Elena Simina Lakatos
E-mail:simina.lakatos@ircem.ro
Doctor, Institute for Research in Circular Economy and Environment "Ernest Lupan"
Cluj-Napoca, Romania
ORCID ID: *0000-0003-0096-4494*

Loredana Andreea Birgovan
E-mail:loredana.birgovan@ircem.ro
PhD student, Institute for Research in Circular Economy and Environment "Ernest Lupan"
Cluj-Napoca, Romania
ORCID ID: *0000-0002-2220-6486*

Andrea Szilagy
E-mail:andrea.szilagy@ircem.ro
PhD student, Institute for Research in Circular Economy and Environment "Ernest Lupan"
Cluj-Napoca, Romania
ORCID ID: *0000-0002-5177-4642*

Viktor Koval
E-mail:victor-koval@ukr.net
Professor, Southern Scientific Center of National Academy of Sciences of Ukraine and Ministry of Education and Science of Ukraine, National Academy of Sciences of Ukraine,
Kyiv, Ukraine
ORCID ID: *0000-0003-2562-4373*

Alexandru Bucur Karshowsky
E-mail: alexandru.karshowsky@ircem.ro
Scientific researcher, Institute for Research in Circular Economy and Environment "Ernest Lupan"
Cluj-Napoca, Romania
ORCID ID: *0009-0005-4364-7124*

THE ROLE OF LIVING-LABS IN CITIES' TRANSITION TO A CIRCULAR ECONOMY

Abstract: *The paper aims to emphasize the role of living-labs in cities' transition to a circular economy (CE). The paper purpose was addressed by an analyse different types of living-labs. The circular economy concept is an umbrella concept that has grown in recent years, both globally and locally, being increasingly addressed through measures, policies and rules. CE is a sustainability paradigm that has the goal to harmonize the sustanability pillars: economic, environment and social.*

Currently more than half of the world's population lives in cities, while forecasts show a two-thirds

increase by 2050 (70%), in addition 75% of global natural resources and 80% of global energy supply are consumed by cities, so that there is a growing need for a transition to a sustainable society.

A living-lab is a system or a consortium of stakeholders, based on open innovation, which is meant to solve a problem the stakeholders face in the society.

The analyse showed that the principal focus of the living-labs model is on the folowing subjects: green, smart mobility, building standards, efficient use of resources, energy conservation, social and economic equity and waste management. The studied model shown that the living-lab concept is an appropriate instrument of CE to meet the sustainable development goals.

Keywords: *circular economy, living-lab, urban living lab, circular cities*

JEL classification: *Q2, R30*

ელენა სამინა ლატაკოს
E-mail:simina.lakatos@ircem.ro
დოქტორი, ცირკულარული ეკონომიკისა და გარემოს კვლევის ინსტიტუტი "ერნესტ ლუპანი"
კლუჟ-ნაპოკა, რუმინეთი
ORCID ID: *0000-0003-0096-4494*

ლორედანა ანდრეა ბირგოვან
E-mail:loredana.birgovan@ircem.ro
დოქტორანტი, ცირკულარული ეკონომიკისა და გარემოს კვლევის ინსტიტუტი "ერნესტ ლუპანი"
კლუჟ-ნაპოკა, რუმინეთი
ORCID ID: *0000-0002-2220-6486*

ანდრეა სზილაგი
E-mail:andrea.szilagy@ircem.ro
დოქტორანტი, ცირკულარული ეკონომიკისა და გარემოს კვლევის ინსტიტუტი "ერნესტ ლუპანი"
კლუჟ-ნაპოკა, რუმინეთი
ORCID ID: *0000-0002-5177-4642*

ვიქტორ კოვალი
E-mail:victor-koval@ukr.net
პროფესორი, უკრაინის მეცნიერებათა ეროვნული აკადემიის სამხრეთ სამეცნიერო ცენტრი და უკრაინის განათლებისა და მეცნიერების სამინისტრო, უკრაინის მეცნიერებათა ეროვნული აკადემია, კიევი, უკრაინა
ORCID ID: *0000-0003-2562-4373*

ალექსანდრუ ბუცურ კარშოვსკი
E-mail: alexandru.karshowsky@ircem.ro

მკვლევარი, ცირკულარული ეკონომიკისა და გარემოს
კვლევის ინსტიტუტი "ერნესტ ლუპანი"
კლუჟ-ნაპოკა, რუმინეთი
***ORCID ID:** 0009-0005-4364-7124*

საცხოვრებელი ლაბორატორიების როლი ქალაქების ცირკულარულ ეკონომიკაზე გადასვლაში

აბსტრაქტი. *ნაშრომი მიზნად ისახავს ხაზი გაუსვას საცხოვრებელი ლაბორატორიების როლს ქალაქების ცირკულარულ ეკონომიკაზე (CE) გადასვლაში. ნაშრომის მიზანი განიხილებოდა სხვადასხვა ტიპის საცხოვრებელი ლაბორატორიების ანალიზით. წრიული ეკონომიკის კონცეფცია არის ქოლგა კონცეფცია, რომელიც გაიზარდა ბოლო წლების განმავლობაში, როგორც გლობალურად, ასევე ადგილობრივად და სულ უფრო მეტად განიხილება ზომების, პოლიტიკისა და წესების მეშვეობით. CE არის მდგრადობის პარადიგმა, რომელსაც აქვს მიზანი მდგრადობის საყრდენების ჰარმონიზაცია: ეკონომიკური, გარემოსდაცვითი და სოციალური.*

ამჟამად მსოფლიოს მოსახლეობის ნახევარზე მეტი ცხოვრობს ქალაქებში, მაშინ როცა პროგნოზები აჩვენებს ორ მესამედს 2050 წლისთვის (70%), გარდა ამისა, გლობალური ბუნებრივი რესურსების 75% და გლობალური ენერგომომარაგების 80% ქალაქები მოიხმარენ, ასე რომ იქ მდგრად საზოგადოებაზე გადასვლის მზარდი საჭიროებაა.

ცოცხალი ლაბორატორია არის სისტემა ან დაინტერესებული მხარეების კონსორციუმი, რომელიც დაფუძნებულია ღია ინოვაციებზე, რომელიც მიზნად ისახავს პრობლემის გადაჭრას საზოგადოებაში დაინტერესებული მხარეების წინაშე.
ცოცხალი ლაბორატორია არის სისტემა ან დაინტერესებული მხარეების კონსორციუმი, რომელიც დაფუძნებულია ღია ინოვაციებზე, რომელიც მიზნად ისახავს პრობლემის გადაჭრას საზოგადოებაში დაინტერესებული მხარეების წინაშე.

ანალიზმა აჩვენა, რომ ცოცხალი ლაბორატორიების მოდელის ძირითადი ყურადღება გამახვილებულია შემდეგ თემებზე: მწვანე, ჭკვიანი მობილურობა, სამშენებლო სტანდარტები, რესურსების ეფექტური გამოყენება, ენერგიის დაზოგვა, სოციალური და ეკონომიკური თანასწორობა და ნარჩენების მართვა. შესწავლილმა მოდელმა აჩვენა, რომ ცოცხალი ლაბორატორიის კონცეფცია არის CE-ს შესაბამისი ინსტრუმენტი მდგრადი განვითარების მიზნების დასაკმაყოფილებლად.

საკვანძო სიტყვები: *წრიული ეკონომიკა, საცხოვრებელი-ლაბორატორია, ურბანული საცხოვრებელი ლაბორატორია, წრიული ქალაქები*

JEL კლასიფიკაცია: *Q2, R30*

Introduction and review of literature

In the twenty-first century, society is confronted with unprecedented difficulties, including a climate emergency, ecosystem degradation, worldwide urban migration, pandemics, and economic change fueled by new technology. These issues are complicated and interwoven, need immediate action at the local, regional, and global levels. Implementing a living lab can be the best approach.

A living lab is a physical or virtual venue where many stakeholders are brought together for collaboration and collaborative ideation in order to tackle societal concerns, particularly in urban regions. Despite the fact that scholars, practitioners, and policymakers are paying more attention to the concept, many people are still confused about what it means [1]. The definition we will refer during his research is:

Living labs are physical or virtual venues and human systems where we create, test, research, and learn from social and technological breakthroughs in real-time, real-world settings. They encourage collaborative experimentation, innovation piloting, critical evaluation of results, and information sharing [1].

Inhabitants are increasingly being involved in city development in order to make cities more flexible to citizens' requirements. It is critical to evaluate the long-term effects of, for example, climate-related problems in cities such as air pollution, flooding, and so on, as well as the social ramifications of the remedies we have implemented in our cities. To handle such complicated issues, we must enlist the help of not just citizens, but also businesses, research communities, and educational institutions, as well as the governmental sector [2].

Academic writing on living labs can be separated into two streams that are mutually beneficial. The first stream is primarily theoretical, and regards the 'Living Lab' as a methodology for innovation, referring to living labs as a model or methodology [3][4]. The second stream of literature, which is concerned with the organization of innovation through living labs, looks at how this paradigm is really implemented.This second stream characterizes living labs as environments [5], milieus [6] or systems [7].

2 Circular Economy and Living Labs

There are many definitions of Circular Economy in the literature, but the one we will refer to in this articles is the one developed on a review of circular economy definitions in 2017[]. An economic system that substitutes the concept of "end-of-life" with reducing, reusing, recycling, and recovering resources in the production, distribution, and consumption processes. It works at the micro (products, firms, consumers), meso (eco-industrial park), and macro (city, region, nation, and beyond) levels to achieve sustainable development, resulting in improved environmental quality, economic prosperity, and social equality for present and future generations. It is enabled by novel business models and responsible consumers" [8].

The current linear paradigm of production and consumption in modern society is unsustainable, and urgent changes are required to solve the socioeconomic concerns of population growth and an expanding middle class [9]. The circular economy (CE), which strives to eliminate waste, increase resource value, reduce negative effects, and build economic, environmental, and social capital [9],[10], is gaining steam as a possible solution to these issues.

Living laboratories are a relatively new type of open innovation network that offers a variety of research options [11]. Multiple fields and concepts are examined in living labs, including the transition to low-carbon economies, experimental governance, and novel approaches to sustainable development [12]. In the production of new technologies, services, goods, or systems, a living lab stresses the responsibilities of user interaction, prototyping, testing, and validating in real-world contexts [13]. Living labs use an experimental approach to co-creation, involving public–private–people relationships.

Urban living labs are increasingly being used for environmental sustainability and circular economy,

with the goal of regenerating neighborhoods, supporting circular businesses, facilitating circular experimental tenders, and allowing the testing of decentralized waste recovery systems [14]. Sustainably oriented urban city laboratories can operate as a unique circular economy environment [15].

Cities, with their inventive capabilities, are crucial locations for addressing serious climate, environmental, and health issues. Living Labs, for example, can serve as a starting point for reintroducing resources into the production cycle and reducing environmental consequences, embracing the circular economy model (CE). In particular, as a form of policy lab, Urban Living Labs (ULL) offer prospects for increased spread of sustainability transitions and are characterized by stakeholder collaboration and experimentation [16] [17]. According to research, ULLs frequently address concerns of sustainability and mobility in order to make cities more sustainable [18].

Methodology

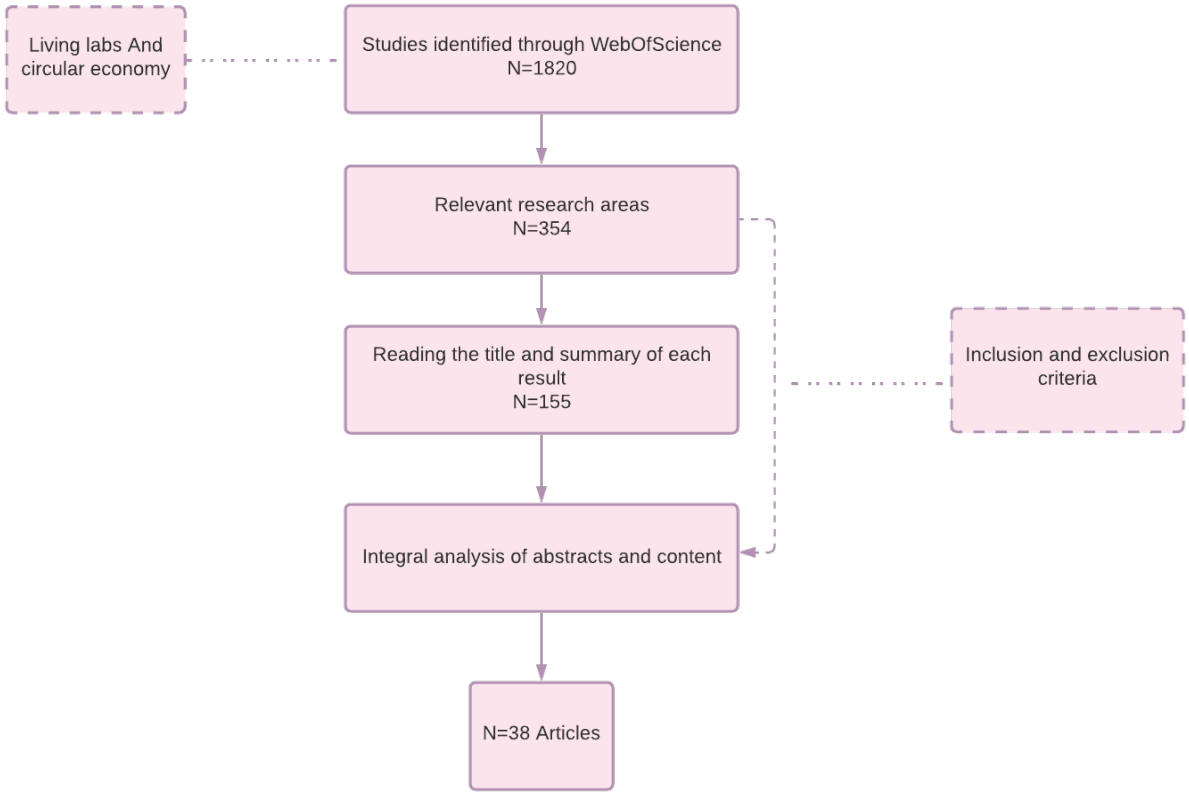
This study aims to see how living labs can facilitate the transition to a more circular economy. We also wanted to see how this paradigm is implemented and analysed in academic research. To do so, we combed through the most important scientific papers in the Web of Science database. Our goal is to look at all of the living labs mentioned in the research papers in order to gain a better understanding of the current university context and how this new approach might aid in the implementation of circular economy approaches.

In order to do this review we used the stages suggested by Kitchenham (2004) and adapt them in order to perfom a systematic review: 1. Planning the review, 2. Conducting the review and 3. Reporting and dissemination. A review of the literature on the Web Of Science (WOS) search engine was done to provide an overview of how the scientific community responds to methodological challenges in order to create living labs. The search was limited to (1) scientific articles or book chapters published in English between 2010 and 2021, (2) relevant topics (living labs, circular economy, green, smart mobility, building standards, efficient use of resources, energy conservation, social and economic equity and waste management), and (3) comparisons between existing living labs. The current study did not take into account metrics that were available online but did not have a published methodological underpinning.

This research, which is organized as a review of living labs for the purpose of implementing the circular economy, included an extensive search to look at different sorts of living labs. Following the search, a screening process was carried out, which involved reviewing the title and synopsis of each result.

The search yielded 1,820 items, however only 155 were deemed the most representative after the initial screening step. We read the abstracts of every article selected in the first phase in the second step of the screening process and decided to delete studies that did not directly address the issue of living labs and circular economy components or showed a high similarity to other articles already included in the review. Following that, we're left with 38 publications that best answer our research query (Fig.1).

Figure 1. The study selection process



Results

We found out during this research that only few articles are referring to living lab and circular economy. But when we were looking for concepts like green, smart mobility, building standards, efficient use of resources, energy conservation, social and economic equity and waste management we found more research. Thus all the articles included in the review are related to circular economy components even if the link is not evident and highlighted.

During our study, we discovered that practically almost all of the living lab publications we saw referred to campus as a living lab.

According to the definition "A Campus as Living Lab is an integrated organizational, technological, and socio-economic approach in which a university uses its assets and facilities to study, test, or demonstrate novel technologies or services by, with, and for its community" [20]. It's referred to as Campus as a Sustainability Living Lab when the ideas being evaluated are concerned with sustainability. These Living Labs bring together teaching, research, and campus operations in one place.

The Campus as a Living Lab allows for the identification of very relevant and significant challenges while also providing a pedagogical framework in which students are truly motivated, involved, and prepared to address a variety of issues involving not only academia but also government, citizens, and industry. As a result, students can apply their theoretical knowledge to come up with practical answers to problems in such situations [21].

As a result, they can serve a variety of purposes and be used in a variety of settings. For example, at an Egyptian architectural university, they tried to use urban living lab concepts as part of the pedagogical process to establish a distinct educational technique for teaching green sustainable design. In this

scenario, they used a real-life environment to give students an integrated understanding of site, climate, and sustainable building design concepts, as well as an understanding of the cultural and social human dimensions of new construction [22].

Because of the things mention above there are a lots of campuses as a living labs initiatives. Some examples are: M IT Office of Sustainability (MITOS), The Green Village at TU Delft, Harvard Living Lab initiative, UBC's Campus as a Living Lab (CLL), The University of Alberta and many more.

Also we found out that urban experiments, such as Living Labs in the subject of circular economy, are critical for developing innovative long-term policies by identifying new products, platforms, and solutions.

In urban contexts, a Living Lab is defined as an innovative policy instrument that allows people to participate in the entire development process as users and co-creators by exploring, examining, experimenting, testing, and evaluating new ideas and creative solutions in complex and everyday situations. Municipalities can act as a promoter, enabler, or partner in Living Labs, with the ultimate goal of understanding how to strengthen transformative urban policies on sustainability and CE [23].

Regarding Public Sector, Living labs contribute to increasing the area for innovation and experimentation, expanding the repertoire of methodologies utilized, and giving a way to rethink and differentiate between diverse forms of public sector innovation outcomes. Living labs appear to disrupt traditional forms of public invention by focusing much more on various forms of co-creation of innovation, particularly through involving users and other stakeholders directly or indirectly in experimental forms of innovation [24].

Conclusions

In a constantly changing world where virgin resources are increasingly limited, it is necessary to transition to a circular operating system. The way we can make this transition has been studied from different perspectives. In the present study, the focus is on living labs as a system to facilitate the transition to a circular economy.

Only a few papers explicitly address the circular economy concept, despite the fact that we uncovered elements connected to the circular economy in all of the articles examined in this study. So, perhaps because there are too many definitions of circular economy and no agreed-upon definition in the research community, and also because living labs are not clearly defined and we found varied perspectives on them.

Future studies should explore the living labs activities regarding the 10R of circular economy to see if all of them are addressed by now or which one is more explored. In order to see exactly what works best or on which components this type of living lab approach best fits, it is important to have some research that aims at what currently exists according to the EC principles.

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