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Fostering Citizen Engagement in South Korea's Living Labs: Key Implications for Management

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Abstract

Purpose: This study aims to explore the factors that impact citizens' attitudes in South Korea's living labs, using quantitative research – an area that has been rarely addressed in previous research. The proposed factors include citizen participation, real-life conditions, multi-method approach, co-creation processes, locality, openness to the public, and the impacts on the economy, society, and the environment. **Research design, data and methodology:** This study conducted an online survey with the assistance of a well-known research firm. Factor and regression analysis were applied to analyze the data. **Results:** The results indicated that factors including real-life condition, locality, and environmental impact significantly influences attitudes toward living labs. This suggest that citizens' perceptions of living labs focused on improving quality of life, particularly addressing real-life conditions, locality, and environmental value have a meaningful effect on their attitude toward participation. **Conclusions:** These findings offer valuable policy and managerial implications. Policies should emphasize the importance of citizen engagement in living labs to address social issues, using innovative and diverse problem-solving approaches. Additionally, improved management strategies are needed to encourage meaningful citizen contributions, particularly through collaborative efforts. Concerted actions are essential to bridge the awareness gap and ensure that citizens are well-informed and actively engaged in living lab projects.

Keywords: Living Labs, Citizen Perception, Managerial and Policy Implications

JEL Classification Code: M30, M31, M20, M10

1. Introduction

Living labs, as an integral part of smart cities, aim to enhance citizens' quality of life by fostering active participation and leveraging technological innovations. Living labs have emerged as a promising approach for advancing smart cities, providing a collaborative platform and co-creation among various stakeholders including government, industry, academia, and citizens (Al-Nasrawi et al., 2015; Falco & Kleinhans, 2018).

Subsequently, Professor Mitchell of MIT introduced the living lab concept as a means to overcome the limitations of traditional laboratories by facilitating the observation and monitoring of interactions between users and IT devices (Dutilleu et al., 2010; Mitchell, 2004; Mukama et al., 2022).

In Korean society, there is a growing trend towards seeking bottom-up solutions to urban and regional challenges or industrial revitalization, reflecting a maturing atmosphere of democratic decision-making (Han, 2016). In South Korea, leveraging advanced IT technology, successful living lab initiatives have been observed with active citizen participation, such as the Seongdaegol Energy Independent Village in Seoul and the Geonneoyu Project in Daejeon (Seong et al., 2016). Leminen et al. (2012) provide a similar definition, describing living labs as either physical regions or virtual environments where stakeholders, including firms, public agencies, universities, institutes, and users, come together in public-private-people partnerships, which

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collaborate in the creation, prototyping, validation, and testing of new technologies, services, products, and systems within real-life contexts.

The aim of this study is to explore citizen perceptions of living labs and identify strategies for improving management and public policies to establish sustainable citizen-centered living labs. This study examined various definitions and the conceptual evolution of living labs in response to changes in societal trends and backgrounds. It investigates how living labs have evolved over time in response to citizen perceptions, technological advancements, and policy considerations. This study explored citizen perceptions of living labs in South Korea, a topic rarely addressed in previous research. Specifically, this study employed quantitative research to measure perceptions of living labs, filling a gap in previous studies. It addresses the following questions: how do citizens understand the definition and scope of living labs? Additionally, this study aims to explore factors that promote living labs and their impact on citizens' attitudes and intention to participate. The proposed factors include citizen participation, real-life conditions, multi-method approach, co-creation processes, locality, openness to the public, and the impacts on the economy, society, and environment. The research questions include: 1) How does perceived citizen participation in living labs affect citizens' overall attitude? 2) How does the perception of real-life condition for living labs affect citizens' overall attitude? 3) How does the perceived use of multi-method approach in living labs affect citizens' overall attitude? 4) How does the perception of co-creation processes in living labs affect citizens' overall attitude? 5) How does perceived locality in living labs affect citizens' overall attitude? 6) How does perceived openness to public in living labs affect citizens' overall attitude? 7) How does perceived economic impact affect citizens' overall attitude? 8) How does perceived social impact affect citizens' overall attitude? 9) How does perceived environmental impact on living labs affect citizens' overall attitude? 10) How does a positive attitude toward living labs influence citizens' intentions to participate? This study seeks to clarify how these factors shape citizens' engagement and intention to participate in living labs.

2. Literature Review

2.1. Origin and Development of Living Labs

The origins of the living labs concept can be traced back to 1990 when it was first explored to describe experimental work conducted by students in a large urban neighborhood of Philadelphia, Pennsylvania, aimed at addressing community challenges (Bajgier et al., 1991). Over time, the concept of living labs has evolved into an approach for addressing complex social issues through the development, testing, and refinement of new technologies (Filho et al., 2023). Central to the living labs approach is the involvement of users as co-creators, placed on equal footing with other participants, and the experimentation in real-world settings (Almirall et al., 2012). According to the European Network of Living Labs (ENoLL), living labs are characterized as user-centered, open innovation ecosystems that employ a systematic approach to user co-creation, integrating research and innovation processes within real-life communities and settings (Mukama et al., 2022). This definition aligns with other descriptions found in the literature, which also emphasize living labs as platforms for innovation where various stakeholders, including users, collaborate in real-world settings (Hossain et al., 2019). The significance of living labs is increasingly recognized as they offer a platform where citizens can effectively respond to various situations, aiming to achieve a sustainable city through collaborative governance (Jang & Kim, 2019). In European cities like Helsinki and Barcelona, citizens are actively engaged in expressing their opinions on service development and play a crucial role in implementing highly sensitive services, a practice that is showcased in international conferences (Jang & Lee, 2015).

As scholarly research on living labs gained momentum around 2010, they emerged as a new strategy to stimulate innovation opportunities in education for sustainability (Filho et al., 2023). Initially, living labs were experimental activities conducted by university students to address community challenges. In the 1990s, Prof. Mitchell further developed the concept of living labs by focusing on developing, testing, and refining new technologies (Mitchell, 2004). Research on living labs has evolved to encompass how to design and manage them effectively, as well as how to engage with stakeholders and apply them in various contexts (Leminen et al, 2015). Living labs such as Amsterdam's Smart Citizen Kit (https://amsterdamsmartcity.com), Coventry's CovJam (https://www.lgcpus.com), and Helsinki's Smart City Living Lab serve as open data repositories that reflect citizens' opinions and inform public policies (Hielkema & Honisto, 2013).

Despite numerous efforts, such as policy promotion and financial support through living lab competitions sponsored by both central and local governments, the advancement of sustainable citizen-centered living labs in South Korea is still perceived to be at the experimental stage (Shvetsova & Lee, 2021). According to Hubavem (2019), establishing an interactive network involving the government, market, and private sector is essential for the continuous development and management of living labs, which offer clear advantages, however, in South Korea, breaking free from decades-old regulatory entanglements within the industrial market remains a challenge. Shvetsova and Lee (2021) highlight the importance of leveraging end users' experiences and creativity. Shvetsova and Lee (2021) also propose that South

Korea, having achieved economic development through an innovation-driven strategy, should embrace a new innovation approach centered on end users' perspectives, particularly within the framework of policy-driven living labs.

2.2. Living Labs in South Korea

With the increasing recognition of living labs' role in addressing societal and local community challenges, research on living lab models that emphasize citizen participation is gaining significant momentum. In South Korea, where living lab initiatives trail Europe by more than a decade - European having established the European Network of Living Labs (ENoLL) in 2006 with around 20 participating labs - the concept was initially introduced as a tool for technological and industrial innovation by the Ministry of Trade, Industry and Energy and the Ministry of Science and ICT (Yoon, 2018). Regarding the diagnosis and evaluation of living labs in South Korea, their significant recent proliferation, especially within local governments, for various purposes ranging from civil complaint resolution initiatives to technology innovation-driven business model creation projects, can be seen as a positive expansion of the foundation for regional innovation (Lim, 2016). However, despite the growing presence of living labs in South Korea, concerns have been raised about their transient nature and failure to establish a sustainable living lab platform akin to the active ones in Europe (Seong & Lee, 2018). To foster the establishment of enduring living labs rather than one-time projects, it is crucial to sustain active participation and communication among stakeholders throughout the entire process, particularly, there is an emphasis on the need for local governments to proactively enhance awareness and develop more systematic policies that consistently validate citizens' perceptions of services related to living labs (Choi et al., 2020).

Despite the advancements in technological infrastructure like ICT, IoT, and AI, citizen participation in living labs in South Korea remains relatively low, and there is insufficient support for the commercialization of living labs and the dissemination of their outcomes (Park et al., 2019). Living labs often result in one-time projects or outcome-driven endeavors, leading to decreased civic awareness, diminished sense of purpose, and reduced connection with expert groups (Jang & Kim, 2019). Consequently, there is a need for better management and operational services that actively involve citizens to ensure the continuous development of living lab projects (Choi et al., 2020). According to Shvetsova and Lee (2021), despite ample technological support for collaboration, Korean companies still lack clear understanding of how to improve business processes within the living lab ecosystem. This challenge is attributed to issues such as heavily regulated market and a disconnect between innovative system and market regulations (Shvetsova & Lee, 2021).

Despite various challenges facing living labs, notable examples of citizen participation include the Geonneoyu project in Daejeon in South Korea (Park, 2019). In this project, citizens identified local issues and collaborated to develop a smartphone app that monitors river flooding during heavy rainfall (Park, 2019). Another example is the energy self-sufficiency initiative of residents in Seoul's Seongdaegol area, who implemented energy-saving measures through their own solar power business. Additionally, Seoul has launched the Metaverse Seoul project, the world's first public Metaverse platform aimed at integrating citizen input and reflecting citywide policies (Seoul Metropolitan Government, 2023). Furthermore, Hanam City has developed the Hanam e Self platform, a digital village living lab that enables citizen participation in identifying and addressing local challenges (Hanam City Living Lab, 2020). These initiatives highlight the increasing significance of citizen involvement in tackling urban and community challenges through innovative living lab approaches.

2.3. Theoretical Foundation of Living Labs

The theoretical foundation of living labs is multidisciplinary, incorporating concepts from open innovation, participatory design, co-creation, user-centered design, socio-technical systems, and experiential learning and each of these elements contributes to the holistic approach that living labs adopt to drive innovation in real-world settings (Chesbrough, 2003; Kolb, 1984; Norman, 1988; Michael, 2003; Prahalad & Ramaswamy, 2004; Trist & Bamforth, 1951). Open innovation, introduced by Henry Chesbrough (2003), forms the cornerstone of the living lab approach, which asserts that organizations can achieve technological and business advancements by harnessing both internal and external ideas. Prahalad and Ramaswamy (2004) emphasize that co-creation enhances value by leveraging diverse expertise and promoting shared experiences.

In living labs, users transition from being passive recipients of technology to active contributors (Ballon, et al., 2005). As such, user-centered design and participatory design are integral to the living lab methodology (Ballon, et al., 2005). User-centered design focuses on understanding users' needs and preferences, ensuring that solutions are tailored to real-life contexts (Norman, 1988). Participatory design takes this further by viewing users as experts in their own experiences, actively involving them in the design process (Michael, 2003). Socio-technical systems theory, which examines the interplay between people and technology within a system, is also pivotal to living labs (Trist & Bamforth, 1951). Innovations in living labs often depend on effectively integrating people and technology within existing social structures, cultural norms, and technological infrastructures (Leminen et al., 2012). Finally, living labs serve as experiential learning spaces, where users

interact with prototypes in real-life settings (Kolb, 1984). This process enables iterative feedback and insights that shape the development of innovative solutions (Kolb, 1984).

3. Hypotheses Development

This study developed hypotheses to investigate the influence of these factors on citizens' attitudes toward living labs. Additionally, insights gained from policy recommendations are expected to inform policy implications and enhance citizens' intention to participate in living labs.

3.1. Effects of Citizen Participation on Overall Attitude

Citizen participation stands as a crucial element in the functionality and revitalization of living labs, a sentiment echoed across various definitions and policies associated with these initiatives in numerous cities. Adopting a user innovation approach, scholars like Leminen (2013) and Almirall et al. (2012) portray living labs as a bottom-up methodology, where users or communities, acting as co-creators, address their needs through active involvement. The pivotal role of user engagement, particularly as citizens, is underscored in living labs, with citizens and civil society being recognized as not only sources of innovation but also essential participants in innovation endeavors (Eriksson et al., 2005; Mulder et al., 2008; Leminen et al., 2015). Moreover, living labs serve to cultivate new products and services by harnessing the diverse knowledge, ideas, and experiences of engaged users (Hielkema & Hongisto, 2013). Choo et al. (2023) highlighted the importance of citizen engagement in smart city planning and identified barrier to the living lab approach through qualitative research involving individuals who participated in the smart city plan. This study posits that actively involving citizens in the co-creation process is significantly important for the success of living labs. Building on this consideration, this study hypothesized the effects of citizen participation factor on overall attitude.

H1: Perceived citizen participation in living labs affects citizens' overall attitude.

3.2. Effects of Real-life Condition on Overall Attitude

The real-life setting in living labs plays a crucial role in shaping citizens' overall attitudes toward these initiatives, especially when it comes to addressing real-world problems. Unlike traditional research settings, the emphasis on real-life environments within living labs is considered pivotal for fostering innovation, offering contextual insights based on user experiences, and promoting openness (Schuurman et al., 2014). Consequently, living labs have expanded the scope of real-life environments from singular, isolated locations to encompass educational institutions, people's homes and workplaces, and various urban settings (Nyström et al., 2014). Examples like the Seongdaegol Energy Living Lab and the Geonneoyu Project illustrate the sustainability of living labs that engage with real issues within authentic life settings (Seong et al., 2016). Such demonstrations underscore the importance of addressing problems directly connected to citizens' lives within living labs. Therefore, living labs that are situated in real-life contexts have the potential to significantly influence citizens' overall attitudes toward these initiatives. Building on this consideration, this study hypothesized the effects of real-life condition factor on overall attitude.

H2: Perceived real-life condition for living labs affects citizens' overall attitude.

3.3. Effects of Multi-method on Overall Attitude

The multi-method approach employed in living labs is seen as positively influence citizens' attitudes toward these initiatives by providing an innovative alternative to traditional research methods. Living labs utilize a methodology encompassing multiple stages of the innovation development process, including exploration, experimentation, and evaluation (Evans et al., 2017). Throughout these stages, innovation advances from initial ideation to conceptualization, harnessing new user-driven data facilitated by advanced technology, and ultimately culminates in the testing and benchmarking of prototypes (Evans et al., 2017). Building on this consideration, this study hypothesized the effects of multi-method factor on overall attitude.

H3: Perceived multi-method in living labs affects citizens' overall attitude.

3.4. Effects of Co-creation Process on Overall Attitude

The co-creation process within living labs is perceived to exert an influence on citizens' overall attitudes toward these initiatives, as it involves collaborative creation between experts in various fields and diverse stakeholders deliberating on problems and solutions. At its core, living labs operate on the principle of open innovation, relying on external sources for innovation through co-creation with a multitude of stakeholders, so by fostering collaboration, living labs facilitate the development and validation of new products and services (Bergvall-Kåreborn et al., 2009; Veeckman & Temmerman, 2021). Schuuman et al. (2014) underscores the significance of co-creation, defining living labs as a form of innovation that places users at the forefront and champions co-creation. Building on this consideration, this study hypothesized the effects of co-creation process factor on overall attitude.

H4: Perceived co-creation process in living labs affects citizens' overall attitude.

3.5. Effects of Locality on Overall Attitude

Locality, within the context of living labs, is believed to have a significant influence on citizens' overall attitudes toward these initiatives, as they focus on local issues and have a direct, tangible impact on the lives of residents in the area. In light of global crises such as economic downturns and climate change, the importance of local collaboration through living labs has been underscored across various socio-economic spheres that vary from one region to another (Boersma et al., 2022). Living labs serve as catalysts for the development of innovative products and services, as well as for the diversification of the local economy, by fostering an ecosystem that enables the sustainable utilization of local resources through collaborative creation and innovative approaches involving stakeholders deeply connected to local issues (Zavratnik et al., 2019). This study posits that grounding living labs in specific local contexts is a key aspect of their success. Building on this consideration, this study hypothesized the effects of locality factor on overall attitude.

H5: Perceived locality of living labs affects citizens' overall attitude.

3.6. Effects of Openness to Public on Overall Attitude

Openness to the public within the context of living labs is believed to exert a significant influence on citizens' overall attitudes, as it ensures transparency throughout the entire process, from inception to outcomes, and facilitates the sharing of reliable data, contrasting with traditional closed studies. Innovation, a cornerstone of the living labs concept, underscores the importance of openness, ensuring accessibility to anyone and integrating user-centered research (Almirall & Wareham, 2011; Schaffers et al., 2007). As evidenced in previous discussions, living labs such as CovJam in Coventry (https://www.lgcpus.com), Helsinki's Smart City Living Lab (Hielkema & Honisto, 2013), Metaverse Seoul (Seoul Metropolitan Government, 2023), and Hanam e Self (Hanam City Living Lab, 2020) serves as open data repositories that reflect citizens' opinions and inform public policy design (Hielkema & Honisto, 2013). Building on this consideration, this study hypothesized the effects of openness to public factor on overall attitude.

H6: Perceived openness to public to living labs affects citizens' overall attitude.

3.7. Effects of Economic Impact on Overall Attitude

The economic impact of living labs on the community, driven by innovative research process that leverage cutting-edge technologies like ICT, big data, and AI, is believed to significantly shape citizens' attitudes. Living labs act as test beds for companies, enabling them to conduct research with trial and error, which ultimately leads to economic benefits for citizens, corporations, and society at large. Value creation, a core principle of living labs, focuses on satisfying consumer needs rather than solely pursuing corporate profit creation through product-oriented approaches, so this emphasis on value creation is expected to generate economic benefits that resonate with citizens and contribute to the overall well-being of the community (Pino et al., 2013). Building on this consideration, this study hypothesized the effects of economic impact factor on overall attitude.

H7: Perceived economic impact affects citizens' overall attitude.

3.8. Effects of Social Impact on Overall Attitude

The social influence stemming from interactions within living labs, involving citizens, local governments, corporations, and expert groups, is believed to have a significant impact on citizens' overall attitudes toward these initiatives. Through these platforms, citizens, research institutes, and companies can engage in ongoing dialogue, plan new projects, and provide feedback, fostering a dynamic social arena for innovation and development (Seong & Lee, 2018). Tyl and Allais (2021) highlighted that living labs aim to engage reuse and repair actors, often from the social and solidarity economy, who hold strong ambitions to create social and environmental value. Building on this consideration, this study hypothesized the effects of social impact factor on overall attitude.

H8: Perceived social impact affects citizens' overall attitude.

3.9. Effects of Environmental Impact on Overall Attitude

The environmental impact of living labs, which strive to achieve harmony between human activities and the natural environment amidst climate change, plays a significant role in shaping citizens' overall attitudes towards these initiatives. Sustainability is a pressing global concern, and living labs serve as platforms for sustainable development and innovation, making them inherently connected to environmental preservation (Leminen et al., 2016). The Seongdaegol Energy Independent Village Living Lab emerged from citizens' concerns about environmental issues following the Fukushima nuclear power plant accident and through this initiative, citizens aimed to create a sustainable energy village by developing mini solar panels tailored to the village's needs, highlighting the role of living labs in addressing environmental challenges and promoting

sustainability (Kim et al., 2017). This study posits that clearly stated environment value is a key aspect of the success of living labs. Building on this consideration, this study hypothesized the effects of environmental impact factor on overall attitude.

H9: Perceived environmental impact on living labs affects citizens' overall attitude.

3.10. Effects of Overall Attitude on Intention to Participate in Living Labs

This study posits that attitudes toward living labs are formed based on factors such as citizen participation, real-life conditions, multi-method approach, co-creation processes, locality, openness to the public, and economy, society, and environment values. Furthermore, this study analyzed whether a positive attitude toward living labs affects a higher level of citizens' intention to participate in living labs. Based on this, this study hypothesized that a positive attitude toward living labs leads to a higher level of citizens' intention to participate in them. Building on this consideration, the following hypotheses are proposed:

H10: A positive attitude toward living labs affects a higher level of intention to participate for citizens.

4. Methodology

The study aims to assess the impact of various factors on citizens' attitudes and intentions to participate in living labs. Data was collected through an online survey administered by a professional online panel company. The survey targeted adult men and women residing in South Korea, with quotas set for gender, age, region, and other relevant demographics. The questionnaire provided participants with an introduction to living labs, including definitions and examples familiar to citizens in their everyday lives. Examples such as Daejeon City's Geonneoyu project (Seong et al., 2016), which utilizes smartphones to monitor river flooding was included to illustrate the potential benefits of living labs in improving quality of life. The questionnaire consists of warm-up questions, main questions, and demographic questions. This study applied a 5-point Likert scale of 1 – strongly disagree and 5 – strongly agree for major variables. Finally, the total of 300 respondents completed the survey, consisting of 28 living lab participants and 272 potential living lab participants. The survey invitation was sent to 3,123 people, and 358 adult men and women participated in the survey, therefore, the response rate was 11.5%. 58 respondents were eliminated through dropout and screening. In order to check reliability of factors developed with various questionnaire items, this study conducted Cronbach's alpha tests. The results of Cronbach alpha include the following: 0.872 for citizen participation, 0.824 for real-life condition, 0.818 for multi-method, 0.875 for co-creation process, 0.875 for locality, 0.837 for openness to public, 0.834 for impact on economy, 0.847 for impact on society and 0.864 for impact on environment. This study applied factor analysis, ANOVA, and multiple regression analysis to test main hypotheses.

Among respondents, 50.0% were female and 50.0% were male. Among respondents, 7.3% were working at educational institution, 2.3% were working at government sector, 5.0% were working at public corporate sector, 45.7% were working at private sector, 10.0% were self-employed, 13.7% were housewives, 8.3% were students, and 5.0% were others. Regarding age groups, 6.0% were 21-24 years old, 21.3% were 25-29 years old, 17.3% were 30-34 years old, 10.7% were 35-39 years old, 17.0% were 40-44 years old, 11.0% were 45-49 years old, 12.0% were 50-54 years old, and 4.7% were over 50-59 years old. In terms of education level, 17.0% had high school graduate, 14.0% had 2-year associate degree, 62.3% had bachelor's degree, 6.3% had master's degree, and 0.3% had Ph.D. degree.

5. Data Analysis

This study checked the validity by using factor analysis. This study applied extraction method with Principal Component Analysis. This study selected factors that Eigen values are greater than 1.00 for major variables including citizen participation, real-life condition, multi-method, co-creation process, locality, openness to public, impact on economy, impact on society, impact on environment. This study applied the following questionnaire items: 1) Citizen participation: Items assess whether citizens are willing to actively participate in living labs, as these are linked to social issues. Responses also gauge whether autonomy through platform use could increase participation. 2) Real-life conditions: Items measure citizens' disappointment with living lab policies if they do not address real-life problems and evaluate the likelihood of greater participation if living labs tackle practical, everyday issues. 3) Multi-method approach: Items examine whether innovative and diverse methods in problem-solving within living labs influence citizen participation, as hesitation may occur if methods lack diversity. 4) Co-creation process: Items assess whether citizens are more likely to participate in living labs that involve meaningful contributions from participants, with a particular focus on collaborative processes. 5) Locality: Items explore the influence of local citizen involvement in living labs, including whether citizens are more inclined to participate if these labs are managed by local individuals. 6) Openness to public: Items gauge citizens' disappointment with living lab policies if they lack openness, as well as the general belief that any citizen should be able to participate. 7) Economic impact: Items explore perceptions of living labs' contributions to the local economy and examine whether economic impacts could drive greater citizen participation. 8) Social impact: Items evaluate the belief that participation

in living labs fosters sustainable communities (e.g., urban regeneration) and assess whether this pursuit of social value encourages greater involvement. 9) Environmental impact: Items examine whether citizens believe living labs contribute to environmental sustainability and consider whether participation may be discouraged if labs are not linked to eco-friendly policies. Table 1 summarized the results of factor analysis for each component of living labs.

Table 1: Component Matrix

	Components (Citizen)								
	1	2	3	4	5	6	7	8	9
Citizen Participation 5	.84								
Citizen Participation 4	.82								
Real-life Condition 4		.84							
Real-life Condition 5		.80							
Multi-Method 4			.81						
Multi-Method 3			.80						
Co-Creation 3				.86					
Co-Creation 4				.82					
Locality 3					.86				
Locality 2					.83				
Openness 3						.87			
Openness 4						.83			
Economy 4							.84		
Economy 5							.83		
Society 4								.86	
Society 5								.85	
Environment 1									.86
Environment 4									.85

This study applied factor scores for multiple regression analysis to find out the significance of each factor on overall attitude toward living labs. ANOVA results showed that *R-square* = .429 and overall, the regression model was significant with F = 24.173 (at alpha of 0.01 level). As summarized in Table 2, the results showed that effects of real-life condition, locality, and impact on environment on overall attitude were significant. Therefore, by applying alpha 0.01 level and 0.05 level H2, 5, and 9 were significantly accepted. Among significant factors, effect size for real-life condition showed greater than other factors, followed by impact on environment and locality. Therefore, the results found that how citizens prefer living labs with focus on the real-life problems of citizens, how citizens expect to participate more in living labs that deal with real-life issues of citizens, how citizens perceive living labs with operation in real life condition particularly through technological innovation affect overall attitude toward the living labs with greater effect size. The results also found that how citizens consider participation in living labs that contributes to the creation of a sustainable environment, consider more in living labs dealing with environmental issues due to climate change, and prefer to participate in living labs related to eco-friendly policies affect overall attitude toward the living labs. The results also found that how citizens consider to participate in living labs that deal with local issues affect overall attitude toward the living labs.

Table 2: Effects of Factors on Citizens' Overall Attitudes

Variable (Independent → dependent)	Standardized Coefficient (*t*-value-Sig)
Citizen Participation → Attitude (H1)	.060 (.717)
Real-life condition → Attitude (H2)	.232 (2.672***)
Multi-method → Attitude (H3)	-.046 (-.511)
Co-creation process → Attitude (H4)	.087 (.852)
Locality → Attitude (H5)	.188 (2.048**)
Openness to public → Attitude (H6)	.044 (.560)
Impact on Economy → Attitude (H7)	-.015 (-.171)
Impact on society → Attitude (H8)	-.015 (-.151)
Impact on environment → Attitude (H9)	.200 (2.391**)

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
denotes statistical significance

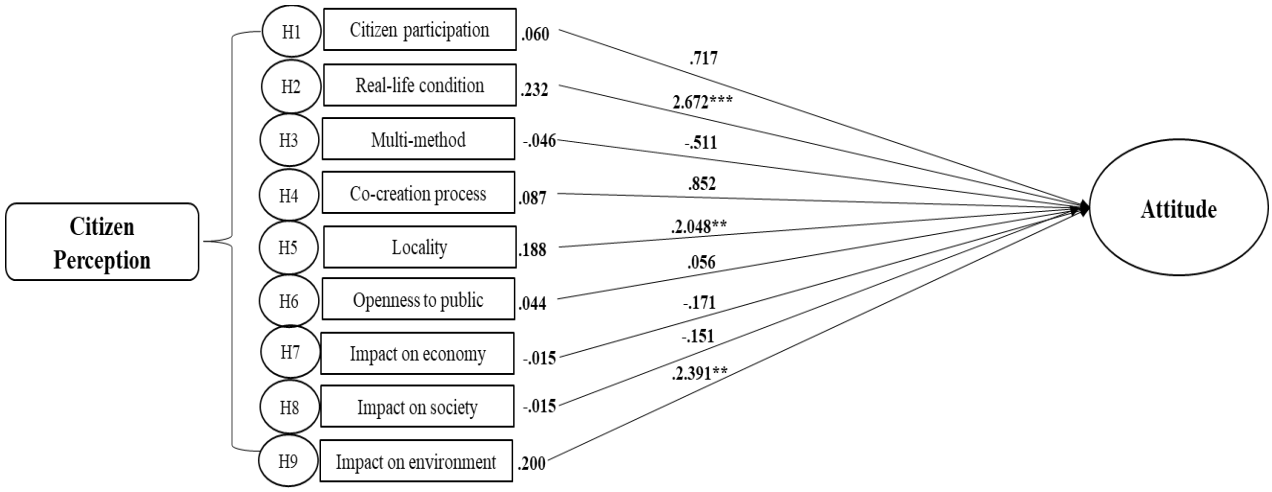

Figure 1: The Logic Model of Multiple Regression Analysis in Study

6. Conclusion

This study conducted multiple regression analysis using factor scores derived from citizen surveys and identified factors such as real-life conditions, locality, and environmental impact that influence citizens' attitudes towards living labs. This study found that factors including real-life condition, locality, and impact on environment on attitude toward the living labs showed significance. Therefore, the results meet the meanings of living labs that considered enhanced local inclusion by applying real-life condition and environmental issues such as climate change and energy consumption in sustainable societies. Among significant factors, the effect size of real-life condition on attitudes showed greater than other factors. This implies how citizens perceive living labs that focus on improving quality of life, particularly dealing with real-life condition affect attitude toward living labs. Furthermore, the results suggest that citizens' perceptions of living lab policies significantly impact their attitudes, particularly when these policies address real-life problems. The likelihood of greater participation increases when living labs focus on practical, everyday issues. The results also suggest that citizens' perceptions of local involvement in living labs significantly impact their attitudes, especially regarding whether including whether they are more inclined to participate when these labs are managed by local individuals. The results also suggest that citizens' perceptions of living labs' contributions to environmental sustainability significantly impact their attitudes, with participation potentially discouraged if the labs are not linked to eco-friendly policies.

This study found that factors such as citizen participation, a multi-method approach, the co-creation process, openness to the public, and impacts on the economy and society did not significantly influence citizens' attitudes toward living labs. Despite this, living labs play an essential role in uniting various stakeholders to address social issues, integrate policing concerns, and support business development for the public good, contributing to broader social integration. Beaudoin et al. (2022) emphasized that today's significant environmental challenges demand the involvement of diverse stakeholders and collaborators to develop sustainable practices that are socially, culturally, and economically robust. The lack of significance found for the co-creation process in this study reveals a notable gap compared to previous research, which has underscored the importance of stakeholder collaboration in living labs. Additionally, factors such as citizen participation, multi-method approaches, and the economic and societal impacts of living labs may have shown limited significance due to factors like low public awareness of living labs and their purpose.

These findings have meaningful policy and managerial implications. Policies should better highlight the importance of citizen engagement in living labs that address social issues, utilizing innovative and diverse problem-solving methods. Improved management strategies are also needed to encourage citizens to contribute meaningfully in living labs, with a focus on collaborative efforts. Moreover, living lab policies should emphasize their potential to boost the local economy, increase citizen involvement, and foster sustainable communities (e.g., urban regeneration) through their social value.

This study also found that 90.7% of citizens have not participated in living labs, and 87.7% of citizens are not aware of them. This implies that while citizens may have heard of living labs, they lack a clear understanding of their meaning and processes. Given the low level of awareness among citizens in South Korea, it is crucial to improve both their understanding and participation to foster a more positive attitudes, greater satisfaction, and better prospects for these initiatives. The findings highlight the need for improved promotional policies aimed at communicating the significance of living labs to enhance citizen awareness and participation. While citizen-centered living labs policies are promoted by the central government, the actual implementation and application of these labs fall largely to local governments. However, the widespread lack of awareness among citizens regarding living labs does not align with the expectations set by government policies. Additionally, the low level of awareness and participation limits the potential success of living labs in contributing to sustainable societies. Therefore, concerted efforts are necessary to bridge this gap and ensure that citizens are properly informed and engaged in living lab projects.

This study has several limitations. Future study should aim to increase the sample size and consider incorporating qualitative methods. Additionally, future studies should conduct comparative analyses across regions, taking into account citizens' varying levels of awareness of living labs. Future research might also explore diverse perspectives based on demographic factors.

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Web Resources:

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