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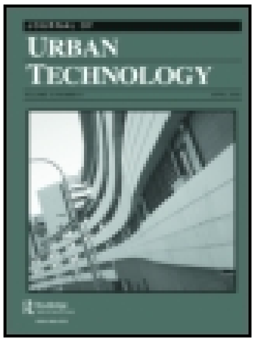

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The Social Appraisal of Techno-Experiments: Whirlpools and Mosaics of Smart Urbanism

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ABSTRACT

Technology-driven experiments—techno-experiments—have become a central mode of spatial intervention in a paradigm of smart growth. They are often considered a manifestation of a techno-managerial approach to governance, built upon the increasing influence of IT corporations on urban politics. Yet, there is little evidence indicating how these interests articulate techno-experiments and shape their legacies over the long run. This paper questions the varied politics of techno-experiments by comparing four projects in Stockholm and Amsterdam: two smart energy grid pilots and two online community-based platforms. Mobilizing the notion of the "social appraisal of technology," it argues that techno-experiments can take different forms depending on how the role of digital technology is defined and negotiated by actors throughout the process of experimentation. The paper empirically shows that experiments can evolve in two main ways, defined as "whirlpools" and "mosaics." As whirlpools, they upscale self-referentially; as mosaics, they instead extend into a set of scattered spin-offs. The key factors producing such outcomes, these cases show, are the form of partnership established at the outset of techno-experiments, and the ability of research funding and governmental agencies to steer projects as they develop.

KEYWORDS

Experiments; smart urbanism; digital (social) innovation; social appraisal of technology; Stockholm; Amsterdam

Introduction

Experimental pilots are increasingly used as a mode of socio-spatial intervention in policy practice, despite being heavily criticized in urban scholarship (Evans, 2016). This "wave" of experimentalism assumes that contemporary socio-ecological problems in cities can be addressed by testing concrete interventions in urban spaces. Experiments are based on the assumption that prototypes of new solutions can be designed within a politically neutral environment and eventually "up-scaled" (Savini, 2018). Actors engaging in experiments often build coalitions around specific technological instruments and share the belief that their success depends on cooperation among a variety of stakeholders in industry,

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technological design firms, research sectors, and governments at all levels (Raven et al., 2016; Raven et al., 2017).

Over the past decade, critical studies on experimentation have revealed that these digital technology-led experimental processes rely on an ideological determinist grasp of socio-ecological problems, which is often blind to the social specificities of urban contexts (Kitchin et al., 2016; McFarlane and Söderström, 2017). In smart city governance, experiments tend to legitimize discourses that depoliticize central problems of contemporary environmental governance. Often, this stimulates a form of start-up urbanism (Rossi and Di Bella, 2017; Savini and Bertolini, 2019). The governmental and corporate optimism surrounding technology-driven experiments is often symptomatic of a techno-managerial approach to socio-environmental problems, led by the influence that IT businesses exert over city politics (Hollands, 2008; 2015; McNeill, 2015; Söderström et al., 2014; Vanolo, 2014; Viitanen and Kingston, 2014; Wiig, 2015).

While current research defines the upscaling of an experiment as its main indicator of success, it hardly questions the nature of upscaling—often understood as a general enlargement of the initiative—nor explains if there is a relation between a specific set-up of the experiment and its legacy. Experiments often follow non-linear paths and actors can form various types of partnerships with one another. They evolve in time and space, whether they are transferred across contexts or remain single episodes of social innovation (Bulkeley et al., 2018; Karvonen et al., 2014). The notion of "experiment" is so resistant to critique because it is intrinsically generic. It is used to label a variety of initiatives, whether relating to urban design, place-making, or eco-consumerism (for an overview of such experiments, see Evans et al., 2016). Understanding the complex relations between power and experimentation, and tackling the biases underlying many experiments, entails exploring the micro-politics of how experiments are constructed. To do so, we need to look at what Kitchin and colleagues have defined as the "last mile" in critical research on smart urbanism: namely, grasping the nexus of actors, funders, users, and designers who shape smart city projects (Kitchin et al., 2017). Despite systemic critiques of contemporary smart urbanism, we still lack an in-depth, comparative, and diachronic investigation of how social powers shape experiments over the long run (Karvonen et al., 2019; Kitchin, 2015; Luque-Ayala and Marvin, 2015).

This paper addresses the current literature's limited account of the multiple legacies of experiments. It demonstrates that experimental action in cities can follow a variety of different pathways depending on the socio-political rationales pursued. To do so, we attend to what we name "techno-experimentation": a practice that explicitly builds upon, and revolves around, the development of specific technological devices in urban contexts. Using the notion of the "social appraisal of technology," we establish a framework capable of distinguishing different types of experimental practices according to their underlying justifications, long-term ambitions, and the role of technology in their formation. This framework allows us, first, to explain the socio-political logics driving the different actors engaged in a given experiment and, second, to trace if and how experiments evolve over time.

Through empirical studies, we compare four techno-experiments in Amsterdam and Stockholm: two large-scale smart electricity grid projects and two local online community platforms. Our results suggest that when techno-experiments are initiated and led by a coalition of city-wide corporate actors, academic research institutes, and governmental actors, they tend to develop in a self-referential way, upscaling incrementally by attracting funding and governmental interest. We define these projects as "whirlpools." However, when techno-experiments are initiated by engaged individuals they tend to evolve instead as scattered spin-offs, which are adaptable to different local contexts and open to influence by research, governmental and commercial interests. We term these initiatives "mosaics."

The following section provides a definition of techno-experiments, and introduces a taxonomy of different experimental practices based on the "social appraisal of technology." We then provide an overview of the paper's research design and methodology. Thereafter, the paper explores the legacy of the four selected experiments, showing how actors have organized, financed, and managed them and do so at present. Through empirical analysis, we unpack the core features of whirlpool and mosaic types of experiments. In the paper's concluding section, we reflect on three key factors in shaping the legacy of experiments.

The Social Appraisal of Technology in Urban Experiments

An "experiment" is nothing more than a purposive intervention that intends to induce change in a given real-life urban environment by testing a possible solution (Bulkeley et al., 2015). Urban experiments can assume a multitude of forms, types, and sizes. Today, they range from demonstration projects and living labs to citizen science initiatives and community platforms. Yet, they always share two key characteristics: they all mobilize a variety of actors in urban policymaking, from business, through research, to civil society, and they all "prototype" a particular object, policy, technology, practice, or design (Evans, 2016). The imperative of urban experimentation is the systematic monitoring and evaluation of the approaches adopted (Karvonen and van Heur, 2014). In doing so, proponents of experiments often build on existing best practices to stimulate further experiments, and build platforms through which to share experiences with other actors and eventually "upscale" solutions they have found (Evans, 2011).

While not all experiments are linked with a particular technology explicitly, it is becoming common for advocates of experimentation to build an experimental process around a particular technological tool. We call this very popular sub-category of technology-led experimentation "techno-experiments," emphasizing how they are deliberately initiated, constructed, and developed by actors in order to use, test, and further elaborate a technology made for application to urban services. Clearly, the functionality and nature particular to a given technological tool will shape the ways in which experiments are designed and realized in practice. However, an experiment's development is determined just as much by power structures that organize social relations around a particular technological tool. As Stirling (2008: 264) points out, "[t]he ways in which context, purpose, and power shape the outcomes of technology choice are […] downplayed and tacitly denied."

Our understanding of the "social appraisal of technology" offers a non-deterministic discursive lens through which to question the politics underlying techno-experiments. "Social appraisal," here, refers to the possible "ways in which knowledges, understandings, and evaluations [of a particular technological artifact] are constructed and rendered salient" (Stirling, 2008: 265). In so doing, these appraisals inform actors' decisions about whether and how they commit to processes of experimentation, oriented towards achieving socio-technical innovation (Stirling, 2008: 265). Examining how technology is "socially appraised" in experimental actions entails observing the justificatory narrative framings that actors enroll in advocating a particular technological tool and, therefore, the allocation of social, political, and monetary resources to a given project. Stirling emphasizes that in order to understand how collective action is organized and structured (e.g., set-ups, procedures, and resource exchange), it is important to observe the normative and instrumental "rationales" that frame a particular technology's use. These framings have the power to foreclose possibilities for technological innovation and channel experimental practices in specific directions. This understanding of the actor–technology relation is grounded in the idea that the trajectory of socio-technical innovation is determined not by the physical-technical make-up of technological tools per se, but by discursive justifications mobilized to legitimize those tools, which in turn produce power structures that limit innovation.

Fiorino (1990) and Stirling (2006; 2008) identify three distinct rationales for participation in technology use (Wesselink et al., 2011): a "normative," "instrumental," and "substantive" one. From a normative perspective, participation in organized collaborative action should "counter the power of incumbent interests and [allow] all who are affected by a decision to have influence" (Wesselink et al., 2011: 2690). If an actor engaged in techno-experiments adheres to a normative rationale, they are often primarily concerned with the *processes* through which the experiment can introduce new values and principles for social practice. A normative rationale for techno-experiments is "value-based" insofar as it justifies an experiment as an explorative process of value building. When experimental action is justified through "instrumental" or "substantive" rationales, in contrast, actors present technology as a *means* through which to realize explicit predefined *ends*. Participation in techno-experiments based on instrumental or substantive rationales selectively "concentrate[s] on the interests of specific constituencies, institutions, or technological systems, irrespective of wider normative values" (Stirling, 2008: 269). We define this orientation towards techno-experiments as "means-ends based," meaning that the experiment is designed through framings that stress the need to achieve a particular goal, not explore possibilities of new social practices.

The distinction between "value-based" and "means-ends based" rationales is more of an analytical distinction than a reality. In practice, actors may have different motivations for engaging in technology-driven practices, and experiments may not have a clear beginning or end. Most often, actors bring new justifications to an existing process or redefine their views as an experiment develops. We therefore propose to add one more dimension, which allows for different possibilities of social appraisal in techno-experiments. The decisions that are made in the context of a particular experiment also depend on actors' expectations about the role of technology in affecting urban socio-spatial dynamics. Actors can perceive the use of a technological instrument as being "fundamental" or "supplemental" in the process of altering particular urban practices or infrastructures. On the fundamental view, technology is a primary driver of urban change. This view underlies contemporary discourses claiming that the "internet of things," smart electricity grids, or smart meters (to give just three examples) are fundamentally reshaping how cities work (Kummitha and Crutzen, 2017: 45; for a critique, see Morozov, 2013). For a supplemental perspective, in contrast, technology only "enhances" or "facilitates" social practices that are already at work in cities. It proposes a more human-driven and incremental view, in which individuals—in their everyday acts of mobility and consumption amid various communities—use technology to support existing practices (Calzada and Cobo, 2015; Kummitha and

Crutzen, 2017). According to this approach, technology has a primarily supplemental role, as it "facilitates" identifiable socio-spatial practices that exist in current urban environments (Carvalho, 2015). The ways in which actors understand the (potential) impact of a technological tool determines how techno-experiments are organized in practice and, therefore, what their long-term socio-political effects will be.

In order to define ideal types of social appraisal in techno-experiments, we assumed that such experiments can differ based on the specific rationale with which they are designed as well as on the specific position that the particular technological tool is assumed to have with regard to existing urban socio-spatial practices (See Table 1). In cases where actors engage in experimental processes primarily in terms of a means-ends based rationale (Types I and III), they justify the use of technology by pointing to how technology can facilitate participating actors in achieving their goals. In the case of both Type I and III, experimentation sets out to accomplish pre-determined ends. When conceived in supplemental terms, the employment of technology is expected to "incrementally" improve an existing practice (Type III). When conceived in fundamental terms, though, technology is presumed to radically reconfigure urban socio-spatial processes by introducing new forms of organized action, including novel roles, resources, and ways of working (Type I). Experimental initiatives of Type I and III are very common in cities. Type I includes, for instance, the development of platforms that are specifically designed to promote the sharing of goods or vehicles. Actors justify prototyping such platforms by emphasizing how they enable people to change their mobility and consumption patterns in ways that save costs and space in dense urban areas. Type III includes, for example, the development and testing of databases and real-time data processing tools that help car drivers avoid traffic jams.

When actors commit to experimental action in terms of a value-based rationale (Types II and IV), they justify the use of technology on the grounds that it provides ways of promoting "engagement" and "participation." Often they suggest that technologies can build common values, a sense of community, or new networks. These justifications rarely refer to concrete goals and remain open-ended. They stress that the implications of technological tools lie in how they support users' interactive choices. When actors view technology as having a fundamental role in social practice, they aim to build previously unknown social relations and social processes (Type II). When they cast technology in a supplemental role,

Table 1. Typology of practices of socially appraising technology in techno-experiments. These are divided according to actors' rationales for participating in joint experimental action, and the perceived role of technology in inducing urban socio-spatial change

		Role of technology			
		Fundamental		*Supplemental*	
Rationale for experimentation	*Means-ends based*	I	Experiments testing prototypes of technologies that develop novel ways of addressing socio-spatial problems, services, or processes.	III	Experiments testing the use of existing technologies to incrementally improve solutions to socio-spatial problems or service delivery.
	Value-based	II	Experiments prototyping technological tools to build socio-spatial relations and processes without expected results specified in advance.	IV	Experiments that employ a technology in support of existing communities of practice.

however, they organize experimental processes in which technology impinges upon existing communities and networks (Type IV). In the literature on smart urbanism, such experimental practices are often praised as a virtuous use of digital technology, which is adaptable to the will of users and citizens. Examples of Type IV include those community-based initiatives that engage with online platforms to better organize neighborhood decision-making about the management of green areas, for example, or children's education. Examples of Type II—value-based and fundamental techno-experiments—are rare. They include experiments in building communities of practice, such as ecologically concerned consumers, self-help housing and neighborhood groups, or political action groups. The creation of digital commons also falls under this category.

In the complex practice of organizing urban experiments, the differences among these ideal types are more analytical than factual. Still, this typology is helpful in grasping the inner logics of experimentation, allowing us to scrutinize why, how, for whom, and with what consequences techno-experiments are initiated, constructed, and developed. The set of distinctions we have proposed can also be understood as a continuum, able to show the extent to which certain experimental practices reflect one particular mode of socially appraising technology over another, and establish how actors frame experimental processes. Furthermore, this framework can be used to identify whether a particular form of social appraisal determines the way an experiment evolves over time. As we go on to show, the justifications adduced for techno-experiments constitute a form of discursive power, which shapes those experiments. Single actors might invoke different rationales for participating in experimental action "for contrasting reasons under diverse perspectives" (Stirling, 2008: 273). Discursive justifications of experimentation, therefore, are fluid and context-dependent, while experiments are unlikely to develop in a linear fashion.

Methodological Note

This study draws on a "diverse comparative case study analysis" of techno-experiments, which we conducted in Amsterdam and Stockholm in 2017 and 2018 (Gerring, 2006). We selected four case studies that varied extensively in terms of their scale, project focus, timeframe, and composition of actors. We considered these cases suitable for this particular study because they show maximum variation across the spectrum of ideal types of social appraisal of technology identified in our framework above: two cases feature Type I characteristics, while two others exhibit Type IV characteristics. We focused only on these two types in order to compare most different cases. Moreover, while Type III experiments are common in practice and have been studied extensively in the literature, Type II experiments are often organized as single prototypes. Selecting cases of the latter type would have made it too challenging to collect sufficient empirical materials for a rigorous most different case comparison.

On the one hand, we expected the experimental smart grid demonstration projects in Stockholm's Royal Seaport area (Smart Energy City) and in Amsterdam New-West (City-zen Smart Grid Amsterdam New-West) to showcase transformative, end-oriented social appraisals of technology (Type I). This was due to their complex multi-actor organizational set-up, strong focus on technological developments, and precisely delineated time horizons. On the other hand, we thought that the development of online community platforms for the IJburg neighborhood in Amsterdam East (HalloIJburg) and for communities throughout the city of Stockholm (LocalLife) would exhibit more incremental and process-oriented social appraisals of technology (Type IV). This is because of their bottom-up beginnings, the relatively small number of actors involved, and their explicit focus on existing practices and structures in local communities.

Between November 2017 and May 2018, different types of data about the cases were collected in parallel. At first, extensive desk research was conducted to locate relevant project descriptions and proposals, funding applications, policy documents, and newspaper and website articles. Analysis of these documents intended to identify the key actors involved in the techno-experiments and to gain insight in the experiments' general ambitions, funding, and development trajectories. The results from this extensive desk research were then counter-validated and further sophisticated by means of a round of interviews with key actors involved in each of the four experiments. Twenty-five actors were approached—including software developers, corporate representatives, citizen associations, local politicians and policymakers. To them we asked detailed questions on how the experiments were initiated, constructed, and implemented over time. Interviews were semi-structured and concentrated on identifying (a) how the initiatives intended to develop innovative urban practices or infrastructures; (b) why actors were interested in engaging in joint experimental action; (c) how they perceived technology and its role in relation to the action in question; and (d) the types of resources they used, and how they mobilized them, in developing the initiatives over time. Interviews were transcribed and analyzed inductively in a reiterative manner, aiming to identify both similarities and differences across the responses in terms of themes, approaches, and actors' practices. Any additional documentation regarding the four techno-experiments' development trajectories obtained through the interviews was in turn analyzed to check, corroborate, and complement the interview data.

Smart Grids and Community Platforms: Four Techno-Experiments in Amsterdam and Stockholm

Like most European cities, Amsterdam and Stockholm have undertaken a heterogeneous agenda of experimental urban initiatives. The two cities exhibit a number of commonalities in terms of the timeline, approaches, and pathways of the urban experiments they undertake (see Angelidou, 2016). Amsterdam and Stockholm contain a variety of local bottom-up initiatives, as well as bigger projects that tackle large-scale urban redevelopment areas. In our study, we deliberately selected four cases that are representative of these projects, with equivalents in other European cities (for an overview of "smart city" initiatives in the European Union, see European Parliament, 2014).

In Stockholm, the project labelled *Smart Energy City* is a pilot project prototyping the use of Information Technologies (ITs) in managing and combining different renewable energy sources within the city's electricity grid. Its aim is to facilitate the creation of energy-efficient homes and energy saving consumer behavior (UrbanT, 2014). To do so, it targets 154 newly built houses that are connected to a smart grid and supplied with smart home technology in the redevelopment area of the Stockholm Royal Seaport (SRS, *Norra Djurgårdsstaden*). The smart home technology deployed in this project enables energy consumption and carbon footprint data to be communicated to dwellers in real-time through an application on a tablet device installed in their apartments (Nilsson et al., 2018). The project is co-financed by the Swedish Energy Agency (SEA, *Energimyndigheten*) and implemented by a consortium of five Swedish companies, including the leading partner Fortum (energy provider), ABB (engineering company), Electrolux (household appliances producer), Ellevio (electricity distribution system operator), and Ericsson (networking and telecommunications company) (UrbanT, 2014). Research support is provided by the Royal Institute of Technology in Stockholm (KTH, technical university) (UrbanT, 2014). The Smart Energy City demonstration project represents the last of a three-phase research and development program in the SRS area. The first phase, which started in 2009, focused on formulation and planning. In the second phase, conducted between 2010 and 2011, the planned project was tested in a "pre-study" (Swedish Energy Agency, 2011). In the third phase, which started in 2013 and finished in mid-2018, the demonstration project was implemented.

Similar to the "smart energy grid" developed in Stockholm, the *City-zen Smart Grid Amsterdam New-West* experiment involves three smart grid demonstration projects. It was implemented as part of a research and development program funded by the European Union, City-zen (2014–2019), which includes initiatives in Amsterdam and Grenoble, France (Amsterdam Smart City, 2016b). The first pilot, named *End-2-End Smartification*, was conducted by the local energy network provider Alliander and its subsidiary company Liander, the electricity distributor and system operator. It sought to develop and implement an electricity grid that could provide energy companies with real-time insight into power flows. This project is justified on the grounds that it ensures reliable and efficient monitoring and maintenance of the grid, and allows companies to test the impact of new services, as developed in different sub-demonstration projects (City-zen, 2016a). The *Vehicle2Grid* experimental pilot prototypes bi-directional charging points, which store electricity produced by households in electric vehicles (City-zen, 2016c). It also aims to test how vehicle-to-grid technology might affect the electricity grid's functioning. As part of the *Virtual Power Plant* pilot project, battery systems are installed in around 50 homes in the Amsterdam New-West neighborhood, a large residential area on the city's western periphery (City-zen, 2016b). These systems are connected both to each other and to the smart grid, creating a "virtual power plant" allowing residents to trade their solar energy on the energy market (Amsterdam Smart City, 2016c). In this pilot, Alliander leads a consortium of partners that includes Energy eXchange Enablers (EXE, software developer for energy market propositions, entirely owned by Alliander), NeoSmart (energy provider), and Wageningen University and Research (WUR, technical university) (NeoSmart, n.d.).

LocalLife (about.locallife.se) is a digital communication platform aimed at putting citizens at the center of smart city projects. It enables them to share information and objects with each other, both within housing blocks and wider neighborhoods (Stand Up For Energy, 2018). As such, the platform operates within a specific local community. It is available through a website and smartphone application, allowing subscribers to interact anywhere. By connecting people with others in their local environments, the platform focuses on strengthening the social capital of Stockholm's communities. LocalLife presents itself as an open platform, easily adapted to users' needs. It intends, broadly, to inculcate and reinforce ecological values by providing users with feedback on their energy consumption choices, inciting them to share experiences of products and services, and to experiment with new forms of eco-consumption such as cooperatives (Luuke, 2017). The platform technology is owned and run by LocalLife Sweden AB, a for-profit limited company that was founded in 2015 by two KTH researchers and a local entrepreneur from Stockholm. The company received research-based financial funding to develop its platform technology. In early 2018, pilot projects testing the platform were initiated in the Bagarmossen and SRS districts in Stockholm.

HalloIJburg (halloijburg.nl) is an online community platform aimed at citizens residing or interested in the IJburg neighborhood on Amsterdam's eastern periphery. It enables users to find and share news updates and information about socio-cultural activities, local organizations and start-ups, and events in the area. The website also offers a marketplace where users can exchange products and services, as well as a weekly e-mail newsletter that is generated automatically. The platform, which as of June 2020 had over 7,600 users (with approximately 6,900 accounts for people and 700 for local organizations) hopes to create a stronger and more lively local community. Upon the request of a neighborhood organization to which he belonged, one resident of IJburg (owner of the one-person IT firm CrossmarX) voluntarily started developing an online platform in 2010 (see Priester, 2017). In January 2016, the ownership of HalloIJburg's platform technology was invested in a cooperative named Gebiedonline ("neighborhood online": gebiedonline.nl), which was founded by representatives of six communities interested in a community platform (Amsterdam Smart City, 2017). From then on, other local communities could make use of the technology underlying HalloIJburg too. As of June 2020, the cooperative had 35 member communities that collaboratively used, owned, managed, and paid for the technology, with the company CrossmarX operating the servers on which the technology runs.

The four projects selected for this research differ substantially from one another. They take place in the capitals of two different countries, and are realized by different actors at very different scales and within different timeframes. In the following section, we highlight how, despite these differences, their trajectories of development exhibit strong similarities in terms of their determining factors.

Smart Grid Pilots as "Whirlpools" of Self-Referential Practices of Social Appraisal

Both the Smart Energy City and City-zen Smart Grid experiments have been developed by business-led consortia. In these cases, ownership of the prototyping of smart grid technologies is firmly concentrated in the hands of a few corporate actors. Two factors are crucial for understanding this: engaged companies' interest in using prototyped technologies for future commercial purposes and the steering role of government-affiliated funding schemes.

Our results show that these projects are explicitly oriented towards prototyping technological solutions in concrete urban settings, and that the handful of companies involved in them set up partnerships to grasp how their technological innovations are performing and whether they suit future commercialization. This is exemplified by Alliander's engagement as leading partner in City-zen's smart grid demonstration projects in Amsterdam. The energy network company and grid provider had already been planning to experiment with new ways of storing electricity, and to equip its electricity grid infrastructure in Amsterdam New-West with technology that streamlines monitoring and maintenance.[1]

Then, in 2012, the Amsterdam Smart City platform—a governmental agency affiliated with the mayoral office—asked Alliander to engage in the City-zen program as a consortium partner and to collaborate on writing a project proposal for a smart city-related call from the European Commission.[2] In this process of proposal writing, Alliander was able to assume a leading role in constructing and implementing three Amsterdam-based smart grid demonstration projects, aligning all three with its commercial interest in developing fiber-power grid infrastructure and smart energy services.[3]

The same appraisal of technology can be found in the Stockholm-based Smart Energy City project. Energy provider Fortum and electrical engineering company ABB had previously participated in smart grid projects, and were both eager to explore smart energy further (ECSIP Consortium, 2013: 103). Ericsson joined with the explicit aim of learning how its products would perform in the context of smart grid and smart home technology, business domains in which the company had not been previously active.[4] Furthermore, Ellevio and Electrolux considered the project an excellent opportunity to enhance their sustainability and social corporate responsibility agendas by making commitments to the city's climate goals.[5] The commercial justification of the Smart Energy City project is found in the active marketing of smart home systems by Fortum Smart Living, Fortum's subsidiary company. Fortum Smart Living sells a stripped version of the smart home system developed and tested in the experiment. A construction firm involved in the project was among the company's first clients.[6]

In these projects, partners bring in long-term funding schemes to expand and solidify an initial partnership. Funding is provided by both national and European agencies to create favorable conditions and strong incentives for corporate actors to *continue* engaging in collaborative techno-experimentation. The Swedish Energy Agency and Vinnova, the Swedish governmental innovation grant agency, provided financial support during the pre-study (2010–2011) and implementation phase (2013–2018) of the Smart Energy City experiment. This offered "a strong incentive for the different stakeholders to keep the consortium together" (ECSIP Consortium, 2013: 103). These funding schemes functioned as "catalyzers," which aligned the project partners' ideas and ambitions not only with each other, but also with the interests of government agencies (ECSIP Consortium, 2013: 103; Swedish Energy Agency, 2015).

More than half of the costs of the Amsterdam-based City-zen project were covered by the European Commission, amounting to over 25 million Euros between 2014 and 2019 (as projected in European Commission, 2015). It is little surprise, then, that the project's research and development program precisely responds to the requirements set out in the European Commission's call for proposals about "smart cities and communities" in 2012. This call (see European Commission, 2012a) contained an extensive list of guidelines and criteria to which proposals had to adhere to be eligible for funding. In this way, the Commission significantly "steered" decisions on the development and use of technology in constructing and implementing experiments. For instance, the call required corporate-led consortia to be formed in advance of an application, clearly outlining industrial partners' "prominent" role in the roll-out of techno-experiments:

> The demonstration activities should involve a critical mass of industrial resources and real industrial dimension in order to achieve the objectives of the particular topic and contribute significantly to the overall expected impact of the demonstration area. Therefore, industry

> should have a leading role in the management and decision structure of the projects, and ideally have a coordinating role […] The proposals shall provide a market replication and deployment plan, as well as a business plan which provides the details how the consortium plans to bring this demonstration project to market deployment and large scale replication. (European Commission, 2012b: 7)

In line with this focus on the commercialization and replication of developed solutions, the call further demanded that consortium partners propose measures that "increase the likelihood of market uptake of project results" (European Commission, 2012b: 32). Consequently, the initiators of the City-zen program proposal—a group of European researchers and selected companies and institutions based in Amsterdam and Grenoble—entered into a "ceremonial dance" with potential partners in business and research across Europe, "attempting to shape the proposed consortium in such way that it would meet all criteria of the call."[7]

Furthermore, in both the Smart Energy City and City-zen Smart Grid experiments, for-profit companies partnered with research institutes to academically validate and monitor the prototyping of smart grid technologies. Corporate actors use these business–research collaborations to more accurately understand how technologies perform and under what conditions they might be commercialized. In Stockholm, the project's consortium partners funded two PhD studies on the project by staff working at technical university KTH.[8] These studies focused on the effects of using smart home systems on the electricity grid infrastructure and energy consumption behavior. As one of the partner's project representatives mentioned, the quantitative and qualitative research data collected in these studies "are interesting for the engaged companies to see," for they indicate "how users deal with the functionalities of the smart home system and if there are things they particularly like or dislike about it."[9] Likewise, Alliander collaborated with the Dutch technical university in Wageningen to systematically monitor and evaluate the Virtual Power Plant pilot's approach to storing renewable energy (NeoSmart, n.d.).

Conversely, engaging in partnerships with corporate actors opens up favorable opportunities for universities to conduct research. Research institutes such as KTH and Wageningen University are eager to partner with commercial actors, because it helps them acquire research funding and grants them access to research sites, data, and installations that are not easily available otherwise. The experiments appear to constitute a unique chance for research institutes to study the effects of smart grid infrastructures and applications on electricity grids and their users in lived urban environments, rather than using abstract models.

At the same time, participating in corporate-driven techno-experiments means that academic ambitions are strongly shaped by commercial interests. Since the corporate actors in the Smart Energy City project consortium provided funding to KTH, and the university did not financially contribute to the project, the academic freedom of the PhD students evaluating the program was restricted. Indeed, they could not be too openly critical of the approach adopted by the companies, and had only limited influence on the project's development. This PhD student's reflections on the "delicate position" of researchers in business-led experimental projects is telling:

> I have been involved in all the processes—how to design the project, what should be in there, et cetera—but as I'm not [working for] a financing partner, I can have a lot of ideas and

> opinions, but in the end they [the engaged companies] are paying for it. So […] it's not always like they are going to listen to you. […] Fun thing is, though, that in the end, I will be the person evaluating it [the project]. So, they also don't want me to write in the final evaluation report to [the funding agency] something like "This company messed up!," you know? They are trying to find solutions all the time.[10]

What is more, the City-zen project proposal expects engaged research institutions to link their activities in the project directly "to the preparation, implementation, assessment, and further replication [or] deployment of the demonstrated technologies" (European Commission, 2012b: 7).

In both the Stockholm and Amsterdam projects, city government bodies have played a proactive role in initiating smart grid experiments. Reportedly, they saw these experiments as an opportunity not only to realize their urban sustainability and technological innovation policy agendas, but also to "export" those agendas to other countries and cities. For example, the City of Stockholm took the first steps towards the Smart Energy City project in 2009, when it began work on a highly ambitious urban sustainable development program for the SRS area.[11] Stockholm was elected Green Capital of Europe in 2010, and the SRS was appointed as a showcase in the Climate Positive Development Program earlier that same year (Executive Office of Stockholm, n.d.). Following these successes, the Stockholm city government wanted the Seaport area "to take up the former role that Hammarby Sjöstad had played in promoting Stockholm as a good player on the national scene of environmentally sound city planning," encouraging actors to focus particularly on reducing CO_2 emissions, using less energy, and working against climate change.[12] In addition, by prototyping smart grid technologies, the City aimed to showcase Stockholm's innovative urban redevelopment agenda, and stimulate further innovation through economic incentives.

The Amsterdam Smart City platform's involvement in coordinating demonstration projects in the Amsterdam-based City-zen program also illustrates the influence that government-affiliated policy agendas can have on the development of techno-experiments. Amsterdam Smart City aims to coordinate and streamline projects dealing with various urban issues and digital technologies. As such, it functions as a network support tool, allowing local authorities, companies, knowledge institutions, and small firms in the Amsterdam Metropolitan Area to showcase their projects and build further partnerships (Amsterdam Smart City, 2016a). In doing so, its goal is to develop new markets and replicate successful "smart" solutions in other urban locales. Indeed, the three smart grid pilots in Amsterdam New-West focus on testing innovative electricity production and consumption services (City-zen, 2016a) that can potentially be scaled up and replicated. As such, the City-zen project fits seamlessly into Amsterdam Smart City's agenda of fostering and scaling up technological innovations, so as to address urban challenges in the Amsterdam region.

The smart grid experiments in Stockholm and Amsterdam also highlight how governmental actors, at both city and European levels, use techno-experiments to transfer successful policies to other locales. Our metaphor for this process is the whirlpool, by which we mean a self-referential reproduction and policy transfer of a techno-experiment's initial goals and tools across space. One focus of the City-zen research and development program is on "sharing its knowledge and experience with other cities […] by going 'glocal'—combining specialist global expertise with local stakeholder energy and knowledge of the context and lifestyle on location" (Smart Cities Information System, 2018). One method through which these combinations were instigated is the so-called "City-zen Roadshow." This involved City-zen representatives from Amsterdam visiting other European cities to help them devise sustainable urban development agendas. These knowledge dissemination roadshows focus on translating and transmitting successful experimental ideas and models, exemplifying some key ways in which governments apply practices of "policy learning" and "policy mobility" in techno-experimentation (Temenos and McCann, 2012).

Online Community Platforms as "Mosaics" of Open-Ended Practices of Social Appraisal

The LocalLife and HalloIJburg community platforms were both initiated by individual entrepreneurs and activists, in close cooperation with academic researchers. Indeed, the LocalLife platform began as a university research project. Researchers from KTH conceived the platform in 2015, following their involvement in a collaborative smart city research project on sustainability in the SRS district. During this project, they observed that technological solutions to sustainability issues rarely consider the needs of local citizens (Luuke, 2017). The upshot of this is that citizens, in using Information and Communications Technologies (ICTs), become "globally connected, but locally isolated."[13] In this process, communities' sense of identity and trust in government and the media decline, as do their feelings of social connectedness, pride, and safety. The Urban Analytics and Transitions (UrbanT) research group at KTH established two research projects to address these developments. One set up an online community platform, LocalLife, as a testbed "to design and evaluate methods of increasing environmental and social sustainability in neighborhoods" (UrbanT, n.d.). The other aimed to measure the effects of using such online community platforms on environmental awareness and social capital in local communities.

The HalloIJburg platform technology has also been shaped significantly by academic research interests, exemplified by the establishment of the cooperative Gebiedonline and its subsequent inclusion in DECODE, a Europe-wide consortium-led project conducted between 2017 and 2019. In 2015, a research fellow at the Amsterdam University of Applied Sciences (Hogeschool van Amsterdam, HvA) began studying bottom-up networks organized through online platforms in the Amsterdam region (Priester, 2017). The HvA researcher's research agenda has considerably influenced how the HalloIJburg platform technology was socially appraised over time. His research aimed to explore and communicate how local communities use online platform services, focusing specifically on how these platforms can best be designed to suit communities' needs. Participating closely in HalloIJburg's development, the researcher observed how the platform had become a showcase of other successful online community platforms in Amsterdam, generating interest from across the landscape of start-ups and digital activism in the city (locally, this is dubbed the "city-makers movement") (Priester, 2017). This surge of interest in the platform raised the question of how to scale it up in ways that could allow it to serve other neighborhoods. Initially, the initiator and developer of HalloIJburg was reluctant to scale up the platform technology, fearing that the values and principles to which he adhered in developing the platform might be watered down or neglected (Priester, 2017).

However, in collaborating with the researcher, as well as representatives of other communities with an interest in using the technology, the developer found an acceptable way of replicating HalloIJburg's technology in other urban locales, allowing for cooperative ownership of the online platform technology.[14] The cooperative Gebiedonline ("neighborhood online") was set up to this end in January 2016, and the HvA researcher was elected its president.

Moreover, since 2018 Gebiedonline has itself become a DECODE pilot project, in which the City of Amsterdam and "Waag," an Amsterdam-based research institute for society and technology, are consortium partners (DECODE, n.d.). In being taken as an experimental pilot, Gebiedonline has allowed developers to test an innovative tool on their platform technology, allowing users to control their personal data. The HvA researcher stressed how the driving principle of the DECODE project "is fully in line with the bottom-up and community-focused approach of Gebiedonline."[15]

In addition, the developers of the LocalLife and HalloIJburg platform technologies have engaged in collaborations with governmental actors at various times, providing those actors with opportunities to use the platforms in implementing policy ambitions and agendas. In the case of LocalLife, the City of Stockholm helped set up pilot projects that use the platform in the Bagarmossen and SRS districts through promoting the platform on its communication channels.[16] It has also used its contacts with housing associations to find potential platform users. The municipality has supported LocalLife primarily because it is interested in how the platform could increase the sharing of goods and services within communities, which would reduce resource consumption and associated greenhouse gas emissions.[17] This would contribute to meeting Stockholm's sustainability ambitions in general and the SRS district's especially stringent sustainability standards in particular (see Executive Office of Stockholm, n.d.).

Local municipal authorities have used the HalloIJburg platform to test ways of making policymaking more accessible to citizens. To this end, Amsterdam East, a city government district, facilitated the prototyping and maintenance of the platform from its inception in 2010 to the present. This included limited financial support.[18] Furthermore, it was in collaboration with Amsterdam East that HalloIJburg introduced its "area policy plan IJburg" (*Gebiedsplan IJburg*) functionality in 2016.[19] Through this feature, citizens can provide feedback on, and make suggestions to, the city district's area policy plan for the upcoming year. After a given period, all suggested plans are reviewed by city district representatives, who are obliged to provide an explanation for why plans will, or will not, be implemented. This initiative indicates the city district's view of the HalloIJburg platform as an outstanding means through which to promote its collaboration with citizens, aiming to "generate as many self-directed and citizen-driven initiatives in the neighborhood as possible" (Gemeente Amsterdam Oost, 2015: 7; translated from Dutch by the authors).

The development trajectories of the LocalLife and HalloIJburg platforms underscore how the ownership and organizational structure surrounding technology substantially impinges on the purposes for which techno-experiments are setup and developed. For instance: although LocalLife was initiated in a predominantly research-based context, it is currently owned by a for-profit company, whose ambition is to market the platform.[20] The funding acquired by the initiators of LocalLife originated from institutions firmly embedded in a research-oriented and commercial innovation-focused context, indirectly "steering" the platform technology towards commercialization as an explicit goal.

Vinnova, an agency supporting digital innovation, provided a research grant (2015–2018) to help develop the platform (Vinnova, 2015). Additionally, in 2017, LocalLife received support from an incubator program (STING) and two KTH-affiliated institutions facilitating the commercialization of KTH research-informed innovations (Luuke, 2017). These research and innovation-driven support structures have enabled further prototyping of LocalLife, and prompted its initiators to look for ways of sustainably commercializing the platform technology beyond temporary funding schemes. One viable option entails integrating third party services into the community platform, such as personalized energy consumption feedback and car sharing.[21]

By contrast with LocalLife, the HalloIJburg platform technology is currently owned, managed, and paid for by the Gebiedonline cooperative's member communities, who are jointly responsible for the technology's future evolution. Cooperative ownership, in this instance, aims "to improve the platform technology as much as possible, in ways that serve the bottom-up movements that emerge in the different communities, potentially enabling systemic societal change."[22] Arguably, the development of experimental platforms with this ownership structure is less likely to be affected by interests other than those of their member communities. Support offered by actors in scientific research, government, or corporations will only be accepted if it is in the general interest of the cooperative's members, as was found to be the case for HalloIJburg's involvement in the DECODE project.

The development trajectories of the LocalLife and HalloIJburg community platforms show how open-ended, process-oriented approaches to techno-experimentation allow projects to evolve over time in terms of their focus and organizational structure. After governmental and research institutes joined the projects, their key aims and management structures changed. At the same time, the absence of predefined goals, and streamlined development stages, makes experiments such as LocalLife and HalloIJburg susceptible to the influence of research and government actors. The initiators' need to secure structural funding for prototyping the platforms, as well as to build legitimacy for transferring experiments to other neighborhoods, allows these larger investors to offer support and, in doing so, to tailor the projects to their own ends. Consequently, the platform technologies have come to resemble "mosaics," which piece together community, research, and government interests. This shows not only how different practices of socially appraising technology can co-exist in the same techno-experiments, but also how resourceful actors can "capture" techno-experiments, bringing them into closer alignment with their interests. Additionally, our study of the respective evolution of LocalLife and HalloIJburg suggests that the funding structures and ownership conditions of digital technologies are an important factor in shaping the legacies of techno-experiments.

Reflections and Conclusions

Existing research tends to adopt a managerial perspective on the study of experimental governance. It strives to identify the best techniques to achieve cooperative forms of interaction between actors in different sectors of society. These studies often put technology at the center of their enquiry, focusing on the intrinsic properties of the tools available and on how these tools affect decision-making and social interaction. Through this focus, they often reach the conclusion that experiments (should) have a linear trajectory from prototype to upscaling to be considered successful. While studies consider upscaling the best desirable outcome of an experiment, they do not question the nature and pathways of this process. This paper has challenged this perspective, understanding technology in urban experiments as an object that is interactively constructed in social practices. We asked whether the ways in which actors justify, frame, and organize resources around digital tools affect how techno-experiments evolve through time. We posed this question in order to advance critical work on smart urbanism and to question the multiple legacies that these experiments achieve.

By foregrounding the "social appraisal of technology," we have been able to define four different ideal types of experiments: those that develop new instruments to achieve specific ends; those that support existing practices by using existing digital tools; those that explore the applicability of digital tools in existing contexts of social practice; and those projects that develop new communities through digital tools. This analytical typology provided us with a grid with which to map how four experiments have evolved, and to grasp why they have evolved in the way they have.

The comparison of four case studies showed that different types of experiments have different legacies and that there are particular conditions that influence the way these experiments evolve in time. The set-up, development, and realization of the Smart Energy City and City-zen Smart Grid Amsterdam New-West experiments have been driven by distinct yet comparable constellations of actors in business, research, and government. Accordingly, the experiments both follow similar patterns of development. Most significantly, their emergence and evolution have developed as a "whirlpool" of concentric networking and partnering practices, which connect a core of actors in the digital telecommunication and energy sectors with governmental bodies promoting smart city agendas and international research consortia. Businesses leading these projects organize resources in ways that sustain their interests in testing, developing, and using smart grid technology. Hence, these projects are presented as "pilots" of smart grid experiments, which catalyze governmental sustainability ambitions and research-based business innovation. In joining forces with government actors, techno-experiments become flagship initiatives, able to export urban sustainability and smart policy visions beyond their initial contexts. The trajectories taken by these experiments with smart grids are determined by institutional partnerships between corporate initiatives and international research funding bodies. These funding bodies explicitly promote applied research oriented towards a predefined goal: developing smart grids and related services. The two cases also show how governmental actors, with their distinctive policy-making practices and ambitions, are crucial in initiating and implementing techno-experiments. Both experiments have become instruments of building and enlarging partnerships, helping to transfer knowledge among businesses, research, and government.

The development trajectories of the LocalLife and HalloIJburg community platforms illustrate how social appraisals of technology can shift during the evolution of a techno-experiment. By and large, it appears that projects move from being exclusively community-driven and value-based to more technology-driven and end-oriented ventures. Over time, these platform technologies have become a techno-experiment "mosaic," in which a variety of different sub-projects in different areas are undertaken by different actors. Both projects started from a private initiative that evolved by acquiring small-scale funding and support from governmental agencies. Research and government bodies in particular have exerted significant influence both over how the platform technologies evolved, and over how their use is scaled up to encompass other urban locales. LocalLife, for instance, is gradually transforming from a purely research-oriented platform into a commercially viable community service, supported by the municipal government. Moreover, HalloIJburg's platform technology, in being steered by research interests, has been made publicly available to other local communities. In the process, the platform's ownership has been entrusted to a cooperative. Now, this cooperatively owned technology is used as a testing grounds for new technological tools focused on personal data management. In this way, it has become part of a wider, consortium-led and European Union-funded research and development project.

By comparing and contrasting the initiation, set-up, and implementation of the Smart Energy City and City-zen Amsterdam New-West smart grid projects, and the LocalLife and HalloIJburg community platforms, we have sought to establish a nuanced understanding of the legacy of techno-experiments. This is conceived as contributing to the development of a sorely needed socio-political critique of experimental governance in contemporary smart urbanism. Our study suggests that understanding three key governance processes helps explain why techno-experiments are so popular today and establish their effects in cities.

First, the initial set up of a techno-experiment, it appears, is crucial to its legacy and potential results. When experiments are developed through partnerships among corporate, government, and research interests, it is highly likely that projects will evolve in a self-referential manner, reproducing their initial appraisal and goals. These initiatives function as whirlpools in that they attract more funding and interest from public and research bodies, and are soon integrated into the process of urban governance. Conversely, when experiments are initiated by individual entrepreneurs with relatively open-ended goals and strategies, and limited financial means, their legacy is likely to be shaped by the kind of support offered by corporate, government, or research actors. In this instance, such projects come to resemble mosaics, piecing together a range of different actors and their interests in techno-experimentation.

Second, a reflexive critique of experimentation in smart urbanism should take into account how particular moments in the process of techno-experimentation are critical in shaping its outcome. Thus, to understand how experiments evolve in time it is insufficient to examine the experiments' starting set-ups or the properties of the technology at hand exclusively. We have shown how although some experiments begin by building a self-organized platform from the bottom-up, such projects are often targeted for research and governmental funding. By providing financial resources, larger corporate and academic bodies are likely to shape or even coopt bottom-up initiatives in ways that were not envisaged by their developers. The aims and direction of research grants, therefore, demands careful attention. The number and character of the funding streams supporting new tools determine their ownership structures, and vice versa. This can make all the difference in shaping how these tools are re-used and assessed, influencing what kind of digital or social innovation is likely to take place.

Finally, our paper has shown that techno-experiments, in line with most experimental practices in contemporary governance, aim to expand their reach across different areas (and countries) but do not do so through one particular model of upscaling. Our empirical analysis highlights that they can employ diverging trajectories to do so. Among our case studies, upscaling seems especially applicable to smart grid experiments, where the initial ends and means were enlarged through city-wide partnerships and international policy networks. It remains possible, however, for community platforms to adopt decentered forms of governance that instead are characterized by processes of replication or dissemination. Engaging in more distributed practices, such projects might permanently and successfully operate as a distributed network of initiatives “scattered” across geographical contexts.

Notes

1. Interview with the project manager of the End-2-End Smartification pilot study at Liander, April 2018.
2. Interview with an Amsterdam Smart City program manager who is also the local coordinator of the City-zen program for Amsterdam, March 2018.
3. Interview with the program manager at Alliander involved in the City-zen Smart Grid pilots, April 2018.
4. Interview with the program director of the Smart Energy City project, also responsible for the energy utility section at Ericsson, November 2017.
5. Interviews with an independent consultant at Ellevio who was involved in the Smart Energy City project, as well as with two Electrolux employees, one being the company’s Smart Energy City project representative, the other being a member of the steering group of the Smart Energy City project consortium on behalf of Electrolux, November 2017.
6. Interview with the managing director of Fortum Smart Living, and former project manager of Smart Energy City at Fortum, December 2017.
7. Interview with the local coordinator of the City-zen program for Amsterdam, March 2018 (translated from Dutch by the authors).
8. Interview with a PhD researcher at KTH involved in the Smart Energy City project, November 2017.
9. Interview with the Smart Energy City project representative at Electrolux, November 2017.
10. Interview with a PhD researcher at KTH involved in the Smart Energy City project, November 2017.
11. Interview with the research administrator at Swedish Energy Agency’s (*Energimyndigheten*) Department of Research and Innovation, December 2017.
12. Interview with the head of development for the SRS district, December 2017.
13. Interview with a postdoc researcher at KTH and founding partner of LocalLife, November 2017.
14. Interview with the initiator and technical administrator of the HalloIJburg platform, March 2018.
15. Interview with a HvA researcher and president of Gebiedonline cooperative, April 2018 (translated from Dutch).
16. Interview with a founding partner of LocalLife, December 2017.
17. Interview with a postdoc researcher at KTH and founding partner of LocalLife, November 2017.
18. Interview with a HvA researcher and president of Gebiedonline cooperative, April 2018.
19. Interview with the initiator and technical administrator of the HalloIJburg platform, March 2018.
20. Interview with a postdoc researcher at KTH and founding partner of LocalLife, November 2017.
21. Interviews with two of the founding partners of LocalLife, November and December 2017.
22. Interview with the initiator and technical administrator of the HalloIJburg platform, March 2018 (translated from Dutch).

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