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Festivals as Living Labs for System Innovation: Experiences from the interdisciplinary innovation programme DORP

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Abstract

The use of Living Labs is a promising approach to develop and test sustainable system innovations. A Living Lab approach that is yet to be discussed in literature, is that of a *Festival Living Lab* (FLL). Festivals can be considered as temporary mini societies with systemic sustainability challenges regarding water, energy, housing, logistics, waste management, food and behaviour. Since a festival is built up from scratch every time the event is hosted, adjustments can be made to its overarching system, and mutual interrelations between different aspects of the system can be experimented with. To evaluate the potential of FLLs as effective real-life experimentation settings for sustainable system innovation we present the *Living Lab Activity Framework* (LLAF), distinguishing various innovation stages and system levels. We deploy the LLAF to evaluate a selection of innovation projects within the DORP Festival Living Lab at the Welcome to The Village festival in The Netherlands, demonstrating that festivals can host various stages of the innovation process on different system levels.

Key words

festival living lab, real-life experimentation, evaluative framework, sustainable system innovation

Introduction

Transition, System Innovation & Living Labs

Transitioning from a linear to a circular economy requires system innovations in order to achieve the large-scale transformations in the way societal functions such as transportation, communication, housing, feeding, are fulfilled (Elzen, Geels, & Green, 2004). Although many enthusiastic entrepreneurs, policy makers and students come up with new innovative products, services and systems to realise a circular economy, only few of these are actually realised, implemented and/or scaled up (Kirchherr et al., 2018). Within the theory of strategic niche management (SNM) Schot and Geels (2008) argue that:

> *[…] for many innovations, especially with sustainability promise, market niches and user demand are not readily available because the innovations are not minor variations from the prevailing set of technologies but differ radically from them.* (p. 539)

To achieve transition, innovation needs to take place on multiple system levels (Schot and Geels, 2008). It is the process of co-evolution and mutual adaptation between these system levels that leads to change (Walker & Shove, 2007). A promising approach for experimenting with the interrelated and mutual adaptation of system levels in real-life settings, are living labs. Leminen, Westerlund and Nyström (2012) define Living labs as:

> […] physical regions or virtual realities, or interaction spaces, in which stakeholders form public-private-people partnerships (4Ps) of companies, public agencies, universities, users, and other stakeholders, all collaborating for creation, prototyping, validating, and testing of new technologies, services, products, and systems in real-life contexts. (p. 7)

From this perspective, a living lab for sustainable transition is well equipped to facilitate real-life experimentation as it may provide a conducive environment in which system transformation may take place.

Within the field of living labs, several sub-categories of living labs can be defined. Commonly used categories are Sustainable Living Labs, Product Living Labs and Urban Living Labs (Bulkeley et al., 2016; Schliwa, 2013; Steen & van Bueren, 2017). A novel

category of living labs are *Festival Living Labs* (FLLs). This paper focuses on the potential of FLLs to facilitate sustainable system innovation.

Festival Living Labs

The potential for innovation at festivals is already being explored through various innovation initiatives. Several festivals in Europe provide access to their sites to conduct scientific research and test new innovations (de Ruiter, 2012; Open-House, 2019; Stichting Innofest, 2019). In addition, several regional and European funded initiatives explore the concept of festivals as test beds for innovation (Stichting Innofest, 2019; Inno-Quarter, 2019). According to these initiatives, festivals pose interesting settings for experimentation because of multiple defining characteristics. These are described extensively in the *Festival Experimentation Guide* (Dijkstra & Boonstra, 2021).

Festivals are celebratory or thematic events that come in many forms. For the purpose of this article, festivals may be defined as *celebratory events that build one or more temporary, independent logistical infrastructures, such as an energy grid, a camp site and/or water supply for the purpose of facilitating the gathering of people.* Combining the definition of a festival with the definition of a living lab, a Festival Living Lab (FLL) may be defined as a *celebratory event that facilitates the gathering of people and that offers (interdisciplinary collaborations between) companies, public agencies, universities, users, and other stakeholders access to one or more of their temporary, independent logistical infrastructures to create, prototype, validate and test new technologies, services, products and systems'*.

With many temporary inhabitants moving, eating, sleeping and generating waste, festival sites are compared to small cities and temporary settlements (e.g. refugee and humanitarian aid camps). They are considered temporary 'mini-societies' with similar sustainability challenges regarding water, energy, housing, logistics, waste management, food and behaviour. For example, the three-day festival LowLands, which uses 300.000 kWh of electricity generated with 120.000 litres of Diesel each edition (LowLands, 2019). This is similar to the amount of electricity needed by 85 Dutch households in one year.

The interesting aspect of festival sites in comparison to cities, however, is their temporary and flexible nature. Because a festival is built up from scratch every time the event is hosted, adjustments and interventions to experiment with their different systems can be made

relatively easy. The clearly defined borders of the festival site, together with its clear demarcation thereby adds to the level of control when conducting experiments, making it relatively easy to monitor and quantify in- and outgoing flows (e.g. material or energy flows) (Dijkstra & Boonstra, 2021). Also, the affordability of experimentation on festivals is mentioned by e.g. humanitarian research projects: 'While large aid agencies can often afford to role-play disaster responses, the festival scene offers an alternative for small, impact-oriented companies without such deep pockets' (Elks, 2019).

Within the transition to a circular economy an important challenge is behavioural change and acceptance of the new. Besides technical and economic aspects, also social aspects can be experimented with at festivals. Festivals are posed as interesting places for introducing novelties, as argued by Potts (2011) and Schulte-Römer (2013), precisely because of the festival framework which is expected to conduce a positive mind-set among the audience towards trying out new things. From a living lab point of view, festivals attract a large amount of people, or 'guinea pigs', that can be engaged as end-users in open innovation processes and experiments.

Another interesting opportunity that is mentioned by the programmes is that with over 1000 festivals in The Netherlands annually, the opportunity for a consecutive chain of FLLs facilitating multiple iterative experiments in a short amount of time and within (slightly) different settings can arise.

Evaluating System Innovation at Festival Living Labs

Based on the festival characteristics described above, it is posed that festivals are promising settings for experimentation and can contribute to sustainability transitions. Since multiple Festival Living Labs (FLL) are already running and to further explore the value of arts and culture festivals within sustainable transitions, it is relevant to examine the effectiveness and impact of FLLs on sustainable system innovation more closely. This results in the following research question for this paper:

> *Research question: Are Festivals Living Labs effective real-life experimentation settings for sustainable system innovation?*

But how to evaluate this? Multiple scholars address the need for standard methods to

evaluate the effectiveness, impacts, and performance of living labs (Beaudoin et al., 2022, Bronson et al., 2021). Based on a scoping review, however, Bronson et al concluded that there is no generalizable approach or framework for evaluating the impact of living labs up to date and that 'the dominant method for evaluation used in the literature is comparative qualitative case studies' (Bronson et al., 2021, p.8). Also, it was found that the purpose of most available evaluation tools is aimed at evaluating the functioning of the overall living lab, or whether it has reached its specific goals (Bronson et al., 2021). In this paper we are interested in evaluating the impact of the FLL on the experiments hosted in the FLL, rather than evaluating the wider impact of the FLL itself and so none of the existing frameworks were fitting to answer our research question.

We therefore introduce the *Living Lab Activity Framework* (LLAF) (section 3) which we use to evaluate the *DORP FLL* (section 4). We answer our research question by discussing the results and conclude the paper by providing recommendations for future research (section 5).

Method

To explore the potential of FLLs for sustainable system innovation we took the following steps:

- **Step 1) Develop Evaluative Framework**: Based on a literature review of existing evaluative approaches and frameworks for living labs, we developed the *Living Lab Activity Framework* (LLAF) to evaluate the movement of innovation projects participating in a FLL across innovation stages and system levels.
- **Step 2) Case selection**: We selected the DORP FLL as a project case to plot on the developed LLAF. We selected this case as all authors have been closely involved in this FLL providing access to relevant documentation. We used existing project documentation to inform the case description of the DORP FLL in paragraph 4.1.
- **Step 3) Project selection**: Over the years, many projects participated in the DORP FLL. To select projects for plotting on the framework, a full inventory of projects that took place within the DORP FLL from 2015-2018 was made. The inventory was put together with the help of project lists provided by the programme leaders of the DORP FLL. Then a selection of projects for the plotting on the LLAF was made based on the criteria below.

This resulted in the selection of 31 out of 70 projects from the project inventory:

- **Criteria a**: Only projects that took place between 2016 – 2018 were selected (3 DORP editions) as projects from the first pilot year of the DORP Summer School deemed not representative as the DORP program was still developing itself as a FLL.
- **Criteria b**: Student projects were excluded from the selection because the research institutions posing these challenges usually had no or little interest in developing these projects into larger initiatives, start-ups or organisations after DORP. They were mostly seen as an educational experience for students. Therefore, many student projects had little to no follow up by default.
- **Criteria c**: Projects with insufficient or incomplete data were excluded from the selection.

- **Step 4) Plotting and analysis of projects**: The selected projects were plotted on the LLAF by identifying their innovation stage and system level before and after their participation in the DORP FLL. The categorization of the projects in the different innovation stages and system levels was derived through an iterative process between the researchers. The categorization is based on the presence of the researchers during the programs, seeing the projects in the field and using the criteria described in table 3 and 4. The resulted plotting is shown in figure 1. The 'activity' of the projects within the DORP FLL was then evaluated through a discussion amongst the authors interpreting whether and how the projects moved between innovation stages and system levels.

Living Lab Activity Framework

As described in the introduction, it is argued that transition is achieved by the mutual adaptation of system levels in niches, as this is where radical (opposed to incremental) innovation that is needed for transition can occur (Sengers et al., 2019). As living labs are posed as an approach to experiment with these mutual adaptations, this suggests that projects within living labs should focus on (I) projects in a stage of experimentation and on (II) projects exploring interdependencies in or between system levels. To explore the potential of festivals as real-life experimentation settings for sustainable system innovation, we therefore identified two sub-questions that should be considered in our evaluative framework:

Sub-question I: On what phase of the innovation process do the projects within the

Festival Living Lab focus?

Sub-question II: On what system level do the projects within the Festival Living Lab focus?

It is commonly agreed that no design or innovation process is a linear process and that within an innovation process many iterations are made. Similar to the fact that innovation processes are not linear, there is no hierarchical sequence for when to address a specific system level of an innovation either. Although the hierarchical approach of system levels somewhat resembles the means-end chain that is often used by designers (Joore & Brezet, 2015) and system levels do influence each other as described in the MLP model of Geels (2008), design and innovation processes are based on the interrelated development of different aspects simultaneously (e.g. technology, legislation, user markets). These aspects influence each other during the design process as demands or barriers from e.g. legislation will change e.g. the product or service. This holistic approach is shown, for example, in the Design-Driven Innovation Process model of Acklin (2010) and in the model of the TU/e Innovation Lab (Den Ouden et al., 2016). By testing innovations in real-life settings, these interdependencies might surface. This means that a project within a living lab can start with a challenge on a certain aspect or on a certain system level but might then find out that adjustments are needed on other system levels or aspects. This 'iterative learning means that experiments are conducted, monitored and conducted again with improvement from the previous round, in order to generate useful knowledge in a real-life setting' (Schliwa, 2013, p.15). It is the possibility for iteration between the innovation stages and system levels that adds value to the design process in living labs.

To illustrate this iterative character between innovation stages and system levels, we plotted both sub-questions in a matrix resulting in the *Living Lab Activity Framework* (LLAF) as shown in figure 1. Herein both sub-questions relate to the two axes of the framework: the system levels (sub-question I) are set out along the y-axis and the project's innovation stages (sub-question II) are set out along the x-axis. To identify the distribution of both axis we conducted a literature review (see table 1 and 2) resulting in five innovation stages on the x-axis (1. Exploration, 2. Development, 3. Experimentation, 4. Implementation and 5. Commercialisation) and four system levels on the y-axis (A. Product-Technology System, B. Product-Service System, C. Socio-Technical System and D. Societal System).

The LLAF is deployed by plotting a project's innovation phase and system level on the framework before and after its participation in the FLL using the criteria described in table 3 and 4. This provides a visual representation of a project's learning activity in the FLL.

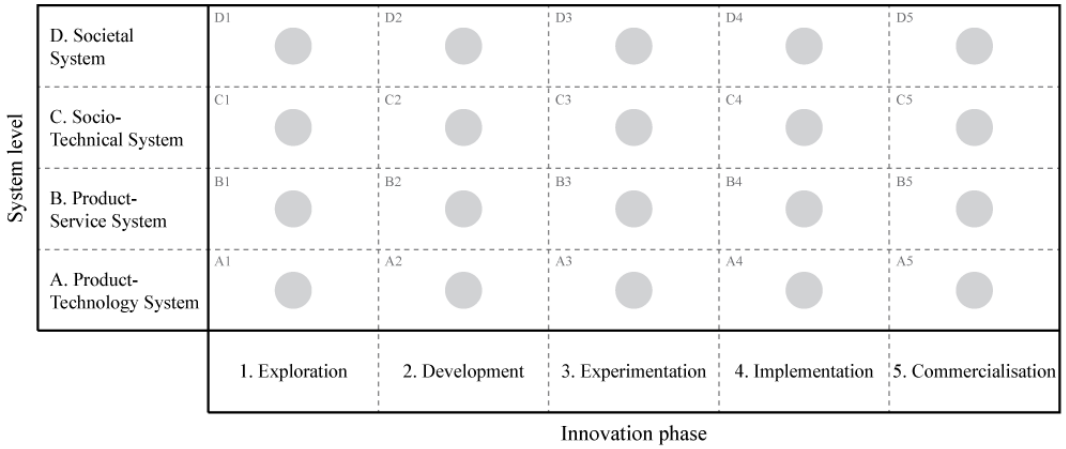

Figure 1. Living Lab Activity Framework (LLAF) for evaluating Festival Living Labs projects

Table 1. Comparison of innovation stages in academic literature (x-axis)

Living Lab Activity Framework	TRL's (Mankins, 1995)	Stage-gate model (Cooper, Edgett & Kleinschmidt, 2002)	The Fugle Model's Innovation Funnel (Du Preez & Louw, 2008)	TUe Innovation lab (den Ouden, 2016)	ULL Way of Working (Steen & van Bueren, 2017)
1. Exploration	TRL0 - Not officially defined by NASA.	1. Preliminary assessment	A. Idea Generation/Identification	Exploration	Research
	TRL 1 - Basic Research	2. Definition	B. Concept Definition		
2. Development	TRL2 - Proof of Principle	3. Development	C. Concept Feasibility & Refinement	Concept Development	Development
	TRL3 - Early lab scale demonstration		D. Portfolio		
3. Experimentation	TRL4 - Lab scale demonstration		E. Deployment	Evaluation and Validation	Testing
	TRL5 - Validation	4. Validation			
4. Implementation	TRL6 - Early prototype		F. Refinement & Formalisation		Implementation
	TRL7 - Late prototype			Market Introduction	
5. Commercialisation	TRL8 - Early stage commercial environment application				Commercialisation
	TRL9 - Market ready application full commercial application	5. Commercialisation	G. Exploitation Stage		

Table 2. Comparison of system levels in academic literature (y-axis)

Living Lab Activity Framework	Innovation levels (Ceschin & Gaziulusoy, 2016)	MDM Model (Joore, 2015)	Transition Management (Geels, 2005)	Intelligent products (Andrews, 2003)	Design for Sustainability (Brezet et al., 2001)	Systems Engineering (Haugan, 2001)	Means-end-chain (Roozenburg and Eekels, 1998)
D. Societal System	Spatio-Social innovation level	S: Societal System	Transitions (landscape)	Rethinking Values	System Innovation	System	Values
C. Socio-Technical System	Socio-Technical System innovation level	R: Socio-Technical System	System innovations (social-technical regime)	Systemic Context	Function Innovation	Subsystem	Needs
B. Product-Service System	Product-Service System innovation level	Q: Product-Service System	Process innovation (niche)	Ecological Context	Function Redesign	Element	Functions characteristics
A. Product-Technology System	Product Innovation level	P: Product-Technology System	Product-innovations (niche)	Immediate Context	Product Improvement	Component	Form

Table 3. LLAF Innovation Stages (x-axis):

Dimension	Description	Criteria
1. Exploration	The process of making new discoveries about a problem or solution and coming up with an innovative concept.	The project is based on an idea or problem but has no evidence to base its assumptions on. It is an unproven concept and no validation has been done yet.
2. Development	The process of advancing basic ideas and concepts into more concrete and holistic requirements of the innovation.	The project is based on a clear concept but needs further development and/or validation of its underlying assumptions.
3. Experimentation	The process of testing and validating assumptions about the innovation.	The project has a prototype that needs to be tested. This can be a physical prototype but also e.g. a service or societal concept.
4. Implementation	The process of applying or integrating the innovation in its designated real-life setting.	The project has a product, service or approach that is tested in relation to its context while being integrated in the larger system.
5. Commercialisation	The process of making the innovation available on the market.	The project has a product, service or approach that is implemented and commercially operates in its (simulated) context testing mutual dependencies between all system aspects (technical, economic and social).

Table 4. LLAF System levels (y-axis):

Dimension	Description	Festival Context	Criteria
A. Product-Technology System	The Product-Technology System level is made up of tangible products that one can touch.	Within the context of a festival the product level refers to the 'hardware' the festival is built up from (its tents, cabins, sound systems, generators, etc).	The project focuses on tangible products.
B. Product-Service System	The Product-Service System level is made out of the combination of physical and organizational components that together fulfil a specific function.	Within the festival the service level refers to the services provided for by the festival; the total of products and services providing e.g. the economic infrastructure (often coins) people can buy food or drinks with, the campsite people can safely sleep but also the provision of drinking water and the service of waste removal.	The project focuses on new types of services (e.g. Product-as-a-Service models, cryptocurrency systems) and/or is exploring their product's market fit.
C. Socio-Technical System	At the Socio-Technical System level 'a large number of components are combined that are not formally related to each other' (Joore & Brezet, 2015). The socio-technical system can be defined as 'a cluster of aligned elements, including artefacts, technology, knowledge, user practices and markets, regulation, cultural meaning, infrastructure, maintenance networks and supply networks, that together fulfil a specific societal function' (Geels, 2005).	Within the context of a festival, this level refers to the coherence of the festival's technical and economic infrastructure together with its entertainment programme, its safety protocols, its organisation, suppliers and stakeholders, and its audience.	The project focuses on the integration of new products or services in (a part of) the full festival system. An important difference within this criterion as opposed to experimentation on other system levels, is that something in the wider system of the festival is depending on the project innovation's functioning.
D. Societal System	The Societal System level relates to the intangible believes, traditions, norms and values of a community of people in a specific place.	Within the festival context the Societal System level is made up of the festival audience that behaves according to their communal believes.	The project focuses on behavioural change or the acceptance of the new.

Although living labs 'are composed of heterogeneous actors, resources, and activities that enable and support innovation at all phases of the lifecycle' (Leminen et al., 2012, p.7), living labs can only challenge projects to make a few iterations within their programmes and settings. Since we wanted to identify the projects' activity while participating in a FLL, the framework only shows the progress of the research, development and/or experimentation process made by the projects within (one edition of) the FLL. The framework does not say anything about the impact of the FLL on a project's overall innovation progress. Also, since not all programmes in our case study focus on the same types of challenges (e.g. one focusses on realising a technical prototype, another creating a business model, and another on researching user behaviour), the phase a project starts or ends in, does not say anything about the quality of the iteration made by the projects. The iterations made by the projects

are therefore not qualitatively comparable.

Results

Case description of the DORP Festival Living Lab

Welcome to The Village (WTTV) is a three-day music festival hosted in the recreation area of the 'Groene Ster' in Leeuwarden, the Netherlands. The festival hosts around 9000 visitors enjoying music from three semi-large stages, together with a side programme including theatre performances, visual arts and a substantive social, sustainability and innovation programme. Between 2014 and 2018 over 70 innovation projects from students, start-ups and companies developed and tested new sustainable concepts, prototypes, business- and service models at the festival via different innovation programmes and initiatives. We refer to the collection of all these sub-programmes as the *DORP FLL*.

Test & Implementation projects

Through the DORP FLL and with the help of Innofest, entrepreneurs can use the festival's technical- or economic infrastructure or its audience to get (user) feedback on their innovation. **Greener**, for example, tested their off-grid battery providing festivals with sustainable energy as an alternative to diesel generators. A project that tested in the economic infrastructure of the festival was **Loyal Garden,** who developed a blockchain system making it possible to reward volunteers of the festival in a specific crypto currency. A prototype version of the system was implemented during the DORP Summer School leading up to the festival. During the festival, the system was tested with volunteers in the backstage area of the festival.

As a festival organisation, WTTV can also act as a launching customer for new sustainable and circular innovations, generally festival related. An example of a multi-year collaboration is **LILY**. LILY is a light installation that initially was developed to illuminate the dark pathway from the festival to its campsite and now illuminates a forest in the Dutch province of Drenthe. Over the years, the LILYs were extensively tested at the WTTV festival and further developed into a floating art installation inspired by the complex patterns that exist in nature, such as schools of fish or flocks of birds. Illustrations of these cases can be seen in the images in figure 2.

Figure 2. Illustrational images of Test & Implementation projects at WTTV: Greener (Picture © Greener), Loyal Garden (Picture © Innofest), and LILY (Picture © WERC).

Innovation projects

A sub-programme of the DORP FLL that uses the festival as place for co-creation is the DORP Summer School (DORP meaning VILLAGE in Dutch). The DORP Summer School was initiated to offer entrepreneurs and organisations the opportunity to further develop their innovative ideas and concepts with the help of an interdisciplinary team of students from different disciplines, faculties and universities before testing them at the festival. The DORP Summer School is set up in a hackathon format and is based on the design thinking approach. For 7-10 days and under guidance of experts, the interdisciplinary teams help the entrepreneurs or organisations to develop their concepts or prototypes and directly validate it during the festival, resulting in a very quick feedback loop in comparison to other hackathon programmes that generally focus on either the ideation or development phase. From a university perspective, the Summer School is designed as an interdisciplinary course to teach students to work together in interdisciplinary teams.

Challenges brought in to the DORP Summer School could be about different aspects and could be in different innovation stages. For example, there could be a need for scientific research to develop innovative concepts, for example the project **Offgrid Basecamps** brought in by construction company Van Wijnen. Within the challenge, the team worked on developing a solution for construction site managers to select the best renewable energy solution for setting up their construction sites. On the other hand, entrepreneurs could also already have a technical prototype that needed to be developed and tested. For example, **Saru Soda**, who needed help with 'hacking' a post-mix lemonade machine so it could also dispense the biological lemonades they make. Or **Comp-A-Tent**, who's challenge it was to develop an attractive and functional festival tent from their newly patented compostable material. Illustrations of these cases can be seen in the images in figure 3.

Figure 3. Illustrational images of Innovation projects at WTTV: Saru Soda (Picture © Nena Bode), Comp-A-Tent (Picture © DORP Summer School), and Offgrid Basecamps (Picture © DORP Summer).

Experience projects

WTTV has a designated area for innovation where festival visitors are introduced to innovative products, business models and services in a fun and interactive way. It the place at the WTTV festival where visitors can, either consciously or unconsciously, be part of scientific research, provide feedback on new products or services from entrepreneurs or participate in experiments as 'guinea pigs'. This helps raise awareness and support for sustainable transitions. An example of such a project is the **Hair-Washing District** developed by the Japanese artist Sachi Miyachi. Together with students from the DORP Summer School, she developed an elevated and self-sustaining construction to wash hair from festival visitors to make them appreciate the little things in life. Another example is the **Snackathon** that WTTV introduced in 2018. Within the Snackathon food entrepreneurs were challenged to develop healthy and sustainable snacks for the 'Cafetaria of the Future' during the DORP Summer School to then test these directly by selling them to the festival audience during the festival. This resulted in a.o. 'Cricket fries', fries made from cricket flour by **&Cricket** and the **Vegandel**, a typical Dutch snack but then made vegan by using seitan. Illustrations of these cases can be seen in the images in figure 4.

Figure 4. Illustrational images of Experience projects at WTTV: Hair-Washer District (Picture © Nena Bode), Vegandel (Picture © DORP Summer School), &Cricket (Picture © DORP Summer School)

Resulting plotting of DORP projects

Plotting the selected DORP projects on the *Living Lab Activity Framework* (LLAF) resulted in figure 5. As can be seen in figure 5, many projects make a forward iteration in their innovation process as they managed to test, implement or even commercialise a product, service or concept at the festival (16/31 projects). For example, **Saru Soda** who went from Product-Technology Development (A2) to Product-Technology Implementation (A4).

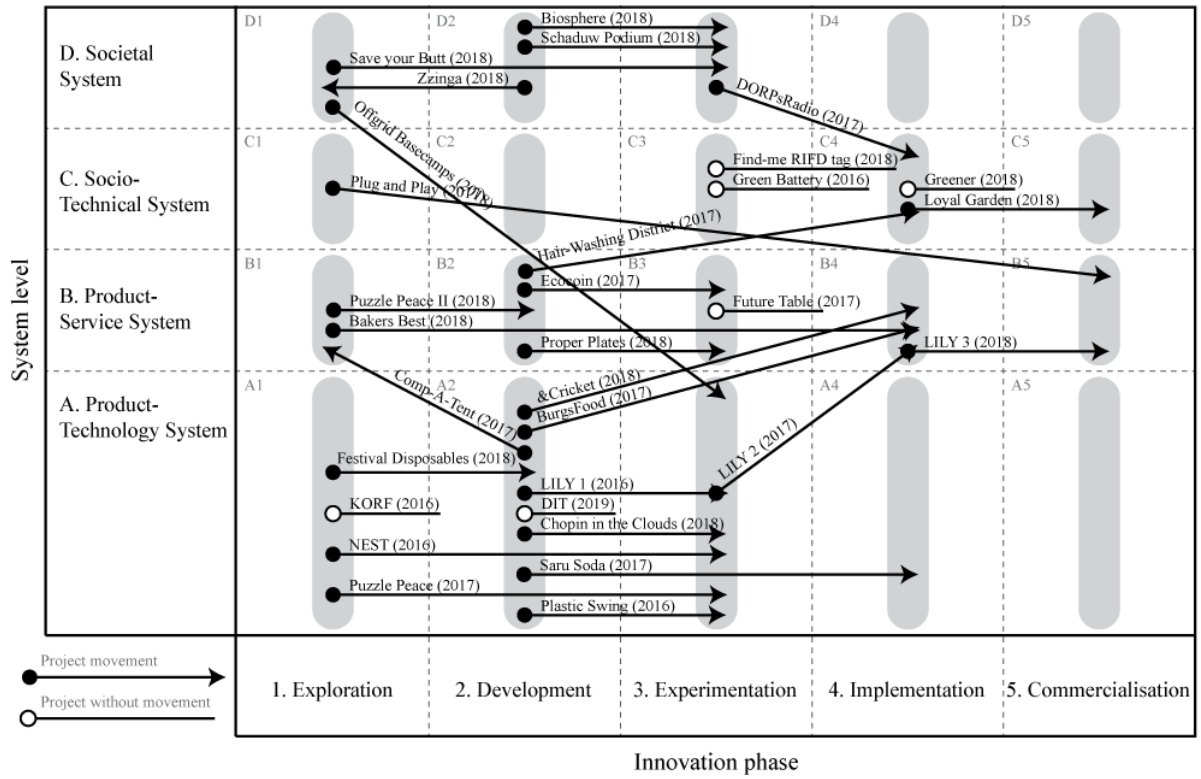

Figure 5. Selected projects participating in the DORP Festival Living Lab from 2016-2018 plotted on the Living Lab Activity Framework (LLAF).

The framework also shows that some projects iterate between system levels (7/31 projects). On the one hand, forward iterations are made. For example, **Offgrid Basecamps**, that researched a solution for construction site managers to select the best renewable energy solution for setting up their construction sites which first resulted in a concept for a decision-based algorithm, and which was then developed (D1) into a protype of a serious game which was tested at the festival amongst its audience (A3). Another project that makes a large iteration is **Plug & Play** that moves from the Exploration phase on the Socio-

Technical level (C1) to the Commercialisation phase on the Product-Service level (B5). Plug and Play was posed by the WTTV organisation as a challenge to explore how the batteries of electric cars of visitors could power their music stages in the future. At the festival, the students who worked on this challenge and managed to 'hack' an electric car, organised a fully operational car-powered silent disco during the festival. Projects that also made quite large iterations are **BurgsFood** and **&Cricket**. These two projects were part of the **Snackathon** and developed, tested and eventually sold sustainable snacks at the festival (see description in case study). As they were challenged to sell their snacks according to the official festival rules (so they would not be unfair competition to other food stalls) these projects were really forced to make a leap from Development on a Product-Technology level (A2) to Implementation on the Product-Service level (B4).

On the other hand, there are also projects that iterate backwards in the framework (2/31 projects) namely **Zzinga** and **Comp-A-Tent**. A backward movement does not mean that no valuable insights were found but that the participant encountered a challenge during their participation in the program that meant that the project had to reiterate the viability of (an element of) their idea in its current form. This was also one of the aims of the DORP Summer School: to identify early in the design process whether an innovative concept is viable before investing a lot of time and funds into its development. For example, Comp-A-Tent joined the DORP Summer School with the aim to design and test a new biodegradable tent for festival visitors based on their newly patented material. During the design process however, they found out that their intended user (the festival visitor) was not their customer. This was actually the festival organisation itself which not only changed the programme of requirements for the tent, but also their entire business case. For Comp-A-Tent the fact that the DORP FLL facilitated all system levels, meant that they could still have learnings about their innovation, just on a different system level than initially intended.

Not directly visible but also notable is that projects that participated in the DORP FLL for multiple years on a row, focus on challenges within different system levels each year. This is greatly illustrated with the **LILY** project from WERC that was present at the WTTV festival every year and developed from a single LILY prototype in 2016 to a fully implemented sustainable art installation in 2018. Also, **Puzzle Peace** illustrates this. First, they joint the DORP FLL in 2017 with a challenge to develop multifunctional furniture which resulted in a successful prototype and which the festival organisation bought as a

launching customer after the festival. The year after they returned to the DORP Summer School to develop their business case which they then tested amongst the festival audience.

Discussion & Findings

The aim of this paper is to understand whether FLLs may function as effective real-life experimentation settings for sustainable system innovation. Our research resulted in three key findings:

Festival Living Labs may function as a relevant real-life experimentation setting for sustainable innovation.

The proposed *Living Lab Activity Framework* (LLAF) enables the visualization of 'activity' of innovation projects in terms of movements between various innovation stages and system levels. The plotting of 31 DORP projects showed 'horizontal' movement, suggesting that a FLL is able to facilitate innovation projects to learn across various innovation phases. The plotting also showed 'vertical' movement of the projects, suggesting that a FLL is able to move between various system levels.

This is important because the radical change needed for sustainable transition requires a systemic perspective and mutual adaptation between these system levels (Walker & Shove, 2007) (Schot and Geels, 2008).

The DORP FLL is a unique initiative closely connected to the identity of the WTTV festival. For an increased understanding of how and if all festivals may be a suitable context to support sustainable system innovation, more research on e.g. characteristics and prerequisites of both FLLs and other categories of living labs is needed.

System innovation can happen in FLLs but this is not yet proven sufficiently.

The temporary and flexible nature of festivals pose that they are great places to experiment with its technical, economic and social systems (Dijkstra & Boonstra, 2021). Within the LLAF, projects focusing on experimenting with these systems would entail projects that interact with sections C3 and C4 of the LLAF. In the DORP FLL there is only a small number of projects positioned in this part of the framework. The derived plotting reveals that most

of the development in the DORP FLL is concentrated on the product-technology systems (level A of the LLAF) and product-service systems (level B of the LLAF). This is not necessarily uncommon, e.g. Steen & van Bueren (2017) found that the majority of Urban Living Labs in their study lacked some of the key characteristics that would be required to develop ground-breaking innovations. The LLAF also showed some development and experimentation with regards to the Societal System (level D), suggesting that festivals are indeed interesting places to experiment with novelties as described by Potts (2011) and Schulte-Römer (2013).

The focus of the plotting on the lower left corner of the LLAF could be interpreted as FLLs not being effective real-life experimentation settings for sustainable *system* innovation. However, the limited number of projects in this area might also be impacted by the limitations of our research. Namely: the fact that (i) we were not able to plot all projects on the LLAF due to the absence of data, (ii) the fact that the plotting of the projects was not done by the project owners themselves who might have different perspectives on the iterations they went through, or that (iii) the programmes of the DORP FLL focus on accelerating (sustainable) innovation in general and did not specifically focus on Socio-Technical System innovation. This means that although our research suggests that FLLs can certainly be effective settings for the development of sustainable innovation projects in general, the results of this study are not necessarily representative to conclude that festivals are especially effective settings for sustainable *system* innovation.

To further explore and develop the effectiveness of a FLL for sustainable system innovation, case studies specifically focussed on innovation on the Socio-Technical System level would be required, investigating how movements on the LLAF towards and from the Socio-Technical system level may be enabled.

The LLAF may contribute to analysing the effectiveness of living labs by providing a framework to evaluate and compare the impact of living labs over time.

There is an increasing need for approaches and frameworks to evaluate the impact and effectiveness of living labs (Beaudoin et al., 2022, Bronson et al., 2021). Visualising the development of living lab projects with the help of the LLAF enables more insight into the

results of a living lab and could help to improve its focus or design to improve innovation outcomes. Herein it should be noted that the LLAF only captures the iteration of projects made within one or several editions of a FLL. It does not provide any insight into whether a project's participation in the FLL impacted the project's long term innovation process outside of the FLL. Evaluating the impact of the FLL, beyond the actual FLL event, is outside the scope of this paper.

To confirm the effectiveness and workability of the LLAF, further research focusing on applying the framework at other FLLs, or other living labs in different contexts (for instance at various Urban Living Labs) would be needed. Additionally, it would be valuable to investigate how and if results and insights of FLL experiments are scaled beyond the FLL.

Conclusion

We have tracked the development or 'activity' of 31 innovation projects at a recurring Festival Living Lab (FLL) over a five year period (2014 till 2018). By visualising the activity of these innovation projects with the *Living Lab Activity Framework* (LLAF), we have determined that FFLs can indeed serve as effective experimentation settings for various types of innovation, including sustainable system innovation. As our results are only based on the tracking of projects at one specific FLL - the DORP Festival Living Lab at the Welcome to The Village festival in The Netherlands - further research would be needed to evaluate the potential impact of FLLs in a more general sense. We suggest that applying the LLAF may provide an effective approach to support the evaluation of FLLs, by effectively visualising the various types and levels of innovations that take place. With an increasing need for generalizable approaches and frameworks to evaluate the impact of living labs, we also suggest that the LLAF may support the evaluation of other types of living labs, for instance Urban Living Labs or Sustainable Living Labs, as a unified way of measuring the effective development of various innovation projects that take place within the context of these living labs.

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