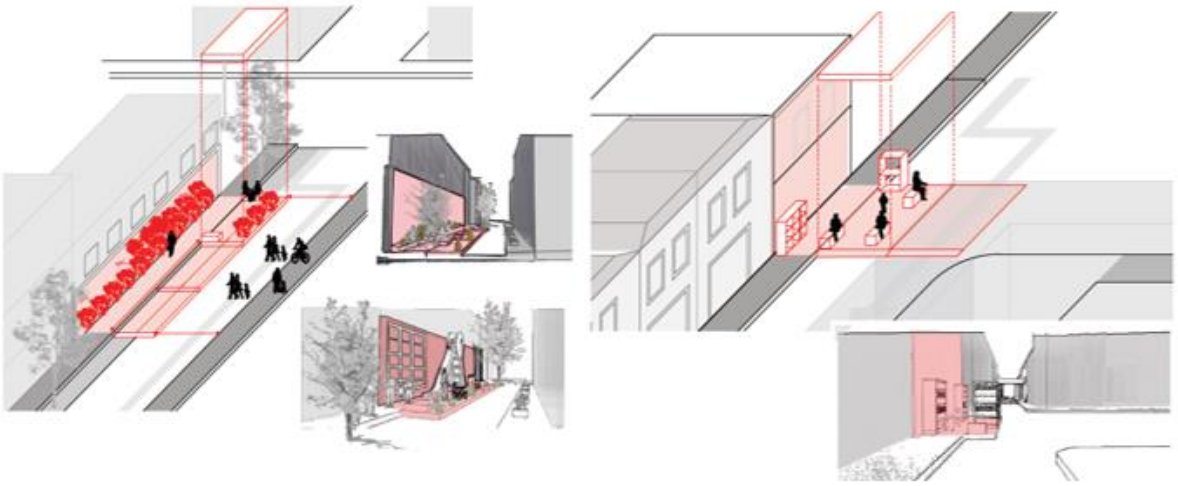

Figure 9 (continuation). Left side: The urban garden module. Right side: Exchange encounters module. Source: Student group.

Conclusion and discussion

The EU's 2050 vision of 'living well within the limits of our planet' addresses the collateral environmental impact of the linear economy and it is a serious threat to the natural, social, and economic systems. The vision calls to an urgent shift towards a circular economy covering the energy transition, material circularity and urban vitality (European Commission, 2020; 2013). Urban circularity relies mainly on circular economy frameworks such as the ladder of R-imperatives and on schemes of loops supported with implementation examples (Marin & de Mulder, 2018; Prendeville, Cherim & Bocken, 2018). Consequently, the notion of context and socio-spatial dimension is lacking in many circular innovations that are not adopted at a large scale, as they are not rooted in social needs and capacities as well as due to almost no attention to the people-related aspects of change in areas such as leadership, culture, and communications (Economic Intelligence Unit, 2008; Aiken & Keller, 2009). Thus, what 'circularity' ambitions imply at the local scale remains an unanswered question specifically at the level of social circular practices; a problem that is eminent for example in Parkstad Region in the Netherlands. People are key for changes: the citizens are the ones that have to buy and implement new technologies for sustainable energy and circular transitions.

This study aimed to investigate how ULLs as a means are able to introduce circularity in the everyday lives of vulnerable neighbourhoods by focusing on three specific public space locations in the area Kerkrade-West in the Netherlands, in Parkstad Region. The analysis of the three year workshop cycle shows that while circularity (and any other sustainable) concept that is not to the concern of inhabitants of vulnerable neighbourhoods, the potential to introduce these to their daily lives broadens the current perspectives on circularity making it more accessible to users of public spaces.

Especially, as inhabitants feel more included and shown intention to incite shared responsibility for the maintenance and management of public spaces as their viewpoint and concerns were taken seriously and laid the basis for young design students to propose future solutions. Three main lessons:

1) Circularity and other sustainable concepts that are being discussed on global level and within the UN sustainable development framework should be introduced to the public realm instead of framing it as a private and business concept only that may only require technical solutions. Primarily, the threshold to the concept can be lowered while introducing it to public spaces especially in those neighbourhoods in which inhabitants are concerned with everyday livelihood rather than sustainability practices, such as in vulnerable neighbourhoods were inhabitants face problems like poverty or a lack of social cohesion.
2) ULLs emphasize the important role of participation and users, and thus have the potential to empower individuals in the urban circular transition: harvesting the needs and capacities of the people involved. The ULL demonstrates that circularity and other sustainable concepts can be introduced in vulnerable neighbourhoods when ‘re-using’ existing social neighbourhoods structures via dialogue. Revitalization this way not only impacts the physical quality of a neighbourhoods, but also ensures and improves wellbeing and life quality of inhabitants, especially when strengthening upon collective values embedded in local history and neighbourhoods structures. Despite the urban interventions remained on paper and not in real-life, the potential to re-unite urban stakeholders in a ULL setting around those sustainability concepts and by engaging inhabitants via dialogue seems a valuable tactic to learn-by-using (Markard et al., 2020) public spaces to accelerate sustainability transitions.
3) The study emphasizes the social value of circularity and other sustainability concepts for tactical urban revitalization. Circular concepts are used in such a way that their impact goes beyond economy, but also contributes to citizenship, sense of community and local identity. They point out features latently present in the neighbourhood, on the basis of which the community can distinguish itself from centres of urban growth, and point the direction toward sustainable futures in a shrinking region or for vulnerable neighbourhoods. Herewith, we also add to the discussion of (in)visibility and randomly distributed urban interventions as argued by scholars (De Bonis et al., 2014). In contrast, we argue that small and easily to implement urban interventions can be visible and that those, while maybe appearing random at first but tactically thoughtfully placed from city or region wide perspective, can add to the general stigma of vulnerable neighbourhoods and as such contribute to the urban circular transition.

To conclude, we argue that the challenges to transition towards more circular economy models is mainly a social-cultural one, and requires a shift in the way we explore, disseminate, and integrate circular practises as well as perceive notions such as ‘circularity’ (see e.g., SUPERLOCAL project) in urban development and the daily lives of citizens, especially in vulnerable neighbourhoods in which inhabitants are concerned more about everyday livelihood rather than sustainability concepts.

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Research in Progress Paper

Milan's ULL co-design pathway to spread green roofs and walls throughout the city

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Abstract

Through a shared governance approach, the city of Milan is adopting a co-design process that involves citizens and their preferences in designing green roofs and walls throughout the city. This process is supported by the CLEVER Cities project co-creation pathway that fosters the engagement of inhabitants and local stakeholders in leading the Urban Living Lab (ULL) in a collaborative environment towards implementing nature-based solutions (NBS). In this short research in progress article, we emphasize the different workshops of co-design held digitally due to latest health emergency, COVID-19, whereas various instruments and tools were tested and implemented with citizens as residents in their own buildings. The current ongoing results yield on the evolvement of the ULL looking at its spatial challenges, flexibility, citizen engagement dynamics as well as stakeholders shared decision-making mechanism.

Key words

Co-creation; Nature-based solutions; Greening Cities; Urban Living Lab.

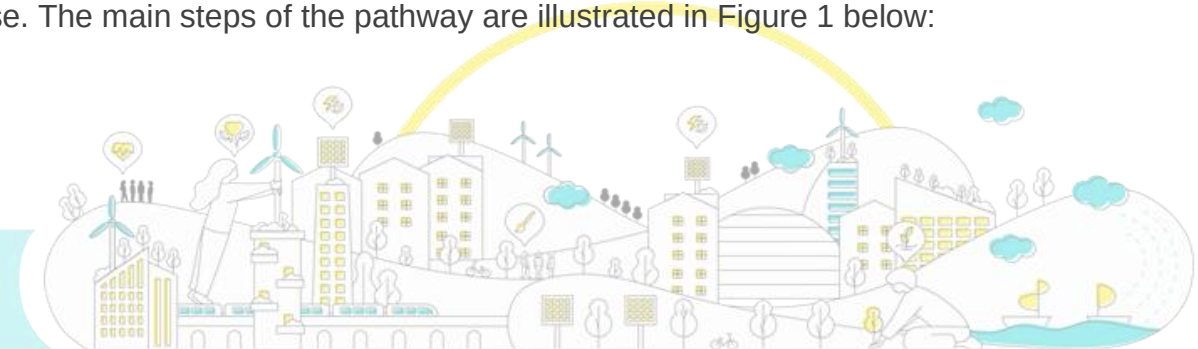
Introduction

To keep heatwaves at bay and bring nature into the everyday lives of residents, the **CLEVER Cities Milan** team is advancing its strategic plan to spread green roofs and walls throughout the city, while applying innovative business, finance, and governance models to engage private actors in their design and implementation. The project develops an inclusive framework for co-creation planning, co-designing, co-implementing, and co-monitoring and co-management of nature-based solutions, see CLEVER Cities. From the main front runner cities, Milan, London and Hamburg, emerging experiences, and results on co-creating NBS with local stakeholders and citizens in the ULLs whereas the interventions are taking place. Milan's ULL puts a strong emphasis on a collaborative approach with residents, public and private sector, as well as professional associations, which enabled the project team to target both public and private buildings for installation of the new green roofs and walls (Schuurman et al., 2019; Scholl and De Kraker, 2021).

As a way to ensure that all interested stakeholders have a voice in the development process of the green interventions, the project team developed a "Co-design pathway" following the process established in the CLEVER Co-Creation Guidance. The Guidance initially ideated by the POLIMI research team yielded promising results in establishing collaborative approaches in decision-making process within the project first three years. The current status of the shared governance of NBS in CLEVER Cities as established by the guidance using a multi-step, multi-actor, multi-sector approaches which helps breaking silos between the city departments and easing the bureaucratic relationship with citizens, associations, and other local stakeholders (Mahmoud and Morello, 2018, Mahmoud et al., 2021).

The Co-creation process in theory, especially if related to urban planning policies, is never static neither linear (Puerari et al., 2018; Bisschops and Beunen, 2019; Lember et al., 2019). Co-creation looks at putting at the centre the different stakeholders interests as well as engaging end-users of NBS within the process itself in order to increase awareness and sense of ownership in ULLs. In practice, latest experiences from similar Horizon 2020 and sister CLEVER Cities projects look at closing the loops between initial co-creation planning and the co-implementation phases by raising awareness on ULLs contexts and NBS co-benefits.

In Milan ULL, the pathway is not linear but rather escalator steps that work together in each phase. The main steps of the pathway are illustrated in Figure 1 below:



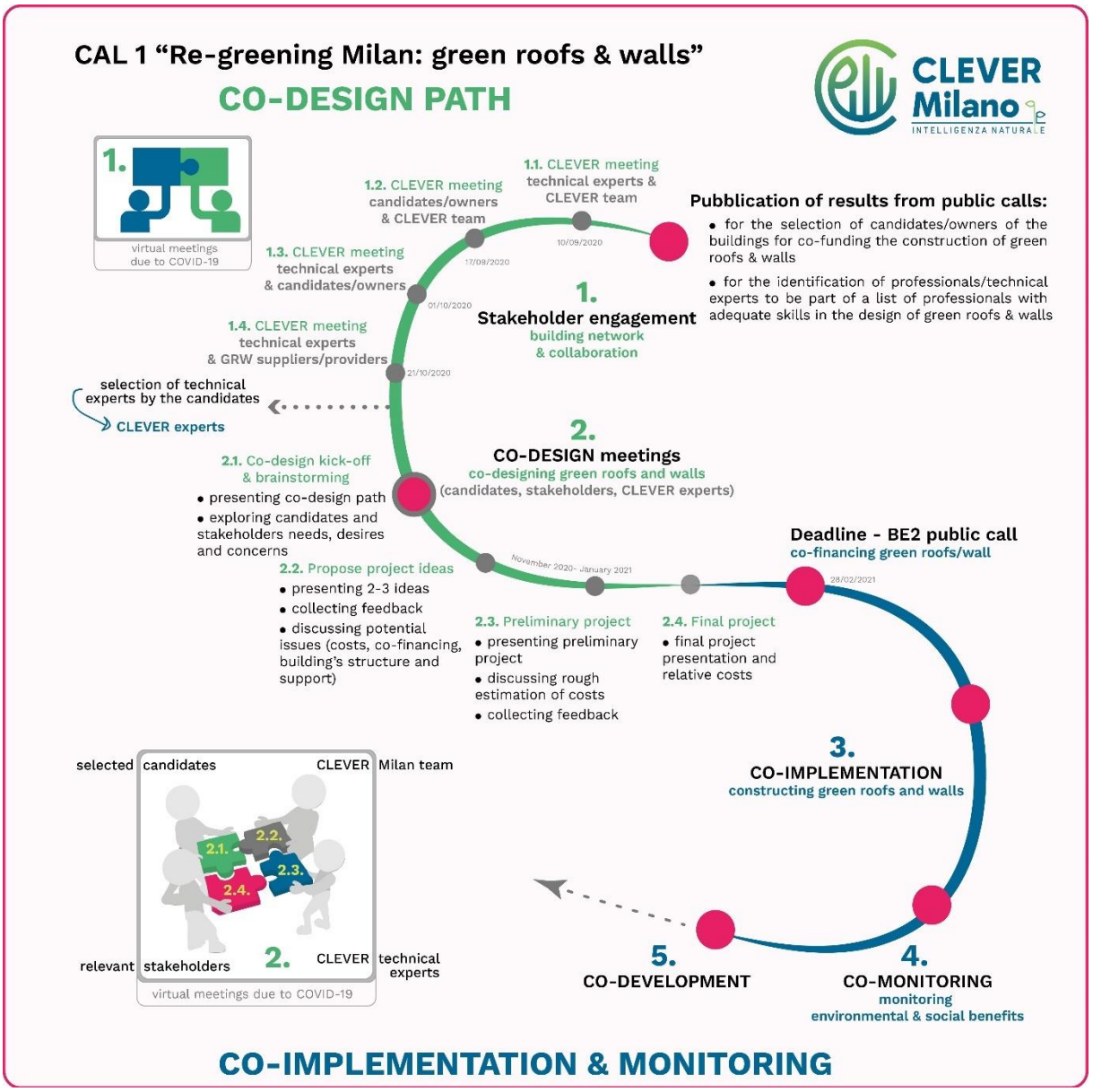


Figure 11. adopted co-design Pathway in CLEVER Cities Milano "Re-greening Milan: Green roofs and walls" Source: the authors.

Methodology: Learning from ULL: Turning knowledge into action

The adopted methodology in this research was based on learning by doing. The project developed multiple steps guidance that turns co-creation using different tools and digital participation instruments into action and co-produces knowledge around the themes of NBS. The first step, taken as preparation step for the co-creation process, was to identify the common barriers to the implementation of nature-based solutions (green roofs and walls), such as lack of access to technical expertise and additional financial resources needed in contrast to grey infrastructure (Shams and Barker, 2019; Langemeyer et al., 2020). Some strategies to overcome these challenges were traced

and a series of awareness-raising activities on the co-benefits of green roofs and walls have taken place, the work of turning knowledge into action started.

Between November 2019 and January 2020, the Municipality of Milan launched two public calls with the support of CLEVER Cities partner Ambiente Italia: one for the selection of ten pilot green roofs and walls schemes, and the second to identify experts with technical skills to support the building owners and residents in the implementation of their nature-based solutions. The newly adopted innovative approach to collaborate between residents and municipality authority enhances confidence on the possibility to develop public procurement methods (Cantergiani et al., 2019) and stakeholder engagement mechanisms that could work across many departments; and eventually involve many actors in a more cohesive and inclusive involvement pathway (Rizzo et al., 2021).

The results of the two public calls were published in August 2020, resulting in the pre-selection of seven green roof projects and three green wall projects, see Figure 2, in addition to 17 qualified technical experts, including architects, agronomists, urban planners, landscape designers and design studios.

Figure 12. pre-selected green roof/green wall projects in Milan. Source: Ambiente Italia 2021.

Owners of the initially ten pilot schemes would receive a total amount of €7,000 to receive technical support for their projects from one of the 17 qualified technical experts. In addition, the Milan's municipality will subsidize 35% of the costs of building green roofs/walls, as part of its public bid "BE2 – Building Energy Efficiency" and CLEVER Cities project, while funding of 30% subsidy is implemented for other projects

participating only in the public bid BE2. The bid integrates a municipal strategy to enhance urban nature in the city, improve air quality, decrease run off and enhance citizen well-being.

Stakeholder engagement mechanism and co-design steps

The following step was to initiate co-design with residents and local stakeholders. Once the results of the public calls had been published, the co-design phase of the work began. During the first phase, a series of stakeholder engagement meetings between September and October 2020 focused on building trust and enabling different actors to meet and network:

- The first meeting introduced the CLEVER Cities project, the CLEVER co-creation pathway, and the requirements of the 35% subsidy of the public call for energy efficiency – BE2 to the eligible CLEVER experts
- In the second meeting, the same topics were introduced to the owners interested in building green roofs and walls
- In the third meeting, CLEVER experts presented their projects and expertise to the building owners with the aim of promoting an exchange of impressions and ideas
- The last meeting brought the CLEVER experts and suppliers of green roofs and walls together, allowing the suppliers to present their offer in terms of products and systems.

At the end of this first phase, the building owners were able to select their preferred CLEVER technical experts who would provide support for the implementation of their respective green roofs and walls.

The second phase consisted of four meetings, held between December 2020 and January 2021, where people living and/or working in the buildings, and other interested stakeholders and actors had the chance to provide feedback and influence the final design of the pilot green roofs and walls using a digital value proposition canvas, see Figure 3. The meetings took place in the following order:

- Meeting #1: Co-design kick-off and brainstorming
- Meeting #2: Presentation of initial project ideas and feedback collection using Miro Board.
- Meeting #3: Presentation of the preliminary project and feedback collection
- Meeting #4: Final project presentation

Currently the project is in the phase of co-implementation and co-monitoring of environmental and measuring social co-benefits of the green interventions.

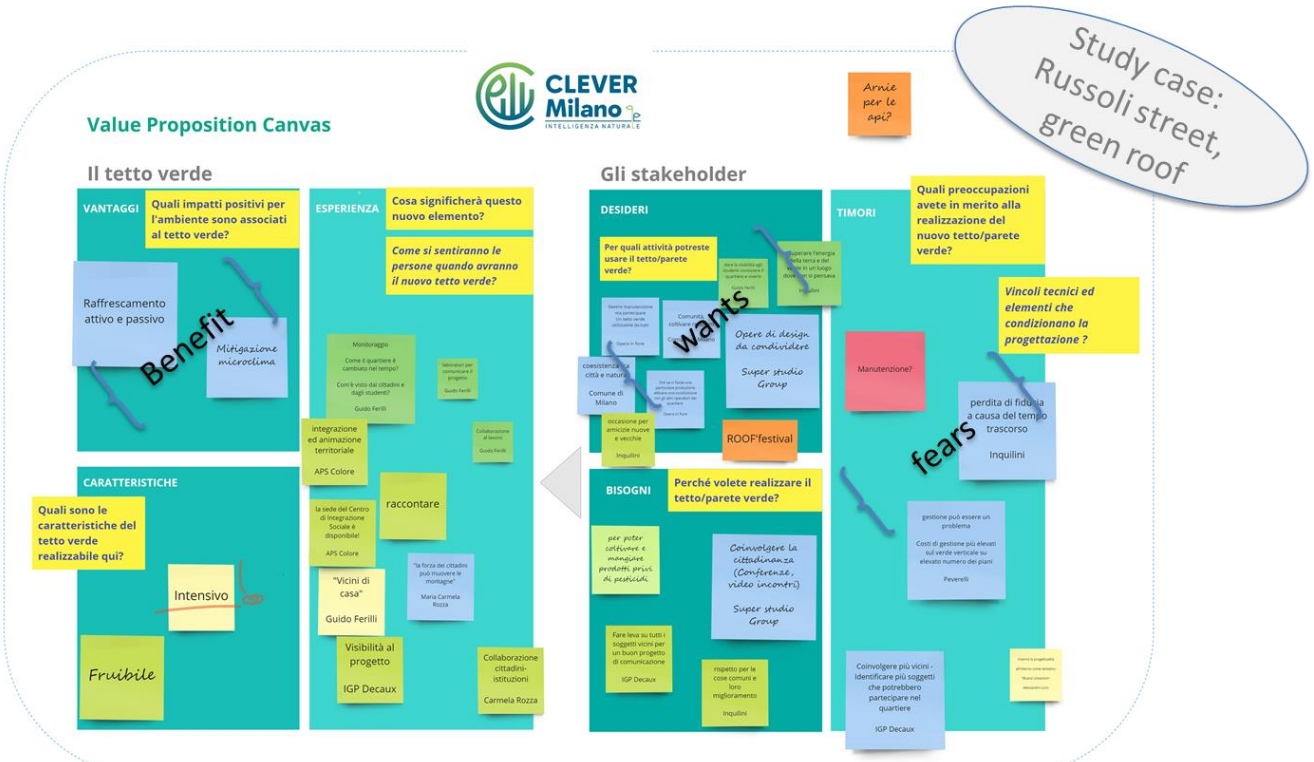


Figure 13. example of Value proposition canvas during online co-design workshops. credits Eliante, AMB, POLIMI and CLEVER Cities Milan team, used with permission.

Discussion and conclusions

There were delays and withdrawals due to the uncertainties caused by COVID-19 during the start of the co-design process. Three factors have emerged as crucial to the change of number of pilot projects participating in the co-creation pathway and during the co-design afterwards:

1. **Economic factor.** The pandemic has affected the financial situation of the applicants for constructing green roofs and walls. Two of them have withdrawn their application/interest precisely because they were facing unexpected economic challenges, or a perception of uncertainty in funding the project, hence preferring to adopt an attitude of postponing decision on the intervention.
2. **Technical barrier such as existing structures of buildings (this applies only to green roofs)**. The technical assessment of existing structures of buildings is a crucial step which preconditions the construction of a green roof. It is closely related to the economic factor for many reasons. If from structural analysis it results that the roof needs interventions to strengthen its structure, then this brings a significant increment of costs. This cost, in the case of private roofs is seen to be unaffordable, so it consequently has immediately stopped the co-implementation process.

3. **Administrative factor**. The administrative and bureaucratic procedures resulted to be the hardest barriers in the co-design and co-implementation of green roofs and walls. They are numerous and vary from:
    - Residential condominium management. In the case of one of the roofs' applicants, the building manager of the residential condominium has resigned and without the reappointment of another administrator the residents cannot take any decision or action for their building. The reappointment procedure takes time and is the reason why the co-design process in this particular roof has not started. While, in the case of another roof, the COVID-19 restrictions have prevented the residential condominium on holding meetings to formalize their decisions, which has consequently led to the withdrawal of their application.
    - Authorization procedures. In the case of more complex management (public or non-governmental management), the authorization procedures have caused important delays on obtaining the public and CLEVER funding as well as on the co-implementation process.
4. **Innovation aspects**
    - The administrative procedure: the public procurement incentives linked to co-design pathway helped the development of the ULL; selection of architecture and construction experts to consult the co-design; the consultation phase and the knowledge sharing of people living in the buildings to generate more informed solutions; the city wide campaign in occasion to generate knowledge and capacity building around NBS; the increase in sense of belonging around the themes of NBS and climate change strategies within the Milan city context.
    - The online experience: the co-design was mostly held online, the development of online canvas around the themes of value propositions, theory of change and users' needs and future wishes.
    - The involvement of a larger community, also local key actors (NABA, Bocconi etc.) to generate local interest at the community level; green roofs are an added value to many people, not only the residents.

The co-design experience from Milan ULL is still ongoing and the lessons learned are still to be gathered. The expected results might lead to a paradigm shift on how the city is handling the NBS implementation and promoting a shared governance approach in launching public calls and assigning incentives with a common vision for urban resilience. In fact, we believe that in Milan urban experimentation is increasingly taking place in ULLs as dynamic form for advancing sustainability and urban development while giving inclusivity in its deserved line.

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The European Network of Living Labs (ENoLL) is the international federation of benchmarked Living Labs in Europe and worldwide.

Founded in November 2006 under the auspices of the Finnish European Presidency, the network has grown in ‘waves’ up to this day.

ENoLL counts today over 150 active Living Lab members worldwide. Directly, as well as through its active members, ENoLL provides co-creation, user engagement, test and experimentation facilities, targeting innovation in many different domains such as IoT& AI, media, energy, mobility, agriculture & agri-food, social innovation, smart cities & regions, culture & creativity, health & well-being, environment, etc.

Via our Action Oriented Task Forces and Working groups, ENoLL empowers knowledge sharing and cooperation in- and outside our network.

The Capacity Building Program of ENoLL creates strong connections in-between the experts of the network and all organizations wanting to learn the principles of setting up & running a living lab.

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