OPEN INNOVATION AND SUSTAINABLE DEVELOPMENT IN CREATING A SMART CITY: THE CHALLENGE "LOJA SOSTENIBLE 2030"

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Abstract: This paper discusses the importance of innovation and sustainable development when building a smart city through participatory processes. We focus on the "Loja Sustainable 2030" challenge, presented by the Ministry of Telecommunications (MINTEL) and the Technical Particular University of Loja (UTPL), in Ecuador. The challenge seeks to encourage diverse stakeholders, such as academia, public and private enterprises, entrepreneurs, students, and citizens, to come up with innovative ideas and proposals that contribute to the development of an intelligent and sustainable city. Our article emphasizes the importance of open innovation in creating innovative solutions and the need to involve students in designing ideas to improve their environment. Additionally, we highlight the relevance of cross-sector collaboration and knowledge management in achieving impactful transformation in urban areas.

Keywords: Open Innovation; Smart city; Agenda 2030; collaboration; knowledge management.

Resumo: Este artigo discute a importância da inovação e do desenvolvimento sustentável na construção de uma cidade inteligente por meio de processos participativos. Focamos no desafio "Loja Sustentável 2030", apresentado pelo Ministério das Telecomunicações (MINTEL) e pela Universidade Técnica Particular de Loja (UTPL). O desafio busca incentivar diversas partes interessadas, como a academia, empresas públicas e privadas, empreendedores, estudantes e cidadãos, a apresentarem ideias e propostas inovadoras que contribuam para o desenvolvimento de uma cidade inteligente e sustentável em Loja, Equador. Nosso artigo enfatiza a importância da inovação aberta na criação de soluções inovadoras e a necessidade de envolver os jovens na elaboração de ideias para melhorar o ambiente. Além disso, destacamos a relevância da colaboração entre setores e da gestão do conhecimento na realização de transformações impactantes em áreas urbanas.

Palavras-chave: Inovação Aberta; Cidades Inteligentes; Agenda 2030; colaboração; Gestão do Conhecimento.

Resumen: Este artículo discute la importancia de la innovación y el desarrollo sostenible en la construcción de una ciudad inteligente a través de procesos participativos. Nos centramos en el desafío "Loja Sostenible 2030", presentado por el Ministerio de Telecomunicaciones (MINTEL) y la Universidad Técnica Particular de Loja (UTPL). El desafío busca incentivar a diversas partes interesadas, como la academia, empresas públicas y privadas, emprendedores,

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estudiantes y ciudadanos, a presentar ideas y propuestas innovadoras que contribuyan al desarrollo de una ciudad inteligente y sostenible en Loja, Ecuador. Nuestro artículo enfatiza la importancia de la innovación abierta en la creación de soluciones innovadoras y la necesidad de involucrar a los jóvenes en la elaboración de ideas para mejorar su entorno. Además, destacamos la relevancia de la colaboración entre sectores y la gestión del conocimiento para lograr transformaciones impactantes en áreas urbanas.

Palabras clave: Innovación Abierta; Ciudad Inteligente; Agenda 2030; colaboración; gestión del conocimiento.

1 INTRODUCTION

Sustainable urban development has become a crucial focus on the global agenda due to rapid urbanization and the need to address environmental and societal challenges (Chen et al., 2022). The most recent report "The Sustainable Development Goals Report", of July 2023, highlights a concerning trend as over half (55%) of the global population is now residing in urban areas, and this figure is projected to further rise to 70% by 2050 (United Nations, 2023).

The Sustainable Development Goal 11 of the United Nations aims to develop sustainable, inclusive, safe, and resilient cities and human settlements for achieving sustainable growth. However, this goal represents a wicked problem, characterised by its complex and interconnected nature (Rochadel et al., 2023). Effective management of knowledge is crucial in tackling the growing urban population, and addressing these complexities requires a comprehensive and collaborative approach, involving governments, local communities, academia, and diverse stakeholders to develop innovative and adaptive strategies for achieving sustainable and inclusive urban development amidst uncertainty and dynamic urbanization patterns (Williams et al., 2020).

Embracing this vision, the Ministry of Telecommunications (MINTEL) and the Technical Particular University of Loja (UTPL) have launched the "Loja Sustainable 2030" Open Innovation Challenge. Intending to foster inclusive, secure, and resilient urban development, this challenge seeks to engage various stakeholders, including academia, public and private enterprises, entrepreneurs, students, and citizens. By harnessing the potential of Information and Communication Technology (ICT), the challenge aims to inspire innovative ideas and proposals that will contribute to realizing Loja as a smart and sustainable city.

This article explores the significance of open innovation and sustainable development in creating a smart city, using the "Loja Sustainable 2030" challenge as a focal point. Through a comprehensive analysis of the challenge's objectives and the involvement of diverse actors,

we delve into the role of ICT in driving innovative solutions and empowering the participative model to experience shaping their urban environment actively. Moreover, we highlight the transformative power of collaborative efforts between academia, public and private sectors, and the broader community and how such alliances can usher in a paradigm shift towards a sustainable future for Loja.

2 THEORETICAL BACKGROUND

This topic explores the relationship between open innovation and smart city initiatives in the context of achieving the United Nations' Sustainable Development Goals (SDGs) by the year 2030. It investigates how open innovation approaches, such as idea competitions and crowdsourcing, can foster collaboration among stakeholders, including government, academia, industry, and citizens, to drive innovative solutions for urban challenges.

2.1 OPEN PARTICIPATION FOR THE 2030 AGENDA

The Agenda 2030, also known as the United Nations Sustainable Development Goals (SDGs), is a comprehensive global initiative to address humanity's critical challenges, such as poverty, inequality, climate change, and environmental degradation (Assembly General UN, 2015). The SDGs form a vital set of 17 interrelated global goals that were adopted by all United Nations Member States in 2015. These objectives are critical in tackling urgent challenges such as eradicating poverty and hunger, ensuring access to quality education and healthcare, promoting gender equality, and fostering sustainable economic growth while conserving the environment and fighting climate change.

One of the key factors contributing to the acceptance and success of Agenda 2030 is its innovative approach to open participation and collaborative idea-building (Williams et al., 2020). The United Nations, along with various governments, institutions, and civil society organizations, actively engaged citizens, stakeholders, and experts from all sectors in developing and refining the SDGs (Fox & Stoett, 2016). Through many open forums, consultations, and idea challenges, Agenda 2030 became a product of collective efforts, incorporating diverse perspectives and priorities.

This participatory approach enhanced the agenda's legitimacy and inclusivity and instilled a sense of ownership and commitment among the global community to actively work towards achieving the SDGs by 2030. Agenda 2030 has demonstrated its capacity to unite nations and mobilize collective action towards a more sustainable and equitable future for all by fostering a culture of collaboration and open participation (Williams et al., 2020).

2.2 MODELS OF OPEN PARTICIPATION FOR SMART CITIES

Open participation and collaboration models are crucial to drive the development of smart cities, enabling solutions that are more effective, inclusive, and aligned with the community's real needs (López-Quiles & Rodríguez Bolívar, 2018). By engaging citizens, businesses, and experts in developing and implementing sustainable solutions, cities are leveraging innovative approaches to address pressing urban challenges and contribute to the global sustainability agenda. Several models of open participation and collaboration have been used to facilitate the development of smart cities. The Table 1 presents some of the particularly pertinent models for open innovation in smart cities, showcasing specific examples of initiatives in different cities.

Table 1 - Cases of Open Innovation in Smart Cities

Model	Example	Contribution to SDGs	Reference
Digital Participation Platforms	Amsterdam, Netherlands - Amsterdam Smart City	SDG 7 (Affordable and Clean Energy) SDG 11 (Sustainable Cities and Communities)	Jiang et al., 2023
Innovation Labs	Copenhagen, Denmark - Copenhagen Solutions Lab	SDG 2 (Zero Hunger) SDG 12 (Responsible Consumption and Production)	Gatski & Galgoczi, 2016
Challenges, Hackathons and Idea Competitions	São Paulo, Brazil - SP Challenges	SDG 9 (Industry, Innovation, and Infrastructure) SDG 11 (Sustainable Cities and Communities) SDG 12 (Responsible Consumption and Production)	Opoku et al., 2022

Source: Authors (2023).

Digital Participation Platforms, such as Amsterdam Smart City in the Netherlands, have emerged as powerful tools for citizen engagement in shaping the future of cities (Jiang et al., 2023). Through this online platform, residents actively participate by proposing ideas, providing feedback on urban initiatives, and collaborating with local government and businesses. This open innovation approach has resulted in implementation of various sustainable projects, including smart energy grids and electric mobility solutions, contributing significantly to SDG 7 (Affordable and Clean Energy) and SDG 11 (Sustainable Cities and Communities).

Innovation Labs, exemplified by Copenhagen Solutions Lab in Denmark, play a pivotal role in fostering stakeholder collaboration to develop and test smart city solutions (Gatski & Galgoczi, 2016). In partnership with citizens, businesses, and research institutions, Copenhagen successfully implemented a project to reduce food waste in the city. This initiative involved the

creation of a digital platform connecting surplus food with charities, aligning directly with SDG 2 (Zero Hunger) and SDG 12 (Responsible Consumption and Production).

Additionally, Challenges, Hackathons, and Idea Competitions are effective mechanisms for promoting open innovation in urban settings. São Paulo, Brazil, exemplifies this with its SP Challenges open innovation platform (Opoku et al., 2022). By collaborating with universities, startups, and citizens, the city co-creates solutions for pressing urban issues. Idea competitions and hackathons addressing sustainable mobility, waste reduction, and digital inclusion have resulted in impactful projects, such as bike-sharing programs, smart waste management systems, and digital literacy initiatives. These efforts actively contribute to SDG 9 (Industry, Innovation, and Infrastructure), SDG 11 (Sustainable Cities and Communities), and SDG 12 (Responsible Consumption and Production).

In conclusion, cities worldwide embrace open innovation through various open platforms and initiatives. By engaging citizens, businesses, universities, and government bodies, these approaches have proved instrumental in fostering sustainable urban development and making significant strides towards achieving the SDGs 2030.

3 METHODOLOGY

Loja Sustainable 2030 is an initiative jointly undertaken by the Technical Particular University of Loja (UTPL) and the Autonomous Decentralized Government of Loja Canton (GAD-Loja). The project aims to implement collaborative proposals that contribute to the territory's dynamic transformation and sustainable management by the year 2030. Grounded in essential strategic guidelines previously identified and validated by society, the initiative is inspired by the fulfilment of the United Nations Sustainable Development Goals (SDGs). Through this partnership, Loja Sustainable 2030 seeks to foster a smart and inclusive city, leveraging technology and innovation to address urban challenges while promoting social and environmental well-being.

The "Loja Sustainable 2030" project commenced in late 2018 when Mayor Piedad Pineda expressed interest in creating a joint agenda between academia and the local government. The goal was to address transformational challenges in Loja canton, aligning with the United Nations' 17 Sustainable Development Goals (SDGs).

3.1 PHASE 1: PROSPECTIVE STUDY (2018)

Around 40 social actors from the city of Loja participated in the participatory construction of a new vision 2040 for the city of Loja. These stakeholders belonged to

universities, public and private sectors, and social collectives. In this opportunity the work was developed with prospective scenarios. They generated a multidisciplinary reflection and formalized a vision where Loja becomes a human-scale territory with a healthy natural environment, sustainability, and a focus on arts, culture, tourism, and technology. The study resulted in ten strategic guidelines to shape future projects.

3.2 PHASE 2: VALIDATION OF RESULTS (2019)

The results of the study were validated through participatory sessions involving public and private institutions, NGOs, and representatives from society, taking into account other local actors. The ten strategic lines were concretized, leveraging Loja canton's potential to guide future initiatives: a) Natural and cultural heritage; b) Organic farming and healthy eating; c) Renewable energy; d) Technology-based social enterprises; e) Tourism and creative and leisure industries; f) Physical and digital connectivity hub; g) Health and preventive medicine; h) Territory on a human scale; i) Binational territory; and j) Open and transparent government.

3.3 PHASE 3: IMPLEMENTATION STRATEGY (2019)

The implementation strategy involved socializing the strategic lines and presenting potential projects to mayoral candidates for the 2019-2022 term. A forum discussed the importance of aligning projects with strategic lines. After the election of the new administration, the UTPL's General Directorate of Linkage officially handed over the strategic lines, initiating the construction of the Academia-Local Government agenda.

In response to the Loja 2030 Agenda commitments, the General Directorate of Linkage launched calls for linkage projects and observatory work, solidifying the university's support for the local government's initiatives.

4 RESULTS AND DISCUSSION

4.1 ENGAGING IN CREATING A SMART CITY

"Loja Sustainable 2030" challenge uses Design Thinking principles to promote ideas and projects through open participation. The approach integrates technology, citizen engagement, and ecological responsibility. A detailed process is outlined in Table 2, including descriptions, associated tools, and techniques for each phase. This procedure was implemented to manage the creation and participation of knowledge.

Table 2 - Methodology for the development of the Challenge based on Design Thinking.

Phase	Description	Tools and Techniques
Empathize	Understand the problem's relevance through investigative and ethnographic work. Use interview models and benchmarking techniques to uncover reasons behind issues.	Interview models, Benchmarking techniques
Define	Converge after accumulating information. Define the focus of action for the creative challenge. Formulate the focus using "(User) desires/needs (desire/need) because (reason)."	Focus of action formulation, Creative challenge establishment
Ideation	Generate solutions for specific problems. Encourage a flow of ideas through brainstorming, fostering an open and festive atmosphere.	Brainstorming
Prototype	Concretize ideas through rapid and cost-effective trials. Utilize various prototyping forms such as role-playing, product/service design, storyboarding, brochures, and mockups.	Role-playing, Product/service design, Storyboarding, Mockups
Validation / Testing	Culmination of idea generation with a strategic decision-making point. Set objectives, define sample and validation guidelines, and test the solution.	Objective setting, Sample definition, Solution testing

Source: Authors (2023).

The following sections outline the results of implementing the Design Thinking methodology in the "Loja Sustainable 2030" challenge. These outcomes include a variety of innovative solutions for different aspects of urban living, demonstrating the potential for a sustainable transformation. Additionally, this topic explains the collaborative process that united the efforts of various stakeholders, such as society, academia, government, and industry. This cooperative approach created a platform for knowledge sharing, idea exchange, and collective problem-solving, leading to a harmonious and forward-thinking urban ecosystem.

4.2 COLLABORATION BETWEEN ACADEMIA, PUBLIC, AND PRIVATE SECTORS

The collaboration between universities, society, government, and businesses ensures that projects are more comprehensive, sustainable, and aligned with the real needs of the communities (Buys & Bursnall, 2007). Universities play a critical role in facilitating collaboration among stakeholders (Schmitz et al., 2018). They provide expertise, research, and resources to support the development and evaluation of proposed projects. The society actively participates in the challenges, contributing local knowledge and diverse perspectives. Governments embrace these initiatives to engage citizens and local organisations in co-creating solutions for urban challenges (Lee et al., 2012). Businesses often support and invest in winning projects, driving their implementation and scaling (Saul, 2010). According to these studies and the composition of the challenge, the actors, roles and contributions analysed during the participation in Loja 2030 are summarised in Table 3.

Table 3 - Actors Involved and their Roles.

Actor	Role and Contribution
Ministry of Telecommunications and Information Society (MINTEL)	- Organize the open innovation challenge with UTPL Science and Technology Park. - Preside over the Technical Evaluation Committee.
Secretariat of Higher Education, Science, Technology and Innovation (SENESCYT)	- Distribute and promote challenges to universities through the Quito Hub. - Participate in the Technical Committee.
Ministry of Education (MINEDUC)	- Contribute to educational centres to solve the challenge. - Participate in the Technical Committee.
Universidad Técnica Particular de Loja - UTPL Science and Technology Park	- Participate in the Technical Committee. - Support participants during challenge development. - Collaborate in the different stages of the challenge.
Autonomous Decentralized Governments (GADs)	- Participate or appoint representatives in the Technical Committee. - Encourage implementing winning solutions in municipalities.
Middle and High School Institutions	- Support and assist participants during challenge development. - Internally promote the challenge and organize open innovation challenges with interested students. - Participate in the Technical Committee.
Private Sector	- Provide promotional support, incentives, and sponsorship for projects.
Citizens	- Develop open innovation challenges focused on smart city development. - Includes students, entrepreneurs, companies, etc.

Source: Authors (2023).

This engagement represents open innovation and highlights knowledge management's role in driving sustainable urban solutions. Each actor's unique contributions within the challenge's framework work together to help the city achieve its sustainable development goals.

4.3 PRIORITIZATION OF PUBLIC POLICIES TOWARDS A SUSTAINABLE LOJA 2030

In parallel, the university, together with some national foundations and the Municipality of Loja, worked on the prioritization of the 10 initiatives mentioned in this document and their implementation through actions within the framework of public policies. This development was done through multisectoral roundtables between 2021 and 2022. There was the participation of 70 new local, provincial and national actors. This initiative was born from the need to generate a proposal from academia, where the vision to achieve a sustainable management of the territory by the year 2030 based on the Sustainable Development Goals of the United Nations is embodied. It also intends to be a tool for the discussion and construction of territorial agendas, which allows betting on comprehensive solutions. In this context, four strategic lines were prioritized in conjunction with the Decentralized Autonomous Government of Loja Canton:

1. Natural and cultural heritage
2. Social and technology-based entrepreneurship
3. Tourism, creative and leisure industries.
4. Physical and digital connectivity hub.

Based on these lines, an articulated project was developed with international funds, where participatory local strengthening methods were proposed in order to achieve the "Territorialization of the SDGs" in the city of Loja. These workshops included the proposal of initiatives related to issues such as the construction of policies with a comprehensive approach; measurement of indicators for public policies; and formulation of public policies, which link and articulate the contents, as well as each of the factors and scenarios that were proposed throughout the workshops (CUDS, 2022).

4.4 PROSPECTS FOR LOJA'S FUTURE AS A SMART AND SUSTAINABLE CITY

Several cities in Ecuador have embraced innovation and sustainable projects. Loja has joined this movement and is working to become a smart city oriented towards a greener and more equitable future. The transformation towards a smart and sustainable city involves the convergence of technology, urban planning, and citizen participation to create an environment where the quality of life is enhanced, and the environmental footprint is reduced. This future vision is integrated into the "Loja Sustainable 2030" initiative, which promises a more efficient city and aims to create a place where people want to stay while preserving nature.

Based on the 4 prioritized axes, Loja must have policies that allow it to consider the conservation, recovery and promotion of cultural heritage as determining axes of conversion, with the objective of generating opportunities in the canton towards a new vision of the territory. The city of Loja will have an inclusive, diverse and representative cultural management model that strengthens identity and social knowledge, recovers its origins and promotes a citizen culture of empowerment and participation.

In the tourism margin, a policy for tourism and creative and leisure industries is required, which should take into consideration the design and execution of a plan focused on Intelligent Tourism Destinations (ITD), through the generation of strategic alliances for the integration of DATA of tourist interest; the objective would focus on developing local planning that involves provincial, regional, national, and binational potentialities.

In addition, encourage entrepreneurship, through training, development of ecosystems, monitoring, search for national and international allies. This policy should be oriented towards

two lines of action, on the one hand, digital transformation and on the other hand, the circular economy, in such a way that it establishes a differentiating effect and a clear value proposition. Fourth, consolidate physical and digital connectivity articulated with territorial planning. The agenda includes the development of urban infrastructure, training plan, regulatory development, internal mobility, among others. Loja must be very well connected physically with its national neighbors and with the north of Peru, in addition to the nearest productive centers (CUDS, 2022).

In order to achieve these proposed policies, Firstly, about Technology Serving the Citizens, the smart city of Loja is characterised by the strategic integration of technology into all aspects of urban life. From waste management to public transportation and municipal services administration, technology optimises efficiency and accessibility. Smart sensors monitor traffic, air quality, and energy consumption, enabling informed decision-making and agile responses to community needs.

Next, in the context of Sustainable and Accessible Mobility, Loja, as a smart city, prioritises sustainable mobility. Pedestrian streets and safe bike lanes interweave with efficient public transport systems and shared vehicle options, reducing traffic congestion and carbon emissions. Urban planning places people at the centre, ensuring all residents can move safely and accessibly, regardless of physical ability. A public transport service, Sistema Integrado de Transporte Urbano (SITU), and the SITU App provide real-time bus routes and schedules, further enhancing the city's mobility infrastructure.

Regarding Clean Energy and Energy Efficiency, the transition to a smart city promotes renewable energy sources and the implementation of energy-efficient solutions. Solar panels on buildings, efficient street lighting, and intelligent energy management systems reduce fossil fuel dependency and mitigate climate change. Citizens are educated to adopt responsible consumption practices. The Villonaco Wind Farm changes the current energy matrix by reducing fossil fuel consumption and greenhouse gas emissions, contributing to a cleaner and more sustainable energy future.

As part of Civic Participation and Open Data, the intelligence of a city lies in citizen collaboration and participation. Online platforms and mobile applications encourage citizen involvement in decision-making and local problem-solving. Open data allows citizens to access transparent information and make informed environmental decisions, fostering a sense of ownership and empowerment.

Another outcome of the project is Resilience and Environmental Conservation. A smart city is also prepared to face challenges. Loja demonstrates resilience by implementing early

warning systems for extreme weather events and promoting the conservation of natural spaces. Urban reforestation, sustainable water management, and promoting sustainable agricultural practices are essential for ensuring a healthy environment for future generations, solidifying Loja's commitment to long-term sustainability.

The vision of Loja as a smart and sustainable city is not a mere fantasy but a path towards a vibrant and prosperous future. Strategic planning, technology investment, and citizen participation form the foundations for this vision. In this endeavour, all citizens, from government leaders to residents, play a vital role in creating a Loja that serves as a model of innovation, equality, and resilience on the global stage.

5 CONCLUSION

This paper discusses the importance of open innovation and collaboration in achieving sustainable urban development within the context of knowledge management. It focuses on the "Loja Sustainable 2030" challenge. With increasing urbanisation, innovative solutions are necessary to tackle complex urban challenges. The "Loja Sustainable 2030" initiative is an example of a forward-thinking approach involving diverse stakeholders in creating a smart and sustainable city.

Sustainable and innovative cities open themselves to strategic alliances. "Loja Sustainable 2030" is a forward-looking perspective of the city of Loja, Ecuador, driven by local government, private enterprise, and academia, aiming to identify innovative opportunities that translate into programs and projects aligned with the ten strategic lines.

This proposal can be scaled to other cities seeking to transition from short-term solutions to socially-focused innovations with vision and strategy, extending beyond political will. It entails creating a city agenda encompassing the most critical topics for constructing a sustainable city.

The current challenge is to involve other decision-making stakeholders in this city agenda, such as organised civil society organisations, additional private enterprises, government actors, other universities, or educational institutions. The goal is for all to participate in co-creating this agenda, contribute to it, and embrace a shared cause to establish "Sustainable Loja 2030". The creation of this agenda should be articulated with the public policy proposal already built based on the territorialisation of the SDGs, especially emphasizing cultural, natural, tourism, entrepreneurial development, and physical and digital connectivity issues.

ACKNOWLEDGMENTS

Universidade Técnica Particular de Loja (UTPL); Gobierno Autónomo Descentralizado de Loja (GAD); and Cátedra UNESCO de Desarrollo Sostenible.

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