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Positioning Living Labs within Action Design Research: Preliminary Findings from a Systematic Literature Review

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Abstract. In recent years, Living Labs (LLs) are emerging as relevant design methodologies among IS researchers. Prior research leveraged Action Design Research (ADR) to position LLs within this discipline. Through a systematic literature review, this paper proposes the positioning of LLs' methodologies within ADR. Based on preliminary findings of this study, we argue that, whilst LL's offer an opportunity to advance learning in ADR in several ways, some critical divergences can be identified in the literature to-date between the two methodologies.

Keywords: Living Labs · Action Design Research · Systematic Literature Review

1 Introduction: Living Labs and IS Research

The concept of Living Labs (LLs) is ascribed to be firstly introduced by MIT Professor William Mitchell in the context of urban planning and city design [1]. The central idea was about bringing citizens together for the design of solutions for their homes. These concepts were taken up and pushed forward in 2005 by the European Commission with the establishment of the European Network of Living Labs (ENoLL). The rationale of LLs concerns enabling users' involvement in the conceptualization, design, and evaluation of new solutions, products and services in real-life environments. Whilst, academic publications on LLs began to appear in 2005. Surprisingly, today, LLs have not yet entered Information Systems (IS) mainstream literature. In this way, recent literature acknowledges that "a theoretical and methodological gap continues to exist in terms of the restricted amount and visibility of living lab literature" [2] and, subsequently, its contributions to research [3]. In order to address this issue, IS scholars [4] started to propose LLs as a new form of Design Science Research (DSR) [5]. Following [6], Thapa et al. [7] propose LL as an exemplar of "the growing interest in conceptualizing the artefact in socio-technical terms, where the artefact is regarded not only as a stand-alone piece of technology, but also as something that is significantly interwoven with organizational and social elements and related logics" (p.2), thus relating LLs to

Action Design Research (ADR) methodology [8]. In this way, one attempt has been made in IS literature to compare ADR and LLs [9]. Their study reflects on a methodological overlap between LLs and ADR projects on the basis of four LL methodologies examined [10, 11, 12, 13] and their fit within the four activity-blocks and cycles of ADR (i.e. Problem Formulation, Building Intervention and Evaluation, Reflection and Learning, and Formalization of Learning) [8]. Based on these reflections, Coenen et al. [9] conclude that "Living Labs Methods are congruous with ADR" (p.4037).

In summary, our research focuses on establishing LLs as an IS methodological guidance for the iterative design and evaluation of IS-related artefacts in user-driven open innovation environments. In this research in progress paper, in response to previous research [9], we argue that before establishing LLs as an instance of ADR, some challenges need to be overcome. In particular, through a Systematic Literature Review (SLR) study we have undertaken on LLs methodologies, we propose a positioning of twenty different LL methodologies systematically identified in the literature to-date (within and beyond IS) within ADR.

This paper is structured as follows: section 2 outlines the SLR method that has been carried out. Section 3 focuses on the analysis of twenty LL methodologies and their positioning within the four phases of ADR. Ultimately, Section 4 proposes preliminary findings of this research and future research avenues that will be undertaken towards establishing LLs as a design-related methodological guidance for IS researchers.

2 Living Labs Systematic Literature Review

The Systematic Literature Review Process adhered to Okoli and Schabram's 8 step methodology [14]. These steps are: (1) Purpose of the Literature Review, (2) Protocol and Training, (3) Searching for the Literature, (4) Practical Screen, (5) Quality Appraisal, (6) Data Extraction, (7) Synthesis of Studies, and (8) Writing the Review. In our case, this study was conducted to analyse the stream of research connected to Living Labs. In this way, the review question (RevQ) defined was: what are the proposed phases in Living Labs methodologies? To answer this RevQ, we used as guidance the Concept Matrix method proposed in [15]. Concerning the third step of [14]'s method, we considered both general and specific subject (i.e. related to IS) databases for searching academic literature. We searched across Google Scholar, Scopus, and the "AIS Basket of 8". Given that the focus of the papers should be on methodological contributions to Living Lab research, the search strategy entailed searching for "Living Lab(s)" in the title or the keywords of academic papers.

In total, we collected 1,143 unique English language papers (after cleaning) from Scopus and GS, though the search across the "AIS Basket of 8" did not produce any result. We subsequently screened papers by analysing titles. At this stage, 427 articles were further considered. At this step, abstracts were read and 169 papers selected for final screening and extraction, by reading the full papers. In particular, we verified their consistency with the RevQ and identified twenty unique contributions for answering our RevQ (i.e. papers in which a unique LL methodology is outlined).

Consistent with the lack of LL-related publications in the mainstream literature, we did not undertake further evaluation of the quality of the papers as a further exclusion criterion, beyond selection of peer reviewed conference and journals only. At this stage, we had arrived at relevant articles needed to answer our RevQ, and proceeded to extraction and synthesis of twenty methodologies found through our SLR process.

3 Positioning Living Labs Methodological Phases within ADR

When extracting the data from these papers we developed an outline of each methodology based on the stages / phases proposed. All phases extracted from the methodologies identified were mapped using Webster and Watson's [15] Concept Matrix technique based on the four phases of ADR: (1) Problem Formulation; (2) Building Intervention and Evaluation; (3) Reflection and Learning; and (4) Formalization of Learning. While engaged in this exercise, we noticed that a number of LL methodologies include a set-up stage prior to the actual problem formulation. Although we recognize that activities such as ensuring long-term commitment and setting up roles and responsibilities are part of ADR (specifically at the end of the problem formulation stage) [8], these were considered separately within the developed concept matrix (see Appendix 1). As shown in Appendix 1, this exercise enabled us to achieve a comprehensive understanding on if and how (and how much) different LLs methodological phases can be positioned within ADR. The following sub-sections provide reflections for each of the four phases.

3.1 Set-up and Problem Formulation

In ADR, the problem formulation stage is drawn upon 2 principles: (1) *Practice Inspired Research,* and (2) *Theory Ingrained Artefact.* Sein et al. [8] acknowledge that a number of inputs can be leveraged for this phase including: practitioners, end-users, researchers, existing technologies, and review of existing research. The problem provides the motivation for undertaking the research effort.

In the context of LL methodologies, as shown in Appendix 1, 11 problem formulation phases were outlined across the 20 methodologies identified. The common denominators across these problem formulation stages are: (1) the active involvement of end-users; (2) the prior establishment of the LL's participants, their roles, and their responsibilities. However, two different typologies emerge from the literature. The first refers to the focus on identifying an actual problem (e.g. "when a change in a political legislation occurs" [16]) or need, emerging from the early stage interaction with members of a defined community [12]. The second one sees a problem or need emerging from predefined usage scenarios [17, 18], general classes of product or services [19], or particular technology-related prototypes or ideas [20]. From another angle, in LLs, this process can be supported by either the identification of an actual problem [10, 13, 16, 18] or through an appreciative form of enquiry for the generation and formalization of needs [12, 20]. Both approaches comply with ADR's Practice Inspired Research principle. In fact, in ADR a problem can be "perceived in practice or anticipated by researchers" [8, p.40]. In relation to the latter, it is noted that the process of generating and formalizing needs is seen as the result of research activities conducted with representatives of communities of users in which researchers are responsible for extracting and analysing narratives to finally generate and prioritise users' needs (e.g. [21]).

On the other hand, the role of theories (i.e. "the power to generalise" [22]) and the need for theory-ingrained artefacts do not emerge as a scope of LL methodologies to-date. One further difference is that set-up activities are undertaken in different stages of the two methodologies. Whereas in ADR activities such as ensuring long-term commitment and assigning roles and responsibilities are undertaken after the problem has been substantially formulated, in LLs these activities are completed prior to the problem formulation stage.

3.2 Building Intervention and Evaluation

This second stage of ADR proposes the implementation of design, intervention, and evaluation cycles. These are undertaken as an iterative process in a defined environment in which design, testing, and evaluation activities operate concurrently. Although Sein et al. [8] distinguish between Organizational and IT dominant cycles based on the actual nature of the artefact, this stage is drawn upon 3 principles: (3) *Reciprocal Shaping;* (4) *Mutually Influential Roles;* and (5) *Authentic and Concurrent Evaluation.*

In LLs methodologies, the design and evaluation processes involve two different levels of iteration finally constituting a spiral process [12]. On a higher level, three iterations are generally proposed in terms of concepts, prototypes and final solutions [12, 17, 18, 23, 24]. The second level of iteration typically involves design, testing / trial, and evaluation cycles within each of these stages. Similar to ADR, these activities are meant to inform actions towards refining the artefact that is being designed (across its concepts, prototype, and final system iterations).

In relation to Principle (3) of ADR, it is noted that intervention in ADR is often described as experimentation in LLs, e.g. [18, 25]. Most of the proposed experimentation and evaluation stages of LLs are undertaken in "naturalistic, natural, and real life settings" [12]. The potential mismatch between LL and ADR in relation to this principle reflects the differences between intervention in ADR and experimentation in LLs. In fact, the shaping in LLs is unidirectional, i.e. the setting shapes the artefact that is being designed. The only exception is [10]'s methodology. This was partially drawn from Baskerville's Action Research process [26]. However, as shown in previous research, ADR is understood as a specific case of Design Science Research in which action is incorporated as opposed to a specific approach of Action Research per se [27]. Overall, we argue that Principle (3) of ADR is not reflected in current formulations of LL methodologies. On the other hand, significant overlap is found for Principles (4) and (5). In relation to the former, the fact that all participants within the LL team have influential roles in the design, experimentation and evaluation activities is well acknowledged. Most of the methodologies found in the literature indicate this process as co-design, e.g. [28], or co-creation, e.g. [29]. Furthermore, this aspect is supported by one of the key principles of LLs: "influence" [12]. This stresses the importance of viewing "all stakeholders" [30] (i.e. the LL team) as active and competent partners in the design process.

Finally, Principle (5) is at the heart of both ADR and LL methodologies. In fact, likewise ADR, design and evaluation in LLs are undertaken concurrently [11]. Also in alignment with ADR, two main iterative evaluation stages are proposed in LLs. In particular, the "alpha version" proposed in ADR is reflected in the evaluation of the actual usability of the prototype in LLs [12, 31], therefore contributing to the refinement of the artefact itself; on the other hand, the focus on the "beta version" of ADR is referred in LLs as the evaluation of the user experience of the final system [12].

3.3 Reflection and Learning

As shown in Appendix 1, only one of the LLs methodologies we found in the literature proposes a stage that partially overlaps with the Reflection and Learning stage of ADR. In this way, Schaffers et al. describe their "Learning" [10] phase as follows: "outcomes of the evaluation phase serve as input for the next development cycle. In a sense the spiral of incremental improvements eventually leads to the best fit of solution closest to the engineering target point" [10, p.6]. It is clear that this phase differs significantly from stage 3 of ADR which focuses on moving "conceptually from building a solution for a particular instance to apply that learning to a broader class of problems" [8, p.44]. Therefore, we argue that the Reflection and Learning stage of ADR (and subsequently principle (6) *Guided Emergence* upon which it is drawn) is lacking in LLs methodologies to-date.

3.4 Formalization of Learning

The last phase of ADR emphasizes the need for moving from "the situated learning […] to general solution concepts for a class of field problems" [8, p.44]. This phase is drawn upon Principle (7) *Generalized Outcomes*. This conceptual move is argued in ADR as being required at three different levels: (a) generalization of the problem; (b) generalization of the solution; and (c) derivation of the design principles from the research design process. As shown in Appendix 1, LL methodologies propose set of activities to be conducted with the objective of moving from a solution in a specific real-world context, to a situation in which the artefact is commercialised [12, 29, 31, 32]. Other LL methodologies similarly stress the importance at this stage of fostering adoption and diffusion of the final artefact [13, 16, 19, 28]. This is meant as enabling market entry of the LL's outcome [31] thus enabling scalability of the artefact [13]. Although this seemingly overlaps with Principle (7) of ADR, it is noted that scalability is understood in a commercial sense only. In other words, LLs methodologies do not address issues in terms of generalizability of the design principles and subsequently, of the contribution to existing theory from the researchers involved in LLs. In summary, we argue that LLs overlap with only two of the three levels proposed within the Formalization of Learning phase of ADR (i.e. generalization of both the problem and the solution).

4 Preliminary Findings

Preliminary findings from this study demonstrate that although LLs might seem congruous for ADR [9], some critical issues and differences still exist. These issues were outlined in the previous section of this paper. In particular, our SLR study demonstrates that ADR's Principles (2), (3), (6), and (partially) (7) are not reflected in current LL methodologies. These divergences support the fact that ADR aims at developing generalised prescriptive knowledge, whereas LLs' outcomes tend to be much more immediate, contextualised, and practice-oriented. In fact, existing methodological approaches do not address the need for academic researchers to reflect on the theoretical learning and to proceed towards its formalization into a contribution to existing IS theories. Partially related to this, the role of theory within LL's studies is vague and unclear. This is in contrast with the Theory-Ingrained Artefact proposition of ADR.

As part of our future research, multiple case studies will be carried out with a specific focus on how academic researchers can formalize the learning (e.g. design patterns and principles) from LLs-based design projects. The preliminary findings presented in this research in progress paper suggest that whilst LL's offer an opportunity to advance learning in ADR in several ways (e.g. its extension beyond organizational settings and its applicability in open environments), LLs should benefit from ADR in terms of conceptualizing and formalizing the prescriptive learning of these processes.

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Appendix: LLs Concept Matrix

LIVING LAB METHODOLOGIES	LL SET UP						PROBLEM FORMULATION											BUILDING INTERVENTION AND EVALUATION											R&L	FORMALIZATION OF LEARNING			
	supporting ICT	performance model	innovation activties management	Organizational Management	initial set up	user engagement	environment and systems analysis	brainstorming with stakeholders	problem	Idea Generation	Idea Selection	Need Generation	Need Generation in the Service	co-create concepts	explore usage scenarios	insight research	exploitable items	concept design	Prototype Implementation	Prototype Testing	Design	action planning	pre-launch	experiment	action taking	Evaluate Concepts	post launch	evaluation	learning	Diffusion and Adoption	development of strategy roadmap	commercialization	consequence
(Molinari, 2011)			x	x				x											x		x			x				x					
(Garcia et al. 2013)			x	x																	x			x				x					
(Katzy et al. 2012)										x	x										x							x				x	
(Corallo et al. 2013)			x	x		x				x	x										x									x		x	
(Vicini et al. 2013)									x	x					x			x			x			x				x					
(Lucassen et al. 2014)	x		x		x		x											x			x			x				x					
(Jessuru et al. 2008)				x					x			x	x																	x		x	x
(Mavridis et al. 2009)			x	x													x				x										x		
(Tang and Hämäläinen, 2012)									x										x									x		x			
(Johansson et al. 2011)												x	x							x	x							x					
(Baedeker et al. 2014)																x			x					x									
(Guzman et al. 2013)										x	x							x	x		x												
(Santoro and Conte, 2009)	x	x		x	x	x				x														x				x					
(Pallot et al. 2013)														x	x				x					x				x				x	
(Pierson and Lievens, 2005)							x				x										x						x						
(Coenen et al. 2014)										x	x								x	x	x			x				x		x		x	
(Schuurman et al. 2014)										x	x							x	x				x				x						
(Bergvall-Kåreborn et al. 2010)												x	x					x	x	x	x					x		x				x	
(Schumacher and Feurstein 2007)										x	x							x			x											x	
(Schaffers et al. 2008)									x													x			x			x	x				
Total Item	2	1	5	6	2	2	2	1	4	8	7	3	3	1	2	1	1	6	8	3	13	1	1	8	1	1	2	12		4	1	7	1
Total Phase	18						33											56											1	13			

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