Greater Effectiveness in Citizen Participation in Smart Cities

A Legal Perspective on Adapting Procedures to Complexity, Uncertainty, and Ambiguity

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Abstract—**Despite the growing emphasis on citizen participation, we agree with the authors who defend that the current mechanisms still often suffer from (i) low utilisation, (ii) limited adherence, and (iii) participant dissatisfaction, highlighting a gap between normative frameworks and their practical effect. To address these challenges, this work combines a targeted literature review with an argumentative legal analysis to propose a specific approach to citizen participation in smart cities, aligning public law with good governance and sustainability and envisioning efficient and equitable decision-making. More precisely, this work proposes a legal-technical framework to enhance citizen participation in municipal decision-making, drawing inspiration from Klinke and Renn's risk governance framework. Still, unlike the authors' risk-centric policy definition, the current study focuses on municipal decisions (excluding contracts, regulations, and administrative acts such as licensing), addressing some of their challenges, including complexity (multi-factor issues), uncertainty (data gaps), and ambiguity (value conflicts). The proposed solution is based on (i) adapted/tailored participation procedures and (ii) targeted engagement of participants, including underrepresented groups (to ensure inclusivity), all driven by (iii) impact criteria (e.g., economic value, the population affected, social significance) to categorise decisions and guide participation, supported by (iv) smart city technologies, like artificial intelligence-driven platforms (e.g., with semantic analysis), to streamline bureaucracy and enable scalable, inclusive, and transparent participation.**

Keywords - smart cities; citizen participation.

I. INTRODUCTION

This first section introduces the identified problem and the proposed solution, outlining the research's methodology.

A. The identified problem

We argue that current municipal decisions – especially those that are strategic/impactful/sensitive decisions that may shape municipal priorities through significant citizen participation – require greater sustainability (encompassing environmental, social, and economic/governance dimensions) and alignment with the principle of good governance. To achieve this, citizen participation, recognised as both a right and a principle, must be a key consideration. In that vein, in 2020, the Organisation for Economic Co-operation and Development (OECD) collected evidence and data that support the idea that citizen participation in public decision-making can deliver better policies, strengthen democracy, and build trust [1]. However, in 2022, Chen et al. [7, p. 141] indicated that, regarding future research, little had been written about the effectiveness of these measures, specifically the extent to which citizen involvement and dynamisation have contributed to social equity and quality of life.

According to some studies, specific mechanisms directly related to citizen participation (such as citizens' conferences, deliberative surveys or citizen consultations), despite being normatively enshrined in their respective legal systems, have rarely been used, have not had excellent adherence or have been unsatisfactory for participants (e.g. [2], [3], [4], [5], [6] and [7]), appearing more important in theory than in practice. This discrepancy, referred to by Delicado [5] as the "participation fallacy" and by Arnstein [6] as "tokenism", reveals a critical gap between the normative value of participation and its practical effectiveness.

B. Purpose and description of the solution

This article aims to develop a legally grounded, technology-enabled framework for citizen participation in smart cities that may overcome the "participation fallacy" by (i) adapting/tailoring participation procedures and (ii) targeting engagement of diverse participants, including underrepresented groups (to ensure inclusivity), all driven by (iii) strategic/impact/sensitive criteria (e.g., economic value, the population affected, social significance) to categorise decisions and guide participation, supported by (iv) smart city technologies, like artificial intelligence (AI) driven platforms (e.g., with semantic analysis), to streamline bureaucracy and enable scalable, inclusive, and transparent participation.

These ideas were inspired by the 2011 work of Klinke and Renn [8], who, based on previous works and in the 2005 white paper from IRGC (International Risk Governance Council) [9], proposed an adaptive and integrative risk governance model to address contemporary risk challenges, expanding the classic risk analysis model (assessment, management, communication) with additional steps (pre-estimation, interdisciplinary risk estimation, risk characterisation, evaluation, and management) and emphasising multi-actor involvement. That work's focus was on designing a flexible, inclusive governance process to handle risks characterised by complexity, scientific uncertainty and socio-political ambiguity.

Complexity, according to Klinke and Renn [8], arises in decisions with intricate technical or scientific components

where cause-and-effect relationships are difficult to predict (e.g., tech policy). The scope is narrow, targeting experts or specialised stakeholders (e.g., engineers, scientists, or industry representatives). The depth demands deep technical analysis, focusing on data-driven or evidence-based contributions rather than broad public opinion.

Regarding uncertainty, according to the referred authors, it occurs when outcomes are unpredictable, but values, priorities, or local knowledge are critical (e.g., environmental Planning and urban redevelopment). The scope targets institutional actors, interest groups, and informed stakeholders (e.g., Non-Governmental Organisations (NGOs), local businesses, community leaders), who are key to surfacing these elements. It is balanced, combining stakeholder insights with technical input, with a focus on values and local context.

Regarding ambiguity, according to the referred authors, it arises in decisions involving moral, political, or value-based conflicts where a broad consensus is required (e.g., zoning disputes and social equity policies). The scope is broad and open to all citizens, ensuring diverse perspectives and legitimacy. It is deliberative, focusing on dialogue and consensus-building rather than technical detail. The general public, citizens, and civil society would be best suited to resolve these value clashes.

Beyond that idea (considering others, such as adaptive and integrative capacity and the governance decision tree), we would like to highlight the spectrum that goes from linear risk problems (as a category with low complexity, uncertainty, and ambiguity, making it suitable for routine risk handling) to those situations which require risk-informed, precaution-based, or discourse-based management. Consequently, stakeholder involvement would vary depending on the risk type. Linear risks (instrumental processing) would involve (only) governmental actors; complex risks (epistemic processing), experts; uncertain risks (reflective processing), stakeholders; and, for ambiguous risks (participative processing), the public.

While inspired by this risk governance theory, our proposed framework is not intended to reform legal structures but to serve as a best-practice, regulatory-level tool adaptable by municipalities within existing legal norms."

C. Research questions

To guide this investigation, this study poses the following explicit research questions:

a) Are participation procedures more critical for strategic/impactful/sensitive decisions compared to linear, routine decision-making processes?

b) How can Klinke and Renn's risk governance framework (especially regarding complexity, uncertainty, and ambiguity) be adapted to design effective citizen participation models?

c) How can administrative procedures be adapted to enhance citizen participation in smart cities?

d) How can smart city technologies support tailored participation by enhancing citizens' engagement, inclusivity, and decision-making?

D. Difficulties, obstacles and challenges

Regarding the challenges of the proposed solution, it is necessary to clarify that, unlike Klinke and Renn's risk-centric model, the current work focuses on municipal decisions (excluding contracts, regulations, and administrative acts, such as licensing) during policy implementation, enhancing participation and governance effectiveness, thereby emphasising the impact of these decisions. By adapting the authors' concepts of complexity, uncertainty, and ambiguity to the municipal context, this approach ensures that participation is tailored to the decision's impact and to its inherent challenges, making governance more responsive and inclusive.

In summary, the authors' framework will serve as a starting point, while our focus will be on impact-driven participation. We will propose six impact-based criteria as the core framework for assessing decisions while offering complexity, ambiguity, and uncertainty as supplementary tools to refine participation strategies when needed. They help municipalities address decisions that go beyond simple impact assessment, ensuring participation is effective in challenging cases. Unlike the six impact-based criteria, complexity, ambiguity and uncertainty are not required for every decision. They are applied selectively, maintaining the simplicity of the original framework while adding depth where necessary.

As such, the aforementioned theory can be applied to municipal decision, recognizing that these decisions differ from risk governance and national risk scenarios, but often share similar characteristics that affect how participation should be structured.

For instance, municipal decisions often involve complex situations with multiple technical components, interdependent systems, or specialised knowledge (e.g. deploying a city-wide sensor network may require technical workshops or cross-departmental collaboration alongside citizen input).

Local governance may also face long-term or unpredictable outcomes (e.g., future population growth and the effects of climate change), especially where data are incomplete. For example, a public transport investment plan might use scenario-based consultations, roundtables or phased feedback to adapt to emerging trends.

Furthermore, as we will see bellow, municipal decisions may also involve sensitive socio-cultural issues, ethical dilemmas, cultural sensitivities, or conflicting stakeholder values. For instance, a zoning change sparking community debate might require deliberative forums (such as citizen assemblies) or mediation to align perspectives, mirroring socio-political ambiguity.

Regarding the difficulties in implementing effective citizen participation, we identify those that we consider more relevant. First, low engagement stems from citizens' lack of awareness, trust, or perceived influence, exacerbated by opaque processes or inadequate feedback loops [2] and [10].

Second, inclusivity barriers – such as digital divides, low digital literacy, or exclusion of marginalised groups – hinder broad participation, particularly in smart cities [4].

Third, administrative rigidity in public law frameworks often employs one-size-fits-all procedures, overlooking the

diverse nature of decisions (e.g., complex technical projects versus value-laden policy choices) [10].

Fourth, although the features of smart cities are becoming increasingly noticeable, their widescale implementation is uneven globally and in terms of technology application. Resource constraints challenge municipalities, such as designing tailored processes or deploying advanced technologies (e.g., AI platforms), which require significant investment and expertise [4].

Fifth, our proposal implies the definition of tiers, which should still be defined in concrete by municipalities (nevertheless, we suggest defining values, for instance, considering that a decision is strategic/impactful/sensitive if any quantitative criterion reaches Tier 3 or above or the qualitative criterion is triggered).

E. Importance of the problem

As to the importance of the problem, the "participation fallacy" is a critical issue for democratic governance and smart city development, with far-reaching implications.

Legitimation is a broader democratic function: participation increases the acceptability and sustainability of decisions, especially where multiple participants and conflicting interests are involved. Thus, participation should not be symbolic or limited to information provision. It must empower citizens to shape outcomes. To overcome these challenges, we advocate for regulatory frameworks that ensure inclusiveness, clarity, and effective and practical implementation. Participation gains legitimacy and adherence when citizens understand how their input will be used. Legal norms and especially municipal regulations must enable not just the right to be heard but also the duty of the administration to respond and justify. It is essential to reach those who need it most, particularly through inclusive technology and enhanced digital literacy.

Ineffective participation erodes public trust, weakens policy legitimacy, and risks suboptimal outcomes as citizens' preferences and local knowledge remain untapped [6]. For municipalities, addressing this gap is crucial to meeting the mandates of good administration and democratic legitimacy. Neglecting this problem risks social exclusion, policy resistance (e.g., in contentious zoning decisions), and missed opportunities to leverage smart city technologies for inclusive governance, rendering it a pressing scientific and practical challenge.

F. Limitations

Our proposed approach has several limitations. First, it relies on municipal capacity to implement sophisticated technologies and regulatory frameworks, which may be challenging for smaller or resource-constrained cities [4]. Second, the proposed tiered criteria (e.g., economic value, population affected) require local adaptation, risking inconsistency across jurisdictions due to subjective interpretations [10]. Third, digital inclusion remains a challenge, as reliance on smart city technologies (which often adopt top-down solutions) may exclude citizens with low digital literacy or access, potentially undermining inclusivity [5]. Fourth, this study has a legal perspective and is strictly limited in scope. It does not address forms of political participation or seek to explore in detail the ethical or philosophical underpinnings of democratic theory. Finally, the exploratory nature of the research lacks empirical validation, necessitating future testing to confirm the framework's effectiveness in diverse smart city contexts.

G. Methodology

Regarding the methodology, this work employs an exploratory, qualitative approach that combines a targeted literature review with an argumentative legal analysis to propose a specific approach to citizen participation in smart cities. Scientific articles were collected from reputable library databases, including EBSCO, IEEE, ResearchGate, repositorium.sdum.uminho.pt, and Google Scholar, as recommended by Callahan [11].

Rather than aiming for an exhaustive summary of all literature – a hallmark of scientific systematic reviews – this work prioritises pertinent sources that either bolster the proposal or illuminate counterarguments, aligning with the qualitative research principles outlined by Jaeger and Halliday [12], Cardano [13], and Günther [14]. This selective approach reflects a core tenet of legal scholarship, where persuasion takes precedence over comprehensiveness, allowing the analysis to construct a compelling case rather than merely describe the field. References follow the IEEE style, as per the conference guidelines. Zotero and Grammarly software were used.

H. IARIA context

We defend that both problem and solution are aligned with the topics of the International Academy, Research and Industry Association (IARIA) Annual Congress on Frontiers in Science, Technology, Services, and Applications, especially regarding smart cities (systems), understood as " *an innovative city that uses ICTs and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations concerning economic, social, environmental as well as cultural aspects*" [15]. Moreover, we have already established that there should be a legal concept of smart cities that is more focused on citizens' rights [16].

I. Structure

This work is structured as follows: the current Section I (Introduction) outlines identified problem, the proposed solution, and methodology. Section II (Research) includes the definition of the impact criteria for decision categorisation, details the tailored procedures (inspired by Klinke and Renn's framework, targeted participants' engagement and the role of smart city technologies. Lastly, Section III (Conclusions) synthesises findings, advocating for legal reforms to achieve substantive participation.

II. RESEARCH

This section develops a framework for effective citizen participation in smart cities, exploring four key ideas: decision impact criteria, tailored procedures, targeted citizen engagement, and the role of technology.

A. Definition of criteria for strategic/impactful/sensitive decisions

Rather than directly transplanting risk typologies into urban governance, our proposal for a framework selectively draws on the concepts of complexity, uncertainty, and ambiguity, as well as their consequences. In our proposal, their role is to fine-tune participation design in situations where impact-based criteria alone may not fully reflect a decision's full significance.

Balancing efficiency and democracy poses a dilemma: overly broad participation in minor decisions wastes resources, while insufficient engagement in strategic/impactful/sensitive issues undermines legitimacy. Thus, we defend the advantages of prioritising higher participation (citizen power) for strategic/impactful/sensitive decisions [6] and [17] and a standardised yet flexible framework (e.g., a municipal regulation) that defines participation levels based on decision impact according to different criteria (thus avoiding case-by-case discretion). Inspired by several authors ([1], [6], [10], [17] and [18]), we defend the existence of six criteria: economic value, number of people affected, territorial area impacted, duration of impacts, risk of irreversible effects and qualitative factors as a "safety valve" (socio-cultural sensitive decisions).

Each of the quantitative criteria, without a hierarchical order, has a predefined tiered system (e.g., tiers 1–5) that ensures consistency and efficiency. We consider that (i) the municipality must define the values of each tier in concrete, according to its reality, and (ii) the tiers may need to be adapted by the municipality according to the matter at stake (e.g., specific NGOs, marginalised communities).

As a theoretical exercise, we propose some values that we consider reasonable for each tier. Regarding the first criterion (economic value), we suggest it should be measured according to the average value of the most expensive public contract awarded in the last 5 years, from $\geq 5\%$ (Tier 1) to $\geq 80\%$ (Tier 5). It measures the financial scale of a decision relative to municipal budgets. Due to their strategic nature, high-cost decisions (e.g., major infrastructure projects) likely require broader or more targeted participation.

The second criterion is the number of affected people (from $< 0.5\%$ (Tier 1) to $> 50\%$ or national/inter-municipal impact (Tier 5)). This criterion resonates with the emphasis on engaging those most affected. Decisions affecting large populations (e.g., urban redevelopment) may warrant broader participation to ensure legitimacy and transparency. Still, the low threshold for Tier 1 ($<0.5\%$) may exclude niche but critical groups (e.g., minorities), thereby risking the exclusion of vulnerable participants, thus highlighting the need for the sixth (quantitative) factor alongside percentages.

The third criterion is the territorial area affected ($< 0.1\%$ (Tier 1) to $> 50\%$ or national/inter-municipal impact (Tier 5)). Despite the high impact, small but densely populated areas (e.g., urban centres) may fall into lower tiers, suggesting a need for density-weighted adjustments.

The fourth criterion is impact duration (< 1 week (Tier 1) to > 5 years (Tier 5)), which highlights long-term decisions which require participation to ensure sustainability and legitimacy. Still, the 5-year threshold for Tier 5 may be too short for some strategic decisions (e.g., climate adaptation plans spanning decades).

The fifth criterion, irreversibility of the effects (may vary from "none" (Tier 1) to "systemic damages" (Tier 5)) aligns with the mention of sustainability and risk governance. Still, the subjective nature of "systemic damages" may lead to inconsistent municipal classifications.

The sixth criterion is a qualitative flag for strategic/impactful (e.g., decisions shaping city identity or long-term vision) or socio-cultural sensitive decisions (which involve value conflicts, public controversy, or stakeholder polarisation, often requiring broad engagement to legitimise outcomes) that may not score high in all criteria but still require broad participation due to their systemic or value-sensitive nature (e.g., a policy shift with moderate costs but high symbolic importance) and their impact on marginalised groups.

Lastly, once the criteria are established, participants and mechanisms should be assigned according to each criterion and tier. In case of conflicting criteria (e.g., high territorial impact but low cost), a decision is strategic/impactful if any criterion reaches Tier 3 or above, as this ensures high-impact decisions trigger appropriate participation. To ensure participation is genuine and impactful, municipalities should adopt evaluative indicators such as (i) representativeness of participants (e.g., demographic match to affected population); (ii) transparency of decision influence (e.g., percentage of proposals integrated into final decisions); and (iii) satisfaction and trust metrics (e.g., post-process surveys). These indicators may be integrated into ex-post reviews of participatory processes or public reports.

B. Tailored procedures (Klinke and Renn's framework)

Further to the previous section, we propose a tiered participation matrix in which tailored mechanisms are linked to each criterion's impact level (Tiers 1–5). The intention is that this structure encourages municipalities to adopt flexible and hybrid approaches, particularly where decisions are considered strategic/impactful/sensitive. Hybrid formats (e.g., combining citizens' assemblies with digital feedback tools) are particularly recommended for higher tiers to enhance both inclusivity and effectiveness.

Similarly, in 2019, Simonofski [17] presented CitiVoice Frameworks, a governance tool designed to help define a citizen participation strategy and as a comparison and creativity tool for evaluating several cities and designing new means of participation.

In sum, we defend that municipal participation could benefit by shifting to tiered procedures, leveraging smart city technologies and grounded in administrative law (proportionality, transparency, inclusivity). First, considering that the administrative procedures include several stages that could be adapted, namely: (i) mechanism selection, (ii) notification, (iii) hybrid organisation, (iv) deliberation/voting, and (v) feedback. Secondly, considering the different tiers mentioned above. Once again, it should be the municipalities to choose the mechanisms they want to apply. Still, as a

theoretical exercise, we propose some values that we consider reasonable for each tier.

Regarding the first criterion, low-cost decisions (Tier 1) could rely on digital forms or passive input tools. Moderate investments (Tiers 2–3) could utilise surveys, focus groups, or participatory budgeting methods. High-value decisions (Tiers 4–5) may require structured deliberation, such as expert roundtables, citizen assemblies, or hybrid forums that combine online and in-person engagement.

Regarding the second criterion, when few are affected (Tier 1), basic notifications or opt-in feedback could be sufficient. As impact grows (Tiers 2–3), engagement could include community meetings and targeted outreach. For large-scale effects (Tiers 4–5), we propose city-wide consultations, representative panels, and multilingual or minority-focused forums to ensure inclusion.

Regarding the third criterion, small-scale spatial issues (Tier 1) could be addressed through geo-tagged tools or apps. We defend that district-level actions (Tiers 2–3) may merit neighbourhood councils, workshops, or participatory mapping. Broader territorial impacts (Tiers 4–5) may call for hybrid assemblies, inter-municipal forums, and cross-district stakeholder planning.

Regarding the fourth criterion, short-term decisions (Tier 1–2) could benefit from simple tools such as Frequently Asked Questions (FAQs), chatbots, or commentable documents. Mid- to long-term plans (Tiers 3–4) should include phased feedback loops, foresight tools, or scenario-based consultations to inform decision-making. Strategic long-term decisions (Tier 5) require civic foresight panels and multi-stage hybrid processes.

Regarding the fifth criterion, reversible actions (Tier 1–2) could FAQs tools or feedback from NGOs. As permanence increases (Tiers 3–4), risk-mapping, ethical reviews, and stakeholder deliberations may become necessary. For systemic or irreversible effects (Tier 5), citizen–scientific panels or bioethics conferences with high transparency are recommended.

Lastly, regarding qualitative triggers, participatory mechanisms could be activated even at lower tiers. These could include storytelling workshops, civic mediation, citizen juries, or cultural forums. At higher levels, hybrid methods (e.g., deliberative assemblies and digital engagement) tend to foster dialogue, trust, and legitimacy.

C. Targeted participation

Participation should be directed and open to all, but especially to those affected and most in need. Also drawing inspiration from Klinke and Renn [8], we defend targeted engagement as *(i)* defining in abstract the most relevant/affected stakeholders (such as local communities, interest groups, or experts), *(ii)* especially those that could be affected or interested and encouraging their participation (avoiding generic or ineffective engagement and notifications), and (iii) providing a platform allowing citizens to select their areas of interest (e.g., urban mobility, environmental policies) and preferred participation methods (e.g., online surveys, in-person workshops).

Regarding the first criterion, low-cost decisions (Tier 1–2) could involve only internal staff or residents. As the financial scale increases (Tiers 3–5), participation could include representatives from businesses, NGOs, budgetary oversight bodies, technical experts, and afterwards general public, ensuring a fair distribution of public resources and legitimacy in high-cost investments.

Regarding the second criterion, we can sustain that minimal population impact (Tier 1) needs only passive notification. As more people are affected (Tiers 2–3), resident associations, interest groups, and schools should be involved. At Tiers 4–5, participation should expand to the general public, marginalised groups, and civil society organisations, reflecting the diversity of those impacted.

Regarding the third criterion, decisions with a narrow spatial scope (Tier 1–2) could involve residents or neighbourhood associations. Mid-tier impacts (Tier 3) typically may require district-level stakeholders, while significant territorial changes (Tier 4–5) necessitate cross-district, inter-municipal, or even regional collaboration involving planners and public institutions.

Regarding the fourth criterion, short-lived decisions (Tier 1–2) may require little engagement beyond direct users. Longer-term decisions (Tiers 3–4) could include policy researchers, institutional actors, or technical experts. Strategic, long-duration policies (Tier 5) could benefit from multi-generational forums, future scenario experts, and cross-sector stakeholders.

Regarding the fifth criterion, for reversible issues (Tier 1–2), one could consult frontline staff or local NGOs. Irreversible decisions (Tiers 3–5) would require the involvement of environmental professionals, ethicists, scientific advisors, and national NGOs, and afterwards general public, ensuring that long-term, possibly irreversible harms are carefully deliberated.

Regarding the sixth criterion, affected communities, cultural leaders, and conflict mediators should be involved in the process. At the highest sensitivity (Tier 5), participation should include minority communities, civil rights organisations, and possibly reconciliation forums, and afterwards general public, depending on the issue's moral and historical weight.

Defining stakeholders can inadvertently exclude groups or marginalise less vocal citizens if the process is not transparent or inclusive. Allowing citizens to choose their areas of interest increases their sense of agency and satisfaction, as they feel their input is relevant and valued (with feedback loops and transparency). A platform could facilitate participation by showing how selected inputs are used and by offering multiple participation methods (e.g., online surveys, in-person assemblies, or asynchronous feedback) to accommodate diverse needs (e.g., elderly citizens preferring in-person interactions, while younger ones prefer digital). This approach reduces barriers such as digital literacy or geographic constraints. A digital platform also risks excluding those with low digital literacy. Therefore, municipalities should preferably combine digital platforms with offline methods (e.g., kiosks and in-person sessions) and involve mediators to reach marginalised groups. Besides, identifying and engaging

stakeholders requires resources and expertise to map relevant groups accurately, which could strain municipal capacities. Indeed, developing a platform (that allows citizens to choose interests and participation methods) is technologically and administratively complex. It may require robust infrastructure, data protection compliance, and a user-friendly design with personalised options, as well as ongoing maintenance, updates, and user support, which can be resource-intensive for smaller municipalities. To mitigate this, municipalities could pilot the platform in phases, starting with specific decision types (e.g., participatory budgeting) and using existing smart city infrastructure to reduce costs. Municipalities could also plan and prioritise strategic/impactful/ sensitive decisions to optimise resources.

Allowing citizens to select topics might result in over-representation of popular or controversial issues (e.g., cycle paths) while neglecting less visible but critical ones (e.g., waste management), potentially undermining balanced decision-making. Furthermore, we are also aware that if citizens could choose their areas of interest, less "exciting" or complex topics (e.g., technical infrastructure policies) might attract fewer participants, reducing the effectiveness of those decisions, which we suggest could benefit from expert input. As a mitigation measure, stratified sampling or weighted representation could be employed in stakeholder selection and platform algorithms to ensure diversity, as suggested by the need for inclusiveness.

D. Impact of technology in smart cities

The OECD [6] has catalogued effective deliberative practices across jurisdictions, revealing that well-designed citizen assemblies, participatory budgeting, and e-consultations can increase legitimacy. Technology in smart cities holds significant potential to enhance citizen participation in municipal decision-making by simplifying interfaces and providing officials and citizens with training on the effective use of technology. One way to address the aforementioned structural barriers is through real-time data analytics and/or smart governance platforms (e.g., mobile apps, online forums), which can make participation more accessible by reducing barriers such as physical access or time constraints, thereby increasing utilisation.

By fostering trust through transparent governance and clear communication, smart cities can encourage sustained participation. Smart cities can also enhance satisfaction by aligning solutions with citizens' needs (e.g., addressing urban issues such as mobility or safety) and involving them in the co-design of services through feedback loop mechanisms, thereby addressing dissatisfaction and encouraging adherence. Moreover, it helps in public awareness campaigns and reduces information asymmetry (namely by leveraging passive participation, e.g. to inform campaigns), thereby increasing governance responsiveness.

However, most examples show that effectiveness depends less on the tool's form than on its adaptation to local sociopolitical conditions and clarity of purpose [6]. Furthermore, inclusivity can be bolstered through accessibility features (e.g., user-friendly interfaces, anytime/anywhere information access, and flexible

scheduling and targeted notifications), making participation more convenient and visible, thereby increasing engagement and hybrid mechanisms. Still, technocentric approaches risk exacerbating dissatisfaction if they neglect marginalised groups or fail to address privacy concerns effectively. To mitigate this risk, laws should mandate clear interfaces and accessibility standards for these platforms to ensure inclusivity, especially for groups with low digital literacy.

The intervention of AI may be particularly transformative, especially in treating the vast information provided during (qualitative) participation (for example, pairing AI semantic analysis with feedback loops to validate the input impact of large-scale citizen participation, notably from social media or e-consultations), offering a pathway to more informed, inclusive, and resilient municipal governance.

To ensure inclusive and trustworthy use of technology, municipalities adopting AI-enabled platforms for participation, beyond complying with legal rules, should incorporate basic legal safeguards. These include: (i) mandatory accessibility standards (e.g., multi-language support, mobile usability, offline alternatives); (ii) participatory guarantees; and (iii) transparency obligations, requiring that AI-supported analysis be explainable in plain language to participants. These safeguards do not require statutory reform but may be embedded in local regulations or contractual requirements.

III. CONCLUSIONS AND FUTURE WORK

Our preliminary analysis supports the hypothesis that legal frameworks for citizen participation must evolve to reflect the differentiated impact of certain administrative decisions and the available technological means. This evolution requires new regulatory models and an institutional willingness to shift from a symbolic to a substantive model of public engagement.

We consider that participation procedures are more critical for decisions that are strategic/impactful/sensitive than for linear, routine decision-making processes. Drawing inspiration from Klinke and Renn's risk governance framework, we may recommend or demand different types of stakeholders. In that vein, we also defend that there should be tailored participation procedures (minimal for routine decisions and extensive for high-impact ones). Moreover, municipal regulation should establish administrative procedures that can be adapted to local realities and the aforementioned impact criteria rather than the current one-size-fits-all procedures.

Smart cities, guided by principles of good governance, inclusive administration, and legal foresight, can lead this transformation by leveraging technologies to support tailored participation, facilitating adaptable procedures, enhancing stakeholder engagement, and utilising AI-driven semantic analysis of diverse inputs. The application of these technologies must be compliant and subject to regulation.

Finally, regarding future work, beyond further analysis regarding the mechanisms of participation and relevant concepts (e.g. stakeholders), as referred to, the exploratory nature of the research lacks empirical validation, necessitating future testing to confirm the framework's effectiveness in diverse smart city contexts.

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