ISSN: 2586-6036
JWMAP website: http://accesson.kr/jwmap
doi: http://dx.doi.org/10.13106/jwmap.2024.Vol7.no1.17

Citizens' Perceptions of Living Labs for a Better Living Environment: Perspectives of Millennials and Generation Z

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Received: March 12, 2024. Revised: March 22, 2024. Accepted: March 22, 2024.

Abstract

Purpose: This study aims to explore the citizens' perceptions of living labs in the context of enhancing the living environment. Specifically, it employs quantitative research to investigate the perspectives of Millennials and Generation Z. This study proposed research questions to examine how the impacts of citizen-driven management, social factors, locally-driven management, open innovation operation, economic value, and environmental value influence the overall attitude toward living labs. Additionally, this study investigated the effects of overall attitudes on intention to participate in living labs and expected satisfaction towards living labs. **Research design, data and methodology:** This study employed an online survey conducted by a well-known research organization. Factor and regression analysis were utilized for data analysis. **Results:** The results revealed significant effects of citizen-driven management, social factors, economic value, and environmental value on overall attitude, with social factors exhibiting the highest effect size on overall attitude. Additionally, significant effects of overall attitude on intention and expected satisfaction were observed. **Conclusions:** The findings suggest which aspects of living labs should be fostered for the development of residents, the local economy, and citizens' quality of life, particularly with consideration of the perspectives of Millennials and Generation Z, who play a crucial role in utilizing a diverse array of ICT tools.

Keywords: Living Lab, Citizen-driven Management, Social Value, Environment Value, Economic Value.

JEL Classification Code: M10, M30, M38, J17

1. Introduction

This study posits that citizens' perceptions of living labs for a better living environment vary depending on several factors, including their experiences, expectations, and interactions within the living lab context. This study addressed that citizens may perceive living labs as catalysts for positive change, driving improvements in sustainability, resilience, and quality of life. Wehrmann et al. (2023) emphasized that living labs represent key environments in the pursuit of science to become more inclusive and open to individuals from diverse backgrounds, spanning fields such as politics, design, and culture. Baccarne et al. (2014) highlighted the growing recognition of cities as primary catalysts for change in a swiftly evolving socio-technical landscape and emphasized the role of urban living labs in the context of smart cities. Hossain et al. (2019) defined that a living lab is a physical or virtual space dedicated to addressing societal challenges, particularly in urban areas. It serves as a platform for bringing together diverse stakeholders for collaborate and collectively generate innovative ideas (Hossain et al., 2019). Compagnucci et al. (2021) investigated the role of living labs in promotion innovation and sustainability, two primary goals. Bergvall-Kåreborn and Ståhlbröst (2009) emphasized that living lab represents new approaches to managing innovation processes and can be regarded as both an innovation milieu and an innovation approach. Baccarne et al. (2014) highlighted that cities are increasingly recognized as primary drivers for change in a rapidly evolving socio-technical environment. Buhr et al. (2016) noted that numerous urban living labs concentrate on sustainable development, which is a prominent and pressing concern in less valued suburbs requiring modernization and social uplift. Feurstein et al. (2008) emphasized that the central element of the living labs, which involve the co-involvement of users at all stages of the development process, constitute a distinctiveness of the method and offers specific advantages to the process. Tabata et al. (2022) proposed an approach to promote voluntary participation and behavioral change among individuals by applying living lab methodologies to improve citizens' wellness.

Based on these considerations, this research aims to investigate citizens' perceptions of living labs for fostering a better living environment by investigating factors that influence overall attitudes toward living labs. This study proposed a comprehensive framework to investigate citizens' perceptions of living labs, particularly focusing on Millennials and Generation Z. The variables included in this study comprise the citizen-driven management, social factors, locally-driven management, open innovation operation, economic value, and environmental value, all aimed at measuring their impact on the overall attitude toward living labs. This study employed quantitative research to examine citizens' perceptions, an aspect that has been rarely explored in previous research. Specifically, the perspectives of Millennials and Generation Z regarding living labs have been seldom examined in prior studies. This study formulated the following research questions: i) how does citizen-driven management impact the overall attitude toward living labs? ii) how do social factors influence the overall attitude toward living labs? iii) how does locally-driven management impact the overall attitude toward living labs? iv) how does open innovation operation impact the overall attitude toward living labs? v) how does economic value impact the overall attitude toward living labs? vi) how does environmental value impact the overall attitude toward living labs? vii) how do overall attitudes impact intention to participate in living labs?; and viii) how do overall attitudes impact expected satisfaction towards living labs?

2. Literature Review

2.1. Living Lab

Dell'Era and Landoni (2014) pointed out that living labs are an emerging and rapidly diffusing phenomenon, as evidenced by the growth of its primary trade association, the European Network of Living Labs. Hossain et al. (2019) highlighted that in the literature, the terms living lab, living laboratory, and living labbing have often been used interchangeably in the literature, while they noted distinguishable approaches to living labs, particularly the North American view and the European view. According to Mukherjee et al. (2023), the concept of a living lab is gaining prominence, especially in Europe, as a means to foster digital innovations through a collaborative process of design and development. This process occurs within real-life usage contexts, both physically and socially (Mukherjee et al., 2023). Berberi et al. (2023) asserted that living labs are advocated as an effective open innovation approach that accelerates the adoption of innovations.

Wehrmann et al. (2023) underscored that living labs are recognized both as a format of participatory research and as a platform for collaborative technology and product development. These labs create and replicate situations that closely resemble everyday life, allowing for observation and experimentation in real-world contexts (Wehrmann et al., 2023). Følstad (2008a) emphasized that living labs serve as environments for engaging users in innovation and development and are regarded as effective means of addressing the innovation challenges encountered by information and communication technology service providers. Arnould et al. (2022) addressed how the living lab approach can enhance the acceptance, adoption and utilization of policy instruments, as well as how it promotes multi-stakeholder collaborations to design and deploy

innovative solutions. Awwal et al. (2022) highlighted that living labs can play a crucial role in facilitating mediation amongst stakeholders, thereby aiding in addressing such challenges. Awwal et al. (2022) also emphasized that living labs are user-centered initiatives focused on developing innovative solutions in real-life contexts through a collaborative process. Følstad (2008b) discussed the significance of involving users in the innovation processes that lead to the development of new ICT services. This emphasis was placed on the importance of engaging users within their everyday contexts (Følstad, 2008b). Battisti (2014) pointed out that social innovation can be examined within living labs, which are regarded as innovation intermediaries facilitating the co-creation of solutions to address users' needs.

2.2 Generations & Adoption of Information Communication Technology

Generations are defined as identifiable groups sharing birth years, age location, and significant life events at critical developmental stages (Kupperschmidt, 2000). Classification of generation cohorts varies across studies. According to Motta, et al. (2000), American cohorts are classified as follows: i) the first cohort, known as the "Depression" cohort (coming of age 1930 to 1939), ii) the second cohort, known as "World War II" (coming of age from 1940 to 1945), iii) the third cohort, known as "Post War" (coming of age from 1946 to 1963), iv) the fourth cohort, known as "Boomers I (coming of age from 1964 to 1972), v) the 5th cohort, known as "Boomers II" (coming of age from 1973 to 1983), vi) the sixth cohort, known as "Generation Xers" (coming of age from 1984 to 1994). Hill (2022) researched generational harmony and classified generations as follows: i) World War II Generation (1901-1927), ii) Silent Generation (1928-1945), iii) Baby Boomer Generation (1946-1964), iv) Generation X (1965-1980), v) Millennials (1981-1996), and vi) Generation Z (1997~). According to Francis and Hoefel (2018), generations are determined as follows: i) Baby Boomers (1940-1959), ii) Generation X (1960-1979), iii) Generation Y (1980-1994), and iv) Generation Z (1995-2010). Due to the significance of the issue and its impact on the economy, labor market, and organizations' marketing strategies, emerging new generations and their characteristics are garnering considerable interest worldwide (Dolot, 2018). The youngest generation, known as Generation Z, has been born and raised in entirely different circumstances to older generations, and they adeptly share information with others (Dolot, 2018). Generation Z is recognized as the most ethnically diverse and technologically sophisticated generation (Agarwal & Vaghela, 2018). Francis and Hoefel (2018) delineated the distinctions of Generation Y from other generations, such as the impact of globalization and the emergence of the internet. Francis and Hoefel (2018) also highlighted how Generation Z stands apart from previous generations, citing characteristics like being digital natives, pragmatic, and expressive of individual truths.

The adoption of Information Communication Technology (ICT) varies among different generations due to factors such as technological exposure, familiarity, and perceived usefulness. While variations exist in ICT adoption and usage among different generations, the overall trend is towards increasing digital literacy and reliance on technology across all age groups. However, Millennials are often recognized as digital natives, possessing a high level of proficiency in utilizing a wide range of ICT tools and platforms for communication, social networking, and work-related tasks. Generation Z, raised entirely in the digital age, are highly tech-savvy and heavily rely on ICT for communication, learning, and social interaction. Toma et al. (2023) underscored that Generation Z members, currently entering adult life, will play a pivotal role in the implementing the concept of a smart city. Følstad (2008a) stressed the necessity to investigate how living labs can be utilized by information and communication technology service providers. In the field of ICT, living labs represent a relatively new type of environment for innovation and development, where new ICT solutions are tested in contexts familiar to users (Følstad, 2008a).

3. Hypotheses Development

3.1. Effects of Citizen-Driven Management on Overall Attitude

This study posits that citizens may view living labs as an opportunity to actively engage in the co-creation of solutions for improving their living environment. To establish living labs in better living environments, citizens may appreciate the chance to contribute their insights, ideas, and feedback, feeling empowered by their involvement in shaping their communities.

Baccarne et al. (2014) emphasized that the role of urban living labs in facilitating urban transitions and empowering citizens in the development processes of innovation, particularly within the context of smart cities. Shin (2019) addressed that living lab approaches, as one of socio-technical approaches, are effective strategy for user-driven technology development. Westerlund et al. (2018) underscored the importance of fostering participation and contribution by supporting users' intrinsic motivation, which involves the internal gratification individuals receive from working towards a goal, as well as extrinsic motivations, which are driven by external forces encouraging participation. Dell'Era and Landoni (2014) addressed that users become aware of their involvement in the co-creation when they are invited to participate and does

not specify the nature of the users. Wehrmann et al. (2023) expressed concern regarding insufficient user participation, noting that participation should encompass a range of activities from test-setting and usability trials of market-ready applications up to open-ended processes. Based on these considerations, this study hypothesized the effect of citizen-driven management on the overall attitude toward living labs.

H1: Citizen-driven management significantly influences the overall attitude toward living labs.

3.2. Effects of Social Factors on Overall Attitude

Westerlund et al. (2018) discussed how living labs aim to achieve social impact on regions by enhancing citizen involvement in the community, developing technologies that more effectively meet local needs, and bolstering urban infrastructures. Mulgan (2012) emphasized that social innovation in living labs encompasses new ideas, including products, services, and models, which concurrently address socially recognized needs and foster new social relationship or collaborations. These innovations are designed to benefit society while enhancing its capacity to act (Mulgan, 2012). Battisti (2014) highlighted social innovation within living labs as an organizational model managed through public-private partnerships aimed at developing solutions to address specific citizen needs. Edvardsson et al. (2011) addressed the significance of value co-creation shaped by social forces and proposed a new framework for understanding how the concepts of service exchange and value co-creation are embedded within social systems.

H2: Social affairs significantly influence the overall attitude toward living labs.

3.3. Effects of Locally Driven Management on Overall Attitude

This study addressed that citizens may value the collaborative nature of living labs, where diverse stakeholders, including residents, researchers, businesses, and government agencies, come together to address shared concerns. They may see living labs as opportunities to build stronger community connections, foster trust and cooperation, and enhance social cohesion. Mukherjee et al. (2023) discussed how locally relevant design is examined through the co-production approach of digital systems within a living-lab framework. Baccarne et al. (2014) also emphasized the importance of city-governed urban living labs in overcoming some of the identified challenges for social value creation and urban transition. Waes et al. (2021) discussed how living labs have emerged as a strategic form of urban experimentation in governance for sustainability transitions among policy makers and researchers. Tabata et al. (2022) discussed the importance of the local government taking a proactive role in managing the living lab and directly addressing social needs as expressed by citizens. Hakkarainen and Hyysalo (2013) highlighted that living lab environments are frequently advocated as a means to involve private companies, citizens, researchers, and public organizations in mutually beneficial learning experiences.

H3: Locally-driven management significantly influences the overall attitude toward living labs.

3.4. Effects of Open Innovation Operation on Overall Attitude

This study posits that citizens see living labs as platforms for innovation and progress, where new technologies, practices, and policies are tested and implemented to address pressing environmental challenges. Gascó (2017) emphasized the significance of public sector innovation on both the agenda of policymakers and academics, while the study advocated for a shift in perspective towards a more open model of innovating. Gascó (2017) addressed that this approach leverages the potential of collaboration among citizens, entrepreneurs and civil society, along with emerging technologies. In their study, Hossain et al. (2019) emphasized that the living lab represents a multidisciplinary phenomenon, encompassing various research domains, despite typically being discussed within the frameworks of open and user innovation paradigms. According to Alexandrakis (2021), it is crucial to engage users throughout the entire innovation process of sustainable living labs and to identify user needs that seamlessly integrate into users' daily lives. Følstad (2008a) discussed various categories of living labs, one of which is exemplified by living labs functioning as open innovation platforms. Open innovative operations encourage participation and collaboration from various stakeholders, fostering a culture that values creativity and new ideas. When citizens have the opportunity to contribute to the innovation process in an open environment, they often feel a greater sense of engagement and ownership over the outcomes. Participation in open innovation initiatives often provides individuals with opportunities for learning and skill development. This can lead to a more positive attitude towards living labs among individuals and organizations involved. This study hypothesized that the effects of open innovative operations on overall attitude can be profound and multifaceted.

H4: Open innovative operation significantly influences the overall attitude toward living labs.

3.5. Effects of Economic Value on Overall Attitude

This study proposed to examine the economic values perceived by citizens within the framework of living labs. Westerlund et al. (2018) discussed how living labs provide avenues for business development to companies by

generating resources and services. Westerlund et al. (2018) also emphasized that living labs facilitate economic development through initiatives such as employment and entrepreneurship and contribute to the creation of customized and holistic solutions as well as the development of digital infrastructure. Sjöman et al. (2020) emphasized that smart mobility as an example of living labs promise opportunities to create large economic benefits. This study suggests that citizen participation in living labs will foster economic development and yield tangible economic benefits through innovation. This study hypothesized that the economic value could influence the overall attitude toward the living labs.

H5: Economic value significantly influences the overall attitude toward living labs.

3.6. Effects of Environmental Value on Overall Attitude

This study addressed that perceptions of living labs may also be influenced by the tangible benefits and outcomes they deliver. Living labs offer a collaborative and participatory approach to addressing environmental challenges. Citizens may evaluate living labs based on their effectiveness in achieving environmental improvements, such as cleaner air and water, enhanced green spaces, energy efficiency, and waste reduction. Positive outcomes may reinforce support for living lab initiatives. Berberi et al. (2023) highlighted that living labs are increasingly prominent examples used to address society's complex socio-environmental challenges, particularly in environmental and agricultural sustainability transitions. This study emphasized that living labs can contribute enhancing environment issues by providing a practical environment for testing and refining environmental technologies and solutions in real-life settings. Participating in living labs will help contribute sustainable environmental conditions and the protection of eco-friendly environment. Further, citizens expect to participate in living labs that address environmental issues caused by climate change. Living labs enable citizens to gain insights into human behavior and decision-making processes related to environmental issues. Therefore, this study hypothesized that environmental values influence the overall attitude toward living labs.

H6: Environmental values significantly influence the overall attitude toward living labs.

3.7. Effects of Overall Attitude on Intention and Expected Satisfaction

Ajzen (1989) defined attitude as *an individual's disposition to respond favorably or unfavorably to an object, person, institution, event, or to any other discriminable aspect of the individual's world* (p.241). Park and Fujii (2023) emphasized the importance of citizens' active participation and identified the elements that influence the level of participation in a living lab. Park and Fujii (2023) also highlighted tat living lab activities are associated with enhanced civic self-esteem and positive attitudes toward smart cities. Toma et al. (2023) noted that being part of the most connected and technology-based generation, the perceptions and attitudes of Generation Z toward the responsible management of a smart city are significant. This study posits that while citizen participation is critical issue for the success of living labs, the willingness of citizens to participate in living labs remains questionable. Compagnucci et al. (2021) addressed that the focus and specialization of the living labs have an impact. Compagnucci et al. (2021) also underscored that while users may be willing to contribute to the generation and development of products and services, they are often reluctant to actively participate in the innovation process. Therefore, this study hypothesized the impact of the overall attitude on intention to participate in living labs and expected satisfaction toward living labs.

H7: The overall attitude significantly influences intention to participate in living labs.

H8: The overall attitude significantly influences expected satisfaction toward living labs.

4. Methodology

This study employed an online survey conducted with the assistance of a reputable survey agency. The survey commenced with warm up questions aimed at gauging participants' awareness of living labs, followed by inquiries addressing the proposed variables, and concluded with demographic questions. This study incorporates various proposed variables including citizen-driven management, social factors, locally driven management, open innovative operation, economic value, environmental value, overall attitude, intention to participate in living labs, and expected satisfaction toward living labs. The study will apply 5-point Likert scales for major proposed items (1 – strongly disagree, 5 – strongly agree). This study collected 217 responses including 135 responses from Millennials and 82 responses from Generation Z. This study applied the classification of generation cohort stated by previous studies (Francis & Hoefel, 2018; Nicolas, 2015). This study delved into the perspectives of Millennials and Generation Z, exploring the characteristics of living labs and the role of Information and Communication Technology (ICT) in facilitating adaption within society. Millennials are recognized as a generation highly proficient in utilizing a diverse array of ICT tools and platforms for communication, social networking, entertainment, and work-related activities. Generation Z is

acknowledged as a generation characterized by being highly tech-savvy and reliant on ICT for communication, entertainment, learning, and social interaction.

The survey utilized stratified sampling, considering factors such as gender, age, and education levels. This study distributed a survey in South Korea to assess citizens' awareness of living labs. This survey achieved nearly equal representation, with 50.7% female and 49.3% male participants completing the survey. Regarding age distribution, 8.3% of respondents were in the 20-24 age group, 29.5% were in the 25-29 age group, 24.0% were in the 30-34 age group, 14.7% were in the 35-39 age group, and 23.5% were in the 40-44 age group. In terms of educational backgrounds, 15.2% held a high school degree, 15.7% attended college, 64.1% obtained a bachelor's degree, and 5.1% held a graduate degree. This study employed factor analysis, ANOVA, and multiple regression analysis to scrutinize the proposed hypotheses. Additionally, reliability was assessed by examining Cronbach's alpha. The Cronbach's alpha values are summarized as follows: 0.845 for citizen-driven management, 0.832 for social factors, 0.801 for locally driven management, 0.817 for open innovative operation, 0.836 for economic factors, and 0.849 for environment factors.

Table 1: Demographics of Respondents

		#(%)
Gender	Male	107 (49.3)
	Female	110 (50.7)
Age	20-24 years old	18 (8.3)
	25-29 years old	64 (29.5)
	30-34 years old	52 (24.0)
	35-39 years old	32 (14.7)
	40-44 years old	51 (23.5)
Education	Middle School	-
	High School	33 (15.2)
	In College	34 (15.7)
	Bachelor's Degree	139 (64.1)
	Graduate Degree	11 (5.1)
Annual Income	Below 10,000,000 KRW	32 (14.7)
	Between 10,000,000-20,000,000 KRW	18 (8.3)
	Between 20,000,000-30,000,000 KRW	43 (19.8)
	Between 30,000,000-40,000,000 KRW	51 (23.5)
	Between 40,000,000 -50,000,000 KRW	27 (12.4)
	Between 50,000,000-60,000,000 KRW	16 (7.4)
	Between 60,000,000-70,000,000 KRW	15 (6.9)
	More than 70,000,000 KRW	15 (6.9)
	TOTAL	217

5. Data Analysis

In this study, factor analysis was employed and scale items were extracted by applying factor analysis. Principal component analysis served as the method for extraction, with maximum iterations for convergence, and factors' eigenvalue was greater than 1 are extracted. VARIMAX with Kaiser Normalization was applied as the rotation method with maximum iterations for convergence. Table 2 presented a summarized component matrix, including factor loadings. In this study, the questionnaire items applied as follows: i) for citizen-driven management, the questionnaire items included how living labs are implemented by applying citizens' opinions, citizen participations, citizen-centered management, and platforms that allow autonomy; ii) for social factors, the questionnaire items included how living labs are implemented by considering social issues that focus on improving the quality of life for citizens, dealing with real-life challenges, and contributing to the formation of sustainable communities, such as urban regeneration,; iii) for locally driven management, the questionnaire items included how living labs are implemented by applying operation led by local citizen and addressing local issues; iv) for open innovative operation, the questionnaire items included how living labs are implemented by applying open participation by citizens, open innovation process to address social issues, and open innovative management led by citizens; v) for economic value, the questionnaire items included how living labs are implemented by considering participation in living labs that benefit the local economy and have positive impacts by facilitating economic growth; and vi) for environmental value, the questionnaire items included how living labs are implemented by considering participation in living labs that contribute to creating a sustainable environment, have a positive impact on innovative environmental conservation, and prioritize eco-friendly policies.

Table 2: Component Matrix for Citizen Driven Management, Social Affairs, Locally Driven Management, Open Innovative Operation, Economic Value, Social Value, and Environmental Value

	Component						
	1	2	3	4	5	6	7
CM2	.83						
CM4	.80						
CM3	.78						
CM1	.75						

SF4 SF3 SF2 SF1		.83 .77 .74 .71					
LM3 LM2 LM4 LM1			.84 .82 .80 .78				
OI3 OI4 OI1 OI2				.86 .82 .79 .75			
EC3 EC1 EC2 EC4					.84 .83 .79 .78		
SV3 SV4 SV1 SV2						.85 .84 .83 .77	
EV3 EV2 EV4 EV1							.85 .84 .82 .81

* CM: Citizen Driven Management, SF: Social Factors, LM: Locally Driven Management, OI: Open Innovative Operation, EC: Economic Value, SV: Social Value, EV: Environmental Value

In this study, multiple regression analysis was employed to test hypotheses incorporating factor scores utilized as variables in the analysis. In this study, independent variables included citizen driven management, social factors, locally driven management, open innovative operation, economic value, and environmental value. The dependent variable employed in this study was overall attitude. The results of the ANOVA revealed that the overall model is significant with an *F* value of 29.104 at the 0.01 significance level and an *R*-square of 0.559. Table 3 illustrated that in this study, the effects of citizen driven management, social factors, economic value, and environmental value on overall attitude showed significance. In particular, the effects of social factors, on overall attitude showed significance at the 0.01 significance level, the effects of citizen driven management and environmental value on overall attitude showed significance at the 0.05 significance level, and the effects of economic value on overall attitude showed significance at the 0.1 significance level. Among the significant factors, the study found that the effect size was highest for the social factors on overall attitude followed by environmental value, citizen driven management, and economic value. As indicated in Table 3, hypotheses H1, H2, H5, and H6 were accepted.

Table 3: Effects of Proposed Factors on Overall Attitude

Independent Variables => Dependent variable	Standardized Coefficient (t-value/sig)
Citizen Driven Management => Overall Attitude	.159 (1.964**)
Social Factors => Overall Attitude	.296 (3.527***)
Locally Driven Management => Overall Attitude	.094 (1.018)
Open Innovative Operation => Overall Attitude	.077 (0.960)
Economic Value => Overall Attitude	.158 (1.743*)
Environmental Value => Overall Attitude	.173 (1.979**)

***significant at 0.01, ** significant at 0.05, * significant at 0.1.

This study also conducted regression analyses to test the effect of overall attitude on intention to use living lab public service and expected satisfaction. For the effect of overall attitude on intention to use living lab public service, the results of the ANOVA revealed that the overall model is significant with an *F* value of 2523.368 at the 0.01 significance level and an *R*-square of 0.922. For the effect of overall attitude on expected satisfaction, the results of the ANOVA revealed that the model was significant with an *F* value of 169.371 at the 0.01 significance level and an *R*-square of 0.441. As indicated in in hypotheses Table 4, H7 and H8 were accepted.

Table 4: Effects on Overall Attitude, Intention, & Expected Satisfaction

Independent Variables => Dependent variable	Standardized Coefficient (t-value/sig)
Overall Attitude => Intention to participate in living labs	. 960 (50.243***)
Overall Attitude => Expected Satisfaction toward living labs	.664 (13.014***)

***significant at 0.01.

6. Conclusion

6.1. Findings

This study explores how citizens perceive living labs as fostering the development of residents and enhancing quality of life, with a focus on the perspectives of Millennials and Generation Z. These generations play a crucial role in utilizing a diverse array of ICT tools. This study incorporated citizen-driven management, social factors, locally driven management, open innovative operation, economic value, and environmental value as independent variables, while overall attitude serving as the dependent variable. Furthermore, this study analyzed the effects of overall attitude on intention to participate in living labs and expected satisfaction toward living labs. The results of this study found that the effects of citizen-driven management, social factors, economic value, and

environmental value on overall attitude were significant, while the effects of locally driven management and open innovative operation on overall attitude were not significant. Among effective factors on overall attitude, this study found that the effect size was highest for the social factors on overall attitude followed by environmental value, citizen driven management, and economic value.

6.2. Managerial and Policy Implications

The results offer managerial and policy implications. Firstly, the insignificance of the effects of locally driven management and open innovative operation on overall attitude provides insights. Citizens might raise concerns regarding living labs are implemented through operations led by local citizens and addressing local issues. Furthermore, citizens might question whether living labs are implemented through open participation by citizens, an open innovation process to address social issues, and open innovative management led by citizens. The significance of the effects of social factors demonstrated the highest impact on overall attitude. Therefore, the results imply that citizens perceive the importance of living labs implemented by considering social issues focused on improving the quality of life for citizens, addressing real-life challenges, and contributing to the formation of sustainable communities, such as urban regeneration. The significance of the effects of citizen-driven management implies that citizens perceive the importance of living labs implemented by incorporating citizens' opinions, encouraging citizen participations, adopting citizen-centered management approaches, and providing platforms that allow for autonomy. The significance of the effects of economic value suggests that citizens perceive the importance of living labs implemented by considering participation that benefits the local economy and has positive impacts by facilitating economic growth. Furthermore, the significance of the effects of environmental value suggests that citizens perceive the importance of living labs implemented by considering participation that contributes to creating a sustainable environment, has a positive impact on innovative environmental conservation, and prioritize eco-friendly policies.

In conclusion, this study highlights the aspects of living labs that should be fostered for the development of residents, the local economy, and citizens' quality of life. Citizens may prioritize transparency and accountability in living lab processes, expecting clear communication, open access to information, and opportunities for meaningful participation and decision-making to be central aspects. They may value living labs that demonstrate transparency in governance, equitable distribution of benefits, and responsiveness to community needs and concerns. Conversely, citizens may have concerns about living labs, including potential disruptions to their daily lives, unequal distribution of benefits, privacy and data security issues, and gentrification pressures in revitalized neighborhoods. Addressing these challenges and ensuring inclusive, equitable participation are essential for building trust and legitimacy. In particular, this study implies which aspects should be improved to develop society and residents by suggesting the perspectives of Millennials and Generation Z, who play a crucial role in utilizing a diverse array of ICT tools. This study suggests that there is necessity to improve citizen awareness on living labs by addressing their role in society. Furthermore, it suggest the development of better policies to promote living labs and address concerns related to their implementation. The role of businesses also needs to be addressed by focusing on the better development of ICT tools that help facilitate the usage of living labs by citizens, enhance quality of life, and improve social, economic, and environmental values.

6.3. Limitations and Future Research

This study acknowledges its limitations and suggests avenues for future research. Future studies could strengthen robustness by expanding the sample size. Future research may explore the perspectives of older generations on living labs beyond Millennials and Generation Z. This broader examination could provide valuable insights into how different age groups perceive and engage with living lab initiatives.

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