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„Urban (Dis)articulations in Assembling Smart City Vienna: Towards a Response-able Urban Innovation“

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List of papers

This compilation thesis is based on original work in the following papers, which are referred to in the text by their Roman numeral.

Paper I:

Sepehr, Pouya, and Ulrike Felt. 2023. Urban imaginaries as tacit governing devices: the case of Smart City Vienna. *ST&HV 48(4): 1-23*. *https://doi.org/10.1177/01622439231178597*

Paper II:

Felt, Ulrike, and Pouya Sepehr. (Submitted). Infrastructuring Citizenry in Smart City Vienna: Investigating Participatory Smartification between Policy and Practice. *Journal of Responsible Innovation*.

Paper III:

Sepehr, Pouya. (forthcoming). Mundane Urban Governance and AI Oversight: The Case of Vienna's Intelligent Pedestrian Traffic Lights. *Journal of Urban Technology*.

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1. Introduction

1.1 Vienna's journey to becoming a smart city: a sociotechnical perspective

Maria Vassilakou, the former Vice Mayor and Executive City Councillor for Urban Planning, Traffic and Transport of Vienna, once declared, "Vienna is not just a smart city, it's a city for smart people."[1] This profound statement has sparked my exploration into the intricate world of smart cities as sociotechnical phenomena. Anchored in the field of Science, Technology, and Society (STS), my central inquiry delves into the complex dance between technological innovation and societal transformation. Vienna's smart city initiatives serve as a rich canvas for this study, enabling me to probe into the specifics that make this investigation both situated and a reflection of contemporary urbanism. While the efficiency of digitalisation and smartness is often highlighted by smart city advocates, it is crucial to critically examine whose interests are truly being served, as Vassilakou's statement suggests, and to consider the long-term impact of smartification on the city and its inhabitants.

My investigation unfurls across three interconnected phases, each addressing distinct aspects of Smart City Vienna (SCW) development:

1. Urban Imaginaries and governance: How do urban imaginaries function as tacit governing devices in shaping Vienna's smartification? What role do experts play in constructing and disseminating these imaginaries? How does the sociotechnical imaginary of Smart City Vienna influence the city's overall transformation?
2. Citizen engagement and participatory smartification: How are citizens engaged in Vienna's smart city development? What tensions and challenges arise in

[1] Reference taken from one her presentation at Urban Transformations event on 24.04.2019 at Wolke 19, Wien.

translating participation visions into practice? How does infrastructuring citizenry contribute to or hinder democratic, equitable, and inclusive urban spaces? How can "response-able" practices foster more participatory development models?

3. Implementation of smart technologies: How are AI-powered surveillance cameras and algorithmic processors conceptualised, designed, and tested in Vienna's Intelligent Pedestrian Traffic Light initiative? What sociotechnical considerations and consequences arise from implementing such smart applications and systems? How do experts frame the use of smart technology, and what alternative approaches are considered or overlooked?

Collectively, these questions aim to unravel the intricate interplay between technological advancements and societal transformations in Vienna, a city that has not only been the backdrop of my PhD journey but has also become a place I call home. The findings of this investigation aim to contribute to a nuanced understanding of the smartification process, shedding light on the complexities and interdependencies at different scales. Furthermore, the research underscores the significance of responsible innovation and critical reflection in shaping the future of smart cities.

1.2 Smart City Wien

Vienna, renowned for its rich cultural heritage, exhibits a multifaceted blend of social and spatial traits that have evolved over centuries. The city's governance is marked by a history of bold, transformative urban experiments, such as the interwar era known as "Red Vienna." During this period, the city implemented ambitious socialist policies to enhance the working class's living conditions, constructing remarkable social housing and other urban facilities (Gruber 1991). This historical context is significant when considering Vienna's readiness to adopt new urban initiatives, like the emergence of smart cities. Vienna's past demonstrates its receptiveness to innovation and its skill in

weaving it into the urban fabric in a way that aligns with its values and heritage (Suitner 2020).

In this vein, Vienna's Smart City program, or Smart City Wien (SCW), is a fusion of the city's extensive urban planning experiments with smart technology. Established in 2014 with a target horizon of 2050, the strategy aims to foster sustainable development, enhance quality of life, and ensure efficient resource utilization (see Paper I). In 2019, the city set a goal of achieving climate neutrality by 2040, aligning the strategy with the UN Agenda 2030's Sustainable Development Goals (SDGs).

SCW's mission is to offer a high quality of life to all Vienna's residents through social and technical innovation, while prioritising resource conservation. The strategy is organised around three core dimensions: quality of life, resource conservation, and innovation, with specific objectives outlined in eleven subject areas. Widely acclaimed for its socially integrated approach, SCW stands as a leading example of best practices in European smart city development[2].

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[2] Smart City Wien has been consistently ranked among the top European and global smart cities. According to the 2020 edition of the IESE Cities in Motion Index, Vienna ranked 9th out of 174 cities worldwide, with a high score in the categories of governance, urban planning, and technology. In the same year, Vienna was also ranked 7th in the Smart City Index by EasyPark Group, which evaluated 100 cities based on their smart transportation, sustainability, governance, digitalisation, and liveability.

Moreover, Vienna has been recognised as a leading example of best practices in smart city development in Europe. In 2020, the European Commission awarded the city the title of European Capital of Innovation, recognising its innovative approach to urban governance and smart city initiatives. The city has also been a recipient of the European Green Capital Award in 2020, recognising its efforts to become more sustainable and improve the quality of life for its residents.

Overall, Smart City Wien has been widely praised for its socially integrated approach to smart city development, emphasising citizen engagement and participation in decision-making processes. It has been recognised as a model for other cities looking to adopt smart city initiatives while maintaining a focus on social equity, sustainability, and liveability.

The Smart City Wien (SCW) initiative represents a contemporary approach to urbanism in the era of smart cities, providing a perspective from which to examine Vienna's smartification processes. Vienna has been active in creating a wide variety of strategic plans, policy documents, reports, and research studies related to various smart city solutions and technologies. The city has also led numerous smart city projects, both locally and in partnership with other European cities (see Paper I & Paper II).

These projects and documents each represent an aspect of what being 'smart' means in Vienna's context. Together, they form a complex picture that illustrates Vienna's multifaceted journey toward becoming a smart city. However, these initiatives are more than isolated efforts; they are part of a larger story that showcases Vienna's journey to become a smart city.

The smartification initiatives act as channels through which the city's goals and values are transformed into concrete actions and public interventions. Through the SCW initiative, Vienna is actively moulding its identity as a smart city, adapting to the new challenges and opportunities that this transformation brings. In essence, SCW is a reflection of Vienna's response to an urban environment increasingly influenced by technological advancement. It's not just a reaction to change but a proactive approach to shaping the city's future in alignment with its heritage and values.

1.3 Urban (dis)articulation in becoming Smart Vienna

In this research, the theoretical framework is anchored in the dual concepts of urban assemblages (Farías 2011; Farías and Bender 2012) and urban articulations (Featherstone 2011). Collectively, these concepts constitute a robust methodological scaffold for the nuanced examination of smart cities.

Urban assemblages, as delineated by Farías and Bender, focus on the dynamic, relational, and processual character of connections within urban spaces. This perspective views cities as complex systems wherein various elements continuously interact and evolve. In contrast, urban articulation, as conceptualised by Featherstone, involves the establishment of contingent linkages among diverse elements, with an accent on the multifarious relationalities that underpin the spatial constitution of social phenomena.

Within the context of smart cities, this dual-pronged approach is instrumental in charting the course through which smart cities are woven into an intricate tapestry of assemblages. These assemblages are akin to a complex nexus of components such as technology, digital infrastructures, governance, and social systems, all of which engage in a dynamic interplay. For instance, the integration of data-centric technologies with governance, within an assemblage that brings together city planners, technology firms, and policymakers, may culminate in an urbanism paradigm that is anchored in efficiency and technological solutionism.

Transitioning to the potential challenges, it is imperative to recognise that articulations can be double-edged swords. While fostering connections, they may inadvertently obscure the concerns of certain societal segments, giving rise to what can be termed as urban disarticulations. This denotes the potential of smart city initiatives to either spawn or intensify societal schisms, be it through unequal access to technology, disparate impacts on diverse social strata, or the genesis of novel power hierarchies.

Furthermore, the integration of assemblage thinking with the spatial and processual lens of urban articulation facilitates the exploration of how an array of structures and elements coalesce in multifaceted configurations across different scales. This synergy between the two concepts is of paramount importance for probing the spatial underpinnings of

articulation and deciphering the complex interplay of relations and trajectories that characterise the emergence of smart cities.

In conclusion, the interplay between urban articulation and assemblage thinking not only unveils the complexity of smart cities but also provides a comprehensive theoretical lens for their analysis. These entities are more than just technological constructs; they are shaped by intricate associations that elevate certain urban forms and lifestyles while downplaying others. This dynamic has significant implications for urban governance, social equity, and sustainability, highlighting the need for a discerning and sociotechnical approach to smart city development. The present study's adoption of this twofold theoretical lens offers a nuanced pathway for both theoretical exploration and practical application within the context of smart city initiatives.

Analysis alone is insufficient when examining the complexities of smart city development. A more nuanced and forward-thinking approach is required, one that transcends mere analysis and delves into engaged research outcomes. In this context, the concept of Responsible Research and Innovation (RRI) emerges as a vital framework, particularly its emphasis on "response-able" practices as described by Felt (2017). The notion of "response-able" innovation goes beyond traditional accountability and liability. It calls for an environment that is not only responsible but also capable of responding to emergent societal issues. This responsiveness is essential for smart city governance, as it fosters a proactive rather than reactive stance, aligning technological transformations with societal desires and needs.

In the context of Vienna's smartification, adopting a "response-able" approach means reimagining the smart city at the intersection of technology and society. It involves recognising and addressing the challenges and limitations that arise when translating policy into practice, ensuring that the transformation is just and inclusive. It offers a

pathway to evaluate smartification towards a sociotechnically sensitive model, incorporating diverse perspectives, and acknowledging limitations and exclusions.

By applying this "response-able" formulation to urban innovation, we can draw meaningful conclusions and provide actionable recommendations for smart city actors. This approach ensures that Vienna's journey in becoming a smart city is not only technologically advanced but also responsive to the multifaceted needs and challenges of its inhabitants, thereby fostering a more sustainable and equitable urban future.

1.4 Research structure and articles' overarching theme

This research aims to explore how smart city articulations shape diverse aspects of urban living, the social dynamics they foster, and the governance systems they institute. This perspective facilitates a critical examination of the winners and potential losers in smart city projects, ensuring that these advancements do not exacerbate existing societal inequalities but instead contribute to the creation of urban spaces that are more democratic, equitable, and inclusive. This research unfolds across three interconnected segments and is based on three distinct papers and a cover essay:

Paper I - Urban Imaginaries as Tacit Governing Devices: The Case of Smart City Vienna (Sepehr and Felt, 2023): The initial phase delves into the origin, propagation, and historical significance of the sociotechnical imaginary of Smart City Vienna (SCW) within Vienna's urban transformation agenda. This stage critically examines Vienna's nascent transition towards a smart city, probing the sociotechnical imaginary supporting SCW's emergence. In this paper, Felt and I identify three key narratives within policy documents: preservation, technological enhancement, and local values accentuation. We also note a lack of citizen voices and the growing influence of digital capitalism. We advocate for

"responsible imagineering," promoting inclusive participation and critical reflection on policy narratives.

Paper II - Infrastructuring Citizenry in Smart City Vienna: Investigating Participatory Smartification between Policy and Practice (Sepehr and Felt, Submitted): The second step focuses on the intentions and impacts of smart citizens in selected SCW projects. It explores how experts conceptualise smart citizens and involve them in the smartification process. Key questions include identifying primary beneficiaries and those at risk of marginalisation, nurturing citizen participation, and recognising overlooked aspects. In this paper, we explore SCW's intricate dynamics and introduce the concept of 'infrastructural citizenship' (Lemanski 2020). We argue that citizen participation is inseparable from digital infrastructures and urban citizenship, leading to questions about participatory justice and infrastructural development.

Paper III - What AI Does and Does not See: De-scribing Intelligent Pedestrian Traffic Lights in Vienna (Sepehr, forthcoming): The final segment scrutinizes the justification, design, and testing of AI in urban spaces, specifically analysing the Intelligent Pedestrian Traffic Lights (IPTL) initiative in Vienna. This paper investigates how experts conceptualise, design, and test AI in urban spaces. It addresses questions about framing smart technology, design capabilities, and overlooked alternative approaches. The paper argues that IPTL offers a lens to re-examine urban temporal order, proposing an alternative pathway to smartification.

Finally, in the conclusion section of this cover essay, the thesis unveils urban (dis)articulations, highlighting imbalanced development and integration, often leading to social and spatial inequalities. It emphasises the need for continuous reflection and critique of smartification practices, focusing on just urban innovation. The research champions an alternative approach fostering responsible, equitable, and just urban

innovation, considering the potential ramifications of smart technologies on urban disarticulation. It explores practical implications for policymakers and planners, providing insights for more inclusive and response-able smart cities.

1.5 Reflecting on smartification of Vienna and pathways to response-able innovation

Having outlined the structure of this thesis and the supporting articles, it is essential to delve into why the three articles together provide an understanding of the smartification process in Vienna. This synthesis is not merely a product of intuition; rather, it is grounded in rigorous analysis and reflection on the interconnected themes and insights that emerge from the articles. The many hours spent examining how Articles 1 and 2 speak to the overall transformation of Vienna into a smart city have led to a coherent understanding of the process. The following reflection aims to articulate this understanding, connecting the three articles and highlighting the significance of responsible-able innovation in the smartification process.

Paper I explores the concept of urban imaginaries in the context of Smart City Vienna. It provides a macro-scale perspective, considering the overarching urban imaginaries and governance structures that guide smartification. The emphasis on responsible innovation underscores the need for a nuanced understanding of the city as a sociotechnical space, shaped by experts and various scales of observation.

Paper II, focusing on the meso-scale, investigates the tension between policy discourse and actual implementation of participatory smartification in Vienna. It critiques the misconceptions and limitations in citizen engagement, emphasising the transformative impact of infrastructuring on urban environments and citizenship. This article resonates

with the first in its call for participatory processes that respond to the uncertainties of smartification.

Paper III zooms in on the micro-scale, investigating a specific technological intervention in Vienna: the Intelligent Pedestrian Traffic Light initiative (IPTL). It critiques the lack of sociotechnical understanding in the design and implementation of IPTL, emphasising the need for engagement with citizens and a reconstructive approach to rethink urban technological interventions.

Finally, the notion of responsible-able innovation emerges as a common thread across the three articles. By examining smartification at different scales, the articles provide a multifaceted view of how Vienna is transforming into a smart city. They highlight the importance of bridging the gap between policy, practice, and technology, ensuring that smartification is not just a top-down process but involves active participation and consideration of diverse perspectives.

In conclusion, these articles contribute to a rich understanding of smartification in Vienna, offering insights and critiques that can guide future urban transformations. They underscore the importance of responsible-able innovation, calling for a more thoughtful and inclusive approach to smart city development. By connecting the macro, meso, and micro scales, they provide a comprehensive view of the pathways towards response-able smartification, emphasising the need for ongoing dialogue, reflexivity, and responsibility.

The remainder of the thesis is structured as follows: Chapter 2 introduces the sensitising concepts that underpin the research, unravelling the multifaceted nature of the smart city from its conceptual genesis to its tangible manifestations in daily life. This exploration is three-pronged, encompassing the smart city as a sociotechnical imaginary, the materialisation of the smart city in public spaces through participatory practices, and the

political performativity of smart technologies in urban governance and politics. Chapter 3 expounds on the methodological approach and research design process employed in this study. Chapter 4 encompasses the three papers that constitute the core of this research. In Chapter 5, synthesises the findings and contributions from each paper, discussing their implications for future research and practice, with an emphasis on response-able urban innovation as an alternative to the conventional smart city agenda.

2. Sensitising Concept

2.1 Articulating and rendering the smart city visible

Scholars in the field of Science and Technology Studies (STS) and urban studies have grappled with defining and examining the role of the smart city in society (Caprotti 2018; Torisson 2022). The challenge partly stems from the intentionally flexible definition of smart cities, which allows various stakeholders to shape its meaning and implications (Clark 2020; Farías and Mendes 2018). Yet, the core obstacle is the tension between what is rendered visible by the inherently invisible digital technologies (Bridle 2022). As such, this tension raises the question of how the smart city is made visible and how in the absent-present (Callon and Law 2004) of invisible smart city our realm of everyday is reassembled (Akrich 1992; Latour 2005a, 2005b).

The smart city, ultimately, is part of a broader digital infrastructural development, subtly integrating with the existing urban fabric, and projecting cities into a smarter future which every city felt an urge to catch up with since the early 2000s (Mattern 2021). The smart city in early realisation phase represents an ideal form of urbanism (Gabrys 2007), based on advancements in information and communication technologies and digital technologies, with profound societal effects. As noted by Rose and Willis (2019), the smart city early realisation exists primarily as a visual construct in urban discourse, appearing in various forms such as urban policy documents, strategic planning, city officials' presentations, websites, and social media.

Seeing the smart city as visual and discursive construct (Rose 2017a, 2017b), led many scholars to identify the smart city discourse as an echo of the corporate marketing storytelling (Hollands 2015, 2008; Sadowski and Bendor 2019; Söderström, Paasche, and Klauser 2014). While, the smart city aims to reshape cities' economic and cultural ways of working under the rhetoric of digital economy, it rather leads to further neoliberalization of cities (Cowley and Caprotti 2019; Sadowski 2020). This is enabled via new urban

indicators and digital ways of monitoring the city (Joss, Cook, and Dayot 2017; Joss et al. 2019) reducing the understanding of the city into set of numbers and measurable elements. The smart city is thus characterised by its invisible effects on urban life more than by its physical visibility in space (Caprotti 2018; Torisson 2022). Smart cities in this regard are equivocal imaginaries in the process of stabilisation (Farías and Mendes 2018).

Latour (2005) notably argues that black-boxing is the primary mechanism that stabilises and immunises translations against criticism, which is quite evident in the realm of the smart city development. This absence of arguments is considered the most pervasive, reliable, productive, and stable form of power where an alternative cannot be seen or imagined because it is regarded as natural and unchangeable (Sadowski 2020).

However, the smart city is not only a visual or discursive construct, but also has tangible manifestations, exemplified by iconic urban landmarks (Halegoua 2020). These include city control rooms such as the Rio Operations Centre (Goodspeed 2015) and Siemens' the Crystal in London (Rose 2017b), as well as data domes or digital operation centres in Bristol (Caprotti 2018), and Dublin's traffic monitoring centres (Coletta and Kitchin 2017). These spaces not only make the smart city visible but also represent techno-cultural processes that bring the future into the present.

Under the guise of physical manifestation, the smart city is an urban technological project that subtly amalgamates within the existing urban fabric, promising to render the smart "visible, legible, and controllable" (Caprotti 2018, 2466). The physical manifestation of smart cities provides visible evidence of its influence and impact, with urban landmarks embodying the values and aspirations of the smart city project. Such landmarks act as tangible and concrete reminders of the promise of the smart city project, which seeks to reshape urban life through technology.

Thus, the primary characteristic of a smart city is its intention to invest in technological infrastructure to make the existing city smarter (Clark 2019). This concept of smartness has been present in urban development projects since the early days of computing in the 1950s, and it continues to be a driving force behind the development of smart cities today (Batty 2013; Townsend 2001). While the specific technological solutions used in smart city projects vary, the overarching aim of planning for a better future through the use of more efficient socio-technological systems remains constant (Baeten and Valli 2021).

Ultimately, as Baeten and Valli (2021) suggest, the concept of the smart city resides at the intersection of envisioning smartness and the tensions that arise during and after its implementation. A process of imagining, making the smart city public in the process of engagement with citizens and finally a collective form of life within the smart environment. In what follows, I will follow these three interlinked aspects that inform the analytical framework employed for this research.

2.1.1 Sociotechnical imaginaries of smart cities

The first aspect of my investigation focuses on the sociotechnical imaginary. As smart cities materialise in specific locations and permeate the everyday lives of urban residents, it is imperative to adopt a context-specific focus. Karvonen, Cugurullo, and Caprotti (2019) emphasise in their edited volume that the manifestation of a smart city necessitates a substantial infrastructural reconfiguration of the urban landscape. This reconfiguration encompasses standards, technological objects, administrative procedures, organisational work, and technology, akin to any large infrastructural development (Slota and Bowker 2017). It involves the negotiation, organization, and catalysation of elements and processes essential for initiating smart city projects (Haarstad and Wathne 2019, 107).

To dissect these infrastructural processes, the term “imaginary” is employed to characterise the projected image of a smart city, which is sculpted through performative processes and has far-reaching effects on the city's perception. The imaginaries of smart cities often resonate with utopian visions, yet scholars in STS and beyond have expressed apprehensions regarding the dystopian modes of order and control they may engender (Vanolo 2014; Shelton and Lodato 2019; Marvin, Luque-Ayala, and McFarlane 2015). This scholarship posits that smart cities represent a neoliberal political project, constituting “a battle for our imagination” (Sadowski 2018, 26).

The concept of the “sociotechnical imaginary,” as delineated by Jasanoff (2015), is instrumental in this context. Jasanoff introduced this term to elucidate the entangled relationship between technology and society, which collectively co-produce political orders through technoscientific endeavours. Sociotechnical imaginaries are intrinsically linked with the active exertion of governmental power, such as the prioritisation of development, allocation of funds, or investment in infrastructures.

As such, smart city imaginaries have palpable consequences, as they serve to rationalise investments in the city, functioning both as a policy goal and an instrument of legitimation (Foley and Miller 2020; Foley et al. 2020). City officials have the agency to deliberately mould these imaginaries, which can be an efficacious means of endorsing and legitimising particular agendas. It is, therefore, paramount to comprehend how such an imaginary is conceived and recurrently enacted until it stabilises and tacitly steers (Felt 2015) smart city transformation processes.

Furthermore, imaginaries are invariably anchored in prior experiences and are subject to technopolitical cultures (McNeil et al. 2017). Consequently, the smartification of contemporary cities must be perceived as an array of diverse experiments (Karvonen, Cugurullo, and Caprotti 2019; Karvonen and van Heur 2014). The experimental nature of

smart city development necessitates engagement with experts' comprehension of sociotechnical complexities (Felt and Fochler 2008) and the ensuing impacts that smart city processes have on the public.

In summary, the sociotechnical imaginary is a pivotal aspect of smart city development. It encompasses the visions, performative processes, and governmental actions that shape the conception and realisation of smart cities. Understanding the formation, enactment, and stabilisation of these imaginaries is crucial for analysing the sociotechnical complexities and implications of smart city initiatives.

2.1.2. Participatory smartification and infrastructuring citizenry

The second aspect of my investigation deals with how experts engage with the public in the process of smart city development, focusing on the concept of infrastructuring citizenry. As the concept of the smart city becomes increasingly ingrained in urban visions, politics, policies, strategic planning, and infrastructural collaborations, the role of citizens in these processes takes on paramount importance (Datta 2018; Datta and Odendaal 2019; Cardullo and Kitchin 2019).

Infrastructuring citizenry refers to the process of actively involving citizens in the design, development, and implementation of urban infrastructures, particularly those related to smart technologies. This approach recognizes citizens not merely as passive recipients of urban services but as integral components of the urban infrastructure itself (Lezaun, Marres, and Tironi 2017; Tironi and Valderrama 2018).

The efficacy of smart city initiatives hinges on the active participation and engagement of citizens as users and data generators, which then necessitates that the smart city be rendered comprehensible, usable, and relatable in everyday life. Infrastructuring citizenry emphasises the co-emergence nature of urban spaces, where citizens are involved in

decision-making processes, contributing to the design and functionality of urban technologies.

Public participation in democratic institutions is a cornerstone of governance (Horst and Michael 2011; Kelty 2019, 2017). Within the context of smart cities, the incorporation of smart technologies into urban life engenders concerns regarding the role of citizens in decision-making processes. This has given rise to the concept of techno-democracy, where the role of participation in shaping urban futures is increasingly intertwined with techno-scientific issues and power dynamics (Farías and Blok 2016; Farías and Widmer 2018).

However, participation is often practised as a means to bridge knowledge deficits and as a form of market research, which frequently fails to address the techno-politics of urban infrastructures (Farías and Criado 2018). Infrastructuring citizenry challenges this approach by promoting a more participatory and inclusive model of urban development. It recognises the importance of citizens' voices, experiences, and insights in shaping the urban landscape (Gabrys, Pritchard, and Barratt 2016).

STS studies of Public Understanding of Science (PUS) accentuate the importance of enhancing public comprehension of science and technology, fostering an informed citizenry capable of engaging in substantive discussions and decision-making regarding the technologies integrated into urban settings (Michael 2012, 2009, 2016; Michael and Lupton 2016; Rob et al. 2019). Infrastructuring citizenry aligns with STS calls for reflexivity and responsibility in the development and implementation of science and technology (Latour 1991, 1992; Ashmore 2015).

In the context of smart city development, infrastructuring citizenry involves fostering dialogue among policymakers, technology developers, and residents, ensuring that their

perspectives are taken into account and valued in decision-making processes. This entails championing a response-able approach with more participatory models of development, where residents are actively engaged in shaping the technologies that will be implemented (Vanolo 2019; Coletta et al. 2018, 220).

Moreover, to devise strategies ensuring equitable access to the benefits of smart city technologies for all citizens, it is essential to examine the everyday lives of smart city residents and how smart technologies subtly emerge and reconfigure daily life through enhanced control and order. Infrastructuring citizenry calls for a critical examination of these dynamics, posing questions about who truly benefits from these technologies, who bears the brunt of the losses, and how alternative approaches can be adopted.

In conclusion, experts' engagement with the public, and particularly the concept of infrastructuring citizenry, is a critical aspect of smart city development. It involves fostering an informed and participatory citizenry, bridging the gap between experts and non-experts, and ensuring that the implementation of smart technologies is reflective of the needs and perspectives of the residents. Through active engagement, citizens can transition from being mere passive recipients to active contributors in shaping the smart city landscape. This transformation necessitates an ongoing dialogue among policymakers, technology developers, and residents, demanding a commitment to reflexivity and responsibility in the development and implementation of smart city initiatives.

2.1.3 Tracing smart technology and its consequences on everyday life

The third aspect involves tracing an intelligent or smart technology within the city and analysing its consequences. The domain of everyday life and the role of smart technological in reshaping it is often overlooked in academic studies, yet I think the

everyday life is a critical space where the impacts of smart city technologies are most profoundly felt. Henry Lefebvre (2004; 1991) characterised everyday life as a terrain of conflict and struggle between one enduring form of ordering society in time and space to the other, long before the advent of smart technologies. The introduction of new technologies into public use is often shrouded in ambiguity, raising concerns about the democratic processes involved and the potential impacts on various groups, especially vulnerable communities. It is the role of critical scholarship to intervene and scrutinise the means and ends of smartification (Mattern 2021).

Everyday life often conceals the underlying significance of how technology affects the ordering of society (Woolgar and Neyland 2013). The pervasive smartification of everyday life has raised concerns regarding new forms of control and ordering of society and space. As Sadowski (2020) illustrates, smart technologies inherently serve the interests of a select few, often by portraying technology as inevitable and digital capitalism as imperative. These technologies come with both intended and unintended consequences, and known and unknown effects. A critical examination of technology involves analysing how interests, imperatives, and impacts are co-produced.

Marres (2020) posits the street as a public trial space for introducing innovations into society. Through her case study of intelligent vehicle testing in the UK, she describes intelligent urban intervention as a “double-edged operation” (2020, 113). On one hand, it involves engaging with citizens and inviting them to interact with new artefacts, which helps designers receive feedback and learn from the public’s use, opinions, needs, desires, and even rejection of the artefact. On the other hand, the street trial has a “normalizing effect” on the public’s use of smart/intelligent technologies.

The street trial is not only about learning from the interactions between the artefact and the public but also about making the artefact visible to the public eye. Consequently, the

realm of the everyday is subjected to new forms of coexistence and behaviour with new technological artefacts in public spaces. These artefacts can have significant implications for individual and collective identities.

Furthermore, tracing ordinary objects of governance reveals an ironic juxtaposition as the same object can have completely different meanings and treatments in different contexts. The practices of governance associated with mundane artifacts can have implications for politics and accountability (Woolgar and Neyland 2013). They demonstrate how dealing with ordinary objects involves setting and operating rules, and monitoring behaviour in relation to those rules.

The diversity of use and users in different contexts calls for a deconstruction of the associations and meanings found in empirical settings (Akrich 1992; Latour 1992). The task is not to take reality for granted but to question how things could be different and why they are not. As Woolgar and Neyland (2013, 7) assert, “it could be otherwise.” This perspective invites analytical scepticism to inquire into the choices that are not perceived by the users and designers. This involves analysing the technical capacities provided by the technology of governance in relation to the structural form and effectiveness of governance itself.

However, these implications are often culturally and/or nationally specific, which necessitates an approach that sees through the actors’ lenses while challenging the ontological status of the artefact (Law 2008; Law and Mol 2020). This involves posing a democratic inquiry to understand the choices—politically, scientifically, and materially—made in the development of technology and after its implementation in everyday life. In STS, there is an understanding that things can always be otherwise, an inquiry that is essential as this research reaches its conclusion.

In summary, tracing intelligent technology and understanding its consequences on everyday life requires a multifaceted approach. It involves examining the sociotechnical imaginaries that shape the introduction of new technologies, understanding the role of public engagement in shaping these technologies, and critically analysing how these technologies are integrated into the fabric of everyday life. This analysis must be sensitive to the cultural and contextual specificities and must be guided by a commitment to democratic inquiry and accountability. Through this approach, we can better understand not only how smart technologies are shaping our cities but also how they are reconfiguring social relations, power dynamics, and the very understanding of what it means to live in a smart city.

2.2 Interplay of imaginary, public engagement, and everyday life

In this study, the research approach is anchored in three sensitising concepts that collectively form the analytical framework for understanding the development and impact of smart cities. In short, the sensitising notions of smart city imaginary, public engagement, and the integration of smart technology in everyday life are inextricably linked. They are the threads that weave together to form the tapestry of smart city development.

In the context of SCW, this study emphasises the importance of tracing the devices of governance employed by city officials, understanding the practices of public engagement, and analysing the role of mundane objects in governance. Through this integrated approach, we can critically examine the means and ends of the smart city agenda.

The concept of Responsible Research and Innovation (RRI) emerges as a pivotal theme in this discourse. As Stilgoe, Owen, and Macnaghten (2013) articulate, RRI demands a

collective commitment to anticipate and reflect upon the implications and societal expectations with respect to research and innovation. By embedding RRI principles into smart city initiatives, we ensure that the development is not just about technological advancements but also about aligning these advancements with societal values and needs. RRI provides a framework to ensure that the smart city imaginary is co-created with public engagement, and that the technologies integrated into everyday life are both innovative and responsible.

Thus, by intertwining the principles of RRI with the three sensitising concepts, we work towards the development of smart cities that are not only technologically advanced but also socially inclusive, ethically responsible, and responsive to the needs and aspirations of all citizens.

In the next chapter I explain how I applied this approach in the context of SCW and how I analysed the empirical observations I made within the study.

3. Method Assemblages

3.1 Methodological approach

This chapter outlines the methodological framework employed to investigate the complex interplay between imaginaries, engagement practices, and everyday life within the smart city landscape. Grounded in Law's (2004) concept of method assemblages, the research embraces principles of openness, fluidity, and multiplicity. Method assemblages emphasise the need for flexibility and adaptability in methodologies to accommodate the complexity and dynamism of the subject matter. Method assemblages underscore the dynamic nature of research, highlighting its situational, procedural, and performative characteristics. This is particularly relevant in the context of smart cities, where elements such as technology, governance, and social systems are in constant flux. This adaptability is manifested through a mix of methods including document and policy analysis, digital material analysis, conducting expert interviews, and ethnographic observations.

Situational Analysis (SA), as developed by Clarke, Friese, and Washburn (2018), is employed as a navigational tool to contextualise empirical observations and to map the interrelations among diverse elements within the research. This chapter also provides a reflective account of the empirical data collection and analytical methods employed from 2019 to 2022, highlighting the importance of attentiveness to narratives, practices, and the fabric of everyday life. Additionally, it examines how policies act as active agents in shaping social realities within smart cities. The chapter concludes with a reflection on the researcher's positionality and a discussion on the limitations of the thesis.

3.2 Situating the research through data collection

This research is situated within the complex realities of empirical worlds, thus the data collection process is instrumental in exploring the multifaceted interplay between the

imaginaries, engagement practices, and the everyday life in smart city Vienna. During the research I employed an ethnographic approach, specifically observational research (Silverman 2011), to explore imaginaries, practices, and the everyday manifestations of "smartness" within SCW. The approach is grounded in three fundamental tenets: heterogeneity, performativity, and impartial relationality. This necessitates recognising that research processes are composed of diverse elements including human actors, materials, technologies, ideas, and discourses, which are interconnected and interdependent.

Data collection was an iterative process, adapting to the evolving landscape of SCW. During the research, I immersed myself in the SCW landscape through active participation in various events and site visits. This allowed me to gain first-hand insights into the practices, narratives, and everyday manifestations of smart city initiatives in Vienna. For the reader of this thesis, I like to reflect on the process and lives of empirical observations ranging from documents as actant, SCW-organised events, and observing the everyday life of smart artefacts in Vienna. I will shortly some ethical consideration and adaptability of the data collection.

3.2.1 Diary of empirical observations

A significant portion of the data collection process involved engaging with **urban policy documents**. Urban policy documents were analysed to discern the development of SCW. These documents encompassed a range of materials including urban policy documents, textual and visual materials from the City of Vienna's website and social media accounts, and European Commission-funded smart city projects' deliverables reports and policy recommendations. These documents were spanning from 2014 to 2022, yet I had to bring insights from previous Viennese urban planning documents and policies since the early 90's that mark the contemporary urban development in Vienna.

The documents were instrumental in shedding light on the sociotechnical imaginaries that underpin the development of SCW. They offered insights into the processes, assumptions, and outcomes of policymaking. These documents revealed how smart cities are not merely technological constructs but are deeply embedded in social, cultural, and political contexts. In the case of Vienna, the documents highlighted the city's efforts to integrate technology to enhance the quality of life while preserving its historical and cultural heritage (see Paper I).

Furthermore, the initial document and policy analysis facilitated the identification of key stakeholders, which in turn informed the **conduct of interviews**. This was complemented by fifteen open-ended expert interviews following the guideline provided by Kvale and Brinkmann (2009), which were semi-structured conversations oriented towards the research questions. The interviews were selected based on their relevance to SCW and their expertise in relevant fields such as urban planning, digitalisation, intelligent urban technology developers and participatory activities. These interviews provided empirical knowledge on a plethora of topics – explain how they were used in the analysis.

Participation in events organised by SCW significantly enriched the data collection process. These events provided valuable insights into SCW's priorities and smart city initiatives; and facilitated the identification of key contacts for subsequent interviews. Additionally, I conducted a series of ethnographic experiments to immerse myself in the everyday manifestations of 'smartness' within the city and its public spaces. Four sites were particularly noteworthy in my **participant observation** and **ethnographic experiments**:

Digital Day Wien 2019 & 2020: I attended the Digital Day events in Vienna in both 2019 and 2020. These events, organised by the City of Vienna, were platforms for showcasing

digital innovations and engaging the public in discussions about the digital future of the city. The events featured exhibitions, workshops, and presentations on various digital technologies and their applications in urban life. I engaged in conversations with experts, technology developers, and citizens, and observed how digital technologies were being presented and perceived.

SmarterTogether Wien Public Events (2019-2020): I participated in public events organised by SmarterTogether Wien around 2019 and 2020. SmarterTogether is a European smart city project that focuses on sustainable urban development through cooperation and innovation. The events in Vienna were cantered on community engagement and showcased smart city solutions in energy, mobility, and ICT. During the fieldwork I observed the interactions between city officials, experts, and residents, and noted the emphasis on citizen participation in shaping smart city initiatives. A series of visits were made to the SmarterTogether site in Simmering, Vienna. The visits facilitated observation of the practical implementation of smart city solutions in a specific neighbourhood and understand the local dynamics and challenges.

Visit to Seestadt Aspern: three visits were conducted to Seestadt Aspern, one of the largest smart city projects in Europe, located in Vienna. During the visits, numerous conversations were held with experts involved in the project, and a tour of the site was taken. The scale and ambition of the project were evident, providing insights into the planning, development, and implementation of smart city solutions. Although no materials from this visit were used in the articles, it was instrumental in broadening the understanding of smart city development.

Ethnographic Experiment on Intelligent Pedestrian Traffic Lights (IPTL): Observations of daily life and interactions with infrastructure were integral to capturing the nuances of visibility, invisibility, and the rhythms that shape space and time (Angelo and Hentschel

2015). A significant portion of my ethnographic observations, particularly concerning the integration of smart technology into everyday life, was dedicated to researching Intelligent Pedestrian Traffic Lights in Vienna. I invested numerous hours observing citizens' behaviour at IPTL sites and the scientists responsible for the development of this technological artefact.

Additionally, I transformed my daily commute to work, both as a cyclist and pedestrian, into an opportunity for rhythmic analysis. This involved traversing numerous traffic lights in Vienna and observing the patterns and flows. The timing of this experiment was particularly noteworthy, as it coincided with Vienna’s lockdown, during which global and local mobility underwent a seismic shift, and the city's rhythm entered an unprecedented state. As one of the few individuals who continued to commute to the department, my experience of navigating the city during this period was exceptional and provided invaluable ethnographic insights.

During this time, significant rerouting occurred around the department’s building due to the construction of a new metro line in Vienna. This entailed the reconfiguration of streets and traffic management. For a period, the traffic lights at the junction adjacent to the department’s building were non-operational, and a police officer assumed the role of directing traffic, reminiscent of bygone days. This presented a unique opportunity to observe and compare the human element of traffic control with the delegation of control to an artefact.

This extended ethnographic experiment was instrumental in understanding the interplay between technology, urban infrastructure, and human behaviour. It also provided insights into the rhythms of the city and how they are influenced by both human and technological agents. However, it is important to note that much of this ethnographic work did not make its way into the main body of this PhD thesis. Although the topic felt somewhat tangential

to the initial purpose of the research, it has laid the groundwork for a series of follow-up projects that I am eager to pursue post-PhD.

3.2.3 Ethical considerations and reflexivity

Ethical considerations were paramount throughout the research process. In conducting interviews and ethnographic observations, informed consent was obtained from all participants. The anonymity and confidentiality of participants were maintained, and care was taken to ensure that the research did not have any adverse effects on the individuals or communities involved.

Reflexivity played a significant role in this research. As a researcher, it was essential to be cognisant of my own biases, assumptions, and the impact of my presence in the field. This involved critically reflecting on how my background, experiences, and perspectives might have influenced the research process and interpretations. In Section 3.4, I will further delve into the reflective aspect of the thesis process, exploring the introspective journey and its implications for the study.

During the data collection process, several challenges were encountered. For example, gaining access to certain policy documents or stakeholders proved to be very difficult. Additionally, the dynamic nature of smart cities meant that the landscape was constantly evolving, which required adaptability in the research approach. On top of that Covid-19 changed the very meaning of site which redirected my approach to data collection. To address these challenges, the research approach was flexible and adaptive. When access to certain data was not possible, alternative sources were sought. The iterative nature of the data collection process allowed for adjustments to be made in response to the evolving landscape of SCW. In the end, the research is rather a collection of smart city fragments to use McFarlane's (2021) term.

3.3 Analysing and making sense of empirical observations

Situational Analysis (SA), as developed by Clarke, Friese, and Washburn (2018), was employed to contextualise and analyse the empirical observations. SA and its mapping techniques are an analytical approach that seeks to understand the social and cultural contexts in which a phenomenon occurs by analysing multiple data sources and employing various visualisation techniques to discern discourses, actors/actants, key elements and associations among them.

A suite of mapping techniques integral to SA helped to visualise the research landscape and understand relationships and associations central to the analysis, especially those related to moments marked by the performance of visions, smartness, or engagement with publics. Memo writing provided a crucial means of clarification and bridging elements on different analytical levels. This facilitated an exploration of relationality and the analysis of associations among different entities within the network.

Overall, **situational mapping analysis** provided a flexible and adaptable framework that yielded rich insights into the complex social phenomena inherent in smart city development. NVivo12 software was utilised for data organisation and coding. Yet, the policy analysis provides a critical lens for examining the complex interplay of power, governance, policy and practice. Approaching urban policy documents, I draw from the importance of studying **policies as actants** (Shore, Wright, and Però 2011), recognising their active role in shaping social realities, and illuminating the often hidden dynamics of power and contestation that underlie policy-making processes.

Policies play a crucial role in defining and delimiting acceptable interpretations of social realities and policy options (Hull 2012) in the smart city context. They contribute to the formation of a comprehensive web of action plans and control, where smart technologies

are employed to make this purpose effective. This is often characterised by policy convergence, forming a complex policy apparatus that stakeholders must navigate and negotiate. Meaning, policies are not merely passive documents but active agents that shape social realities, influence power dynamics, and actively participate in the construction and regulation of societal norms and behaviours (Asdal 2015; Asdal and Reinertsen 2021; Bowen 2009; Shankar, Hakken, and Østerlund 2017). This is particularly evident in the policy cycle stages, from agenda setting to policy formulation, decision-making, implementation, and evaluation. Each stage is not a linear or isolated process but a complex network of interactions where policies act as significant players.

Interpretive policy analysis, a key component of STS and anthropology fields, provides further insights into this process. It emphasises the role of language, discourse, and meaning-making in policymaking (Shore, Wright, and Però 2011). Policies are seen not just as texts, but as discourses that construct and are constructed by social realities. This approach highlights the power dynamics involved in policymaking, including the tensions and politics of policy convergence. It underscores the role of policy in shaping power relations within governance structures and the importance of understanding the subjective and interpretive dimensions of policymaking.

Ethnographic studies of policy, as part of interpretive policy analysis, provide valuable insights into these dynamics. In this approach I posed a set of questions that are designed to illuminate the complex and often hidden dimensions of policy: What are the different perspectives on an issue? Whose views prevail? How do these ways of seeing become hegemonic? These questions are aimed at understanding the dynamics of power, the construction of policy narratives, and the ways in which these narratives become naturalised or taken for granted. In this regard, policies played a crucial role in scrutinising the smart urban imaginaries in Vienna and the prevailing effect it has in governance of the

city for the future. Paper I extensively draws from this work and discusses the role of policy documents and the underlying sociotechnical imaginaries in them as a governing device.

The approach also recognises that policies can be contested as they are translated into concrete situations. This process of contestation can reveal the ideological foundations of policies and the particularistic interests they serve. For instance, policies can be studied as contested narratives that define the problems of the present in ways that either condemn or condone the past, and project only one viable pathway to its resolution. Paper II looks at few case studies in which smart city and citizens participation is at the policy-practice focus. The case studies mostly draw on the EU's smart city policy in a local level and they fail to adhere to the local situations. Paper II is in a sense a study of policy translation into practice and prevailing outcome they have in the context of digitalisation and smart city programme.

3.4 Reflective note on the shortcomings and limitations of the research

As this chapter draws to a close, it is imperative to engage in a reflective exercise on the limitations and challenges that were encountered during the course of this PhD research. These reflective moments were not only inevitable but also invaluable, as they provided an opportunity to critically examine my positionality and the lenses through which I perceived and analysed SCW.

One of the key tools that facilitated this reflective process was the use of research diaries. These diaries served as repositories for documenting experiences, challenges, and insights gained while navigating the field. They were particularly instrumental in capturing the dynamics of access to the field, which was contingent upon local conditions and the gatekeeping practices of city officials. Notably, there was a marked contrast in the

openness and willingness to engage in discussions between female experts and higher-level managers, who were predominantly male. The latter group often reiterated the rhetoric prevalent in policy documents, whereas the former exhibited a greater willingness to critically engage with the challenges inherent in realising a just smart city.

Another significant hurdle was the language barrier. My proficiency in German was not at a level that would allow for conducting interviews in the language. Consequently, interviews were conducted in English, which occasionally led to discomfort among interviewees and raised questions regarding my identity and intentions as an Iranian researcher.

Methodologically, the research involved experimenting with various methods, including digital sociology and digital methods for data collection. Despite the initial investment of time in digital methods, the decision was made to not rely on them systematically. Instead, insights gleaned from these methods were integrated into the more traditional qualitative research methods employed in the study.

Furthermore, the sheer volume of existing research on smart cities presented a challenge in carving out a distinct and original contribution to the field. However, Vienna's unique local characteristics and its pragmatic approach to smart city initiatives, which emphasises incremental improvements with technology as an enabler, offered a fresh perspective.

Ultimately, the research necessitated making choices regarding which stories and observations to include. These choices were guided by intuition and a focus on what seemed most salient within the research context. While the findings are inevitably shaped by my perspectives and methodological choices, the overarching aim is to offer alternative lenses through which smartness can be conceptualised, thereby contributing

to the evolution of a more just, responsible, and reflective city. It is my hope that the insights and observations contained within this research will resonate with and be of value to stakeholders in Vienna. The worth of this research will be determined by its capacity to inform and inspire those who are actively engaged in shaping the city's future.

4. Publication

“The modern city is a machine for producing boredom and conformity, where the only escape is through the deliberate creation of situations that challenge the status quo and liberate our imaginations.” From Theses on the Situationist International and Its Time by Guy Debord, published in 1972.

4.1. Paper I: Urban Imaginaries as tacit governing devices

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Urban Imaginaries as Tacit Governing Devices: The Case of Smart City Vienna

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Abstract

Many cities have formulated strategies, visions, and policies to deploy a local version of the "smart city." While analysts have frequently focused on tech innovators as central players, this paper takes one step back investigating policy documents and how they open a space to reimagine the city. Taking Vienna as a case study, we examine how policy documents translate and adapt globally circulating smart city imaginaries into local versions. This offers insights into values and power relations that underpin urban imaginaries and allows to reflect how they participate in tacitly governing the future directions of urban transformation. Identifying three dominant narrative strands, we gradually trace the emergence of a sociotechnical imaginary of preservation and (technological/digital) enhancement that discursively underlines the importance of local values. However, simultaneously, we witness the striking absence of the voice of citizens in shaping these future visions and how digital capitalism enters the scene through indicator-driven urban positioning work. This leads us to call for responsible imagineering, which not only means to more collectively imagine and

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engineer the future city involving a more diverse set of actors but also to critically reflect related forms of storytelling as performed in policy documents.

Keywords
sociotechnical imaginaries, urban transformation, Smart City Vienna, urban policy, responsible imagineering, imaginaries as governance devices

Introduction

Many cities of scale have formulated strategies, visions, and policies to transition into "smart cities." The smart city alludes to contemporary aspirations to implement technological fixes for all sorts of urban challenges (Marvin, Luque-Ayala, and McFarlane 2015). Various aspects of the smart city agenda and its sociotechnical realizations have already been investigated from diverse angles (e.g., Albino, Berardi, and Dangelico 2015; Anthopoulos 2017; Datta and Odendaal 2019; Karvonen, Cugurullo, and Caprott 2019). Further along these lines, we argue that there is a need to pay careful attention to the local versions of how urban futures are imagined. Sadowski and Bendor (2019), for example, have analyzed efforts made by big corporate actors to develop compelling narratives for smart cities, which contribute to the emergence of powerful, globally circulating smart city imaginaries (Joss et al. 2019). This paper moves away from the vanguard of innovation, so it does not discuss specific sociotechnical realizations or specific tech innovators. Instead, it documents the role of policy actors in their efforts to bring to life a local smart city imaginary for Vienna, and how the imaginaries themselves can function as governance devices.

Why investigate imaginaries? First, imaginaries are key in urban transitions "as they encode not only visions of what is attainable through science and technology but also of how life ought, or ought not to be lived" (Jasanoff 2015, 4) in the city. Imaginaries support the creation of specific realities while precluding others and distribute roles and responsibilities in novel ways (Foley et al. 2020; Hommels 2020; McNeil et al. 2017). Secondly, imaginaries demand our attention specifically because they often come under the guise of "simple visions," easily escaping public scrutiny and leaving critical inquiries unaddressed (Felt and Fochler 2010; Farías and Blok 2016). It is important to understand imaginaries as political objects (Miller 2020). They can serve as powerful justificatory devices in political

decision-making (Hull 2012; Asdal 2015), explicitly or tacitly governing the future directions of urban developments (Felt 2015; Karvonen 2020; Konrad et al. 2017).

This paper presents a detailed investigation of urban imagineering expressed through policy documents envisioning Vienna as a burgeoning smart city. These urban policy documents are relevant testimonials of how a Viennese version of smartification is cast into concrete projects. This allows us to gain insight into the values and power relations that underpin urban imaginaries and how they are manifested in urban governance (Foley and Miller 2020). Investigating smart city imaginaries thus allows deeper insights into practices of *imagineering* (Suitner 2015) smart urban futures, that is, the processes of simultaneously imagining and engineering urban futures through technological interventions. We conceptualize both the practices of imagineering and the resulting imaginaries as governance devices shaping urban decision-making in multiple, often tacit ways.

To root our analysis in the wider field, we begin with some key insights into smart cities from an science and technology studies (STS) perspective. We then outline our conceptual framework pointing to the process that leads to the city becoming an experimental space where policymakers explore projections of urban futures. After introducing our material and discussing documents as an object of study, we present the analysis in three interrelated narrative strands. These narratives together form the basis of smart city Vienna's imaginary. Across these narrative strands, we witness governance as it is practiced by emerging coalitions of discourses. Thinking in terms of discourse coalitions leads us to focus on particular storylines and how they come together, on the actors producing them, and the practices and contexts in which these storylines are employed (Hajer 2009, 60).

Starting with the role of Vienna's past achievements, we stress the importance of highlighting continuities (quality of life, social inclusion) throughout past and future urban transitions. Secondly, we engage with a narrative strand that connects the 2030 sustainable development goals (SDGs) as an emerging urban discourse to stories of past achievements in Vienna. Third, we explore the surfacing of innovation narratives that portray technological enhancement as assuring environmental preservation, which is key to maintaining Viennese high-quality-of-life standards.

In conclusion, in these policy documents, we see efforts to create a sociotechnical imaginary of preservation and enhancement. We also point to important invisibilities, such as the absence of active citizens participating in shaping these future visions. We conclude that if imagineering and imaginaries become important devices for tacitly governing urban smart

futures, then we need to call for responsible imagineering as a collective and a more inclusive effort to envision these futures.

Investigating the Smart City Vienna Imagineering

Investigating urban transformation has a long tradition and has often been connected to study the underlying infrastructural processes (Mumford 1961; Farías 2011). To a large extent, smart cities are an infrastructural reconfiguration of the urban. Investigating smart urbanism means paying attention to infrastructures as "a bundle of heterogeneous things (standards, technological objects, administrative procedures) . . . which involves both organizational work as well as technology" (Slota and Bowker 2017, 531). Infrastructures never grow *de novo* and always must come to terms with preexisting sociocultural routines, and a specific distribution of roles and responsibilities between the actors involved (Star and Ruhleder 1996). New urban infrastructures "emerge out of and store within them forms of desire and fantasy" (Larkin 2013, 329). They addresses specific concerns and values and relate to specific pasts (Hecht 2009).

Of course, it is essential to describe and analyze the outcomes of urban transformations (the implementation of smart technologies in urban management), but as we argued in the introduction, it is even more important to draw attention to the processes that guide those implementation processes, including their visionary elements (i.e., the smart city vision and respective policymaking). Looking at smartification imaginaries means being attentive to how global imaginaries are translated into local versions, specifically connecting a city's past and future through a specific trajectorial vision (Appadurai 2012) and related narrative practices.

In this line, STS contributors critiqued utopian visions of the smart city while raising concerns over the dystopian modes of order and control (Marvin, Luque-Ayala, and McFarlane 2015). Sadowski (2018) goes as far as contending that smart cities are a neoliberal political project and constitute "a battle for our imagination" (p. 26), without falling into the oversimplification of some smart city debates (Coletta et al. 2018). Without a more progressive vision and politics of smartness, as Sadowski argues, urban actors might remain constrained by the continuous neoliberal politics of urban imaginaries.

It is through the imaginative work of a set of urban actors that technoscientific developments can become enmeshed in performing and bringing specific versions of the future city to life. This includes anticipating the lives that will become possible and how the city will be governed. Sadowski

(2018) and similar studies focus specifically on imaginaries imposed by giant tech companies that become involved with city management, for example, through local council's practice of using proprietary software to monitor the city via dashboards and manage traffic flow. The need to study locally specific smart city practices has been stressed in STS (Karvonen, Cugurullo, and Caprotti 2019), but there is still a considerable gap when it comes to carefully investigating the narrative infrastructuring work needed to produce a locally contextualized smart city imaginary—a gap that this paper contributes to filling.

Drawing on Taylor's (2004) reflections on the social imaginaries of modernity to fully understand the processes of smartification, we must first reflect on how policymakers and city officials imagine the social existence of urban citizens. Tracing the social imaginary of a smart city allows us to grasp the "deeper normative notions and images" (p. 23) embedded in specific urban environments, shaping how people (should) cohabitate. However, the central role played by technological innovations urges policy analysts to think beyond social relations. Here, Jasanoff's (2015) concept of the "sociotechnical imaginary" is key. It points to the entangled relation of technology and society, which together coproduce "political orders and technoscientific projects" (McNeil et al. 2017, 449).

Technological realizations seen from this perspective to "operate as performative scripts that combine values and interests, materializing and making tangible the invisible components of social imaginaries" (Jasanoff and Kim 2015, 12). Sociotechnical imaginaries can thus become "associated with active exercises of [a city government's] power," for example, through the "selection of development priorities, the allocation of funds, [or the] investment in material infrastructures" (p. 123). Therefore, it is essential to grasp how such an imaginary takes shape and is reperformed in new urban planning documentation or public events, exercises of engagement with publics and on other occasions (Foley and Miller 2020), until it manages to stabilize and to tacitly drive (Felt 2015) smart city transformation processes.

At the same time, contemporary cities' smartification processes must always be understood as a series of diverse self-experiments (Karvonen, Cugurullo, and Caprotti 2019; Karvonen and van Heur 2014), which also demands a degree of openness to unexpected outcomes. In a comparative analysis of the smartification of the Sydney metropolitan area by Dowling et al. (2021), they point to the tension between "narratives of strategically governed smart development trajectories," and the fact that "the reality of making places smart is just as likely to be piecemeal, composite,

incremental and adaptive" (p. 3303). Thus, while smartification creates opportunities for imagining new futures for the city, these imaginations are always also bound by prior experiences and subjected to political interests.

In Vienna, omnipresent references to past urban transformation experiments are daring. One central reference point is the interwar period when *Red Vienna* was transformed in a "socialist laboratory" performing extensive and ambitious experiments in socialist city politics (Gruber 1991, 12). After winning the municipal elections of 1919, the Socialist Party engaged in an ambitious housing program to improve the situation of the working-class, extended public health, and social welfare services, and profoundly reformed the education system. Attempts to make the ideal socialist city for and with the people are some of Red Vienna's key legacies. The party believed this would allow the "organized working class [to] emerge as a powerful force" (p. 12) that could transform Viennese society. The "socialists' belief [was] that they could be the midwives in the creation of '*neue Menschen* [new humans]'" (Gruber 1991, 46).[1]

After almost a century of socialist governance in Vienna,[2] frequent references to its inhabitants' willingness to cooperate for multiple processes of transformation could be interpreted as a form of "invention of tradition" (Hobsbawm and Ranger 1983). An effort to balance the anticipated radical change created through future with the "attempt to structure at least some parts of social life within it as unchanged and invariant" (p. 2). References to tradition and retrospection that highlight the cherished past support a narrative where smart futures appear as an attractive possibility for both the city and citizens in a rapidly changing sociotechnical world.

The tacit underlying assumption is that the smart city is an inevitable future, so both the city and the citizens must be prepared for it. Vienna needs to adapt to ongoing change, as the city successfully did in the past. Urban transformation is staged as a tradition that Vienna embraces, while always being attentive to preserving quality-of-life standards for all—a historically rooted narrative we encounter frequently in our analysis.

Methodological Approach

This study analyzes urban policy documents, contextualized by participation in presentations and some conversations with actors. We understand documents are an inseparable part of organizational work. The agency (Law 2004; Hull 2012) and transformative capacity (Asdal 2015; Asdal and Reinertsen 2021) of documents have been widely debated in STS. A "document" is not understood as an object but as a verb that acts (Shankar,

Hakken, and Østerlund 2017). Documents are not a mere representation of their subject: they are a referential node in a network of "practices, objects, rules, knowledge, and organizational forms that produced them" (p. 62).

As Hull (2012, 260) puts it, "documents also help generate larger-scale forms of sociality—from organizations to states—not only directly as instruments of control but also as vehicles of imagination." In this sense, documents reflect imaginaries of control, social order, the organization of things, and a shared desirable future. In this investigation, we regard documents as capable of making networks and interacting with(in) diverse contexts. Thus, we investigate the selected documents to understand how they become governance devices outlining futures for the smart city over time, how they situate and embed such futures in wider frameworks, and how they create ideas of a future urban space described as worth inhabiting.

We analyzed urban policy documents published between 2014 and 2019 that capture the efforts involved in realizing Smart City Vienna, including elements from the EU's smart city agenda and its promoting bodies, such as the network EUROCITIES, to which Vienna's visions are closely connected to.[3] This is supplemented by textual and visual materials publicly available from the city of Vienna's website and the respective smart city initiatives.[4] These materials are essential components of Vienna's smart city media representation and outline the elements of the urban future to be realized.

These local government policy documents are complemented by documents from two European Commission (EC)-funded smart city projects involving Vienna, which play an important role in developing and positioning conceptualizations of "smartness" (e.g., Giffinger et al. 2007; Caragliu, Del Bo, and Nijkamp 2011). These additional documents allow us to reflect on the European Union's (EU) role in promoting a particular view of the smart city as part of an Europeanization project and provide insight into how Vienna relates to other smart cities. These projects try to define what a smart city is—or should be—and how it can be characterized and measured through indicators. The first, *TRANSFORMation* (2014), engages smart cities to address the conditions needed to transition to a low-carbon city as a necessary step toward environmental sustainability.[5] It plays a crucial role in the development of the Viennese strategy (Hartmann et al. 2015). The second project, *CITYkeys*, developed smart city key performance indicators (KPIs; Jakutyte-Walangitang and Neumann 2016).[6] The *CITYkeys* project (Kontinakis and De Cunto 2015; Kontinakis, Portail, and Dragonetti 2017) is important because it proposes developing data architecture for monitoring both smart city developments and the progress of smart city

projects across Europe, in other words, to shape the assessment of smart cities toward their goals.

Our situational analysis was informed by the recommendations of Clarke, Friese, and Washburn (2018) and required us to engage in a bottom-up coding process assisted by NVivo software. During the coding process, we identified the key narratives that together aim to govern the development of Viennese version of the smart city.

How Memories Matter for Smart City Developments

Frequent references to past urban transformation events and the city's long-term commitment to improve/maintain "quality-of-life for all" was one of the consistent reference point that appeared in the document we analyzed. To take one example, in the *STEP-2025* document, we find implicit and explicit references to the Red Vienna legacy to build a quality place for every resident (STEP-2025 2014, 9-10). During this time, the municipality built more than 60,000 new domiciles in Vienna, which offered homes to almost 200,000 Viennese, mainly working-class people. References to the "municipal housing projects of the interwar period, the gentle urban renewal approach since the 1970s and the renewed flourishing of the city after the dismantling of the Iron Curtain in 1989" (SCWFS 2014, 12) all point to a dense memory work meant to create a feeling of continuity despite signaling that profound change lies ahead. In short, "[t]he further development of Vienna equals development for all and is to be perceived as such by all citizens" (SCWFS 2014, 15). To uphold and even improve this quality, the policy documents call for the city "to change and reinvent itself" in the new era (SCWFS 2014, 12) and for citizens to embrace such transformations.[7]

Vienna's smartification strategy underlines that it "brings together all topics of relevance for the city's future" and wants "to offer a joint strategic package for all relevant policy areas" (SCWFS-SDGs 2019, 24), while also stressing the need to align with the core socialist value of putting people at the heart of any future agenda. Thus, one of the three pillars of smartification is dedicated to the city's inhabitants under the thematic framing of "quality-of-life." Readers are reminded that "high quality of life is not an achievement that can be maintained through occasional minor readjustments," but needs "developing new perspectives for the liveable city of tomorrow" (SCWFS-SDGs 2019, 28). The "livaeble city" is meant to assure Vienna's growth and expansion in STEP-2025[8] while staying aligned with the city's history and long-standing socialist values. Without

clearly defining what quality-of-life means, documents often take us back to the interwar period, pointing to urban transformation under the leadership of the Socialist Party—a period subsequently labeled "Red Vienna." This allows policymakers to tacitly communicate a commitment to justice and inclusion without needing to spell out what this would mean in the context of smart cities with its inherently neoliberal urban agenda.

We also encounter references to another important historical transformation in Vienna's urban development. After World War II and Austria's liberation in 1955, the city—again under socialist leadership—adopted a new political agenda for urban development. Two pieces of legislation framed the new urban agenda of the 1970s: one for the *preservation* of characteristic townscapes and the other for the *renovation* of urban infrastructures (Suitner 2015, 120). During this time, the combination of renewal and preservation became an important discursive element within Viennese urban development. Infrastructural developments were perceived as essential to bringing back the city to where it was before World War II. This 1970s trope reappears in contemporary smart city discourse: new developments meet the need for preservation and renewal to successfully bring past achievements into the present and assure that values rooted in past developments also guide visions of the future.

A third shift in rethinking the urban can be identified in the early 1990s after the fall of the Iron Curtain. The comprehensive Urban Development Plan STEP-94 for Vienna aimed to respond to a fundamentally changed geopolitical context. Considering globalization, economic growth, and cross-regional cooperation and competition (Suitner 2015, 115), Vienna resituated itself in an extensive urban network. Vienna reimagined itself at the center of Europe, thus reconnecting with its past geographical and geopolitical emplacement. This new vision was institutionally stabilized through Austria's accession to the EU in 1995; and with the enlargement of the EU to include much of Eastern Europe in the early 2000s.

Since the 1990s, the economic rationale has become dominant in urban transformation. Vienna envisions itself as becoming an international hub for the knowledge economy; a place fueled by tech start-ups and inhabited by smart people. As these new visions gained prominence, concerns have also risen about overshadowing the previous core values of socialist politics (Suitner 2021). The slogan "Think European—Act Regionally—Develop Vienna" advanced in the 2005 urban development plan (STEP-05), expresses this concern through acknowledging the wider pan-European policy while stressing the need to develop locally specific solutions.

In the period following STEP-05, we see the first turn toward the smart agenda. Gradually, mobility and energy concerns became the key drivers of change and became embedded in international and European development (Exner et al. 2018). Bold changes are described as necessary, with new smart/digital infrastructures and the major readjustments that would come with them always presented as an opportunity to sustain a specific quality of life. The narrative of the need to preserve past achievements when imagining the future under the smart city framework was still present.

We have seen that the first narrative strand in Vienna's smart imaginary holds that to successfully cast a new urban development in Vienna, it needs to be aligned with entrenched narratives of prior achievement. Even though it remained largely underdetermined, the quality-of-life narrative had become a quasi-obligatory passage point when imagineering a future for Vienna as early as the 1990s. This resonates with what Bos et al. (2014, 151) have called "steering by big words," that is, steering by using "encompassing concepts that are uncontested themselves, but that allow for multiple interpretations and specifications."

The Smart City and Sustainable Futures to Aim for

Quality-of-life entangled with the idea of preservation remains a particularly powerful argumentative resource in the smart city imaginary, but it increasingly needs to articulate with contemporary challenges of environmental sustainability, resource preservation, and energy consumption (SCWFS 2014). An example for such an alignment is the agenda of greening Vienna. Formulating the vision to have more than half of Viennese land devoted to green spaces as a preservation goal (STEP-2025 2014, 9) could be easily connected to Vienna's long-standing tradition of having large-scale green gardening spaces and parks, dating back to the early twentieth century.

Yet new values and concerns must also find their place. The preservation theme gets linked to questions of intergenerational justice, particularly when it comes to climate change and energy consumption. Initial steps to prepare the Smart City Wien Framework Strategy (SCWFS) were driven by the EU's energy and climate agenda for 2050,[9] prompted by Vienna's collaboration in an EU project envisioning infrastructural projects to reduce CO_2 level in the city called TRANSFORM.

The 2019 Vienna smart city strategic framework firmly integrates SDGs, framing this move as an international responsibility: "appropriate adjustments to the objectives of the Smart City Wien Framework Strategy and a

strong commitment to local implementation of the UN 2030 Agenda and its Sustainable Development Goals (SDGs) are imperative" (SCWFS-SDGs 2019, 9). Not only is this ambition repeatedly stated in policy documents, but it is also staged as a future reality: in 2025, "[a]s a smart city, Vienna consumes resources sparingly, uses energy highly efficiently and draws increasingly on renewable energy carriers" (STEP-2025 2014, 10). We thus witness the emergence of a clear problem–solution package: if sustainable development is the problem, then smartification is *the* solution.

However, straightforwardly connecting sustainability to a tech-oriented solution might carry potential dangers on two levels. First, studying the efforts to incorporate the normative imaginaries of sustainability with the idea of a smart city by policymakers in London and New York City, Miller (2020) expresses a clear warning. While the sociotechnical imaginary (Jasanoff 2015) of sustainability might be strong in presenting "a set of goals and values for science and technology," the co-existing "techno-politics dominated by corporate actors and techno-scientific optimists may ultimately prevent cities from opening up space for alternative imaginaries" (Miller 2020, 367). Miller's observations urge us to be attentive to the danger that the sustainability imaginary is reframed to fit smart solutionism (Vanolo 2014; Parks 2020). Second, a case study by Foley et al. (2020) of debates regarding groundwater pollution in Phoenix, AZ, points to another critical dynamics when looking into Smart City Vienna's sustainability discourse. Observing citizen engagement practices in the course of addressing this pollution issue, the authors show that citizens were gradually excluded as technical expertise was moved to the center. In the end, the water management experts left little space for citizens and other stakeholders to pursue their vision and propose their solutions to the problem. Considering that imaginaries are, as Jasanoff (2015) puts it, "a crucial reservoir of power and action, lodg[ing] in the hearts and minds of human agents and institutions" (p. 26), it is vital to focus our attention on powerful actors such as municipalities and high-tech companies (e.g., Siemens is very active in providing services to Vienna's urban management) with the resources to invest in gradually transforming a vanguard vision (Hilgartner 2015) into a desirable collective future.

In our document analysis, we observe that Vienna's futures to be aimed for draws on expert-driven narratives, and we hear few traces of citizens' voices. This emphasis on technocratic narratives allows for a specific set of meanings and values relevant to urban development to be articulated and circulated. This enables policy actors to stabilize a core set of publicly recognized narrative registers (i.e., quality of life, sustainability, and

climate change) that guide future visions but do not include much specification. These narrative registers are also key actors in translating the global urban discourse around smart cities into local urban technological innovation.

Smart City Vienna's development aptly illustrates Michael's (2017) description of a process of discursive transformation of "big futures"—that is, futures whose "spatiotemporal horizons are relatively large-scale," such as the SDGs—into more locally oriented, well circumscribed "little futures" that possess a "relatively tighter spatiotemporal horizon" (p. 510). This discursive transformation facilitates a tighter sociocultural embeddedness while holding space for equivocation and fluid interpretation. The question remains who had and will have a voice in defining these little, much more local futures. Such a discursive transformation becomes even more visible in the innovation narrative in Smart City Vienna, which we will unpack in the final narrative strand we identified.

Innovation as a Central Agent in Future Cities

Innovation is depicted as "the third major approach" (SCWFS 2014, 14) in Vienna's smart city development. We regularly encounter statements such as, "[a] smart city conserves resources and the environment and improves its quality of living through innovation in all fields" (SCWFS-Overview 2014, 5). In the SCWFS (2014), and even more so in SCWFS-SDG (2019), social and technological innovations are imagined to coemerge, to target and disrupt entrenched habits and structures while simultaneously maintaining or even improving the quality of life, and to stay in line with local value ecologies. Innovation is consistently described as essential to addressing global challenges such as urban population growth, rapid global technological development, and climate change (SCWF-SDG 2019, 15-17), which are described as threats imposed on the city from the outside. Meanwhile, a prevailing narrative underlines Vienna's ability to turn challenges into innovation opportunities. We thus gradually observe the coming into being of an imaginary where preservation and technological enhancement narratives coexist.

While the ideal of preservation and enhancement through innovation is explicitly spelt out, the precise meaning of innovation remains ambiguous. Overall, innovation is staged as a motor for change, "a magic word" (Godin 2015, 12), closely entangled with research, education, and the contemporary market economy. It is largely left unaccompanied by clearly articulated explanations or action plans. While this could be seen as problematic, we

want to point to the fact that it is precisely this ambiguity, as Farías and Mendes (2018) argue, which creates a space for alliances of future-making actors in the urban context. In other words, the inherent fuzziness of the very notions of innovation and smartness, as well as of the future agenda for change, allows a variety of actors to make sense of and connect to the idea of necessary transformations.

In a similar vein, Dowling and co-authors (2021) analyze the urban smartification process as city (re)branding and show how a city's history matters. They argue that multiple situated development aims become interwoven with political agendas "in the design, capacitation and implementation of the smart city in ways that are more deeply contextualized and incrementally constituted" (p. 26). In the case of Viennese urban policy, innovation discourses also have to demonstrate some form of "*Austrianness*" (Felt 2015), for example, by fitting into the local value ecology and wider urban development narratives.

In Smart City Vienna, innovation—as vague as it is left to be—becomes a value of its own. It manages to meet specific expectations related to quality of living standards; it also makes the city competitive in attracting people and investment. Both narratives are reflected in the city's good ranking, listed alongside other European metropolitan regions (see SCWFS-SDG 2019, 124).[10] As a result, we observe the making of Smart City Vienna's identity in relation to and comparison with other cities, particularly in the European context. Yet comparison is never an innocent undertaking: it is meant to fuel regional competition and facilitate a new kind of geopolitical positioning work. As such, the Viennese vision for science and research to be achieved by 2050 is:

> Vienna is one of Europe's leading innovation hubs and is known as the research capital of Central Europe. This makes the city especially attractive to students and academics, researchers and innovative enterprises and start-ups. There is a lively exchange with other major international research centres and with research partners in the wider metropolitan region, especially in sectors that are among Vienna's key strengths and drive the city's progress as an incubator of innovation. (SCWFS-SDG 2019, 122)

To this end, the *CITYkeys* project played a key role in Vienna. It was designed to define KPIs and collect relevant information for being able to document smart city development (Hartmann et al. 2015). This project comes alongside an innovation-oriented and neoliberal-tainted discourse, which highlights the importance of implementing new technological

infrastructures while defining indicators that allow achievements to be measured against set goals—further supporting comparison and ranking on an international scale. As is often the case with indicator-driven change, comparative assessment opens a very specific set of developmental opportunities while it closes others (Porter 1995; Power 1999).

Indicators do not simply measure and represent the smart city, they also define what a "good" smart city is (Kontinakis, Portail, and Dragonetti 2017, 24). For example, in an indicator-driven environment, if there are no clear indicators for capturing social dimensions of smartification, such concerns could easily fall out of the attention zone and gradually be marginalized due to the difficulty of capturing them within the logic of indicators. The introduction of this infrastructure, which is meant to measure performance and trace achievements, could also be seen as an enactment of governance by code (Kitchin 2017). Although this shift has been politically embraced by local governments, it also calls for careful reflection. Any set of performance indicators has to be seen as "a model for, rather than a model of, what it purport[s] to represent" (Anderson 1991, 178).

In practice, the innovation narrative in Vienna simultaneously promotes adjustments and advancements for both the city and its citizens. Innovations must always demonstrate a sufficient fit with certain traditions—to be successfully implemented, sociotechnical developments are either Viennese from the start or they must be made Viennese. Adjustments at the social level often take the form of promotional and educational programs to develop the necessary digital skills, particularly among two age groups: children and older adults or, in some cases, among members of socially disadvantaged communities, such as refugees. Adjustment, however, also means that both businesses and "members of the workforce [have] to acquire new skills and qualifications and repeatedly change direction" (SCWFS-SDGs 2019, 15) to fully thrive with new technological opportunities.

The 2019 Framework Strategy formulates: "Vienna's ambitious climate action target can only be achieved through a radical reduction in energy consumption in all areas . . . . It can be done with the aid of highly efficient technologies and technical innovations . . . . However, it *also requires changes in behaviour*" (SCWFS-SDGs 2019, 46, our emphasis). This explicitly acknowledges that the success of innovation ultimately relies on the capacity to make citizens embrace the needs created by these transformations. Later in the report, this point is further emphasized by stressing that "the Viennese public" has to show "forward-looking consumer behaviour" to make the transformation possible (SCWFS-SDGs 2019, 85). In the end, it

is the citizens who are required to adapt to a new kind of infrastructure and ways of being and behaving in the smart city.

Conclusion

In this paper, we analyze policy documents to document the emergence of three dominant narrative strands that establish and stabilize a sociotechnical imaginary of Vienna as a smart city. We also saw that these documents mainly give voice to policy experts and that specific storylines are repeatedly performed to establish the idea of continuity and preservation. We thus witness the emergence of a strong discourse coalition (Hajer 2009). This creates an experimental space for imagineering a smart city future that claims to reconcile local value ecologies with the seemingly universal smart cities agenda. It brings to life a sociotechnical imaginary of preservation and technological/digital enhancement that frames, guides, and governs the development of smart urbanism in Vienna.

Our analysis critically scrutinizes these discourses and offers insights into how the processes of imagineering, and the resulting temporarily stabilized urban imaginaries, become crucial governance devices. By examining the construction and evolution of an urban sociotechnical imaginary, we gain insight into the process by which diverse actors must converge to shape a vision of the future that aligns with particular values and interests, as well as what is deemed appropriate for the future. And we can get a deeper understanding of how such a governance device can transcend the boundaries between different areas of practice and discursive ecologies. Ultimately, this analysis can inform the development of more reflective, responsible, and inclusive urban governance strategies that engage a broad range of actors in the creation of a sustainable and equitable future. In our concluding remarks, we will identify three major tensions that challenge responsible ways of imagineering a smart city.

Firstly, considering imagineering and imaginaries as governance devices in the context of documents that mainly feature policymakers and experts prompts us to examine how citizens are present/represented within these narratives. Our analysis suggests that the voices of citizens are largely absent or unheard. Instead, citizens appear to be relegated to the role of future consumers in a technologically reconfigured, improved version of the city. Although presented in a language of participation of and care for citizens, the documents reflect a more paternalistic vision of the collective urban future, with policy actors assuming they can speak for the citizenry, know their needs, concerns, and desires.

A strategy employed to generate acceptance of (or at least to reduce resistance to) sociotechnical change is to frame fundamental technological transformations as being in line with the past. This may explain the trend of embedding Smart City Wien's current developments in a trajectorial narrative (Appadurai 2012), linking Vienna's past, present, and future to create a space that accommodates the idea of innovation-driven progress. In this narrative citizens are expected to adapt to changes and acquire new skills to align with the smart city of the future. This can be viewed as a discursive continuity with the interwar period, when urban transformations in Vienna aimed to create "new humans" (Gruber 1991, 46) capable of fitting into experts' imagination of urban transition. We thus witness a significant contradiction between a discourse of participation and a top-down paternalistic imagineering of the future city.

Secondly, the policy documents analyzed here extensively reference the significance of local values (e.g., social justice, inclusivity) and a reflexive discourse on the preservation of Viennese values during urban transformation. Yet proposed solutions primarily focus on technical innovation. Smart City Wien thus aligns with the logic of digital capitalism (Sadowski 2020) and smart solutionism (Vanolo 2014), restricting the range of possible innovative directions and limiting the diversity of solutions. Here, we observe another perplexing paradox. Despite the emphasis placed on "Viennese values" as guiding the city's imagineering, the fact that they always remain underdetermined allows smart capitalism and its solutions to take center stage.

The emphasis on technological innovation in the policy documents reflects a larger trend of prioritizing digital solutions and smart technologies in urban development. This trend is driven by the belief that smart solutions can both solve complex urban problems and enhance urban livability. However, this approach limits the range of possible innovative directions and diversity of solutions, while fundamentally neglecting the multiple lived realities of citizens that would have to be considered in the processes of envisaging local, little futures. They matter when it comes to embracing and making sense of urban transformations.

Thirdly, our analysis highlights that the smartification of Vienna also leads to transforming its understanding of its position in a global geography. Smart City Vienna seeks to contribute to the global trend of developing smarter futures while emphasizing its unique history and local distinctiveness. However, under the current prevailing neoliberal logic, defining one's place on the map of urban transformation also involves making decisions about how to compare, collaborate, or even compete with other cities.

We learn from debates on the "quantified self" movement (Lupton 2016) that practices, meanings, discourses, and technologies associated with tracking are inherently shaped by broader digital capitalism. Smart City Vienna's reliance on indicators—such as progress toward SDGs—risks neglecting the complex social and environmental contexts that underpin urban development. While it is important to assess the impact of policies and reflect developments, a more critical and reflective approach is necessary to ensure that the smartification of Vienna aligns with its values and priorities, considers existing inequalities and power imbalances, and makes space for context-sensitive social innovations.

In the end, combining these three key findings, our analysis brings to light the inherent tensions involved in imagineering and in the resulting imaginaries. Neither the practice of imagineering nor the outcome is neutral; they are never just future projections or social experiments, but rather powerful governance devices shaping the possibilities of the smart urban lives of the future. Citizens' roles and responsibilities are redefined; vague references to "Viennese values" allows digital capitalism to unfold as a powerful force; and data-driven understandings of urban progress draw attention to a narrow set of features while relegating others to the background. Our analysis of Vienna's imagineering process thus points to the need to reconsider what responsible smartification would mean in the urban context. We have shown that responsible smartification cannot start when implementing the digital solutions into urban environments and instead needs to include a critical examination of imaginaries crafted and deployed through policy documents—and of the actors that can(not) participate in developing them. We need to design processes of *responsible imagineering*, acknowledging the inherent tensions, complexities, and power relations. Being more attentive to this early stage of urban transformations would allow for more inclusive forms of governance.

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Notes

1. For more insight on Vienna's socialist city-making past and present, see Kazepov and Verwiebe (2021).
2. The Socialist Party has governed the city of Vienna since 1919 with an interruption only between 1934 and 1945 when the Austrofascist and National Socialist parties were in power.
3. EUROCITIES is a network of more than 140 major European cities in which Vienna is an active partner.
4. https://smartcity.wien.gv.at/en/projects/.
5. http://www.transformyourcity.eu.
6. http://www.citykeys-project.eu.
7. For a detailed study of Vienna's urban development periods, see Hatz (2008). Hatz, Gerhard. 2008. "City profile Vienna." Cities 25(5): 310-322.
8. Vienna's number of inhabitants has grown from approximately 1.5 million during the 1980s and 1990s to more than 1.9 million today.
9. https://ec.europa.eu/clima/policies/strategies/2050_en.
10. Find a list of rankings in which Vienna appears on the top (https://www.wien.gv.at/english/politics/international/comparison/).

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4.2 Paper II: Infrastructuring citizenry in Smart City Vienna – investigating participatory smartification between policy and practice

Infrastructuring citizenry in Smart City Vienna: Investigating Participatory Smartification between Policy and Practice

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Infrastructuring Citizenry in Smart City Vienna: Investigating Participatory Smartification between Policy and Practice

The notion ‘smart city’ has established its place in urban visions, policies, standards, planning, and infrastructural development often coming with the promise of participation in shaping urban futures. In this paper, we investigate Smart City Vienna policy imaginaries juxtaposing them with realizations of urban participatory experiments. This allows reflecting the tensions between policy discourse and realizations. Embracing RRI sensitivities, we argue that these tensions render visible misconceptions of what it means to give voice to citizens, residual paternalistic framings, and limits of participation in *projectified* urban transformations. We show that infrastructuring not only transforms the materiality of urban environments, but also the very meaning of being a citizen and of citizenship. Understanding urban reinfrastructuring as a real-world experiment then means acknowledging the messiness, the unknowns, and uncertainties of smartification processes. This, in turn, demands to design participatory processes able to respond to this open-endedness and processuality of urban transformation, always asking who is experimenting with what and who can participate in shaping urban futures.

Keywords: participatory smartification, infrastructuring citizenry; infrastructural citizenship; digitalization; smart city Vienna;

1 Introduction

> Vienna 2050 – Policymakers and administrators are aware that a Smart City strategy, if it is truly effective, cannot be imposed from above. Smart City Wien is therefore the outcome of a collective design process that is coordinated by the municipal authority but sustained and supported by great many individuals. It is founded on a shared awareness of the current challenges and a shared vision of the future that is worth committing to.
> *Smart City Wien Framework Strategy 2019-2050 (SCW-FS 2019, 126)*

This future vision to be achieved by 2050 has been voiced in a policy paper outlining the Smart City Wien framework strategy for a sustainable urban development (SCW-FS 2019). It is one of numerous examples stressing that this reconceptualization of cities as

‘smart’ demands policy makers to not only digitally reinfrastructure the city but to do so in a bottom-up manner, reconsidering how citizens can (be encouraged to) participate. The notion of smart city has established its place in urban visions, politics, policies, standards, strategic planning, and infrastructural development. Alongside various forms of technological/digital solutionism (Morozov 2013) there is a growing trend to involve city residents in urban digital transformation processes (Schuilenburg and Pali 2021; Mora, Deakin, and Reid 2019; Coletta et al. 2019). These initiatives and their associated discourse align with over a decade of discussions on ‘responsible research and innovation (RRI)’ (Owen, von Schomberg, and Macnaghten 2021).

RRI emerged from a desire to shift from reactive to proactive governance, fostering technological transformations that are not just acceptable, but also societally desirable. In the context of urban transformations, it is crucial for citizens to be able to engage in innovation processes and to have a say in shaping their direction. Ultimately, it should be the citizens who determine whether or not technological advancements truly improve their real-life experiences (von Schomberg 2013).

Adopting a forward-thinking approach and engaging with the future possibilities that emerge from transformation is crucial in RRI (Stilgoe, Owen, and Macnaghten 2013). Adding the adjective ‘responsible’ to innovation is best understood as creating space for more ‘response-able practices’ (Felt 2017; Haraway 2008). In the context of urban smartification, it means that the focus is not solely on accountability or liability, though they are necessary, but more importantly on the *ability* to remain *responsive* to emergent issues. This approach is based on the understanding that technological transformation inherently involves experimentation, which requires to be critically cared for (de la Bellacasa 2017). It demands inclusion of diverse voices to ensure that the transformation is also just. To speak with Callon and co-authors (2009, 109), ‘if the

end justifies the means, only debate can justify the end.' Urban smartification thus necessitates reflexivity in recognizing and addressing the limitations, exclusions and emerging 'collateral realities' (Law 2011).

This paper will specifically examine the participatory efforts in the digital transformation of Vienna, as they are a key component of any response-able approach. Adopting an RRI approach encourages us to be attentive to a wide range of innovation values, particularly shifting our attention from the market value *of* innovation to questioning the values that are embedded *in* and realized *through* innovation (Felt 2017).

In this context, we draw on extensive scholarship on the smart city programs, participation experiments and the projected roles of smart citizens. Analysts have noted numerous incidences where participatory efforts failed to create an environment where citizens could actively reshape their urban surroundings (Marvin, Luque-Ayala, and McFarlane 2015; Klauser, Paasche, and Söderström 2014; Gabrys, Pritchard, and Barratt 2016; Cowley, Joss, and Dayot 2018). Such failures risk reducing the 'smart citizen' concept to an *empty signifier*, 'a generic figure served through stewardship or civic paternalism' (Kitchin 2019, 220).

While critique of participatory efforts is often general, it is crucial to gain a more nuanced understanding of *the situated, local challenges* faced when policy visions of participation are translated into practices in specific urban settings. We will critically examine both the tensions in the policy imaginaries that outline Vienna's participatory smartification and the visions, potentials, and limits of concrete efforts to engage citizens in digital transformation.

In doing so, we do not view urban smartification as a single, well-aligned transformation, but rather as a highly experimental and multi-sited process. We aim to

explore citizen engagement in planning and practice, and to determine whether certain forms of participation risk creating a compliant rather than proactive citizenry (Datta and Odendaal 2019; Cardullo and Kitchin 2019), or prematurely closing down issues instead of opening them up (Stirling 2008; Felt 2016).

Furthermore, Korn and coauthors (2019) notion of 'infrastructuring publics' and even more so Lemanski's (2019, 1) notion of 'infrastructural citizenship' will support us in highlighting 'the links between the material and political nature of' a city's relationships with its inhabitants. This sharpens our attention to the deep interconnections between the digital re-infrastructuring of the city, the expectations and practices of urban policymakers, and the everyday lives of citizens. In this context, citizenship refers not to a specific political status, but to the implicit social contract–rights and obligations–that comes with co-inhabiting an urban space undergoing transformation. This understanding will be crucial when examining the possibilities and limitations of participatory smartification.

This paper begins with an engagement with STS debates on the participatory turn, considering its enactments, achievements, and limitations. After presenting our material and the methods of analysis, we delve into an examination of key recent Smart City Wien (SCW) policy documents, providing insights into how these documents frame participation, identify participants, and outline the issues to be addressed by these participatory exercises. Following this, we analyze three cases of participatory activities. This allows us to witness the tensions emerging when urban experimentation is embedded in a *projectification* logic which predominantly shapes contemporary urban transformation processes (Torrens and von Wirth 2021). In conclusion, the paper revisits the concept of response-able innovation, reflecting on what all this means for being a smart citizen in Vienna.

2 Participation and Experimentation in the Context of Digital Urban Re-Infrastructuring

The concepts of public participation, engagement, and involvement have gained widespread acceptance and significant support form policy actors at the time of writing this article. Within the context of participatory experiments in urban smartification, we could argue that both society and technology are subject to experimentation and testing (Engels, Wentland, and Pfotenhauer 2019). Participatory events thus become temporal laboratories where such experimentation and testing occur, with a laboratory defined as 'a space with the properties to separate controlled inside from uncontrolled outside' (Guggenheim 2012, 101). This distinction between the controlled inside and uncontrolled outside matters when studying the logic of participation in Vienna, as it draws our attention to which citizens are (or are not) given voice in such experimental setups.

While participation is now widely practiced, it remains an 'evasive, wily concept' that has evolved over time to encompass all aspects of deliberation and democratization (Kelty 2019). Analysts have also pointed to the fact how participatory exercises do not simply engage pre-existing groups but bring specific publics into being, while others are marginalized or even silenced (Braun and Schultz 2009; Felt and Fochler 2010). Even when citizens are being invited to participate, we must remain attentive to issues of *participatory justice*. That is, we need to care for differences among the participants in participatory settings that may affect their ability to express themselves and be heard.

Despite the extensive literature investigating various forms of participation, it is important to acknowledge that we are in a deeply ambivalent moment. On one hand, digital innovations have become inevitable players in urban development accompanied

by ‘discourses on speed, pressure and promising directions to follow’ (Felt 2016, 179), which are characteristic for innovations more generally. On the other hand, as outlined in the introduction, we are witnessing increasing pressure to become more participatory and inclusive towards a wide range of societal actors when making techno-scientific choices–an approach that is generally quite time-consuming.

Time is undeniably a crucial resource when it comes to participation. It requires being mindful of the various temporalities that shape participatory processes and the combined impact of ‘different temporal dimensions on techno-scientific developments, democracy, citizenship and participation’ (Felt 2016, 181). This entails asking questions about the appropriate duration of participatory processes, as it determines which concerns can be brought to light and which ones will remain neglected. Moreover, it necessitates considering the optimal moment in the innovation process when citizens can voice their opinions. Specifically, we must contemplate whether a particular participatory experiment revolves around a predetermined issue for which participants can develop or adapt solutions.

De Saille (2015, 99) has even spoken of an ‘anxiety about untrustworthy publics’ and pointed to ‘increasing levels of control’ exercised around participatory engagements. When comparing different formats within any specific context, the importance of the situatedness of participatory events becomes palpable. This underscores the risk or reducing participation to mere ritual and strictly adhering to established protocols ‘by the book’ (Felt et al. 2013). Furthermore, Horst and Irwin (2009) have critically evaluated the idea of consensus, emphasizing that this approach could inadvertently limit the space for disagreement and suppress the expression of minority viewpoint.

In the end, the timeframe allocated for participation also plays a role in determining if the outcomes of such an event are deemed robust enough by other members of society and policymakers. It raises the question of whether sufficient time was dedicated to addressing the matters at hand (Flaherty 2010). Lastly, the policy documents and participatory experiments, that we analyze, all contemplate future possibilities for urban digital transformations. While the objective is to imagine and assess potential futures, it is of utmost importance how participants can relate them to past developments and experiences.

3 Research Approach

Our research approach, considering the various aspects previously mentioned, finds promise in the application of an assemblage framework to examine participation. This approach allows us to address the intricate, interconnected nature of participatory processes and their outcomes (Stage and Ingerslev 2015). It brings to light the dynamic interplay of individuals, ideologies, organizations, procedures, timelines, and emotions, among other factors, all of which warrant our attention. This perspective facilitates a discussion on the quality of participation, particularly its capacity to redistribute power and decision-making equitably. Viewing participation through the lens of an assemblage prompts us to question how each participatory process assembles these diverse entities into specific forms, and how these processes effectively generate value and deliver the promised new capacities.

Our research methodology extends beyond a comprehensive analysis of documents that describe Vienna's participatory urban smartification development. It encompasses a wide range of materials, including audio-visuals, ethnographic observations, and insights gleaned from websites and social media platforms associated with the SCW’s citizen engagement efforts.

The primary policy documents examined in this research include the Smart City Wien Framework Strategy, 2014 (SCW-FS 2014), its updated 2019 monitoring report incorporating the United Nations' Sustainable Development Goals (SCW-FS 2019), and the more recent climate-focused publication, Smart Climate City Wien: Our way to becoming a model climate city (SCCW-FS 2022). Another significant policy document, the Digital Agenda Wien 2025 (DAW2025 2019), serves as the city's principal administrative guideline for digitalization procedures within the SCW. Additionally, we included the 'Practice Manual Participation. Developing the city together' (Manual 2012) as a foundational resource for our analysis of urban participation.

We also studied the smart city project, SMARTER TOGETHER[1], often hailed as a best practice example of smart citizen engagement across Europe. It aims at integrating both the technical and the societal aspects of smartification, stressing the necessity of participation when implementing smart city initiatives. We focused on the extensive final report on Viennese activities, supplemented by project deliverable reports and the extensive PR and communication publications. Concretely we investigated an experiment on a neighborhood level in Vienna (*Simmering)*.

These diverse documents are central to our research. We perceive them as being active agents (Asdal 2015) in shaping and materializing visions, reflecting 'the social processes through which [they are] produced and reproduced' (Shankar, Hakken, and Østerlund 2017, 59). We thus see 'documenting' not as an innocent practice, but as being an expression of agency and transformative potential, as playing an important role in projecting both undesirable and aspirational futures (Asdal 2015).

[1] Smarter Together is a major EU funded smart city project with Vienna being a lighthouse city (ST_Vienna. 2021). See: https://www.smartertogether.at/

However, we recognize the limitations of relying solely on documents. To address this, we attended several events, including the Smarter Together annual gathering in the City Hall in December 2019, and the 'Digital Day Wien 2019' event. We also conducted eight in-depth interviews with policymakers and the administrative staff responsible for participation affairs.

To provide a comprehensive understanding of the participation assemblages in SCW, we selected three case studies from a wide range of examples encountered during our observation and analyzing of participation events in Vienna. Each of them offers a unique account of how different group of people engage in participation and how this relates to the issues at stake. These cases, individually and collectively, present the diverse ways in which individuals in Vienna engage with being a smart citizen, and the different forms of life and interactions that are embedded in the SCW's experiments with participation and smartification.

4 'Smart Citizens' Encounter 'Smart Vienna' in Policy Documents

Vienna aligns with many global cities in proposing digital solutions to various issues. However, the city's *Digital Agenda* aims to distinguish itself from other smart city initiatives by emphasizing a 'central characteristic' (DAW2025 2019, 14): 'Technology follows people, and not people follow technology.' This principle underscores the city's commitment to involving citizens in the preparation of any measures, a promise that relates to Vienna's self-representation as being 'recognised worldwide for the deeply entrenched yet uncomplicated way in which it accords ample possibilities of participation and codetermination to all parts of the population' (Manual 2012, 19).

Against the backdrop of this understanding of urban smart development, it is crucial to analyze the narrative formations surrounding three key aspects: (1) the envisioned participants, (2) the identified issues, and (3) the proposed formats of

participation. This analysis will enhance our focus when investigating the three empirical case studies, particularly on how ‘public-participation-issue packages’ can emerge— that is, how these three elements find successful articulations within the context of digital urban transformation. In the following, we will delve into an analysis of these three elements.

4.1 ‘Making Publics’ in Participatory Policy Imaginaries

The policy documents pose the question of who should ideally participate in the creation of a smart Vienna. To address this, we start with a brief analysis of the *Practice Manual Participation: Developing the City Together* (Manual 2012), particularly focusing on how it addresses the concept of publics. This manual was designed to aid city collaborators in professionally preparing and executing participation processes. Emphasizing the importance of clearly defined key concepts and of building trust in the envisioned digital transformation, it outlines four benefits of participatory policy making: ‘find solutions that suit the Viennese; achieve better results and work more smoothly; decide well and with acceptance; strengthen Vienna and democracy.’ (Manual 2012, 8).

The manual categorizes the urban actors to be involved in the participatory processes into three subcategories: the general public, the organized public, and the expert public (Manual 2012, 9). The first subcategory equates to ‘citizens’, further divided into individuals and citizen initiatives. However, it specifies that only those initiatives that are ‘loosely organized, event-related, and active for a limited time’ fall under this category. The term ‘citizen’ is broadly defined to include people without Austrian nationality and young people who do not yet have voting rights. The second subcategory, ‘organized public’, encompasses ‘interest groups, civil society organizations, and more local organizations.’ Finally, the ‘expert public’ subcategory

includes individuals with specialized knowledge in particular area, with the stipulation that those classified under this category should have ‘no predominant personal interest.’

The manual thus subtly links expertise to the ideal of an ‘objective approach’, implying a lack of personal or emotional involvement, while the first two subcategories are allowed some degree of personal relation to the issue at hand. The terms ‘citizens’ and ‘people’ are most frequently used in the documents, while ‘the public’ is used less often. The term public is primarily used as an adjective for transportation, space, participation, engagement, sector, health, and more to emphasize the shared nature.

An interesting linguistic difference is also observed. While the English term ‘public participation/engagement’ is most commonly used in the academic literature when analyzing the inclusion of societal actors in the shaping of future cities, both the policy documents and the Manual predominantly use the notion ‘citizen’ in this context.

The manual’s classification logic and detailed differentiation of relevant actors and their roles do not translate into the policy documents. Only occasionally, and in a few specific problem constellations, do we encounter references to distinct situated subgroups that need to be attended to in the participatory smartification process to ensure the creation of a successful and sustainable digital environment. Age is one such exception. It is used to distinguish different needs and concerns regarding digital urban transformation, referencing to children, the youth, elders/65+, seniors and others. People’s relationship to place seems to be another aspect that attracted attention, as we encounter terms like residents, neighbors, or migrants, as well as frequent phrases like ‘Viennese citizens’ or ‘local citizens’. The deployment of such language refers to either emotional attachment to a place or a specific kind of affectedness by the digital re-infrastructuring, the aim being that these citizens have a voice and are not overlooked or excluded.

Citizens, imagined as part of the participatory experiment, are described with positive adjectives such as active, assertive, concerned, or interested. Their agency is deemed important and valuable for realizing urban futures. The most recent report even emphasizes that ‘Smart City Wien relies on the engagement and initiative of the Viennese public. The project thrives when as many people as possible buy into it and make an active and autonomous contribution’ (SCCW-FS 2022, 144). While the language of buying-in suggests a clear pre-framing of the issue, it remains an invitation to participate in some form of shaping. However, the policy documents do not provide much detail on the concrete visions of how roles and agencies in such participatory processes should be distributed and realized in practice. It also remains vaguely described how voiced concerns would enter final decisions on developmental directions.

A city administration staff provided us an anecdotal glimpse into the discrepancy between the envisioned ideals of policy documents and the reality on the ground. They described the participants as ‘the usual suspects’, specially ‘middle-aged to elder white men’, who tend to dominate participatory settings by ‘rather complaining and scrutinizing the city administration experts relentlessly, without offering any valuable insights’.

The policy documents under scrutiny not only portray the participants and their active role in shaping the city’s future but also weave a narrative of a different nature. They depict the city and its digital re-infrastructuring as catalysts for citizen empowerment, promising improved services *for* them, based on the expertise of professionals who understand people’s needs and desires. These assertions also include assurance of employment, fair wages, and a decent quality of life. However, in certain sections of these policy texts, citizens are presented less as active participants and more as mere addressees of digitalization. They are positioned as passive beneficiaries for

whom digital transformations are presented as inevitable progress. Here, decision-makers speak on their behalf, defining what they deem necessary and beneficial for the citizens. This approach raises a question, as suggested by Callon and co-authors (2009): Does this form of representation and decision-making inadvertently silence the voices of urban inhabitants, thereby preventing them from expressing their own needs and desires?

4.2 Articulating Issues at Stake

What is at stake when soliciting citizens to participate in shaping SCW? A detailed examination of the Smart City Wien Framework Strategy which spans from 2019 to 2050 (SCW-FS 2019), and its subsequent focusing on urban climate (SCCW-FS 2022) provides profound insights into the evolving argumentative logic.

Both the slogan 'The future starts now!' as the point of departure of these comprehensive reports, and the changed structure of the reports compared the framework strategy formulated in 2014 (SCW-FS 2014, 16), indicate a shift in conceptualizing the smartification process. The 2019 update of SCW's planning until 2050 underscores the escalating climate crisis as primary challenge for urban development. It also points to other challenges such as urban growth, an accelerated 'technological revolution', 'end-to-end digitalisation […] penetrating all spheres of life' and 'consumption of resources […] increasingly exceeding the tolerable limits' (SCW-FS 2019, 15-18). In their pursuit of 'ambitious responses', Vienna's policy reports then position their plans in the broader international policy landscape, such as the 2015 Paris Agreement on Climate Action, the European Climate Alliance and the UN 2030 Agenda with its Sustainable Development Goals (SDGs). This reorientation of Vienna's policy is not a choice driven by the citizens but described as a necessity to maintain the city's leading role in international developments. This ambition is evident when the

documents refer to Vienna as ‘setting new standards’ and being an ‘international pioneer’ and expressing the high commitment ‘to retain its position of frontrunner within the network of responsible cities and to continue shaping the global debate’ (SCW-FS 2019, 9). All these efforts are made with the aim of developing ‘a local response to global challenges’ (SCW-FS 2019, 15), and improving the lives of the inhabitants.

Vienna’s global challenges are thus translated into local infrastructural concerns. Smartification serves as a means to not only address these challenges but also to enhance the existing urban infrastructures while preserving Viennese local values and achievements (Sepehr and Felt 2023). It is evident that high-level issues pertaining to urban development are not framed by citizens’ visions, concerns or urban living experiences. Instead, they are defined through the translation of global issues into local responses, where citizens get voice at specific time windows, primary determined by policy processes.

The revised version of Vienna’s smartification agenda (SCW-FS 2019) and the subsequent urban climate report (SCCW-FS 2022) identify several ‘thematic fields’. Each of these fields addresses the three main goals established by the city’s governance back in 2014 (SCW-FS 2014): *conservation of resource, enhancement of quality of life,* and *promotion of innovation*. These thematic fields encompass crucial areas such as energy supply, healthcare, mobility and transport and water and waste management, among others. Two new fields were introduced in 2019 compared to the 2014 version: ‘digitalisation’ and ‘participation’. Although these fields were already present as overarching issues in 2014, they now manifest in two distinct ways: as integral parts of the urban transformation process and as stand-alone thematic fields i.e., *issues* that the strategy must explicitly address.

Each issue's presentation adheres to a clear structured. It begins with a brief glimpse into the future. Under the heading 'Vienna 2050', readers are transported into a future where the fundamental accomplishments of urban smartification have been realized. This is followed by a concise description of the 'agenda' and a series of derived objectives—often targeting 2030—intended to ensure the realization of this future.

The Smart Climate City Wien report maintains a similar structure but deviates slightly by not focusing as much on a visionary future. Instead, the presentation of each issue begins with a section titled 'What it's all about', followed by a graphical representation of goals and an extended section on 'What we are planning'. This always concludes with a box labelled 'Where we need support!'.

Over less than a decade, we thus observe a shift in how issues are presented, from being examples for a broader policy aim, to receiving individual attention with a futuristic touch, and finally, being framed as ongoing work that requires the support and engagement from citizens and policymakers alike.

Although it would exceed the scope of this paper to delve into how each issue is framed and its relation to participation, it is pertinent to our analysis to examine the section on digitalization more closely. The City of Vienna aims to address the challenge of living 'in the age of the digitization of all areas of life' by using the Digital Agenda Wien as a guiding strategy to navigate this transformative process successfully (DAW2025 2019, 4). Digitalization is thus presented as an inevitable, non-negotiable technical transformation to which all Viennese—from the municipality to citizens and businesses—must adapt. This explains why participation and interventions are generally conceived at a rather detailed micro-level and broader issues that might arise from these digital transformations remain unaddressed.

In this context, the grammar of a need-based approach replaces the recognition of these wider issues. This is why we also find the term ‘users’ and ‘involvement of users’, and the statement that their ‘concerns, needs and interests have been the guiding principles for setting priorities, implementing projects and designing new services’ (DAW2025 2019, 3).

On a more general level, the digital transformation of urban life is linked to a number of broader issues. We once again encounter the general statement that ‘digitalisation […] is to serve people and their needs and further improve the quality of life in our city,’ which runs under the label of ‘digital humanism’ with Vienna aiming to become a centre for developing expertise in this domain. Even the often-voiced fear of labor market transformation is reframed as an opportunity, with the city of Vienna pledging to ‘help its citizens to make the most of the opportunities offered by the digital revolution’ (SCCW 2022, 38). Digitalization is portrayed as an all-encompassing solution to societal problems: it is not only ‘a driver of innovations’ but ‘digital platforms and communication channels [will also] increase public engagement and participation’ (SCCW 2022, 38). In the context of digitalization, participation thus serves as both a means and an end. While participation supports the development of Vienna as a smart city, digitalization is anticipated to facilitate participation in innovative ways.

4.3 Enacting Participation in Urban Policy

How should the urban actors and issues previously discussed assemble in participatory settings? And in which ways do these forms and formats of participation bring specific actors and their roles into being? Participation is presented in the policy documents in two ways: as an integral part of the urban digital transformation facilitated by the city government, and as a critical issue by itself that needs to be addressed.

The Practice Manual (2012) provides a comprehensive and nuanced guide to considerations necessary for implementing participation in urban planning. It begins by defining various terms used in the context of participation, aiming to distinguish clearly between information, consultation, and cooperation as the key modalities of engaging citizens in urban planning. The manual also highlights the importance of considering the myriad forms of informal and formal participation. The manual further delves into decision-making processes regarding the appropriateness of participation and the optimal timing for its implementation during the urban transformation process. The final sections of the manual, which includes ‘dos and don’ts’, advice for planning the process, and a collection of methods, consistently emphasize the need for context-sensitive formats and the importance of clarifying from the outset what aspects are open to collective decision-making and what parameters are already set.

The shift towards greater participation in urban policymaking is reflected in policy documents such as the Smart City Wien Framework Strategy 2014. For instance, the document highlights that Vienna is globally recognized for its deeply rooted and ‘uncomplicated’ approach to providing extensive opportunities for participation and co-determination to all segments of the population. It underlines that ‘[c]itizens take active part in developing their city. There are many ways of participating: everyone has the possibility of voicing, discussing and implementing their own ideas and opinions regarding the city’ (SCW-FS 2014, 19).

Such sentiment is in a quite similar wording echoed in the updated Smart City Wien Framework Strategy 2019, with the addition of ‘co-creation and involvement in decision-making’ (SCW-FS 2019, 127). This addition signifies an important discursive shift. While Vienna is described as already having ‘multiple formats for public information and dialogue, as well as a body of relevant experience to build upon’, it is

also acknowledged that '[p]rocesses for actual participation in decision-making are less well established, and rules and tools will have to be developed for this purpose' (SCW-FS 2019, 128). This distinction between participation as consultation and participation in decision-making is crucial, as it suggests a more challenging path towards integrating citizens into the processes of re-infrastructuring the city through digital technologies.

Furthermore, it is underlined that 'special attention is to be paid to those groups who, for various reasons including language and educational barriers, lack of time and/or financial resources […], only have limited choices and scope for decision-making and therefore tend to be under-represented in traditional public participation processes' (SCW-FS 2019, 130). Indeed, extensive research has revealed quite alarming disparities in the distribution of participatory activities across the city. Rather than being evenly spread, these opportunities seem to be concentrated predominantly in urban areas characterized by elevated income and educational levels, where avenues for participation more easily exist (Ahn and Mocca 2022, 44; see also Jonas and Hassemer 2020 for participation in Vienna).

The Smart Climate City Wien policy report (SCCW-FS 2022) subtly addresses the challenges by redefining the stakes in participation. The section title expands from 'Participation' (SCW-FS 2019) to 'Participation, engagement & culture' (SCCW-FS 2022, 114), emphasizing the need to view digital transformation as a cultural shift. The report speaks of 'a shared vision of the future that is worth committing to', the need to foster 'a culture of participation based on mutual respect', and repeats that 'special attention is to be paid to those groups having limited choices and scope for decision-making'. It further calls for using 'the creative potential of artists and cultural producers' (SCCW-FS 2022, 114).

The report explicitly mentions co-creation and living lab approaches, highlights opportunities provided by digital media, and promotes increasing participatory budgeting initiatives. While it outlines future actions, the report acknowledges the complexities inherent in participatory processes. It emphasizes the need for support in realizing the vision of involving 'hard-to-reach groups' and giving 'them a say in policy decisions relating to climate change' (SCCW-FS 2022, 118). The facilitation of participation plays a central role in making and unmaking publics that have a say, either fostering inclusion or furthering exclusion (Felt and Fochler 2010).

The concluding portion of this section necessitates a synthesis of the three primary observations and an exploration of whether and how the SCW policy documents manage to create robust public-issue-participation packages. This involves examining how issues engage publics through distinct participatory processes and understanding the interdependent relationship among these three elements. Regrettably, the policy documents do not directly address this crucial question, making it essential to focus on a series of case studies. To achieve a more detailed understanding of the localized adaptations of participatory smartification, we will examine three specific case studies.

5 Assembling Participation in Practice: Analysis of Three Case Studies

To explore citizen participation in Vienna, we will examine three specific cases: (1) the use of a mobile info-kiosk for neighborhood activities, (2) an e-mobility carsharing initiative in a large housing complex, and (3) a digital information/planning platform used for creation of the Digital Agenda Wien (DAW2025 2019). These cases are part of a larger European project called SMARTER TOGETHER, in which Vienna played a prominent role (see Farías and Mendes (2018) for insights from Munich in the same project). By analyzing these cases individually and collectively, we hope to gain

insights into the different approaches and strategies employed in Vienna to engage citizens in smart city initiatives.

5.1 Meeting the Future Smart Citizen at Street Level

Our first case study introduces us to activities related to citizen engagement within the framework of the Smarter Together project. Under the label of Urban Living Lab which broadly stands for innovative methods to engage with citizens and raise their interest in taking part in activities (ST_D5.2.1. 2018), the plan was to establish a mobile space where local residents could interact with urban smartification projects. To this end, the Urban Renewal Office (GB*)[2] was converted into a mobile caravan booth, functioning as an info-kiosk named SIMmobile (an abbreviation for *Simmering*[3] Mobile). The intention was to create a mobile InfoPoint that would 'go where the people are' (ST_D5.1.2. 2019, 6) and engage with as many residents as possible. One of our informants from GB* likened SIMmobile to a *Würstelstand* (a sausage stand), an iconic Viennese stall where people gather to discuss public affairs while enjoying sausages and drinks. The design was intended to make their presence mobile, flexible, noticeable, and enjoyable.

Despite emphasizing the importance of SIMmobile, another informant shared the challenges of engaging with citizens, citing an instance where only three citizens

[2] GB* stands for the notion of *Gebietsbetreuung*, meaning those who care for a specific urban area.

[3] One of the 23 districts in Vienna (>100.000 inhabitants) with the lowest average age of population, a moderate average income and the lowest share of inhabitants with an academic degree in Vienna.

attended an event with five experts waiting for them. She described the situation as follows: ‘We have learned from previous experiences, and we understand the Viennese approach to citizen consultation. [...] Usually, only the usual suspects show up, and the rest of the citizens are not accustomed to being asked for their opinion. In fact, people were so surprised that we approached them outside of a political party framework and not around election time (laughing).’ This aligns with other experiences in the Austrian context (Felt, Fochler, and Müller 2006), where there is little to no culture of public participation. As this quote suggests, street-level engagement with citizens typically occurs during political campaigns around election time, with a clear objective–to attract votes.

Who were the intended audiences for this form of engagement? Children were a significant target group in the Smarter Together project. The project implementation report (ST_D5.1.2 2019) highlights the success of over 3500 people visiting SIMmobile, with children being described as: ‘Outreach (sic!) was either based on information or gamification, making children the real Smart City ambassadors’ (ST_D5.1.2 2019, 12). The use of the label ‘Smart Kids’ (ST_D5.1.2 2019, 14) suggests that children can be guided/educated to find their place in a specific urban future, while the chances for behavioral change in other population groups are perceived much lower.

On the other end of the spectrum, elderly people are also identified as an important target group in the digital urban transformation process. This focus points to the growing aging population in Vienna, where digitalization is seen as a necessity to assist the city in providing better services. Several programs are under development to support the aging population with their care needs, health, communication, and wellbeing. Alongside these developments, we also observe training being offered for elderly people to adapt to the digital culture.

In a sense, Vienna aims to prepare its aging population to adapt to the digital world while training the smart kids as the future generation of coders and programmers. Although the project does significant work to make smart city elements visible, the process already began with a fixed set of goals and plans to be implemented, with limited space for citizens to shape the objectives and priorities of urban development. Within these outreach activities, participation remains at the level of information exchange, being a collection of ideas, opinions, and some PR-style communication of goals to stabilize an already pre-framed vision of a smart future. These activities demonstrate what being smart should be like, while offering little space for actively contributing to the creation of a desired future. Participation, as occurred on street-level in this setting, thus becomes more of a means to stabilize and rehearse an already determined smartness for the citizens.

5.2 Participation Incentives and Public Engagement in E-Mobility

E-mobility was a key goal of the Smarter Together project, aimed at bolstering environmental sustainability. Under this goal, the project launched an e-carsharing initiative for a housing complex with over 1000 tenants. The location was described to us as a subsidized housing area, not social housing, with households typically owning two cars and many inhabitants being of retirement age.

The project faced challenges in communicating the concept of e-carsharing to residents. Despite the exceptionally low rental price of one Euro per hour, residents were initially resistant and did not grasp the opportunity. Citizens were described to us as even being ‘angry’ as ‘they didn’t understand the entire concept, yeah? And we were surprised, in 2016 that they, none of them, understood the concept of carsharing, that it’s like for free for them if they don’t use it, but that it’s a good chance if they want to use it.’ The project team had to work quite hard to convince them of the benefits. This

resistance was attributed by our informant to skepticism ‘towards the city, skeptic[ism] towards the elites [money coming from the EU in this project]’ and as ‘something that we see all over in Europe.’

However, the residents’ reluctance to engage with e-carsharing cannot be explained away by pointing at a lack of understanding. Instead, it could be viewed as a solution that did not address a problem they were concerned about. The residents had no shared concern that would match the technological solution offered by the project. Interestingly, our discussions revealed that residents saw e-cars as being for the wealthy, not for them. In the end, the e-carsharing facility was implemented with only a few people participating and using the e-cars, most of whom being already interested in cars. For some, using the e-car replaced public transportation, which had been their first choice. This raises at least two kinds of questions about the sustainability dimensions of the initiative: does this initiative replace classical car ownership or increase urban car usage? The latter raises the question of energy sustainability, and what will happen once—the now subsidized—rental prices would significantly increase after the project's end, which bring into doubt the affordance of cars and distributive justice it holds.

So, what does this e-mobility story tell us about participation? It’s not just a prime example of ‘no issue, no publics’ (Marres 2007; 2015). Rather, it shows that a pre-defined solution (e-mobility) must first become an issue of public concern to become a matter of public engagement. The e-car, despite its extremely low price, did not foster engagement around e-mobility or trigger a wider reflection process. Lacking a shared problem perception and a trust base, the offer failed to attract interest and make the project meaningful for a wider group of residents.

If the goal was to involve citizens in reshaping mobility, then e-carsharing didn’t seem to be the means to reach this end. The assumption that temporary low-cost access

would create engagement was based on the wrong premise that people shared the same concern. To bridge the gap between the residents and the project's understanding of the issue at stake, the project had to offer incentives in the hope of forming publics to carry on with the project's purpose. In this context, the city becomes a realm of social experimentation, where the urban public is shaped and molded through the envisioning, development, and implementation of smart infrastructures. Exposing citizens to smart infrastructuring reveals the experts' notions of publics and participation, exposing the democratic deficit that exists in engaging with citizens during the process of defining the very purpose of smartification.

5.3 Vienna's Participatory Digital Governance

The final case study brings us to the heart of this paper, focusing on the participation in drafting Vienna's digital agenda, which is intended to promote participation. The statement, 'Vienna has 1.8 million brains, let's use them' (DAW2025 2019, 14), found in the policy document related to the preparation of DAW2025, is designed to highlight the need to expand input from societal actors and underscore the importance of citizens as a wellspring of creativity and inclusivity. This statement further lays the groundwork for what the document refers to as Vienna's 'digital participation culture'.

In crafting and promoting this narrative, the document seeks to employ a method inspired by a participatory process[4] used in 2012[5] for the drafting of the Vienna Charter, which utilized a combination of online and offline participation methods. The

[4] For more information on the process and its results see: https://www.wien.gv.at/english/living-working/vienna-charter-results.html

[5] An overview of the participation methods used in the Vienna Charter: https://www.partizipation.at/vienna-charta.html

overarching argument is that digitalization is facilitating Vienna's transition from a top-down bureaucratic governance model to a more participatory one. As such, the document provides a valuable lens through which to observe how 'the digital' opens up space for the democratization of urban future imaginaries and the roles citizens can effectively play within the process of shaping these imaginaries.

DAW2025 (2019) designed a three-step process to involve citizens in defining Vienna's transition to a smart city: first, an online collection of ideas for the Digital Agenda, where citizens are envisioned to provide input. Second, DAW experts select and bundle the collected ideas to create a draft action plan. Third, participants can review the ideas and express choices through an online voting platform.

The first and third steps were conducted on an online participation platform, with approximately 867 participants who made 320 comments and posted 1303 votes. Although the significance of these numbers in terms of the level and type of participation is unclear, the experts we interviewed viewed it as a participation milestone. Our informants described the process as a significant advancement compared to previous efforts, stating, 'the previous Digital Agenda was written by two experts in this office. But for this update, at least 600 people had a say. This is a first.'

To invite participants, the DAW primarily sent out an email to all the companies and individuals who had previously worked with the DAW. This approach mirrors Wynne's (2007) concept of 'invited participation', where experts purport to invite the general public to a consultation meeting but actually only bring only a very small subset of potential publics to the table. However, to broaden potential participation, the DAW experts also promoted the process on their website and put-up posters around the city.

Our informants were largely convinced that the email list was the most effective means of invitation, as the people on the list already share an interest in digitalization

and a good understanding of it. However, despite the open invitation policy, the group of people who engaged with the process remained relatively small. We encountered some reflection on the limitations of this approach among the DAW experts. And we generally concur with Lerman's (2013) observation that only relying on digitally literate citizens and thus sidelining the needs of digital non-users creates new forms of 'voicelessness', as the medium technologically and socially preselects specific kinds of publics that can participate.

Investigating digital participation then draws our attention to the questions posted on the platform, where we encounter a quite strong pre-framing of the issues at stake. As the questions already position ICTs as the solution, participation is mainly limited to some adaptation work. This is a classic example of cooptation and contributory autonomy (Kelty 2019, 14), putting the autonomy of the individual 'to work in the service of a collective.' It opens 'the door to more participation, but of a much less powerful kind' (Kelty 2019, 173). This form of participation could therefore be understood as potentially 'democratizati[ng] of inequality' (Lee et al. 2015) through strengthening the voices of those ready and digitally skilled enough to participate, thus reinforcing existing forms of inequalities. The DAW participation event also rewarded the top three ideas (based on the number of votes each idea receives) with a grant for implementation. This was meant to incentivize participation using nudging techniques to increase user activity on social media.

We thus see a vision of urban governance that understands 'people as infrastructure' (Simone 2004), as a collection of individuals ready to depose their visions. Consequently, people do not gather around an issue (to be) defined by them, but they are encouraged to participate in discussing rather specific aspects/choices of an already largely defined solution, which experts saw as crucial for safeguarding Vienna's

future. In this context, ‘the digital’ needs to be reflected on two levels: while it is the subject of deliberation it also shapes the space in which this deliberation is supposed to occur. Thus, both issues and publics are largely predefined in the participation process.

6 Discussion and Conclusion

This study delved into the multiple tensions between policy ideation and practical implementations concerning participation in smart urban transformation processes. While there is a robust discursive commitment to participation in urban digital reinfrastructuring and a drive to ensure that Vienna meets the inclusivity goals, we also uncovered contradictions, tensions, ambivalences, and limitations.

First, our observations resonate with what Chilvers and Kearns (2020, 350) term a ‘residual realist imaginary of participation.’ This implies that the participants and the suggested formats in the context of SCW were often assumed to be ‘pregiven, and external categories’ that were ‘imported into the design […] of participatory practices.’ (Chilvers and Kearns 2020, 349) While it was crucial to clarify the different understandings and formats of participation through the development of the Manual, this approach seemed to limit the space for more diverse forms of bottom-up, experimental, co-produced socio-material practices of raising voice. The ‘ideal citizen’ would need to conform to these pre-existing roles and formats, and those who did not align or trust the city policy actors would then be seen as an obstacle to the full potential of digital transformation.

Thus, the policy agendas seem to lack the necessary responsiveness and did not take into account the fact that publics are not pre-existing entities but are formed through participatory practices. This lack of reflection runs the danger of leading to an unequal and unjust distribution of voice, as certain ways of contribution were favored over others. Furthermore, there is a frequently diagnosed lack of a vibrant tradition of

participation in Austrian culture, making it important to carefully create space and build trust in these more bottom-up approaches to urban transformation, particularly for underprivileged segments of the population.

Secondly, and in line with our first observation, our analysis of the policy documents showed that while citizens are ascribed quite active roles, we simultaneously encounter a specific kind of participatory paternalism (Degelsegger and Torgersen 2011) that persists. This refers, in our case, to the co-existence of the imaginary of active citizens who can and want to shape urban digital environments, and of citizens that need to be catered with services with experts knowing better what they need and what is the best for them. As a result, we most frequently encounter invited forms of participation (Wynne 2007) where the space of participation is somewhat predefined, and people can voice their concerns and make suggestions on issues that were already clearly pre-framed.

Thirdly, while policy papers remain quite generic, participatory activities often address very specific, well-delimited issues. This creates disconnected silos of participation, narrows down who should ideally participate within the framework of each projectified experiment, and times participation in ways to fit the project logic. These projectified temporalities also define how smart urbanism can be ‘conceptualized, how problems get assembled, how publics are made and how potential action and responsibility is imagined’ (Felt 2016, 192). Such participatory projects follow a managerial logic of efficient organization, an approach that risks rendering invisible the deep interconnectedness of issues, experiences, and participatory collectives, as well as the messiness and non-linearity of such transformation processes. This might, as Torrens and von Wirth (2021, 14) have argued, contribute to ‘depoliticising

experiments' and not necessarily support complex long-term sustainable transformations.

Considering that any participation assemblage inherently means collective experimentation, we also argue for the importance of remaining responsive in the design process and devote more attention to what comes before and after the discrete moment of any participatory event, thus, to extend reflection beyond the project framing. Concretely, this means that taking participation in urban reinfrastructuring seriously, a much more processual approach is needed, stretching over longer periods in time. This calls for attention to the fact that participatory urban transformation can never consist solely in a set of well confined experiments aiming to reach solutions to a pre-framed problems or to make a specific technological choice. This particularly pertinent of digitalization as it is perceived by the policy actors themselves also as a cultural transformation.

To overcome limitations, urban governance would have to keep exploring ways of engaging with citizens, allowing the bottom-up creation of 'public-participation-issue packages' that meet the visions and needs of Viennese citizens, and gives them enough space for experiencing being a collective. Only this would make meaningful exchange possible over longer periods in time. For sure this challenges the very logic of digital reinfrastructuring which often makes choices which can hardly be questioned at later points in time (Felt et al 2023). This brings us to our last broader conclusion.

We began stressing that smart urbanism discourse follows on many levels the logic of RRI, particularly underlining the participatory elements which should assure inclusiveness, broaden reflexivity, collectivize anticipation, and through this make smartification *response-able*. However, when looking through the lens of specific cases,

we encountered quite serious limitations in the implementation. Why is it essential to be attentive to this discrepancy, to the policy-implementation gap?

Our analysis reveals that citizen participation cannot be viewed as an activity separated and distinct from the infrastructural imaginaries and developments of smart city initiatives. Instead, it is crucial to recognize that participatory activities are deeply intertwined with digital infrastructures and with being an urban citizen. This leads us to reconsider Lemanski's (2019) notion of 'infrastructural citizenship' and reflect on the entanglement of digital infrastructures and citizenship through and beyond the participatory experimentation in the process of urban digitalization. It is important to acknowledge proactively that the transformation into a smart city is not solely a technological process, as it also significantly impacts the ways of being a citizen in these new urban spaces.

Hence, even though smart urban infrastructuring often seems at a first glance technical and at the service to people, it is essential to be attentive to two key aspects; first, to the many 'political, ethical, and social choices that have been made throughout its development' (Bowker et al. 2010, 99), which created situations of inclusion or exclusion and forces us to ask the question of participatory justice; and second, to the *infrastructuring of citizenry* accomplished through the ongoing entwined making of digital and participatory infrastructures, on one hand, and urban citizens, on the other (Korn, Reißmann, Röhl, et al. 2019).

That is the reason why it is essential to see the smartification of Vienna as a large-scale socio-technical transformation, which is not solely about technological choice through participation. Rather, it is a real-world experiment (Gross 2018) which needs to admit that a separate controlled inside is not possible, and to acknowledge the messiness, the unknowns, and uncertainties of digital transformation processes. It is

therefore key to open up the idea of experimentation to more carful broader consideration, always asking who is experimenting with what and how to better continuously integrate the diverse inputs when it comes to making urban futures.

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4.3 Paper III: Mundane Urban Governance and AI Oversight – The Case of Vienna's Intelligent Pedestrian Traffic Lights.

Mundane Urban Governance and AI Oversight: The Case of Vienna's Intelligent Pedestrian Traffic Lights

ABSTRACT

This article delves into the profound implications of integrating Artificial Intelligence (AI) into urban landscapes, with a specific focus on the Intelligent Pedestrian Traffic Light (IPTL) initiative in Vienna. As cities globally become the primary arenas for AI deployment, Urban Artificial Intelligences (UAI) emerge as technologies tailored for urban contexts, reshaping cities' everyday governance. The IPTL, a manifestation of such UAI, employs advanced surveillance and algorithms to automate pedestrian signaling, aiming to deter jaywalking and optimize traffic flow.

Drawing from both theoretical models and empirical research, the study illuminates the tangible effects of UAI on urban life, governance structures, and the broader socio-economic fabric. The research employs a mixed-method approach, analyzing expert narratives, public reactions, and the technology's design and implementation. It uncovers the profound influence of seemingly mundane technologies on urban spaces, human-transport interactions, and the broader sociotechnical fabric of the city.

Findings reveal that while the IPTL and similar AI interventions promise enhanced urban governance and mobility, they often overlook the diverse needs of urban populations, as evidenced by the neglect of visually impaired pedestrians in the IPTL's design. The study underscores the need for a more inclusive and holistic approach to AI-driven urban interventions, emphasizing the importance of understanding and catering to the diverse needs and rhythms of all city inhabitants. The article concludes by advocating for a reconstructive approach to urban AI, emphasizing the importance of democratizing urban spaces and prioritizing pedestrians in future mobility initiatives.

Keywords: Urban Artificial Intelligence, urban mobility and AI, Smart City Vienna, traffic lights, AI otherwise

INTRODUCTION

The integration of Artificial Intelligence (AI) into our urban landscapes is both profound and continually expanding. Acting as an invisible intermediary, AI shapes and governs the interactions between humans and their surroundings across various dimensions (Ames, 2018). Cities have become the primary arenas where these AI technologies are conceived, refined, and deployed. Cugurullo (2020) terms such technologies, specifically designed for urban settings, as Urban Artificial Intelligences (UAI). These systems not only draw their purpose from urban contexts but also redefine what the city is and how it functions.

This evolving relationship signifies a pivotal transformation in urban dynamics, transitioning from simple automation to comprehensive autonomy. As urban environments increasingly rely on sophisticated AI systems, it's crucial to grasp the deep-seated implications of this shift. While theoretical frameworks offer valuable insights, there's an urgent call for empirical research to uncover the real-world impacts of UAI on urban living. Such investigations can shed light on the transformative effects AI brings to residents, governance mechanisms, and the broader urban socio-economic landscape. Through meticulous empirical exploration, we can address challenges and maximize UAI's potential in shaping urban futures.

Many AI systems are embedded within tangible entities like computers, vehicles, or infrastructure, becoming essential to the AI's operation (Cugurullo, 2021). A case in point is Vienna's Intelligent Pedestrian Traffic Light (IPTL) initiative, which utilizes advanced surveillance and algorithms to automate pedestrian signaling, with goals like curbing jaywalking and enhancing traffic flow. In the context of the IPTL, “intelligence” refers to the prowess of smart surveillance combined with algorithmic traffic management. This system can detect and identify entities, predict movements, and assess behavioral trends at

intersections. Notably, this system is implemented at junctions with 'sans button' pedestrian traffic lights, where pedestrians must manually activate the signaling light. In this respect, the intelligent system comes to replace the activation required or possible at the crosswalk.

While the foundational algorithms of IPTL might seem straightforward, this ostensibly ordinary technology profoundly impacts urban environments and interactions between humans and transport. Given its role in Vienna's expansive sociotechnical ecosystem, the IPTL's aims and outcomes deserve in-depth examination. This article delves into the intricate interplay between technology, society, and urban spaces.

From a Science and Technology Studies (STS) vantage point, two aspects are vital when assessing the societal emergence of technology. Firstly, technologies aren't mere instruments; they are complex artifacts mirroring the visions of their creators (Akrich, 1992). They possess distinct characteristics that determine their function within particular social milieus. Secondly, technologies are not static; they are emergent processes, stemming from intricate material-semiotic networks (Law, 2004; Latour, 2005). These networks, comprising a range of actors from individuals to political entities, collaboratively dictate the artifact's societal role.

The widespread integration of AI into daily routines, driven by algorithmic governance, challenges the conventional “city-as-computer” metaphor, which perceives urban intricacies as programmable entities (Mattern, 2021, 62). It is also important to recognize that urban technological interventions draw and build upon the giant corporations’ imaginary of tech-solutionism, and they come with (un)intended reasons and (un)known effects that increases control over social order (Sadowski, 2020; Sepehr and Felt, 2023). The IPTL exemplifies such technological interventions, highlighting AI's role in urban mobility. It prompts us to question the types of urban space that emerge from these technological advancements (Tironi

and Valderrama, 2018). This research probes the IPTL's influence on public spaces, focusing on aspects of visibility and invisibility during its development and rollout.

To elucidate this, the research will delve into the underlying motives for the IPTL, the justification accompanying its introduction, and the urban dilemmas it aims to resolve. This involves scrutinizing expert narratives, gauging public responses, and evaluating the technology's design and execution. The investigation will also contemplate potential alternative strategies, providing a holistic perspective on the IPTL's repercussions on urban movement and spatial design.

Research Approach

This study undertakes a thorough examination of the IPTL's emergence, design, and deployment, focusing on the interplay between technical elements, societal actors, and urban mobility governance. By charting the network of involved actors—including designers, policymakers, experts, pedestrians, and other stakeholders—the research seeks to demystify the intricate associations underpinning the IPTL's inception.

Data collection encompasses in-depth interviews, observations, and document analysis. The study initiated with a review of publicly available documents, social media, and newspaper coverage from 2019 to 2021, honing in on the driving forces behind the IPTL's implementation. This entailed referencing urban policy documents, academic articles, and traffic management standards. Key sources include the UN Convention on Road Traffic, Geneva, 1949; academic works on traffic light evolution; the Vienna Urban Mobility Plan STEP-2025, December 2014; the Viennese Traffic Light Signaling System, (Verkehrslichtsignalanlagen RVS 05.04.31, 1960, updated in 1994); and the Programme "Mobility of the Future" (Mobilität der Zukunft MdZ)—RTI Agenda and Roadmap for

Personal Mobility, Vienna, August 2018. The IPTL project remains central to this document analysis.

Public relations materials from the IPTL, along with four academic papers from the computational design's scientific team, offer insights into the artifact's technical dimensions, its alignment with existing regulations, and AI's envisioned role in Vienna's future mobility. Media coverage from prominent Austrian outlets, such as Kronen Zeitung, Der Standard, and Kurier, coupled with a radio segment on ORF.at, further illuminate the IPTL's Vienna implementation. Twitter searches also contribute, capturing public discussions and experiences related to Vienna's traffic lights, including IPTL mentions.

To supplement the document review, the research incorporates direct observations of the IPTL prototype tested at five diverse Vienna locations. Over ten hours of field visits, conducted between March and September 2021, centered on the temporal dynamics of crossings where the IPTL was active. These observations captured the varied rhythms of users and identified different pedestrian types and mobility modes. The goal was to grasp the pedestrian experience with the operational IPTL, offering insights into behaviors and associated temporal dynamics.

For a deeper technical understanding and insight into the IPTL's design challenges, comprehensive interviews were held with six experts integral to the project. Interviewees, chosen based on their IPTL design roles, included members from the Technical University of Graz and experts from Vienna's Traffic Management Department. These discussions aimed to capture expert perspectives, decision-making processes, and the sociotechnical factors influencing design decisions. The gleaned insights offer a rich context for interpreting the IPTL's impact on pedestrian temporal rhythms.

Subsequent paper sections situate the analysis historically, retracing traffic lights' evolving roles in cities and their urban space transformation favoring vehicles over pedestrians. Building on this historical foundation, the research probes traffic lights' contemporary role as temporal regulators, culminating in a detailed exploration of the IPTL's current significance and implications in Vienna.

HOW TRAFFIC LIGHTS TRANSFORMED STREETS AND ITS USERS

Traffic lights stand as one of the most influential inventions of modern times. Few innovations have achieved the universal adoption that traffic light signaling mechanisms have (McShane, 1999). They epitomize the potential for a global law and order system (Zeno-Zencovich, 2016). The traffic light's invention and widespread adoption tell a captivating tale of streets transitioning from primarily pedestrian spaces to thoroughfares for cars. Peter Norton's "Fighting Traffic" (2011) chronicles the transformation of American streets during the early 20th century. As automobile numbers surged, fatal accidents skyrocketed in the 1920s. This alarming death rate sparked public concern, leading to media debates and calls for official intervention. This period saw a public discourse about the purpose of streets and their rightful users (Norton, 2007, 331).

Various societal groups, each with their values and aspirations, proposed solutions. The Motordom lobby group, representing the American Automobile Association, was particularly influential. They championed cars as symbols of freedom and American progress (Norton, 2014). Their campaigns promoted streets as spaces primarily for unhindered vehicular movement, advocating for the removal of pedestrians. Pedestrian traffic lights emerged as tools to achieve this, keeping pedestrians off the roads. The term "jaywalkers[1]" was coined

[1] Joseph Stromberg (Nov 4, 2015) explains the etymology of the word of Jaywalking on *Vox* mentioning that: "during this era, the word 'jay' meant something like 'rube' or 'hick' — a person from the sticks, who didn't

during this era, derogatorily referring to those violating traffic rules as individuals ignorant of city walking norms (Norton, 2014, 25).

While traffic lights aimed to ensure safety and order, they also introduced a new disciplinary regime. With their installation came the policing of "jaywalkers[2]," distinguishing between compliant and non-compliant citizens. Traffic lights didn't merely regulate behavior; they were part of a broader transformation prioritizing automobility (Sheller and Urry, 2000). They redefined urban spaces. Symbols like traffic lights and the concept of jaywalking facilitated and visualized these spatial transitions, underscoring the need for democratic scrutiny.

The sociotechnical reshaping of streets was a facet of broader spatial and environmental shifts. Mumford (1964) had cautioned about the detrimental impacts of rampant highway construction and car usage. He foresaw cities overwhelmed by vehicles and deteriorating highways. Presently, cars contribute significantly to environmental degradation through CO2 emissions and consume vast urban spaces. Streets, often occupying up to a third of a city's built environment, predominantly cater to cars[3]. This vehicular prioritization has come at substantial costs, with streets becoming sites of congestion, accidents, trauma, and political contention (Braun and Randell, 2022b).

Calls for more livable streets are gaining momentum[4]. Activists and urbanists champion a shift in transportation priorities. Concepts like carless cities, 15-minute cities, and open streets are gaining traction. These urban discourses, in various ways, advocate for reclaiming

know how to behave in a city. So pro-auto groups promoted use of the work ‘jay walker’ as someone who didn’t know how to walk in a city, threatening public safety.”

[2] Goodyear, S.: The Invention of Jaywalking, in: The Atlantic Cities, 24.04.2012, http://www.theatlanticcities.com/commute/2012/04/invention-jaywalking/1837/

[3] In Vienna the surface area of the street takes up %14,5 of the city area and almost %25 of the built environment. See more here.

[4] see *Platz fur Wien* campaign.

streets from cars, creating more public spaces (see Sheller, 2018 for discussions on 21st-century mobility justice). However, the role of traffic lights in this transformation, especially with the advent of new traffic control technologies, remains underexplored. This article seeks to address this oversight, spotlighting traffic lights as pivotal temporal regulators of urban spaces.

Traffic Lights and the Temporal Ordering of Space

Historically, the role of temporalities in shaping space has been overlooked. Monstadt (2022) posits that viewing through the prism of temporality and urban rhythms enhances our grasp of how infrastructures influence urban change. Infrastructures, the author notes, are intertwined with past legacies while simultaneously bridging present aspirations and future ideals. This temporal alignment often witnesses conflicts between established infrastructures and the promises of emerging technologies. The IPTL exemplifies this, offering AI-driven efficiency while anchored to traditional urban traffic management paradigms.

Traffic lights inherently prioritize certain modes of transport over others (Coletta, Röhl, and Wagenknecht, 2020). Their design dictates priority based on the time allocated to different mobility modes and traffic flows (Coletta and Kitchin, 2017). As rhythmic regulators, they choreograph the movement of both humans and objects within urban spaces. Consequently, the IPTL initiative finds itself at the nexus of competing interests concerning temporal ordering and diverse mobility modes.

Coletta and Kitchin (2017) explore how computational algorithmic management reshapes urban rhythms. Drawing inspiration from Miyazaki's (2013) concept of "Algorhythms," they introduce the term "algorhythmic governance" to analyze how smart cities monitor and regulate the multifaceted temporal rhythms of urban existence. They challenge us to reconsider measures, linearity, and cycles as outcomes of rhythm-creation processes (Coletta

and Kitchin, 2017, 4). The diverse uses and users in varying contexts necessitate a deeper examination of the power dynamics and control exerted by temporalities.

Mobility's power dynamics invariably manifest in space (Cresswell, 2006; Sheller, 2017). Mobility takes various forms, each conveying a distinct “power as a productive, enabling, and local force” that highlights specific mobility modes within space (Jensen, 2011, 258). Jensen (2011) advocates for a broader understanding of mobility's power dynamics by focusing on the practices, rationalities, and emotions associated with mobility, which are deeply rooted in the political and social fabric of urban spaces. Simultaneously, the varied interpretations of common governance objects in different locales present intriguing contrasts (Woolgar and Neyland, 2013).

Consider the varied interpretations of traffic lights across cities. In Vienna, pedestrians typically adhere to red signals, even when no vehicles are in sight. Woolgar and Neyland (2013) contend that governance practices linked to everyday artifacts, like the IPTL, reflect the politics and established norms of collective behavior. They emphasize that the sociotechnical aspects of daily life revolve around rule-setting, behavior monitoring, and adherence to these rules (Woolgar and Neyland, 2013, 6). Yet, a rich STS tradition reminds us to question the status quo and envision alternative approaches to technological phenomena. That is to say “any particular set of actions or behaviours in relation to [a technological] phenomena, it could be [approached] otherwise” (Woolgar and Neyland, 2013, 7). This perspective encourages analytical skepticism, prompting us to delve deeper into the political, scientific, and material choices underpinning new artifact development.

Building on this foundation, the subsequent chapter will dissect the IPTL's role in temporally ordering mobility within space, highlighting the new associations and implications AI introduces for automating routine urban activities.

THE INCEPTION OF IPTL: JUSTIFICATIONS, DESIGN, AND TESTING

Justifications to initiate the IPTL

Vienna operates approximately 1,300 pedestrian traffic lights, of which 200 employ a "sans button" system. These traffic lights require pedestrians to press a button to activate the signal, allowing them to cross. Locally, these are referred to as "Bettlerampel," translating to "beggars' traffic light." They are typically found on busy roads with infrequent pedestrian traffic, activating only upon request. A traffic engineer from the City of Vienna highlighted a challenge with the sans button system, noting, "they often lead to misunderstandings and confusion since pedestrians anticipate the signal to change automatically." To address this, the Traffic Light Department of the City Administration (MA 33) collaborated with the Computer Vision and Surveillance Lab of the Technical University of Graz (TUG) to develop a system that detects pedestrians intending to cross, thereby changing the signal without manual activation (Ertler et al., 2018).

Elaborating on the issue, an expert from the research group shared, "Initially, pedestrians might be unaware that they need to activate the traffic light using the sans button system, which can cause delays." The confusion is exacerbated as the button box bears a resemblance to the acoustic signal systems designed for the visually impaired. The expert added, "Even if a pedestrian activates the button, they might cross immediately if the road appears clear, effectively jaywalking." This behavior has a cascading effect: "After the individual crosses, the light turns red, halting vehicular traffic even though no pedestrian is present." The primary concern is the unnecessary delay for both vehicles and pedestrians unfamiliar with the pushbutton system. Summarizing the objective, the TUG expert stated, "to get rid of the pushbutton box [sans button] and replace it with a more reliable and automated system."

Design Protocols

To address the sans button system's challenges, MA33 invited the TUG team to propose a solution using intelligent surveillance technology. Initially, the research team conducted a feasibility study. As one interviewee explained, the study's purpose was to establish a shared understanding with the client, document the project's objectives, estimate the budget, and outline the implementation steps. In essence, the feasibility study reviews current state-of-the-art techniques to present various technical options aligned with the project's aim. This study acts as an *inscription manual* (Akrich, 1992) that "define[s] a framework of action together with the actors and the space in which they are supposed to act in" (Akrich, 1992, 208). Thus, it delineates—or in Akrich terminolody it *de-scribes*—the technology's purpose, its users, and the ideals, morals, and values it embodies. Unfortunately, social scientists that want to get hold of the feasibility study will face fierce rejection, so this study cannot say much about it.

Nevertheless, it was possible to comprehend how certain sociopolitical presumptions influenced the design protocol and technical development. For instance, privacy concerns were high, given the use of smart camera surveillance technology, which complicated the project. To address this as a requirement, the team adopted a "privacy by design" approach, ensuring all data remained within the camera to prevent potential image leaks. This design choice posed technical challenges, as finding a reasonably priced processor capable of analyzing data from a high-resolution camera proved difficult. The team had to balance camera resolution quality with the processor's capabilities. Media coverage of the innovation consistently highlighted the project's success in preserving privacy, indicating that public sensitivities influenced the technology's development.

The TUG research team, during the research phase, introduced a more advanced prediction system that offered features beyond the initial proposal. Utilizing global

movement models and recorded data, they developed learning algorithms that detect a pedestrian's intention to cross even before reaching the traffic light. As one TUG expert explained, the camera can identify everyone “within an eight by five meters field of view in seconds!” The rapid processing mechanism “takes one second for an initial estimate, which becomes reliable after just two seconds, resulting in a total prediction duration of less than four seconds.” This speed surpasses manual activation, leading to a more efficient traffic flow.

The TUG researcher further detailed three primary functions of the new system, extending beyond the project's initial objectives: (1) If pedestrians are in the designated waiting zone, the signal automatically turns green. (2) If a pedestrian departs before the signal turns green, the signal change halts, allowing uninterrupted vehicular flow. (3) For larger groups, such as schoolchildren at peak times, the green phase extends automatically. These functions emerged from lab experiments, which not only sought the best technical combination within the project's scope but also unveiled new technical capabilities. Thus, the lab experiments illuminated new possibilities and capacities.

The Street Trial of IPTL

Upon finalizing the best configuration, the next step involved creating a prototype and initiating a trial phase in public spaces. Drawing from Marres' case study on intelligent vehicle testing in the UK (2020a; 2020b), streets serve as public trial spaces for introducing societal innovations. She identifies this as a “double-edged operation” effect (Marres, 2020b, 113). On one side, it's about engaging with citizens, inviting them to interact with the new artifact, which in turn helps designers gather feedback. This feedback encompasses the public's use, opinions, needs, desires, and even potential rejections of the artifact. On the flip side, the trial also serves to normalize the new artifact in the public's daily life, making it a familiar entity.

Marres (2020a) champions a “re-constructive approach” in design protocols, emphasizing the importance of how social aspects are rendered visible or become obscured during tests (Marres, 2020a, 540). The IPTL's street trial phase mirrors Marres' findings. While the trial was designed to have a double operation effect, it seemed to miss the mark on capturing the full social dynamics in its design protocol.

The IPTL trial was conducted at five different crossings throughout the city. These locations were strategically chosen to represent a variety of crosswalk situations. For instance, one was near a busy intersection adjacent to a metro station, while another was situated in front of a bustling shopping mall. The trial phase's primary goal was to usher the IPTL into society, aiming to replace the older technology with a more advanced AI-automated system. However, soon after the trial's initiation, two significant challenges emerged.

Firstly, the city of Vienna received complaints from the Association for Early Intervention for the Blind, Visually Impaired, and Multiple Visually Impaired People. Given that all pedestrian traffic lights in Vienna are equipped with a sonic guide system that closely resembles the sans button box, this presented a challenge. The sonic guide system had to be incorporated, which directly conflicted with the project's aim of eliminating the box. Secondly, despite the system's rapid ability to detect a pedestrian's intention to cross, a safety margin was still mandated before the traffic signal could change. This requirement rendered the system's impressive 4-second detection time moot in practical scenarios.

The trial phase illuminated a disparity between the technology's theoretical promises and its real-world delivery. The technology, which promised efficiency and reduced confusion, fell short due to stringent safety regulations and a narrow understanding of its user base. Notably, the needs of visually impaired pedestrians were overlooked, effectively rendering them an “invisible” user in the design process. This oversight might have been addressed

earlier if the feasibility study had been open to public-expert commentary. Instead, the experts appeared to have a homogenized view of users.

In response to these challenges, two new developmental paths were proposed, leading to a subsequent project. First, engineers sought to integrate higher-resolution cameras and faster processors to enhance the system's ability to detect individuals with disabilities. Second, to amplify the system's impact, it was proposed that the entire street be integrated into the system. This integration would facilitate a broader data collection, optimizing traffic flow across multiple intersections. For the engineers, improvement was synonymous with enhancing the system's detection capabilities. However, this was strictly from a technological perspective.

Throughout this process, a myriad of technical and social (in)visibilities came to the fore. A combination of sociotechnical elements steered a series of decisions and adjustments in the design protocol and prototyping. The initial design protocol's oversight of certain user needs prompted a reevaluation of both design and implementation. This oversight is reminiscent of a classic social deficit model, as described by Marres (2020a). To address this, the study proposes a reconstructive approach, reimagining the otherwise sans button system.

The Mission Impossible: Coordinating Disparate Rhythms of Mobility

Building on the challenges and intricacies of the IPTL's deployment, it became imperative to delve deeper into the nuances of pedestrian behavior in relation to traffic management. This led to empirical observations across the city, specifically focusing on the sans button crosswalks. The aim was to discern and observe the myriad ways pedestrians interact with these crosswalks, providing a tangible context to the theoretical discussions on traffic management.

During the fieldwork, four distinct types of pedestrian behaviors were observed at sans button crosswalks:

(1) Locals familiar with the sans button system: These individuals are well-acquainted with the sans button. Upon reaching the crosswalk, they promptly activate the button and wait for the green signal.

(2) Locals who rely on traffic rhythm: This group, while aware of the sans button, opt not to use it. They have an innate understanding of the traffic rhythm and cross when they deem it safe.

(3) The car-stoppers: These pedestrians, aware of the button, press it but don't necessarily wait for the green signal. They cross when they spot an opening in the traffic, potentially causing delays for vehicles. This is perhaps the group that causes unnecessary waiting time for cars, deliberately or not. In the case of the deliberate car-stoppers, they are contesting against the unjust priority granted to cars in a mundane way. They can stop cars unnecessarily to complain, just like in many cases a pedestrian traffic light does to pedestrians. IPTL will take away this possibility.

(4) Unaware pedestrians: Typically tourists or non-locals, these individuals are unfamiliar with the sans button system. They often rely on other pedestrians to activate the button or wait for a natural break in traffic to cross.

The behaviors of these groups underscore the significance of local knowledge. The first three groups, familiar with the sans button, adapt their actions based on the situation. The first group activates it right away and waits until the signal turns green to pass. The second group is not bothered by the sans button and follows the traffic flow. The third group protests automobility via engagement with the sans button. The fourth group often overlooks the sans button due to its inconspicuous design, merely, the sans button is not visible enough.

Empirical observations also revealed that the timing of pedestrian signals is often influenced by the preceding traffic light. The signal schedule is designed to minimize traffic disruption, but this often results in a 40-60 second delay between the last car passing and the pedestrian light turning green. The traffic flow calculation sums the total distance taken by a car within the speed limit. The duration of the travel then is the average time span for a car to get from one point to the other. In a sense, the jaywalkers are the people who know this and find it unreasonable to wait for the traffic light to grant them a pass. Even this problem can be solved with a slightly better adjustment of traffic signaling system.

Upon consulting a traffic engineer from MA33, several reasons for this delay were identified. Regulations mandate a safety margin during signal changes, which can take up to 15 seconds. Additionally, the method used to calculate traffic flow, based on average car speeds, can contribute to this delay. In Vienna, traffic flow is typically gauged on long, straight roads, taking into account intersections and traffic lights. However, these measurements can be skewed by drivers who exceed speed limits. Some drivers in Vienna have even realized that by accelerating beyond the speed limit, they can bypass multiple red lights, effectively becoming "*Jaydrivers*."

A traffic control manager from MA33 described the intricacies of traffic management as a "mission impossible." The challenge lies in balancing the needs of various road users (cyclists, motorists, pedestrians, public transport) within the constraints of road space and signal timings. This is how he described the situation: "different parties must be included: cyclists, motorists, pedestrians, public transport. Then we only have a limited road space and a limited green light time! Bringing these two limitations together it is very challenging to keep everyone happy! It is the mission impossible." The traffic light signal regulation

(VLSA-RVS 05.04.31)[5], which mandates a 90-100 second signaling cycle for all traffic lights in Vienna, further complicates matters. This fixed cycle offers limited flexibility, influencing drivers to speed to match the green cycle and causing pedestrians to wait unnecessarily.

Challenges in Altering Traffic Management in Vienna

Following the complexities of the IPTL's deployment and the intricacies of pedestrian behavior, a deeper exploration into the broader traffic management approach in Vienna was warranted. During a conversation with a traffic engineer from TUW, the challenges of altering the city's traffic management system were brought to the fore.

The engineer highlighted the financial and systemic constraints, noting, “It would be very difficult to change the signaling program in Vienna. Unfortunately, one has to change the whole system, and that would cost a lot of money.” He further elaborated on the challenges of integrating human behavior into traffic models, stating, “You can collect tons of data, but then it would be very difficult to rationalize it based on a model as a simplified version of reality, because human nature doesn't really follow rational thinking all the time.”

Historically, traffic modeling has often overlooked the nuances of human behavior and adaptability. The engineer explained, “Models cut part of the reality to make it functional, or they exclude it as a factor for various reasons, including predictability and challenges in measuring it. So, when there's a change in the network, it's perceived as a new network, and the model sees it as a fixed reality. This perspective is also influenced by how data is collected and how modes of transport are understood as the basis of modeling.” This

[5] RVS 05.04.31 Einsatzkriterien - Verbindlicherkärung + Grundtext

perspective underscores how technology can sometimes solidify a particular version of reality, offering solutions to problems that might not even exist in the way they're perceived.

However, the technology's promise of new capacities doesn't necessarily translate into a reimagined vision of future traffic. This limitation can be attributed, in part, to the traditional role traffic lights play in traffic management. Research by Frey et al. (2011) critiques the current traffic management infrastructure in Vienna, labeling it as both inefficient and unjust. The system's primary focus on automobility overlooks the need to account for the dynamic nature of traffic, which evolves over time. Frey and his colleagues argue that a software-centric view in traffic management fails to recognize that "human beings are far more adaptable to changing conditions [of streets] than is represented in the software" (Frey et al., 2011, 73). This adaptability is evident in phenomena like jaywalking, which arises from pedestrians' situational understanding of traffic flow and street conditions.

Reimagining IPTL and the Dynamics of Urban Mobility otherwise

The urban landscape is a testament to human adaptability and the inherent flexibility of our movements. Leth, Frey, and Brezina (2014) have championed the cause of decriminalizing jaywalking, not just for pedestrians but also for cyclists. Their research underscores how traffic regulations and modeling, exemplified by systems like Vienna's traffic lights, have historically marginalized non-motorists. The call to action is clear: future traffic modeling must transcend the narrow confines of automobility (Sheller, 2017; Braun and Randell, 2022a). This entails a paradigm shift, moving away from car-centric mobility to a more inclusive model that prioritizes human rhythms. It is about reimagining spaces where pedestrians are central, not marginalized as jaywalkers due to outdated regulations. In this context, there is an imperative to rethink and redesign traffic lights and their role in urban mobility.

One visionary who dared to think otherwise about traffic management was Dutch traffic engineer Hans Monderman[6]. In the early 2000s, Monderman introduced the "shared space[7]" model, a radical departure from conventional traffic management. His approach emphasized simplifying street design, eliminating the clutter of traffic signals, signs, and road markings. Monderman believed that an over-reliance on technology and physical barriers not only undermined people's common sense and intelligence but also eroded the collective sense of responsibility and individual connection to space. His vision was to move away from rigid control mechanisms, fostering human connectivity and communication on the streets.

In a similar vein, London has recently piloted an innovative "pedestrian priority" approach (Revesz, 2022). This system defaults to a green signal for pedestrians, only turning red when vehicles approach. The underlying technology is straightforward: sensors detect moving objects from a distance. The results have been promising, enhancing street safety, saving pedestrians considerable time (about 1.3 hours), and increasing compliance with traffic signals. Moreover, the system is cost-effective, sidestepping privacy concerns inherent in more complex technologies.

Spain has leveraged similar sensor technology, albeit for a different purpose: curbing speeding on rural roads. These sensors not only alert speeding drivers (*jaydrivers)* but can also halt vehicles that flout speed limits. Drawing inspiration from these examples, Vienna has the potential to redefine its approach to traffic management. By prioritizing pedestrians and leveraging simple, effective technologies, the city can foster safer, more democratic urban spaces.

[6] The Guardian has a review of Monderman's traffic model and proposes it for the UK: https://www.theguardian.com/news/2008/feb/02/mainsection.obituaries

[7] Read more about this project and its new development here: https://www.pps.org/article/shared-space

To truly democratize urban spaces and challenge the dominance of automobility, it's essential to cultivate new visions of what streets can and should be.

Conclusion: Reimagining Traffic Lights in the Age of AI

Traffic lights, omnipresent in urban landscapes, subtly dictate our daily movements. Yet, their political ramifications often go unnoticed. While primarily orchestrating traffic, they inadvertently champion automobility. The advent of Vienna's Intelligent Pedestrian Traffic Light (IPTL) has prompted a deeper exploration into the broader sociotechnical interplay of streets and mobility. This study probed the IPTL as both an artifact and a transformative process, spotlighting its role in unveiling the often-overshadowed temporal controls within urban settings. The IPTL emphasizes the nuances of everyday governance and necessitates a reevaluation of technological manifestations in public domains.

The IPTL's emergence in Vienna provides insights into the intricacies of deploying AI-driven solutions in urban contexts, insights that resonate globally. As smart cities increasingly harness technology for urban governance, Vienna's experiences become instructive. Cultural norms shape perceptions of practices like jaywalking, which varies from commonplace in some cities to a penalized act in others. Recognizing these cultural distinctions is pivotal when crafting AI interventions, as universal solutions may falter.

The IPTL serves as a lens into the challenges and prospects of “mundane urban governance.” With cities globally integrating AI into their fabric, Vienna's lessons underscore the need for comprehensive, inclusive strategies that resonate with the diverse urban populace. As we navigate the dawn of AI-enhanced urban governance, the IPTL exemplifies both the potential challenges and rewards. Drawing from these insights can guide us towards more inclusive and equitable urban futures.

Throughout the IPTL's journey, themes of (in)visibility consistently surfaced. The research pinpointed a deficiency in understanding traffic lights as temporal regulators and rhythm influencers. This shortfall was glaringly evident in the oversight of the visually impaired community during design phases. The system's limitations were twofold: it overlooked diverse user needs and lacked an innovative vision for pedestrian crossings. The IPTL's primary aim—eliminating the sans button—appeared myopic, bypassing the broader intricacies of urban movement.

The IPTL's introduction marks a pivotal juncture, offering an opportunity to challenge the long-standing paradigms of car-centric mobility. This research champions a reconstructive approach, advocating for a pedestrian-centric vision augmented by technology. Such a perspective demands a holistic grasp of urban dynamics, acknowledging the myriad needs and aspirations of its denizens. It also necessitates a critique of prevailing tech-solutionist narratives, which often prioritize control over societal enhancement.

The neglect of the visually impaired in the IPTL's design prompts reflection: why were their needs sidelined? An encompassing engagement with the multifaceted utilization of urban spaces is imperative. Echoing Akrich's (1992) insights, this engagement should be foundational to design protocols, ensuring urban initiatives are deeply rooted in their sociotechnical milieu. By recontextualizing jaywalking from an individual misdemeanor to a sociotechnical interplay, this study accentuates the pivotal role of traffic lights in the complex choreography of urban mobility.

Furthermore, the study's findings underscore the importance of considering the socio-cultural implications of technological interventions. The IPTL, while innovative, inadvertently perpetuated certain biases and overlooked the diverse needs of urban dwellers. This oversight not only highlights the challenges of designing inclusive AI-powered solutions but also underscores the broader implications of such interventions on urban governance and

mobility. The case of Vienna serves as a cautionary tale, emphasizing the need for a more holistic and inclusive approach to urban planning and governance.

In conclusion, as cities worldwide grapple with the complexities of integrating AI into their infrastructures, the lessons from Vienna are instructive. They highlight the importance of a democratic, inclusive approach that takes into account the diverse needs and aspirations of all urban dwellers. This is only possible if a much wider range of actors are engaged int the process of design and prototyping of the artifact. As we stand on the cusp of a new era of AI-powered urban governance, it's imperative to approach these innovations with a critical, informed perspective that reflects citizens needs and desire for what kind of urban spaces we wish to create. The introduction of the IPTL offers a window into the potential pitfalls and promises of such interventions. By learning from these experiences, we can pave the way for more inclusive, effective, and just urban futures.

Disclosure Statement

The author reports there are no competing interests to declare.

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5. Conclusion

“Imagine if we grafted social and epistemic infrastructures onto technical and architectural ones, and if we valued public design, ownership, and maintenance of those systems. Imagine if we cultivated urban rootstock that prioritizes environmental, racial, and digital justice over efficiency; that draws nourishment from epistemic pluralism, blending computational logics with feral intelligences, sensory experiences, and local knowledge. A city built to recognize the wisdom ingrained in its trees and statuary, its interfaces and archives, its marginalized communities and more-than-human inhabitants is ultimately much, much smarter than any supercomputer.”(Mattern 2021, 166)

5.1 The 'Response-able' Smart City: A Path Towards Inclusive Urban Innovation

This thesis has undertaken an exploratory journey through the complex terrain of smart city development, with a specific emphasis on Vienna. As we approach the conclusion of this thesis, it is crucial to consolidate the insights gained and contemplate their wider implications for the evolution of smart cities.

Drawing from the fields of Science and Technology Studies (STS) and urban studies, this research underscores the academic challenge of defining the concept of a smart city. It also raises questions about the visibility and manifestation of smart cities within urban policy and practice. The notion of a singular, definitive smart city is debunked; instead, the existence of diverse smart cities is acknowledged. These smart cities emerge in various forms, contingent on who is conceptualising them, when, and where.

The ambiguity inherent in smart cities is also seen as a characteristic strength. This fluid state of formation allows for a multitude of actors to interpret and connect with the concept in their unique ways, thereby involving a wide range of participants. However, the ambiguity of the smart city concept, as unveiled through this research, is a double-edged sword. While it allows for flexibility and a variety of interpretations, it also presents challenges in terms of coherence and effective implementation.

The research revealed that smart cities are not monolithic structures but are shaped by the interplay of various factors including technology, governance, social dynamics, and historical contexts. In the case of Vienna, the research brings to light both the opportunities and challenges in smart city development. The city’s historical and cultural contexts significantly influence its smart city initiatives. However, there is a call for increased reflexivity and critical engagement with technology.

In this context, the concept of 'response-able' innovation, as articulated by Felt (2017), provides a guiding principle for responsible smartification. It underscores the need for innovation to be not just accountable and liable, but also responsive to emerging issues. This calls for a proactive approach to governance, where technological transformations are not only acceptable but also societally desirable.

Becoming a 'response-able' smart city involves creating an environment where diverse voices are included, and where there is ongoing reflection on the limitations, exclusions, and emerging realities of the smartification process. Based on this principle, I will reflect on the findings of this research to suggest ways to approach Smart City Vienna (SCW) in a 'response-able' manner.

5.1.1 Reimagining Smart Cities: A Response-able Approach to Urban Innovation

This research has critically examined the narratives and storytelling that underpin the smart city model, with particular attention to the power dynamics inherent in these narratives (Sepehr and Felt 2023). The study delves into the sociotechnical imaginaries and underscores the necessity of democratising urban visioning in a responsible manner.

As we ponder the future of smart cities, it is essential to acknowledge that this is a rapidly evolving and dynamic field. The concept of the smart city must be continually reimagined and redefined to accommodate the shifting needs and priorities of urban environments. This necessitates a commitment to learning, adaptation, and responsible innovation and research. The research recognised the need for more nuanced languages that acknowledge the complexity of the problems at hand, the fact that technology will not provide a panacea, and the reality that cities will evolve alongside technological advancements.

Consequently, urban policies and narratives require continual updating. This necessitates a consideration of timescales and an acknowledgment that the city is in a constant state of flux. There is a pressing need for a nuanced engagement with the various aspects of urban

life's complexity on an ongoing basis, rather than as isolated events at specific times driven by the hype surrounding the prevailing discourse of smart urbanism. This calls for a reflection on the need for a more nuanced language around smart city narratives and the capabilities of technologies.

In this context, the research underscores the importance of citizen participation and engagement in smart city development. It is vital for citizens to have a voice in shaping the urban environment and to be actively involved in decision-making processes from the outset, particularly when a new urban vision and policy are at stake. This necessitates the creation of urban spaces for dialogue, collaboration, and critical reflection. Therefore, the smartification of the city should not be viewed as a mere technological shift but as a societal experiment that requires careful scrutiny.

The research also calls for the adoption of a more nuanced understanding of the possibilities that technology can offer us. It emphasises the need to consider power structures and to engage in long-term planning. The transformation of a city into a smart city is not just about implementing smart technologies; it is about creating a city that is inclusive, reflexive, and responsive to the needs and concerns of its citizens (de la Bellacasa 2017; Haraway 2008). It is about fostering a culture of participation where citizens are not just passive recipients of technological innovations, but active contributors to the shaping of their city.

5.1.2 Democratising the Smart City: Participation, Power, and the Role of Citizen Engagement

In our discussion in Paper II, we explored the relationship between democracy, participation, and smart city initiatives. While these initiatives have the potential to enhance communication between citizens and local governments, our research has revealed that genuine citizen participation is lacking in most smart city projects. The current practices of public engagement tend to prioritise technical solutions and project-based thinking, which often overlooks the underlying societal issues that need to be addressed. It is crucial for us to

consider power structures, social hierarchies, and relations of power in order to identify and rectify any inequitable or unjust practices.

We also highlighted that while policy papers tend to be broad and generic, participatory activities tend to focus on specific and well-defined issues, from the perspective of those who have the power to define them. This creates a fragmented approach to participation, limiting the scope of who should ideally be involved in each project and constraining participation to fit within the project's framework. This managerial approach to participation risks overlooking the interconnectedness of various issues, experiences, and participatory collectives, as well as the complexity and non-linear nature of transformation processes.

Given that any form of participatory assembly inherently implies collective experimentation, it's crucial to thoroughly examine and comprehend the social context in which the city's residents live, a context that you are also contributing to shape. This research emphasises the importance of maintaining responsiveness throughout the design process, paying close attention to the stages that precede and follow any discrete participatory event, thereby extending beyond the confines of project-based logic. In practical terms, this means that if we are to take participation in urban reinfrastructuring seriously, we must adopt a more process-oriented approach over extended periods.

For instance, if you are contemplating digital inclusion and civic participation, it is important to have a meaningful and well-defined process for achieving these objectives, as well as a way to assess whether these efforts were successful or if the digitalisation initiatives you launched actually resulted in actionable outcomes. Additionally, it is crucial to prioritise the needs and concerns of the most vulnerable, marginalised, and socially disadvantaged populations, and carefully consider the potential risks and benefits they may encounter through the proposed initiatives.

How can we ensure that all residential communities and populations are actively involved in the decision-making and evaluation processes of smart city initiatives right from the start, rather than simply tokenizing their inclusion at the end? This would involve dedicating resources towards conducting inclusive listening sessions, and genuinely learning about the diverse knowledge and experiences of city residents.

Additionally, how can we lead civic-minded and socially just democratic efforts to achieve these objectives, while also seeking expertise from sources beyond municipal governments and engineering/computer science departments at universities? It is crucial to invite a wide range of voices and knowledge from external sources in order to achieve these goals effectively.

To gain a comprehensive understanding of successful projects and their positive outcomes, it is crucial to focus on smaller initiatives that have been deemed successful not only by public officials but also by community members. These smaller projects, rather than large-scale metropolitan endeavours, deserve more attention. It is of utmost importance to pay close attention to the accomplishments achieved on a smaller scale. Therefore, the guiding question to explore should include historical inequities in the city, problems identified by citizens that require immediate or long-term solutions, and grassroots initiatives driven by the local population. As municipal officials, it is essential to prioritise these initiatives, as they may have the potential to be scaled up or receive resources to further enhance the quality of life in these local contexts.

5.1.3 Beyond Technology: The Sociotechnical Dynamics of Smart City Development

In Paper III, I underscore the need for a critical evaluation of the necessity of digital technologies in smart city projects. The dominant discourse often overlooks the importance of discerning whether digital technologies are required, or if they are merely available. It is

crucial to address the issues and questions that arise in discussions with citizens and determine the necessity of these technologies in that context.

The utility of revisiting and experimenting with traffic lights or other technologies is undeniable. However, the real challenge lies in addressing mobility issues. Encouraging walking, cycling, and public transportation usage can be more effective than continually optimising the road network. Smart city solutions often serve as temporary fixes rather than long-term, sustainable, and resilient solutions. Cities must question whether investing in public transport and cycling infrastructure could be more beneficial than upgrading their intelligent transport systems.

A thorough evaluation of the utility of technology is essential. It is crucial to determine whether the technology is useful and capable of solving a critical problem. The focus should be on finding the appropriate level of utility for the technology, without overselling its capabilities. It is important to consider whether the technology is being used sensibly, whether it can maximise benefits while minimising harmful effects, and whether it is aware of what these harmful effects might be.

Reflecting on the meaningfulness of the technology is necessary. This reflection should consider how the technology will change governance and citizenship, whether it will deepen spatial social inequalities, and whether it is serving all citizens. Questions around fairness, equity, citizenship, justice, and bias should be addressed. There should be oversight and redress systems that evaluate each project and determine whether it will truly serve our citizens, rather than merely creating a profit line for a company with a technology that provides marginal benefit.

Thinking about the social context also requires considering it in the technological context. This involves thinking about what technology might mean to city government at a local level, understanding the relationships different populations have with technology, and reflecting on

past city government initiatives. Reflecting on the specific social, cultural, economic, and technological context in which new or different smart city initiatives are being implemented is crucial.

We should avoid reducing urban dynamics to static forms, neither solely human-centred nor technology-centred, and instead encourage thinking through the relationship between the city and technology, with the character of the city as a central theme. In STS, the tradition of thinking about how things can be otherwise is key, which implies not only finding technological solutions but also questioning the ways in which problems are understood, framed, and applied to specific situations. Any attempt to foster responsible urban innovation, however technical, can and should be enhanced by sociotechnical analysis and understanding. This entails learning from history, and being attentive to the diverse needs and values of all inhabitants, which should expand to the environment and multispecies forms of life.

5.2 Final words

Jane Jacobs insightfully stated in 1961, “Cities have the capability of providing something for everybody, only because, and only when, they are created by everybody” (Jacobs 2011, 238). This sentiment is echoed by Shannon Mattern (2021), who challenges us to reimagine the fabric of our cities. This vision calls for a reorientation of urban innovation, one that is grounded in social values, environmental sustainability, and justice. It is a call to recognise the diversity and richness of urban life and to create cities that are not just technologically advanced but are also wise in terms of social cohesion, collaboration, and democratic processes.

To move towards responsible and just urban innovation in Vienna, we may need to reconsider the notion of smart cities. The term 'smart city' has often been associated with data capitalism and surveillance technology, which can enhance control and social order but

leaves little room for a caring and interactive space. Such a space should be filled with social life and social interaction. Even when the notion of smart city is localised with a socialist or green approach, it still falls into the trap of technological solutionism. There is nothing inherently wrong with technological advancement, but as repeatedly mentioned in the literature, the concept of smartness comes before the city, which is a problematic agenda.

Drawing inspiration from Toronto's shift away from the 'smart city' concept, the focus should be on creating a city that is smart—prioritising innovation (Jacobs 2022), involving the community, and addressing ethical and social implications. The future of urban innovation lies in cultivating inclusive, sustainable, and just environments co-created by everyone. This forms the foundation for a truly smart city—one that is not only technologically advanced but also socially wise and equitable.

As cities like Vienna continue their journey towards becoming smart cities, it is hoped that the insights and recommendations provided in this thesis will guide them towards a future that is not only technologically smart but also socially responsible, sustainable, and value-driven. By interrogating the values that underpin and are actualised through innovations, promoting a culture of active citizen participation, and constructing a 'response-able' smart city. This thesis calls for a paradigm shift in smart city development, emphasising inclusivity, reflexivity, and responsiveness to the needs and concerns of citizens.

As city officials, to gain a thorough understanding of your city's situation, consider the following questions:

- Can you identify and explain the historical injustices that exist in your city, particularly how they have affected different communities or groups?
- What urgent issues have your city's residents previously pinpointed? Can you describe these problems and determine whether they need immediate solutions or long-term strategies?

- Are there any ongoing grassroots initiatives in your city aimed at resolving these issues? What measures can you implement to better support and enhance these grassroots initiatives? How can you allocate resources or aid to boost their positive impact on residents' daily lives?
- How has the COVID-19 pandemic influenced the deployment and adoption of smart city technologies? In what ways has it strengthened the argument for smart cities?
- Given the pandemic, what have we learned about the importance of addressing real problems faced by citizens and focusing on civic infrastructure? Will we give priority to more inclusive and citizen-oriented projects over costly and ambitious ones?
- Furthermore, how has the crisis highlighted the importance of civic and public infrastructure, especially in terms of ensuring equal access to technology and bridging the digital divide? What lessons have we learned about our collective responsibility to address societal challenges and ensure fair access to technology and information during crises?

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Appendix – Abstract

Abstract (English):

In the evolving landscape of urban development, the city of Vienna stands as a testament to the intricate dance between technological innovation and societal transformation. This research, rooted in the field of Science, Technology, and Society (STS), delves into the multifaceted nature of smart cities, using Vienna as a focal point. The study is structured around three pivotal axes: the shaping power of urban imaginaries, the nuances of public engagement, and the tangible integration of smart technologies into the daily lives of citizens. These axes, while distinct, are interconnected, weaving a comprehensive narrative of smart city development. The research underscores the importance of a holistic approach, emphasizing not just technological prowess but also social inclusivity and responsiveness. Central to this discourse is the concept of Responsible Research and Innovation (RRI). RRI serves as a guiding principle, ensuring that the development and implementation of smart city initiatives are aligned with societal values, ethical considerations, and the broader public good. By championing RRI, this study advocates for a smart city model that is not only technologically advanced but also ethically grounded, socially inclusive, and attuned to the aspirations of its citizens.

Abstract (German):

In der sich wandelnden Landschaft der Stadtentwicklung ist die Stadt Wien ein Beispiel für den komplizierten Tanz zwischen technologischer Innovation und gesellschaftlichem Wandel. Diese im Bereich Wissenschaft, Technologie und Gesellschaft (Science, Technology and Society, STS) angesiedelte Studie untersucht die Vielschichtigkeit von Smart Cities am Beispiel von Wien. Die Studie gliedert sich um drei zentrale Achsen: die Gestaltungskraft städtischer Vorstellungen, die Nuancen des öffentlichen Engagements und die konkrete Integration intelligenter Technologien in das tägliche Leben der Bürger. Diese Achsen sind

zwar unterschiedlich, aber miteinander verbunden und bilden eine umfassende Darstellung der Entwicklung intelligenter Städte. Die Forschung unterstreicht die Bedeutung eines ganzheitlichen Ansatzes, der nicht nur die technologischen Fähigkeiten, sondern auch die soziale Inklusion und die Reaktionsfähigkeit betont. Im Mittelpunkt dieses Diskurses steht das Konzept der verantwortungsvollen Forschung und Innovation (Responsible Research and Innovation, RRI). RRI dient als Leitprinzip, das sicherstellt, dass die Entwicklung und Umsetzung von Smart-City-Initiativen mit gesellschaftlichen Werten, ethischen Erwägungen und dem allgemeinen öffentlichen Wohl in Einklang gebracht werden. Indem sie sich für RRI einsetzt, plädiert diese Studie für ein Smart-City-Modell, das nicht nur technologisch fortschrittlich, sondern auch ethisch fundiert, sozial integrativ und auf die Wünsche der Bürger abgestimmt ist.