Mapping Open Design and Participation in Smart City Solutions: A Systematic Literature Review

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Abstract: This article presents a systematic review on the adoption of open design practices in smart cities, considering how Information and Communication Technologies (ICT) enhance sustainable and inclusive urban solutions. After applying the PRISMA protocol in databases such as ACM, IEEE, Springer and Scopus, 74 articles published from 2013 to 2024 were selected. The results of analysis reveal that, although there are advances in the application of IoT, in platforms for citizen engagement, and in environmental sensors technology, there are still gaps in the standardization of definitions for "smart city" and a lack of evaluation methods. There is a strong concentration of research in Europe and North America, suggesting the need to expand research to contexts of other continents and regions of the world. The analysis is conducted through the Semiotic Framework and contextual factors, showing that the acceptance of solutions depends on a balance between the social world, the digital world and infrastructure offered. In conclusion, open design emerges as a promising strategy for the development of truly smart cities, demanding more multidisciplinary cooperation, robust evaluation methodologies and greater inclusion of diverse social contexts.

1 INTRODUCTION

The exponential advances and applications of Information and Communication Technologies (ICT) have changed society's relationships in the context of the cities (Fu and Lin, 2014). At the same time, such technologies can potentially increase the complexity of people's interaction with the cities. This is a clear concern in human-computer interaction (HCI) to understand the complexity of designing for people living in those cities (Slingerland and Overdiek, 2023).

The concept of a smart city has become recurrent in political speeches and in the media, but there is no consensus on its definition or meaning (Opromolla et al., 2015; Rocha et al., 2022). urthermore, smart cities are evolving from a strongly technological orientation toward more inclusive and participatory approaches, where citizens are expected to play an active role in their planning and development. (Keskin and Markus, 2024).

ICTs have been considered potential solutions to contemporary challenges, often related to the United Nations Sustainable Development Goals (SDGs) (UN, 2015). Previous studies (Lilis et al., 2015; Hayar and Betis, 2017; Dinc and Sahingoz, 2019) show that the world concentrates on good and promising results that demonstrate an evolution in dealing with smart cities.

However, from 2019 to 2023, a pandemic affected the way of life in cities worldwide (Fariniuk, 2020) and has put many aspects of smart cities to the test. Although these cities have the potential to offer innovative solutions, the crisis has revealed some limitations and challenges, such as connectivity and digital inequality, and the reliance on digital technologies for essential services such as telemedicine and education.

Mobility and social distancing with public transport and urban mobility have been affected. Cities need to rethink planning to ensure safety, health care, and to deal with the decline of rights and press freedom, privacy and data security, and disinformation. Cities must balance innovation with data protection.

Indicators such as the Social Progress Index (SPI) (Wilm et al., 2024) reveal that the world is indeed

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moving very slowly toward achieving the Sustainable Development Goals (SDGs); so slowly that the 2030 goals require more energetic actions to be met. This shows that there is still a long way to go and several challenges to be faced to consolidate what are expected to be smart cities. The pandemic has highlighted the importance of active citizen participation in urban decisions. Smart cities must involve the community in their development.

For this involvement to happen, we argue that the concept and methods of smart city design could benefit from Open Design (OP) approaches (Baranauskas, 2015) with open, collaborative, and voluntary work in which everyone can participate at any stage of the process. In these approaches, process, information, and product are accessible, participatory, and (re)usable by anyone and for any purpose (da Silva et al., 2019).

Whereas OP aims to involve the active participation of the community, market, sources, contributors, and operation in the design of solutions, smart cities use advanced technologies to improve inhabitants quality of life and make cities more efficient and sustainable.

1.1 The Current Research

This paper presents a comprehensive, systematic synthesis of the literature raised on works involving open or participatory or codesigned design of smart cities. We focus on the ways practices are integrated into development of solutions, highlighting the technologies employed, design phases, user engagement, and sustainability impacts. Considering the literature found, this paper offers four main contributions to smart city contexts. First, it provides a comprehensive review of the characteristics of existing studies on open or participatory design practices in smart cities. Second, this review summarizes the current definitions of ”smart cities,” which helps to understand how the concept is treated and sense is made in this scientific context. Third, the review contextualizes the factors that impact implementation and acceptance of these practices across different sectors, allowing stakeholders to gain a broader understanding of the challenges and enablers of involvement of people in different urban contexts. Finally, the paper summarizes the technologies and technological artifacts used and highlights best practices and appropriate models for evaluating the effectiveness of open and participatory design in smart cities. A set of research questions were formulated to structure the review, as follows.

RQ1: What are the characteristics of existing studies on open or participatory design practices in smart cities?

RQ2: What are the current definitions of ” smart cities” in the literature, and how do these definitions influence the design and implementation processes?

RQ3: What factors impact the implementation and acceptance of open or participatory design practices in different sectors related to smart cities?

RQ4: What technologies and technological artifacts are used in open or participatory design processes in smart cities, and what best practices and models are effective in evaluating the success of these implementations?

This paper aimed to identify relevant literature and summarize the types of research projects and paradigms considered in published studies on practices that consider the involvement of people in the design of solutions in smart cities. This allows us to highlight the complexity of the research conducted and the limitations that should be addressed in future studies.

2 METHODOLOGY

In this section, the activities defined and the procedures adopted to achieve the results of this study are described. The systematic review was conducted following the PRISMA guidelines.

2.1 Search Strategy and Eligibility Criteria

The study followed the Preferred Reporting Items for Systematic Reviews and meta-Analysis (PRISMA) guidelines (Gough et al., 2012) (Figure 1).

The authors developed the search strategy, first carried out in July 2023, and updated to consider publications from 2013 to 2024, in the English language. The search string contained the terms (Table 1) looked for in the title, abstract or keywords, and full text.

Table 1: Search Terms Used in the Review.

Categories	Search Terms
Open design	("open design" OR "participatory design" OR "co-design" OR "opendesign")
	AND
Smart city	("smart city" OR "intelligent city" OR "technologically advanced city")
	AND
Tool	(tool OR software OR platform OR system OR framework OR iot)

Four databases were searched: ACM Digital Library, IEEE Xplore, Springer Link, and Scopus.

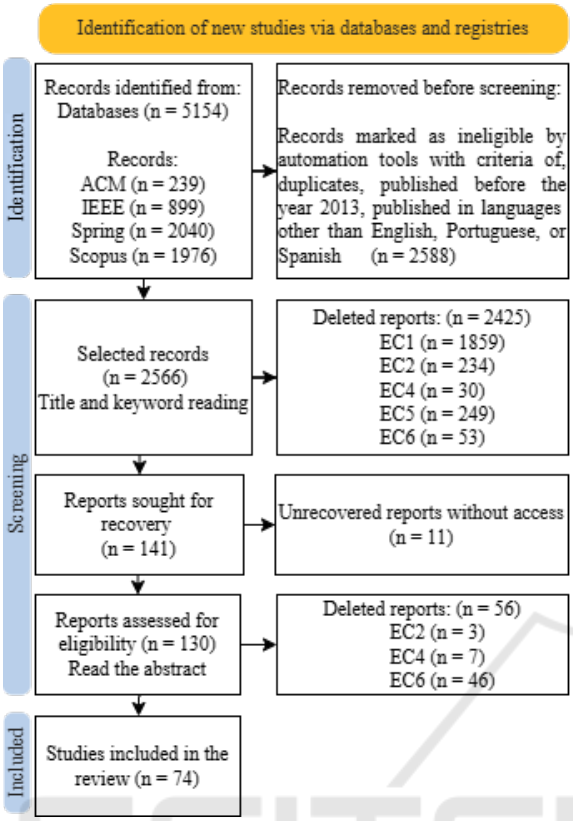

Figure 1: Steps for identifying relevant literature (based on PRISMA) (Gough et al., 2012)).

There was no need to manually include papers, as the search generated a significant number of relevant studies.

2.2 Screening and Selection

A total of 5154 articles were identified, of which 2588 articles were identified as ineligible by the platform settings considering the defined criteria (Table 2), In addition to articles published before the year 2013, duplicates, books, languages other than English, Portuguese, or Spanish and number of pages less than 4 and greater than 50.

After this step, we conducted a three-step screening with three reviewers on the 2,566 articles identified. Since database searches capture many studies that use the same terms but do not have the same focus, we systematically applied exclusion criteria during the screening. Thus, articles that did not meet the criteria were disregarded.

During the initial screening, which involved reading the title and keywords of each article, 2,425 were excluded, while 141 articles were selected for abstract reading. We identified that 11 articles were not accessible, so 130 articles were selected for abstract reading.

Table 2: Inclusion and Exclusion Criteria.

Type	Description
Inclusion criteria	IC1. Studies addressing the theme of smart cities that consider open design or participatory practices, involving any type of participant, including governments, companies, civil society organizations, communities and individuals.
	IC2. Studies presenting tools that support technologies that design and/or evaluate smart cities.
	IC3. Studies evaluating interventions related to the implementation of smart cities that consider open design, such as urban infrastructure projects, applications, services and other information and communication technologies.
	IC4. Studies that use comparisons to evaluate the effectiveness or impact of interventions related to the implementation of smart cities that consider open design, such as the comparison of different implementation strategies, different locations or different groups of participants.
Exclusion criteria	EC1. Studies that do not use a clear and precise definition of smart cities that consider open design.
	EC2 - Papers with fewer than 4 and more than 50 pages.
	EC3. Studies published before 2013
	EC4. Papers that cannot be classified into any of the previously defined types of papers, such as books, theses, abstracts, seminars and pre-conferences.
	EC5. Duplicate study.
	EC6. The terms in the string are only cited and are not the focus of the research.
	EC7. Studies published in languages other than English, Portuguese or Spanish.

The abstract reading stage was initiated considering the inclusion and exclusion criteria (Table 2); 130 articles were analyzed, of which 74 were selected as eligible for full reading.

In the complete reading stage, the second and third authors read 8.2% (n=6) and 9.6% (n=7), respectively; the remaining 60 articles were analyzed by the first author, who represents 82.2% of the selected articles.

2.3 Control of Similarity of Responses Between Authors

To ensure the consistency and reliability of the analyses performed in the systematic review, a control process involving three authors who evaluated the same articles was carried out. The objective was to test the responses' similarity to a structured form used to capture data from reading. Five articles were selected from the 74 for full reading. Each reviewer received the same articles to read and complete the form. The first author treated Open-ended responses qualitatively, and the simple agreement rate between the reviewers was calculated for questions with nominal variables. For example, "Does it involve the user?" showed 100% agreement, indicating total alignment between the authors.

2.4 Data Extraction

Data were extracted according to a form with a prespecified checklist. The form [1] was made available online (Google Forms) for access by the authors. The checklist included questions to ensure a systematic and comprehensive analysis. First, we sought to identify the design processes used in the studies, considering whether these processes involve the user, how this involvement occurs, in what phases of the process they are, the application domain, and whether there is consideration of sustainable objectives, such as the UN Sustainable Development Goals.

Next, the technological artifacts produced and the types of technologies used were investigated. We also assessed how the developed artifacts were tested or validated. In addition, the questions included verification of the authors' affiliation and the location where the research was carried out. Finally, we analyzed how the document presented the concept of smart cities and there was space for additional comments from the reviewer. These questions enabled the standardized and detailed extraction of information relevant to the study.

3 RESULTS

In this section, we analyze open and participatory design practices in smart cities. Through a review of 74 articles, we explored aspects such as the level of user involvement, the prevailing definitions of smart cities, and the factors that influence the implementation of these practices. In addition, this section examines the most widely used technologies, such as engagement platforms and IoT, and the evaluation methods used to measure the success of these initiatives. Finally, we identify interconnected elements that demonstrate actions that promote more inclusive and effective solutions in smart cities.

3.1 What Are the Characteristics of Existing Studies on Open or Participatory Design Practices in Smart Cities? (RQ1)

Of the 74 selected articles, 14 did not have effective user involvement. These articles addressed collaborative practices (examples) and used only user data to analyze and understand user perception. In 60 articles, user involvement in at least one process of participatory practices was reported. When performing a descriptive analysis on the year of publication of the articles analyzed, it is noted that there was a fluctuation in publications over the years, we can separate them into 3 moments and relate them to global conflicts that moved ICTs.

The period from 2013 to 2018 can be associated to the consolidation of emerging technologies; during this period, the expansion of the IoT contributed to the integration of connected devices that enabled the boosting of the use of technology in cities that aimed for the smart city status (Zanella et al., 2014).

In the period from 2019 to 2021 there is a downward trend, which may be related to the impact of the pandemic; this global crisis has significantly affected people's intentions (Magare et al., 2020) and hindered research and development activities.

The resumption of publications in the period from 2022 to 2024 may be associated with the recovery of the post-pandemic economy and the exponential advances in artificial intelligence (B P et al., 2022)

Considering the affiliation of the authors' countries Table 3, Europe, and North America are at the top in terms of scientific contribution, with the countries with the highest number of publications being Italy and the United States, both with 13 publications each, reflecting a high concentration of research in developed countries.

Significant presence from Asia, including countries such as Japan and China contributing a significant number of publications, with 11. Modest contributions from Africa and South America, indicating areas with potential for future expansion or with little focus on the topic.

Regarding the demographic distribution of the countries hosting the studies, the countries with more

[1] Form used in data extraction: Appendix 5

Table 3: Author by country.

#	Author's Country	No. of Authors	#	Author's Country	No. of Authors
1	Australia	7	16	Namibia	1
2	Belgium	2	17	Netherlands	4
3	Brazil	2	18	Norway	1
4	Canada	3	19	Poland	1
5	Chile	1	20	Portugal	5
6	China	2	21	Russia	2
7	Denmark	1	22	Saudi Arabia	1
8	England	1	23	Spain	5
9	Estonia	2	24	Sweden	1
10	Finland	4	25	Switzerland	2
11	Germany	4	26	Taiwan	1
12	Greece	2	27	Türkiye	1
13	Italy	13	28	United Kingdom	5
14	Japan	4	29	United States	13
15	Morocco	1			

studies were European countries, such as: Italy 13 studies, Germany, Spain, and the United Kingdom with 7 studies each and Finland and Denmark with 5 studies each. North America also stands out with the United States with 12 studies. On the other hand, we have underrepresented regions such as Africa and parts of South America that have a smaller number of studies.

Regarding the focus of the articles on scoring or citing which SDG or sustainable initiative they address (Figure 2), there is a percentage of 75.68% (59) of the selected articles that do not provide information. Thus suggesting that most publications still do not explain how their initiatives relate to sustainable development goals at a global level, despite dealing with smart cities and considering open design.

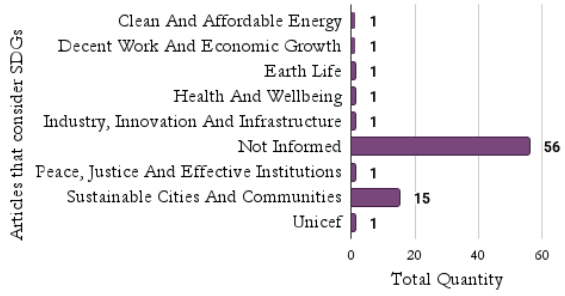

Figure 2: Articles that consider SDGs.

The goals are part of the UN 2030 Agenda to promote prosperity, equity and global sustainability, however only 6 of the 17 existing objects were mentioned. Among them, goal #11 - Sustainable Cities and Communities stands out with 15 mentions, which reflects the intention of improving urban services and social inclusion, essential factors for the development of smart cities centered on people.

In a smaller proportion, goal #13 - Climate Action appears with two mentions. The unique presence of the other goals and the absence of others shows that, to date, the focus themes of the 2030 agenda are issues that have not yet been addressed or explicitly related to global sustainability goals in most of the selected articles. Broader goals, such as SDG #1 - No Poverty, #2 - Zero Hunger and Sustainable Agriculture or #6 - Clean Water and Sanitation, end up not being addressed directly, as they do not seem to be seen as the core of the development of technological solutions or open design models aimed at smart cities. Although the concept of open design can benefit vulnerable groups and promote inclusion, the studies do not directly correlate it with deeper social problems, such as goal #5 - Gender Equality or #10 - Reduced Inequality.

3.2 What Are the Current Definitions of ”Smart Cities” in the Literature, and How Do These Definitions Influence the Design and Implementation Processes? (RQ2)

Of the selected studies 28 (37,84%) did not have a clear definition of smart city. The absence of a common definition in the reviewed articles reflects both the complexity of the topic and the multidimensional nature of work on smart cities. For example, an article presents gamified methods and co-creation in urban planning, without exploring the concept of ”smart city” as a whole (Kavouras et al., 2023).

In the article (Kudo, 2016) explores co-design and co-production in smart mobility systems, without articulating how these practices fit into a broader model of a smart city. In the article (Jensen et al., 2021) addresses eco-feedback systems, but limits its analysis to environmental issues, without discussing the general concept of a “smart city”.

Articles that propose to define smart cities total 46 (62,16%), in Figure 3 illustrates through a word cloud the most common words in the definitions of smart cities used in the articles. It is possible to notice a pattern that relates to the use of technology to constitute the social world, digital world and infrastructure.

The words in Figure 4 categorized by social, digital and infrastructure, illustrate factors that might impact the implementation and acceptance of design practices in smart cities:

- Social Layer: Engaging citizens, people and em-

Figure 3: Most frequent words in the definition of smart cities.

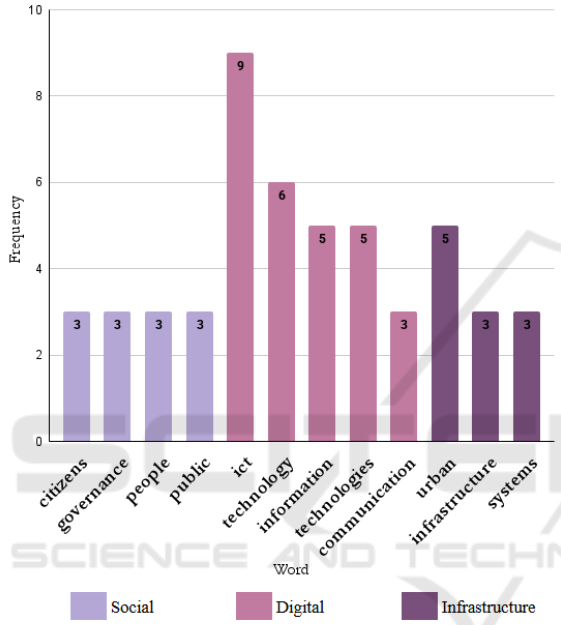

Figure 4: Most frequent words in the definition of smart cities.

powering the public requires collaborative governance and open discussion processes.

- Digital Layer: ICT, together with other technologies, function as a platform for information collection and communication. However, it is essential that these solutions are co-created, prioritizing digital inclusion and usability.
- Infrastructure Layer: Urban transformation involves modernizing infrastructure and smart systems. Successful smart city projects combine these components with social participation, creating sustainable solutions aligned with real local demands.

In summary, when analyzing the frequency of words in the different categories, the importance of articulating the social world, digital world and physical world in a balanced way becomes evident, ensuring that innovations in smart cities not only incorporate new technologies, but also meet people's needs and strengthen participatory governance.

3.3 What Factors Impact the Implementation and Acceptance of Open or Participatory Design Practices in Different Sectors Related to Smart Cities? (RQ3)

The implementation and acceptance of open and participatory design practices in smart cities are strongly influenced by semiotic dimensions and the socio-technological context in which they are inserted. The correlation of the articles with each of the semiotic dimensions of Open Design was explored through the use of the Semiotic Framework (Figure 5) addressed by Open Design Platform [2] to offer an insight into the impact of these factors on participatory design practices (Dos Reis et al., 2020; Gonçalves and Baranauskas, 2021; Alves et al., 2024; Baranauskas et al., 2024).

- *Social World*: the interaction between signs and their meanings is central to the social world, as communities attribute different values and meanings to proposed solutions according to their cultural and social realities. In the case of vulnerable communities, such as Detroit (Singh et al., 2022), participatory design reveals how residents, through design workshops, shape the collective meaning of solutions. The analysis of the relationship between design practices and the experiences of participants shows how the spaces and solutions designed have to be culturally sensitive and adapted to local realities, which reinforces the idea that communities play an active role in the co-creation process. This process of meaning making is vital for the acceptance of practices, as it involves not only the creation of solutions, but also the understanding and internalization of the concepts that support them.
- *Pragmatics*: accentuates the desire for action and the consequences can be seen in the dynamics of political participation between citizens and other stakeholders, as illustrated in the Long Beach studies (Sidqi et al., 2022) and Windhoek (Seberger and Shaffer, 2023). These cities used interactive games as a participatory design tool, allowing citizens to act as co-designers in solutions to urban problems. The "well-played game" approach in Long Beach not only encouraged par-

[2]Open Design Platform: https://opendesign.ic.unicamp.br/

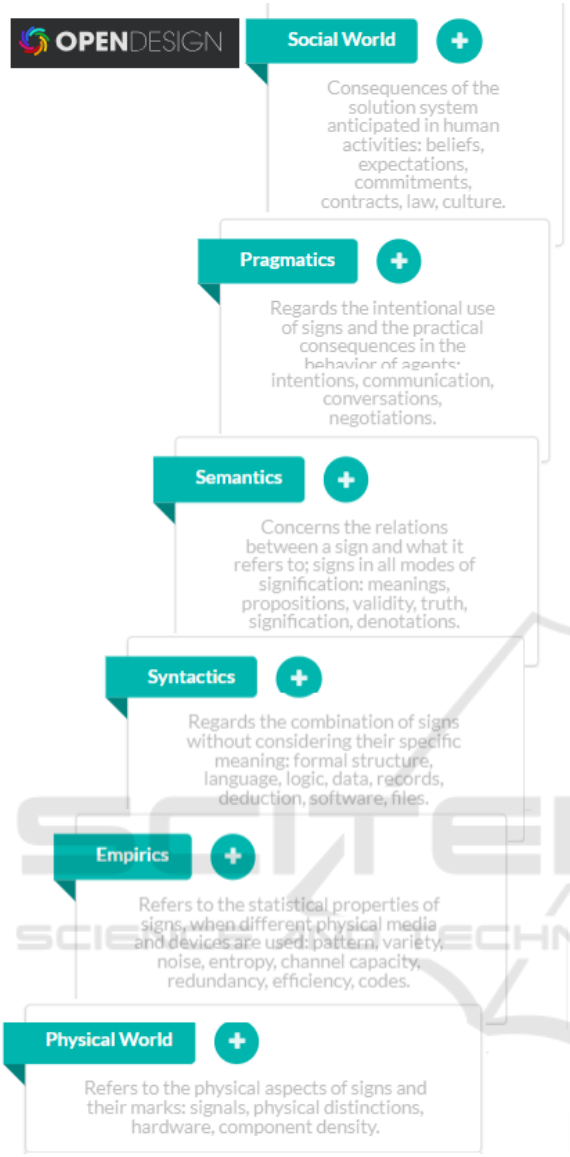

Figure 5: Open Design - Semiotic Framework artifact (Gonçalves et al., 2020).

ticipation, but also promoted active communication between different interest groups, reflecting a pragmatic design practice where the intention is to achieve a balance between local needs and technological solutions.

In the example of Newcastle (Gordon et al., 2023), citizen engagement in environmental data collection and the development of digital tools for air quality monitoring illustrates the pragmatics of participatory design. The aim of using new data collection methods is to provide a quantitative measure of willingness to raise awareness and local action on environmental issues, with a direct impact on changing citizen behavior.

- *Semantics*: the signs used to represent urban solutions and their interactions are crucial to the acceptance of design practices. The use of digital and physical representations, such as 3D models or digital twins, allows citizens to understand and interpret proposed changes in their urban environments. This can be seen, for example, in the article of (Gama, 2017), which describes the construction of interactive urban models for visualizing suggested solutions. The semantics of 3D models facilitates the perception of the impacts of urban solutions, helping citizens to visualize how their contributions translate into tangible changes in the urban space.

  The creation of "models of the future" (Righi et al., 2015) in co-creation workshops also exemplifies how semantic representations help foster a shared understanding of communities' needs and desires. Artistic or digital representations allow citizens to explore future scenarios and better understand the impact of designed solutions, facilitating the acceptance of innovative solutions.
- *Syntactics*: which addresses the organization and combination of signs without considering their specific meaning, is clearly observed in the technological platforms used in smart cities. The application of technologies such as sensors, data collection platforms and gamification, as seen in articles (Van Kleunen et al., 2021) and (Rocha et al., 2022), is a demonstration of how the structure and organization of information can facilitate citizen participation. The use of data collected by sensors (Freeman et al., 2019) and the transformation of this information into practical actions demonstrate the importance of syntactics in creating a common language between technologies and citizens.

  In the example from Windhoek, the use of interactive games as a design tool (Seberger and Shaffer, 2023) shows how the syntax of digital interactions can be used to transform data and decisions into playable elements, creating a framework that not only engages citizens but also enables them to interact in an informed and meaningful way with the participatory design process.
- *Empirical*: Collecting and analyzing quantitative data on user behavior is essential to evaluating the effectiveness of participatory design solutions. In papers such as Newcastle (Gordon et al., 2023) and "creative safety" with LEGO modeling (Paraschivoiu et al., 2022), empirical analysis provides a solid basis for adapting and validating proposed solutions. Collecting data through surveys and tools such as questionnaires or inter-

active games (Bastos et al., 2022) allows design decisions to be constantly evaluated and adjusted based on citizen responses.

The use of data for environmental monitoring (Keskin and Markus, 2024) exemplifies how empirical data collection can be used to validate proposed changes and adjust solutions according to urban reality and observed real-world impacts.

- *Physical World*: the material space where participatory design takes place, influences the implementation of solutions. Urban infrastructure, such as digital platforms (Freeman et al., 2019) and the use of sensor technologies (McCord and Becker, 2023), play a crucial role in the perception of design solutions. Accessibility and technological suitability are essential to ensure that citizens can actively participate in and understand proposed solutions.

  The adoption of prototypes and physical environments, such as the co-creation workshops mentioned in Articles (Van Kleunen et al., 2021) and (Sakamoto and Nakajima, 2016), highlights the importance of developing concrete, accessible and interactive solutions for citizens. This approach ensures that proposals go beyond theory, being tested, refined and understood in the real, physical context of the city.

3.4 What Technologies and Technological Artifacts Are Used in Open or Participatory Design Processes in Smart Cities, and What Best Practices and Models Are Effective for Evaluating the Success of These Implementations? (RQ4)

Information about artifacts and technologies was grouped according to their frequency of use and is presented in Figure 6. Looking at Citizen's Engagement Platforms and Documentation and Training Manuals, they stand out as the most used technological artifacts in the design of smart cities, reflecting the focus on empowering and interacting with urban solutions. Engagement Platforms facilitate active participation by the population, while Manuals and Training are essential to ensure the adoption and effective use of technologies.

A diversity of technologies and technological artifacts was found, which are presented in Figure 7. Environmental Monitoring and IoT Devices play important roles in data collection and analysis, contributing to urban sustainability and efficiency. The lack of information on some technological artifacts reflects the diversity and gaps in documentation, highlighting the complexity and variation in smart city implementations.

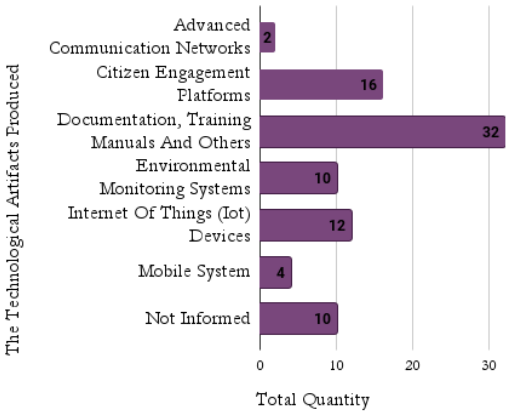

Figure 6: The Technological Artifacts Produced.

IoT Devices, Data Management Systems, Sensors, and Communication Networks technologies stand out for enabling the collection, analysis, and transmission of data in real time. Next, Dashboards and Strategic Planning Tools provide visualization of indicators and support strategic decisions, while Cloud and Mobile Computing ensure availability and continuous engagement of citizens. Technologies such as Big Data, Crowdsourcing, Digital Platforms, Gamification and Machine Learning, although less frequent in the sample reviewed, demonstrate potential data oriented uses.

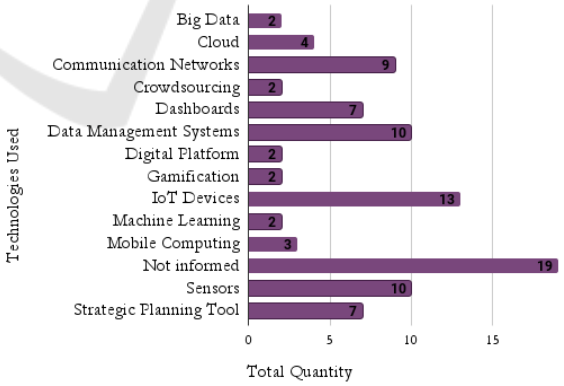

Figure 7: Technologies Used.

Regarding evaluation tools Focus Groups are highlighted with greater frequency, highlighting the relevance of group discussions with key participants. Expert Assessment appears next and may be related to assurance, technical validation and the viability of proposed solutions through expert analysis, which should complement users' perceptions.

Direct Observation and Field Research stand out as approaches that allow us to understand the "in loco" use of technologies and artifacts, identifying usability problems or functional gaps directly in the urban environment.

Usability testing can be considered the systematic evaluation of the user experience, which allows identifying friction points and opportunities for improvement. A/B Testing, although less frequent, has proven effective for comparing solution variants and objectively measuring the performance of each version.

Case studies provide a broad view of how technologies and technological artifacts behave in specific scenarios, enabling the extrapolation of good practices to other contexts. Models such as Living Labs, User-Centered Design and Design Thinking encourage continuous cycles of prototyping, testing and reformulation of solutions, supported by empirical data and stakeholder feedback. However, the lack of transparency in methodological reporting in several studies compromises the replicability and comparison of results, highlighting the need for better documentation practices.

4 DISCUSSIONS

This paper presented a systematic review of the state of the art on design practices that consider users participation in smart cities, focusing on technological contributions, user involvement and the impact of sustainability initiatives. Based on the defined research questions (RQ1–RQ4), it was possible to:

- **Understand the characteristics of existing studies (RQ1 - subsection 3.1):** A diversity of studies was identified, with different levels of user involvement and varied methods of data collection and analysis. A certain concentration of research was also observed in developed countries, mainly in Europe and North America, indicating research opportunities in underrepresented regions, such as Africa and South America.
- **Understanding the definitions of "smart cities" (RQ2 - subsection 3.2:** The analysis revealed that there is no consensus on the term "smart city". Several articles use digital technologies and seek more sustainable urban solutions, but only 46 of the 74 papers provide clear definitions of what they consider a smart city. The importance of balancing the social layer (people and interactions), the digital layer (ICTs, data) and the infrastructure layer (urban systems) to meet the real demands of society was noted.
- **Identify factors that impact the implementation and acceptance of participatory design practices (RQ3 - subsection 3.3):** Using the Semiotic Framework of the OpenDesign platform, it was found that the successful adoption of participatory practices requires an understanding of the social context, clarity, and coherence in communication processes, the relevance of the content and functionalities offered (semantics and pragmatics), as well as the adequacy of technologies (syntax) to the local reality and the needs of citizens (physical world). These factors are crucial to ensuring active community engagement and the sustainability of initiatives.
- **Mapping assessment technologies and best practices (RQ4 - subsection 3.4):** The technological tools adopted are varied, including engagement platforms, training guides, environmental monitoring sensors, and integration with IoT, among others. Regarding evaluation practices, the adoption of approaches such as focus groups, usability tests, field research, and case studies was highlighted to validate the developed artifacts, ensuring relevance and alignment with urban demands.

Although the results indicate considerable progress in the development of participatory solutions for smart cities, there are still important gaps. First, the lack of standardization in the definition of "smart city" makes direct comparison between studies difficult and may compromise the application of good practices in different contexts. Second, many studies do not report their evaluation methods in detail, limiting replicability and the consolidation of robust empirical evidence. Furthermore, the concentration of research in developed countries reinforces the need to investigate more diverse realities, including developing regions, where the application of participatory design can generate significant social impacts.

5 CONCLUSION

The concept of a smart city has become recurrent in political speeches and in the media, despite the unclear meanings and definitions. Works on smart cities have lately evolved from a strongly technological orientation toward more participatory approaches, where citizens can have a role in their design. This paper presented results of a systematic literature review conducted to raise aspects of open and participatory involvement of people in the design of smart cities.

Data extracted from the analyzed articles confirm the potential of open and participatory design as a strategic approach for developing sustainable, inclusive urban solutions aligned with the population's desires. As further work, a community-oriented design is suggested, based on the OpenDesign Platform. Through it anyone can propose and participate in design projects and everyone can express their concerns, propose ideas and debate solutions in a democratic manner.

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APPENDIX

The data used in this study are stored in the Zenodo repository, ensuring reproducibility and accessibility. They can be accessed directly at the following address: 10.5281/zenodo.14715439

We included in this repository:

- Form template used.
- Original dataset extracted from the selected articles used for analysis.
- List of references.

We recommend that readers interested in replicating this study consult the files available in the repository.