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Social Smart Cities

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VOLUME FOUR, SPECIAL EDITION

Social Smart Cities: Reflecting on the Implications of ICTs in Urban Space

The fourth volume of *plaNext* stems from the 5th Media City Conference, "Social Smart Cities", held at Plymouth University, UK May 2015. The authors of the studies published in this volume apply different approaches to the theme of the conference, 'social smart cities', raising important question regarding our future cities. *plaNext* is pleased to have published this inspiring volume. Such focused explorations in special editions allow for the publication of cutting edge research on particular topics. They also help generate debates with more impact than those promoted through regular issues. For these reasons, the publication of special editions at *plaNext* has become a tradition. Every year *plaNext* publishes at least one special edition, and one regular volume. Since the inauguration of *plaNext,* the special edition is designed to publish selected papers from the annual conference of the AESOP-Young Academics Network. The first volume of *plaNext* (2015) published studies on urban resistance, the theme of the 8th YA conference, "Cities that Talk", held in Gothenburg, Sweden in March 2014. In 2016, the third volume stemmed from the 9th YA Conference, "Differences and Connections: Beyond Universal Theories in Planning, Urban, and Heritage Studies", held in Palermo, Italy in March 2015. The year 2017 is unique. *plaNext* publishes two special editions. The first is this volume, Social Smart Cities, and the second volume will publish selected studies from the 10th AESOP-YA Conference, "Spatial Governance: Bridging Theory and Practice", Ghent, Germany, March 2016. What distinguishes volume four, Smart Social Cities, is that it is the first volume that was entirely managed by external editors. The editorial board of *plaNext* joined the review process in the final stage, supporting the guest editors Dr. Lorena Melgaço and Dr. Katharine Willis.

Feras Hammami
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Content

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Editorial: Social Smart Cities: Reflecting on the Implications of ICTs in Urban Space

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Much of our thinking around technology and the city is based around polarising paradigms. These tend to move between two different approaches; the technocratic and the social. On one hand the smart city agenda is underpinned by a vision of data-centred optimisation of urban systems, whilst on the other hand there is a focus on open-source, citizen driven approach based around ad-hoc practices and prototyping of counter-culture scenarios. To date, the technocratic paradigm has tended to dominate smart city projects and initiatives, which are often led by ICT companies. Many smart city concepts and projects tend to prioritise data capture that leads to top-down, technocratic governance (Kitchin, 2014), and a number of existing publications in the field focus on the technical and economic dimensions of smart systems (Paskaleva, 2011). This is despite the fact that the social issues and implications have been recognised as critical within the context of urban development (Hollands, 2008; Luque-Ayala & Marvin, 2015). Kitchin (2014) describes how the term 'smart cities' encompasses both cities which are 'increasingly composed of and monitored by pervasive and ubiquitous computing' and those 'whose economy and governance is being driven by innovation, creativity and entrepreneurship, enacted by smart people' (p. 01). This highlights the polarising nature of smart city rhetoric; the former presents a more technocratic and neo-liberal paradigm of ICT driven urban change, whilst the latter focuses on the positive societal impacts of ICTs in urban space. Consequently, Marvin, Luque-Ayala and McFarlane (2015) highlight the need for international comparative research, bringing a 'critical insight across disciplines and places' (p. 03).

The core problem with the technocratic approach in the emergence of smart cities is that they tend to operate on a neoliberal logic that prioritises market led solutions for urban development based on efficiency (Kitchin, 2014; Hollands, 2008). Brenner & Schmid (2015, p. 157) highlight how the smart city agenda functions under a neoliberal agenda, since:

> Contemporary discussions of 'smart cities' represent an important parallel strand of technoscientific urbanism, in which information technology corporations are aggressively marketing new modes of spatial monitoring, information processing and data visualization to embattled municipal and metropolitan governments around the world as a technical 'fix' for intractable governance problems (Greenfield 2013; Townsend 2013).

This approach not only reinforces a universalising view of urban development, but it also masks the social role of its citizens in its construction. According to Leontidou (2015), this has implications for the social benefits for citizens in smart city projects since 'digital technologies saturate the quotidian and the public realm, and they increasingly fall to the hands of digitally literate, highly educated (hence, intelligent), highly skilled young people' (p. 84). Even where the social impacts of smart cities are considered, discourses are usually based on the rhetoric of community participation rather than on effective participation (Hollands, 2008). To counter this, academics have tried to highlight and prioritise the role of citizen engagement in the making of the smart city. Oliveira and Campolargo (2015), for instance, call for a 'human smart city', where 'the city government supports the implementation of an ecosystem of urban innovation, which applies co-design and co-production of social and technological innovation services and processes, in order to solve real problems' (p. 2336). De Lange & de Waal (2013) also highlight the potentialities of urban technologies to 'people to become active in shaping their urban environment, to forge relationships with their city and other people, and to collaboratively address shared urban issues' (p. 493). The main challenge is how this citizen-driven approach will challenge the existing neoliberal framework in which socially driven projects of the smart are still being developed.

By directly addressing the role of the social in 'smart city', in this Special Issue we intend to make it clear that the 'smart city' as such should be understood as a socio-technical ensemble (Bijker, 1997) formed by the interrelations of individuals and groups, technology and the space they produce (Latham and Sassen, 2005).

Reflecting on the many challenges embedded in thinking a more socially engaged smart city, the 'Mediacity 5: social smart cities' conference was held in Plymouth, UK in 2014. The conference took the topic of 'social smart cities' in order to consider more fully the multiple, subtle, and interdependent spatio-temporalities which together work to constitute ICT-based urban change. The conference explored urbanity and digital media and ideas of place and space and reflected on new models, landscapes and frameworks in the social smart city. Contributions addressed different perspectives on the social through a pragmatic approach to the topic, evaluating current limitations and trends that accompany the ubiquitous presence of ICTs in urban spaces. The papers in this Special Issue have been developed directly out of the doctoral session at Mediacity 5. Within the conference programme, the doctoral session enabled PhD students to contribute to an open and supportive discussion platform on the conference topic. It brought together students from different geographical locations (from both North and South) and fields; among them Architecture, Interactive Arts, Geography, Sociology, Business Studies and Urban Studies. The contributions here presented focus on the specificities of the social smart city, by discussing case studies and methodologies that react to the problematic overgeneralisation of this emerging field.

In the first contribution 'Intelligence is Open: Smart City versus Open City', Pinheiro approaches the politico-economic role of ICTs in the urban, by exposing the conflictive nature of the smart value as public good; in contrast to market oriented strategies. The author reminds us that '*smart* technologies do not necessarily yield a positive *social product*' and underscores the role of the openness of information in the process by discussing three technological initiatives related to urban planning: Waze, Uber and OpenStreetMap. In 'Mechanisms of the Smart City: A case study of Smart City Búzios, Brazil', Batista and Fariniuk investigate the Smart city Buzios project, in Brazil to understand whether smart grids can change urban space and engage local people. The authors highlight that due to a lack of a citizen driven approach, the project was advantageous to the private energy companies

while marginally benefitting local citizens, who often could not even identify possible transformations led by the implementation of the smart grid in Buzios.

The following two contributions use a case study approach to investigate the issue of participation in ICT driven urban projects. In 'Build it and They will come: Analysis of an Online Deliberation Initiative', Lusoli and Sardo address the increasing use of ICTs for digitally-mediated citizen cooperation, by investigating the processes of design, deployment and use of a digital platform created to engage citizens in the discussion and deliberation processes of urban-related issues in a project developed by Cezena's city government in 2014. The authors highlight the need to overcome an instrumentalized approach to e-participation, and suggest that participants be not mere users, but 'agents capable to change the rules inscribed in the technological artefacts'. With a broader scope of e-participation strategies that used gamification strategies, 'Let's play Urban Planner: The use of Game Elements in Public Participation Platforms', by Thiel evaluates and compares how market and research led strategies may foster more participation in the public sphere.

In 'Delving Deeper: Considerations on Applying Empirical Research Methods to Infrastructural Urban Technology Projects', Fortin challenges the lack of interest of public institutions that deliver artistic experiences through digital infrastructures in measuring the success of their initiatives by investigating the 'Quartier des Spectacles' in Quebec and offers an ethnographic multidimensional method to evaluate urban technology.

Early career researchers working with the issues around the social smart city have to deal with an emerging, fast changing and challenging field, that is both complex and informed by many different actors. This Special Issue hopes to enrichen the field by, firstly, putting into evidence the work that is being done by early career researchers, and secondly, collecting creative and innovative work that identifies the gaps of the field and introduces new approaches. This is critical if the social is to be taken to have importance in the future of smart cities.

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Intelligence is Open: Smart City versus Open City

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In this paper we explore the impacts, current and potential, that new technologies have on city planning and management, comparing the different ways in which those impacts can be harnessed for either the public good, for private profit or for a mixture of both. We argue that *smart* technologies do not necessarily yield a positive *social product*, and that the openness of information (in its different levels) plays an important part in maximizing the *social product* of new technologies applied to urban space. In the first part, we briefly discuss urban complexity and how technology can be used to make cities readable and actionable upon. In the second part, we analyse three technological ("smart") initiatives related to urban planning; Waze, Uber and OpenStreetMap, analysing the different processes by which information can be turned into use-value (and from there into exchange value). In the third part, we try to understand the economic process by which information is turned into capital through its restriction. We conclude by analysing the potential conflicts between the common good and the turning of information into capital, exploring some of the ways in which open data might be important in the process of making better cities.

Keywords: Urban planning; Open data; Smart city; Smart technology; Collaborative platforms.

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Introduction

In this paper we explore the impacts, current and potential, that new technologies have on city planning and management, comparing the different ways in which those impacts can be harnessed for either the public good, for private profit or for a mixture of both. We argue that *smart* technologies do not necessarily yield a positive *social product*, and that the openness of information (in its different levels) plays an important part in maximizing the *social product* of new technologies applied to urban space.

What is information (and what is smart)?

The definition of information can be broad. For the purposes of this article, we will focus on a stricter sense of the word; that is, specific pieces of information that are relevant to the decision-making process in using, interpreting, managing and planning the city. Every decision taken when using and managing a city is based on specific (albeit vast) bits of data. These data constitute a very complex network of information that influences and is influenced by the actions of citizens and urban planners. We will treat the word information as any processed data relating to how people use the city; where they live, where they work, how and when they move from one place to another, where and why they spend their time and their money, and so on. That definition of information is intimately related, then, to the definition of intelligence (or intelligibility). A Smart City (i.e. a city doted of intelligence) is, then, a city that is capable of gathering, systematizing and applying information related to it. In that sense, any technology that gathers and makes use of information applied to the urban space is *smart*; and, by extension, any city where this technology is used becomes smarter by this use. Smart technology is not necessarily open; that is, some forms of it gather and process information for the exclusive use of a limited number of individuals or companies. We will see why this is relevant throughout this paper.

What is open?

The definition of 'open' is not absolute. Information can be accessible, but in a selective and unsystematised way; it can be downloadable, but readable only with the use of proprietary software; it can be openly available but in such complexity that it makes it difficult for regular people to understand and act upon. The Open Data Institute was cofounded by Sir Tim Berners-Lee to help create a framework of knowledge over which open data can be shared and systematised[1]. It has proposed the concept of the data spectrum that ranges from 'open' to 'shared' to 'closed', with given examples falling along any point of that spectrum (Broad, 2015). It has also proposed the '5 Star Open Data' scheme, where data can be described as being open in some level from one to five stars. We will not attribute a specific rating of openness for each case described in this paper; suffice to say that data can range from completely closed (inaccessible to the public) to completely open (accessible, readable, downloadable, interconnected), falling anywhere along that spectrum.

Use and exchange value in urban space

The process of gathering and systematizing urban information has played an important role in human development since the beginning of history. The citizens of Jane Jacobs's fictional first city, New Obsidian (Jacobs, 1969), probably took decisions based solely on their personal experiences, but as cities grew, each citizen became less capable of individually encompassing their full complexity. Tools through which some of that complexity is gathered, systematized, presented and acted upon are the basis of any action of urban planning and management. Maps are at the basis of these sets of tools; zoning, land uses and mobility

[1] http://5stardata.info/

systems are some of the different planning tools that are discussed based on maps and, conversely, have direct influence on them. The process of mapping cities is also a political tool: *favelas* (slums) in Brazil have notoriously been left out of most official maps at least until the eighties (Magalhães, 2013). If they were not politically relevant for the governmental institutions making the maps, they did not have to be seen; and if they were not seen, they did not have to be acted upon.

Like other commodities, the exchange value of information varies according to its availability (Tregarthen & Rittenberg, 2000). The complexity of the process of building comprehensive and updated maps means this is an industry with a tendency for oligopoly, since it's not feasible (or collectively efficient) to have several companies doing the same, massive amount of work. The largest digital mapping company until recently, Navteq, has dedicated roughly half of its revenues to generating, expanding and updating its map database between 2002 and 2006 (Navteq, 2007). If there had been double the number of companies in this industry with similar commercial reach, Navteq's expenditures in database building would not have changed significantly, but its revenue would be roughly cut in half (assuming proportional market shares). The profit margins for the industry would virtually disappear. Even though it would probably serve a broader range of customers and, therefore, have an increased use-value overall, competition and the diminishing marginal exchange value (Jain, 2010) of the information being sold would very quickly absorb any marginal profits brought on by these new companies.

Even though *smart* technologies are often portrayed as uncontroversially positive and desirable, recent literature on smart cities have started to question this view, such as in *Against the Smart City* (Greenfield, 2013) and *Smart Cities* (Townsend, 2013). This is not to say that smart technologies are necessarily bad. What we propose, instead, is that these technologies be analysed as to the amounts of public and private good that they generate. A starting premise is that the social product in each initiative be positive, with the ultimate goal of it being the best possible. This means, for instance, that if a technology is profitable and generates no negative externalities, it should not be opposed; and if it can generate positive externalities at the cost of some of that profit, this should be encouraged (through laws, regulations or direct actions). To that end, we present, in the following section, three case studies of smart technologies to understand some of the process through which they operate and generate use- and exchange value. They are not competitors nor directly comparable, but they all have potential impacts on their users and they all generate significant externalities. Each study is presented with four subsections: a brief introduction; an analysis about the level of openness of each platform; a case study presenting data about each of them; and a comparison of the use- and exchange-values generated by each platform. The analysis does not intend to be exhaustive and should be deepened in further studies; furthermore, its accuracy is dependent on the availability of relevant information in each case, and should, therefore, be adjusted as that information changes and becomes more accurately and widely available. Our purpose is, rather, to understand the different incentives that different platforms offer in the process of converting information into use value.

Case Studies: Smart technologies applied to urban space

OpenStreetMap: not-for-profit, free and crowdsourced mapping

The OpenStreetMap (OSM) initiative started in England in 2004. Its creator, Steve Coast, inspired by the way Wikipedia worked, created a collaborative project to put user-generated GPS data together (Coast, 2014). In 2006 the OpenStreetMap Foundation was established

to promote the development of OSM maps. By 2008 the project had mapped about 29% of the area of England, where it started, with dense areas such as the city of London covering as much as 80% of the Ordnance Survey's database, the British's government official database (Haklay, 2010). A year later, in 2009, coverage in England had increased more than twofold, reaching 65% (Neis & Zielstra, 2014). In 2009, OSM's database surpassed TomTom's in Germany (Neis, Zielstra, & Zipf, 2011). As to accuracy, a study published in 2012 showed that OSM's data provided significantly shorter routes, due to broader or more precise coverage, than Navteq's or TomTom's databases in the four cities surveyed (Miami, San Francisco, Berlin and Munich) (Zielstra, 2012). A recent study comparing OSM's database to that of ATKIS, the German authority for topographic-cartographic information, found that in the surveyed area, in southern Germany, OSM's maps showed a completeness of over 80% and a correctness of over 90% for urban areas (Dorn, Törnros, & Zipf, 2015).

Openness

The 'opening up' of the mapping industry brought about by the widespread use of personal devices with GPS and an internet connection, starting in the year of 2007, had two significant impacts: for one, it has severely hurt the map licensing business. TomTom's revenue from licensing fell by 60% from 2009 to 2014 (TomTom, 2010, 2015). Navteq reported a net income of US$ 110 million for the fiscal year of 2006, its last annual report before being acquired by Nokia. By the second quarter of 2012, Nokia's Navteq operation was reporting operating losses close to € 100 million per quarter (Dediu, 2012). The second, and most significant, impact was the realignment of the process of mapping, comparable to the 'revolution' brought about in the industry with the opening up of GPS technology in 1983.

The geospatial information went from remaining largely lost in the abstract, during medieval times, to being processed and used mostly by governments, with its political incentives and biases. In the eighties, with the opening up of GPS technology, it became a commodity, which was captured and turned into exchange value. Then, around 2009, it began its move towards becoming a common good. While it is hard to put its social product in numbers, nearly no one argues against OSM. One could try to make the case that open data has cost profits and jobs of the proprietary companies that dominated the sector until 2009. TomTom issued a statement in May of 2012 where it argued against open source mapping and wrote that 'mapping errors can be extremely dangerous', citing 'recent studies' that have highlighted some of these dangers but without pointing to any source. The statement featured a world map made of coins. It has since been pulled from their website, but is still accessible through the Internet Archive's Wayback Machine[2](InternetArchive, 2015). There seems to be a consensus that the social benefits far outweigh the costs and lost profits of the move towards open sourced mapping.

Case Study

The fact that maps lost their market value is not to say that they lost use-value. On the contrary: if their use was, up to that point, restricted to companies that were willing and able to pay millions of dollars for their licensing, OSM's open licensing[3] meant that a vast array of platforms could be built over it, for free. That meant that the access to current and comprehensive geospatial information was no longer accessible only for companies and

[2] Snapshot of TomTom's statement of May 2012, named 'Open source maps and their alternatives', taken in July 5th, 2012. Retrieved 19/09/2015, from https://web.archive.org/web/20120705204316/http://www.tomtom.com/en_gb/licensing/newsletter/201205/didyouknow/

[3] OpenStreetMap licensed its maps under a CreativeCommons license, later adding its mapping underlying data to the Open Data Commons Open Database License (ODbL).

institutions that had enough commercial or governmental interests to justify buying a use license, but for everyone. These two movements were, then, in opposite directions: as geospatial information lost its market value, it became available and useful for an increasingly wider range of people. In a sense, then, maps have slowly shifted from one end of the diamond-water paradox[4] spectrum to the other. As it became more widely available and more useful, it lost market value.

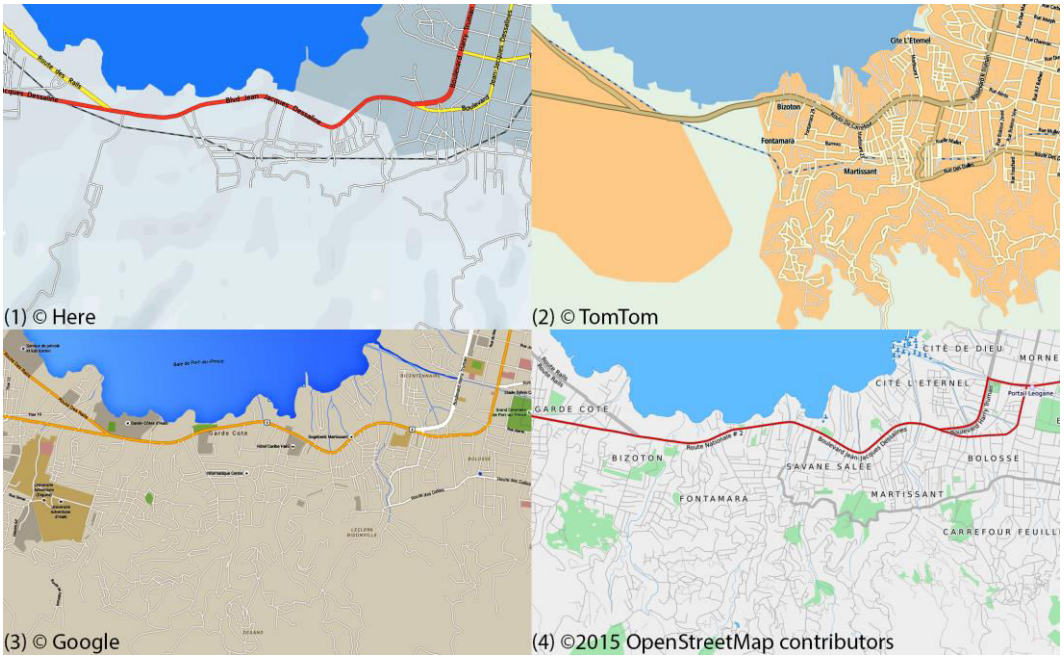

Figure 1. Comparison of the current state of digital maps provided by Navteq/HERE (1), TeleAtlas/TomTom (2), Google Maps (3) and OpenStreetMap (4) in the same part of the city of Port-au-Prince, Haiti. *Source:* Retrieved from each institution's official website on November 9th, 2015.

The impact was more clearly felt in areas with little commercial appeal, especially poorer regions and countries. OSM's database had much more precision in richer areas than poorer ones in the first few years, as the first users were generally wealthier and mapped predominantly their own surroundings (Haklay, 2010). In the last few years, though, a host of humanitarian projects, as well as increasingly cheaper GPS devices and computers, have mapped poorer areas with more detail than governments and companies were ever able to do. After the 2010 earthquake in Haiti, several hundred users joined forces to map Haiti's main cities based on GPS data and aerial photographs with the objective of helping citizens and humanitarian institutions; as a result, the number of map nodes in Port-au-Prince increased 9-fold. Later, in 2013, after typhoon Yolanda hit the Philippines, over a thousand users again joined efforts to map the affected areas, with cities such as Tacoblan having its node content increased by a factor of 11.5 (Palen, Soden, Anderson, & Barrenechea, 2015). The changes the mapping guidelines and interface went through after the experience with Haiti are as interesting as this collective mapping effort. That could be felt in the Philippines three years later, which is the topic of *Success & Scale in a Data-Producing Organization: The Socio-Technical Evolution of OpenStreetMap in Response to Humanitarian Events*

[4] Often attributed to Adam Smith, some form of the diamond-water paradox, or paradox of value, can be traced back to Plato (Sandelin, Trautwein, & Wundrak, 2014). It revolves around the fact that, even though water is much more useful to humanity than diamonds, diamonds command a higher market value.

(ibidem). So not only OSM served as a platform over which people volunteered efforts to map socially fragile areas, but it also learnt from its experience and could do a better job the next time it needed to.

Figure 1 shows the level of detail provided by each of the four largest digital map databases currently available in a poor area of Port-au-Prince, Haiti. The crowdsourced maps, on the bottom, show much more detail in these areas, with OpenStreetMap showing a level of detail since the aftermath of the 2010 earthquake that commercial initiatives, on top, have not incorporated several years later.

Use value vs exchange value

We identify, therefore, two separate moments in the mapping industry. First, between 1983 and the early 2000s, mapping became an important industry as the two big companies in the sector started building digital maps. Even though the marginal value of maps decreased, the total value of the industry increased; then, as the process of mapping became easier and accessible to the general population, the market value of mapping information decreased accordingly, to the point where its marginal value became negative (i.e., the entire industry lost market value). This is explained by the economic principle that the exchange value of one unit of a commodity is equal to the marginal value of the last unit added to the market (Jain, 2010). That means that, regardless of how much investment was made to build an industry, the total exchange value of that industry's output is the multiplication of its total product by the exchange value of its latest addition. In this case, between 1983 and the early 2000s, the process of converting mapping information from the abstract into usable and comprehensive databases was costly and concentrated in the hands of the two companies that had the resources to do it. Because their maps had huge market value, they were able to finance their operations with large profit margins. The shift in the industry brought about by OpenStreetMap and other open mapping platforms meant that, with enough users, the process became increasingly cheaper until it became virtually free. With the marginal cost of mapping nearing zero, this meant not only that new information had a diminishing market value, but also that the existing databases lost their exchange value.

Waze: a private navigation software 'paid for' with volunteered information

Another open sourced mapping platform, called Freemap, was founded in Israel in 2006. Its founder, Ehud Shabtai, stated that he was 'tired' of having to pay thousands of dollars for map data and decided that 'the only way to develop something free is by creating a community that develops free maps by itself' (Rom, 2014). Its original Terms of Use stated that the 'aim of the project is to create, by the community users, a free digital database of the map of Israel, and to ensure its free content, update and distribution, for non-commercial usage, as convenient as possible'. Besides the map database, the community also forked[5] an open-source software, Roadmap, to launch a navigation app for mobile devices. In 2008, the creators of Freemap raised investment funds, started a corporation and renamed the project to Waze. The Waze navigation software remained open source, but the maps, though openly accessible and editable through a website interface, were made property of the company. As smartphones with data connections became more popular, Waze began capturing traffic speed information from users and integrating it into its routing server. Though the navigation app was bound to remaining open by its open source code that carried a GPL

[5] A term used in the open software community for when someone starts a new project based on source code openly released by someone else.

license[6], the app was allegedly rewritten from scratch in 2012 and turned into closed source. While remaining free (though moving towards the 'closed' end of the data spectrum), Waze built a user base of nearly 50 million users by 2013, when it was acquired by Google after a bidding war with Facebook and Apple (Cohan, 2013). Waze's main asset was not its geospatial information, which had lost most of its market value (and of which Google had plenty); its main asset is its user base with all the traffic information they provide, passively or through specific reports (idem).

Openness

Waze currently sits somewhere in the middle of the spectrum between open and closed data. Any user can edit its maps, though with some restrictions: new users can only edit the area inside a radius of one mile around the paths they have driven while using Waze. Editors are ranked from level 1 through 6, according to their experience and number of edits, and some areas (such as important avenues and highways) are locked so that they can only be edited by users in higher levels. Any user passively uploads information about their average speed while they are driving; that information is then processed and used as reference so that the routing server can give faster routes, depending on the time of day and day of the week. Users can also report and comment on issues such as accidents, potholes, construction sites and so on. A lot of that information can be accessed through their website, but only on a user level; that is, it is possible to check route times between two different points at different times of the week, but not to download and process that information systematically[7].

What Waze does, then, is to capture traffic-related information from the abstract and turn it into use-value. It also records that information in a closed environment, which Google then uses to feed its own applications. By opening up some of the information it gathers, it becomes useful to users who provide the application with more data; and by keeping some of that information closed, it provides its parent company with information over which it can monetize in a number of ways (such as displaying ads, learning about its users' behaviour and so on). Waze also exchanges information with some public authorities it has deals with, such as the city of Rio de Janeiro, but the exact content and extent of that sharing is not disclosed (Machado, 2013).

The information Waze deals with is of vital importance in modern urban planning. Understanding urban mobility has been at the core of planning at least since Johann Henrich von Thünen, a German economist, developed in the early 19th century different models around the economics of land use, transportation costs and marginal productivity (von Thünen, 1826). Von Thünen, however, only considered physical distances. Now traffic, transportation modes and types of roads are of significant in determining the amount of time spent to overcome a given distance. The actual travel distances inside cities are an essential piece of information to accurately gauge density limits, design public transportation systems and decide where to build public infrastructure, such as schools, hospitals and parks. Several mathematical models have been proposed to try to estimate how traffic speed varies according to road characteristics, time of day, number of vehicles and so on; but it is nearly impossible to correctly estimate some of the variables at a given moment, since it can vary greatly depending on time of day, day of the year, number of cars sold, specific events, etc.

To that end, some cities have invested in the installation of traffic sensors aimed at measuring traffic speed and volumes in major roads; the Georgia Navigator system, for

[6] GNU General Public License, which requires that software based on open-source code be released under the same open license.
[7] That corresponds to a one star rating in Open Data Institute's 5 Star Open Data initiative.

instance, has dedicated US$ 140 million in infrastructure to monitor and manage traffic conditions on 90 miles of highways in the metropolitan area of Atlanta (Excellence, 2008). These sensors are usually limited to main roads and provide data directly to authorities in charge of traffic management. The opportunity that Waze offers is to measure and record real time traffic data in entire cities, making it possible not only to estimate actual time distances inside a city, but the way these distances evolve in time. It establishes a two-way relationship with its users, by measuring traffic speed data at the same time as it distributes users through the fastest available route at any given time. This is particularly important because the marginal impact of each new car in a particular route increases exponentially beyond its saturation point. That is: if there are two possible routes between two points (route A and route B), where A is saturated but B is not, rerouting 5% of the cars from A to B might decrease travel times in A by 8 or 10% while not having a significant impact for travel times on route B. This sort of redistribution of traffic constitutes a 'soft layer' of urban planning that might play a significant role in making cities more efficient with little or no centralized investments.

Of course, reducing travel times is not an absolute priority in urban planning. It is part of the complex network of costs and benefits that include environmental, historical, social and other variables. In the case cited above, route B might be of historical or environmental significance, for instance, and rerouting cars from A to B might not be in the city's interest, even if it would make for a more efficient traffic network. That is why the openness of platforms such as Waze is important. If Waze kept all of its data closed, charging a subscription fee, its sole incentive would be to save its users' driving time regardless of any other factors. Because it is relatively open, it can serve as a backdrop for citizens, drivers and public authorities to negotiate and find solutions together on a case-by-case basis. Besides, being free attracts users, which makes the platform increasingly accurate.

Case Study

To illustrate Waze's capability of mediating conflicts in proportion to its openness, we have studied such a case using Waze's data. Bel Air is one of the richest residential areas in Los Angeles, but it is situated close to the busiest interstate highway in the USA, the I-405. Its residents have recently been complaining that, as Waze becomes more popular, more cars have been using Bel Air as a shortcut during peak times (Roberts, 2015). Without sufficient data, this type of issue can easily become limited to a power struggle, with either side using arguments based on ideology, depending on whether they are interested in defending the rights of local dwellers or the city's traffic network efficiency in general. Actual data, therefore, is a key aspect to settling such matter.

Using Waze's web site, we have measured average travel times between a point at the Ventura Boulevard, to the north of Bel Air, and Sunset Boulevard, to the south, both through the I-405 and through Bel Air. The results are shown in Figure 2. We can see how traffic is at its peak between 07:30 and 9:00 for the southbound traffic, and between 16:30 and 18:30 for northbound traffic. It is also visible how traffic in the main route (I-405) is substantially faster through the day, but spills over to the alternative route (Roscomare Rd.) at peak times, particularly for the northbound traffic at the end of the afternoon. For the southbound traffic, however, average travel times on the alternative route did not change considerably at the peak hours of the morning, increasing by only 5.9% when compared to average travel times through the day. Northbound travel times through in that route increased by 30.5% at its peak.

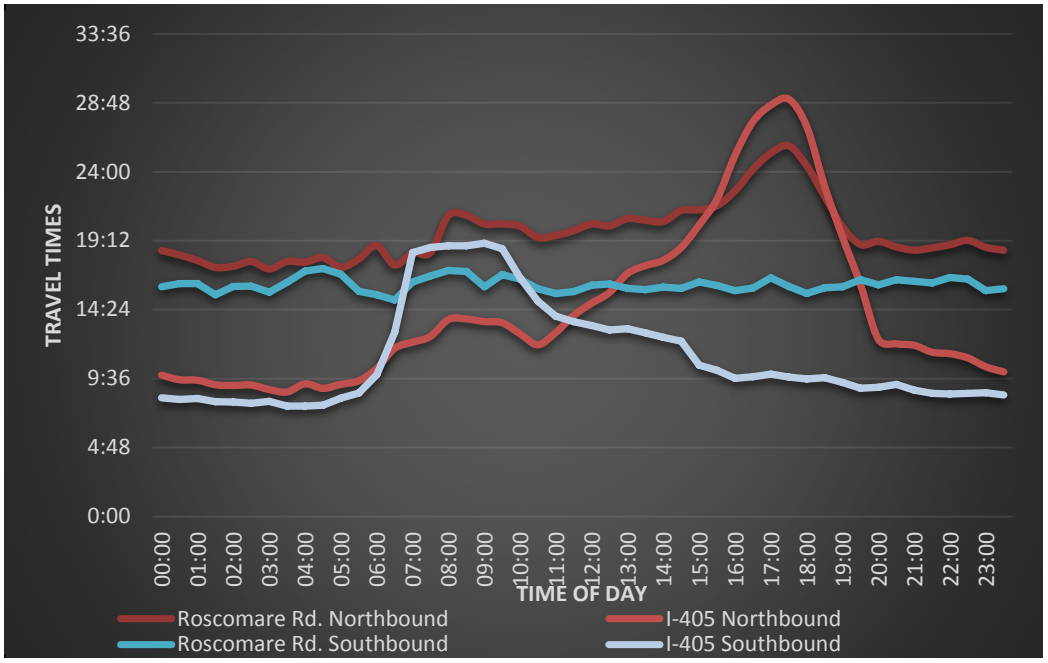

Figure 2. Average travel times (mm:ss) between Ventura Blvd. and Sunset Blvd. throughout the day, using either the main route (through I-405) or cutting through the residential area of Bel Air (through Roscomare Rd.). *Source:* Produced by the author using data manually extracted from Waze's website on September 1st, 2015.

Upon examining the map, we found that a user had edited one of the roads inside the alternative route, adding a turn restriction between Longbow Drive and Mullholland Drive for the time segment between 07:00 and 09:00. This restriction meant that Waze's routing server could not route traffic through Roscomare Road at those times, so that its users would be instructed to either remain on the I-405 or take a longer alternative route. We posted about this restriction at Waze's Community Forum; one of the Country Managers for the USA drove to the area to check and found that there was no sign posting that restriction, meaning that it was probably made up in an attempt to divert rush hour traffic. He corrected the map error and set a lock, restricting changes for higher-level users. To measure the impact of the change, we started monitoring average travel times for one segment in each of the routes studied above: a southbound segment of the I-405 and a parallel segment that would have been avoided for through traffic during the restriction[8]. The results are shown in Figure 3.

While the peak for the I-405 segment remained relatively stable in the days following the map correction, with a slight increase of 5.9%, the alternative segment started to climb right after Waze's maps were updated, on September 4th, and steadily climbed to a rise of 80.7% after 18 days. Waze's routing server uses recent travel times to predict traffic flow and guide its users through the fastest routes, so it is likely that estimated travel times vary according to a moving average. This suggests that the made-up restriction that was in place had a significant role in reducing the amount of traffic through Bel Air during the morning rush hour. We cannot, however, assert this as a definitive conclusion without access to the raw data in Waze's servers, or their methodology for calculating average travel times, to assess the significance of our findings and what other elements might have had an impact on them.

[8] Woodcliff Road, Scadlock Lane and Longbow Drive.

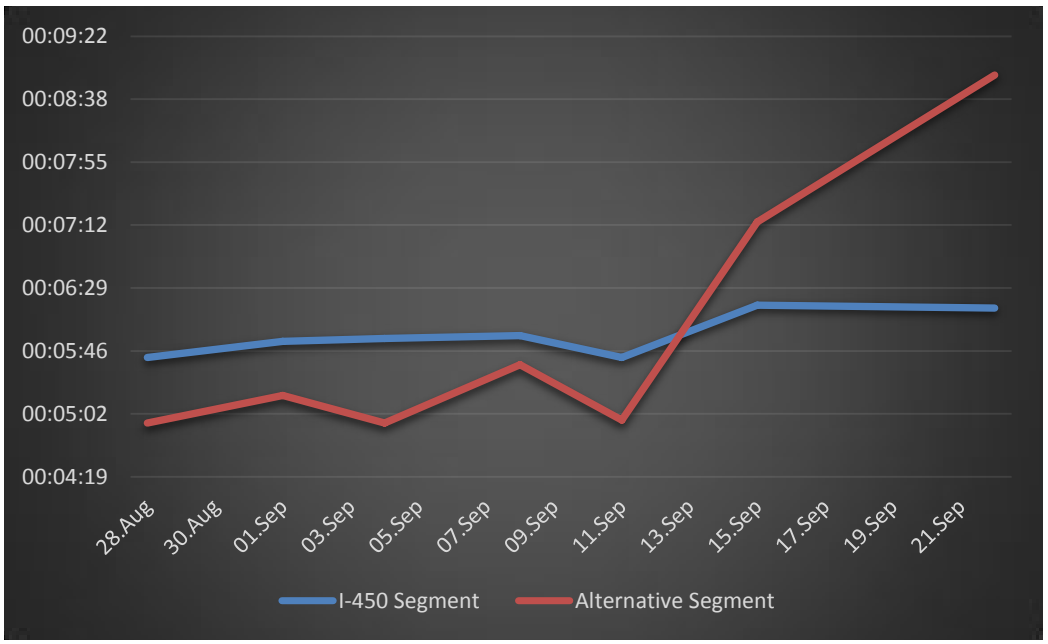

Figure 3. Evolution of average travel times (mm:ss) at peak hour (08:00) for two possible southbound segments after the inexistent turn restriction was removed from Waze's server on September 4th, 2015. *Source:* Produced by the author using data manually extracted from Waze's website on August 28th, September 1st, 4th, 8th, 11th, 14th and 22nd.

The consequences of different levels of openness can be seen in this experience. First, the two-way relationship established between drivers allows traffic to be redistributed along existing city streets. This process, considering the exponential nature of the marginal cost of each new car on busy roads, tends to yield a positive sum, that is; taking one car from a busy avenue and routing it through an empty street is, *ceteris paribus*, beneficial to every driver. This benefit from Waze needs only a slight amount of openness; it can happen as long as drivers' mobile devices receive and send information to Waze's main server. This information does not need to be readable by other machines or by humans, meaning that it can happen even if it is less open than the one-star rating of the 5-Star Open Data mentioned earlier. A further level of openness allows us to track current and historical information about travel times for any city with enough users; this has allowed us to analyse the dynamics of traffic in Los Angeles and to assess how different actions and policies influence the evolution of travel times in studied areas. Although this information is not directly downloadable (which would make it a 2-Star), Waze's servers allow for enough queries that we are able to extract data from them into spreadsheets through simple computer scripts. This allows citizens and urban planners to conduct studies and form opinions on topics that would previously be left to either expensive research or to guesswork. A third level of openness allows users to edit maps to add roads, edit their attributes (such as type of road, routing priority and so on), set restrictions, correct errors and update data in near real-time. Even though the made-up restriction we found in Bel Air seems to have been added by an individual user, Waze's map and forums can be used as platforms to mediate negotiations between different actors, making it possible to adopt such policies to manage interests that would otherwise have to be taken in the political and ideological spheres.

Use value vs exchange value

We have seen how, in its current state, Waze can play an important role in establishing two-way information exchanges between different actors in the city, helping advance the role of

the 'soft layer' of urban planning. This contribution is limited, however, from the point where Waze closes its data. We cannot, for instance, access and download historical data. Waze's algorithms that convert past drives into current predictions are not known, and so the significance of researches like the one we have presented is limited. Other statistical information, such as traffic flow, origins and destinations of each drive or number of accidents and other events reported by region, are not disclosed. Disclosing this kind of information in a systematic way could go a long way in helping making cities better, but they could also hurt Waze's current business model, which relies on the exclusivity of the information it harnesses to make use of it for its parent company, Google[9].

To sum up, inasmuch as it is open, Waze tends to generate a positive social product to cities; and inasmuch as it is closed, it has the potential to turn that social product into private profit, even to the point where it potentially yields a negative social product for the city. If, for instance, they stopped providing traffic information openly and began charging for its services, there would be an incentive for them to route its paying customers through faster routes regardless of the external effects it might have, and no one would be able to measure or have an influence on this process. Waze seems, from this analysis, to be in a point of the openness spectre where it generates much more profit than OpenStreetMap, but less profit than it could if it were completely closed.

Uber: private drivers as a policy for urban mobility

Founded in 2009, Uber's platform puts passengers and drivers in touch to hire taxi-like trips inside certain urban areas. Its stated advantage over current taxis is that any citizen can become an 'independent contractor', setting their own conditions such as working hours, driving areas and who to pick up (Uber, 2015b). It also bypasses the current structure of call centres of different companies to put potential passengers in contact with drivers that are currently close to them, saving idle time and infrastructure costs. Since it uses a web-based information platform to exchange, in real-time, information about where passengers and drivers are currently located, mediating their relationship and storing a wide range of information about every trip, it fits our definition of smart technology.

On-demand transportation is an important part of a city's urban mobility platform. Since collective transportation is inherently generalist and does not usually offer direct, door-to-door trips, their utility depends on the availability of connected stations between the user's origin and destination, and on the running of vehicles around the times the user is looking to make the trip. While this is usually the case for most trips in dense urban areas, the occasional need for specific, direct trips between places or at times when public transportation is not sufficiently available makes for-hire car services an important complement to mass transit systems. As such, they are often regulated by local laws that set rates, service conditions and obligations, car specifications and so on. These policies have short- and long-term impacts on how citizens use public and private transportation modes. Several studies have assessed the elasticity[10] of taxi demand with regards to fares: Schaller (1999) found that elasticity in New York City to be of -0.22 with regards to drivers' revenues, and of somewhere

[9] An Israeli member of the initial Freemap community, Roey Gorodish, has filed a lawsuit demanding that the community of contributors receive half of Waze's profit with its sale and that it opens up its data in the spirit of Freemap's initial Terms of Use (Appelberg, 2014).
[10] In economics, elasticity the measure of "the response of one variable, such as quantity demanded, to changes in another variable, such as price." (Lipsey & Harbury, 1992, p. 62)

between -1.05 and -1.22 with regards to miles driven[11]. This is significant because it means, for instance, that a 10% decrease in taxi prices tends to increase drivers' revenue by 2.2% (due to increased demand) and the number of miles driven by a little over 10%. Because taxi services compete, in some level, with all other forms of transportation, their availability and fare rates are often object of public regulation. Following the stock market crash of 1929, there were as many as 30,000 private drivers in 1930 in the streets of New York City (Van Gelder, 1996). Some of them would drive 16 hours a day and not pick up a single passenger, which led to the passing of the Haas Act in 1937, regulating the taxi industry and limiting its number to 16,900 (Mathew, 2005). That number went down as some drivers failed to pay annual fees, and has not changed significantly since.

Uber started operating in 2011, offering services comparable to that of taxis. Drivers sign up as 'contractors' and drive their own cars, accepting or rejecting rides that are offered to them on smartphones provided by Uber (Fagin, 2014). Its legality has been disputed and has not yet been settled in most cities. There are two main legal issues usually cited: one is whether the service itself is legal, since taxi companies are regulated by specific laws; and the other is whether its drivers should be considered employees. For the purposes of this paper, those issues are not immediately relevant; we will study Uber's social and economic impacts in cities and analyse how it relates to the platform's level of openness.

Openness

The consequences of Uber's operations in a city are not easy to measure, since it releases almost no data. The total number of active drivers in New York City remained unknown until 2015, when an article, funded by Uber, was published by Hall and Krueger (2015). Called *An Analysis of the Labor Market for Uber's Driver-Partners in the United States*, its stated focus is the labour market, with a special emphasis in comparing Uber drivers' earnings, demographics and work dynamics to that of taxi drivers. The mere comparison between Uber and the current taxi industry is misleading, however, since it leaves out externalities that might be significant for urban planning. The total number of drivers has an impact on wait times, which might restrict or induce demand; a rise in fares tends to attract more drivers, while lower rates tend to attract more passengers. General public transportation costs influence car ownership in the long run, with an elasticity of between 0.1 and 0.3 (Litman, 2013), and it is natural that car ownership affects demand for parking space, which, in turn, has an influence on housing prices in urban areas. Uber can, then, have a positive effect, if it helps lowering housing costs and broadening the range of citizens that can afford it; or it can have negative effects, if it takes people out of the public transportation network and into cars, making traffic worse for everyone. Actual data regarding Uber usage is, for this matter, of the utmost importance. As in *The Problem of Social Cost* (Coase, 1960), externalities play a very important part in understanding the issue.

Case Study

New York is a city of importance to this analysis, not only because it is one of the first cities where Uber started operating, but also because it releases most of its data through its NYC Open Data program[12]. This allows us to better estimate the complex consequences of Uber operations. It is also the only city for which they have released statistics for hourly rides, which they did as a way to fight Mayor Bill de Blasio's proposal do cap the number of drivers

[11] Several other elasticity relationships are cited by Litman (2013) and Rose and Hensher (2014), which show to which extent changes in fares, availability and efficiency of taxi services have a ripple effect in the entire transportation network of a city.
[12] Available at https://nycopendata.socrata.com.

of ride share companies (Tepper, 2015). Since Uber itself releases very little data, we will work on some assumptions to understand not necessarily its actual impacts, but its potential impacts on urban planning.

The most consequential policy that Uber can adopt is its pricing model. Lower prices induce demand, while higher prices attract more drivers. Because of the exponential nature of the marginal impact that each new car has on traffic, two variables are essential in estimating Uber's impacts: the number of active drivers at any given time, and the proportion of trips that were induced by Uber (i.e., excluding trips that would still have happened in taxis or private cars). According to Uber's data, there is an average of 1,675 Uber cars on the streets of the Central Business District (CBD) of NY, with a peak of 4,510 for June and July of 2015 (Uber, 2015a). An article published by The Economist (2015), based on leaked data, estimates the number of proportion of trips stemming from induced demand to be of about 13% in the CBD. That is almost certainly an underestimation for rush hour, since Uber's rides are more concentrated between those hours than taxis' (Bialik, Flowers, Fischer-Baum, & Mehta, 2015). If we assume 13%, this means that Uber adds an equivalent of 586 new taxi medallions to the CBD. A model developed by Charles Komanoff called 'Balanced Transportation Analyzer' (BTA) suggests that this addition in the area results in a decrease in traffic flow of about 3.9% (Komanoff, 2015). Though it may not seem much, the model estimates that this equates to an aggregate social cost of US$ 260 million per year in wasted hours[13], increased crash damage costs, air pollution, decrease in bus speeds and a number of other factors that the BTA takes into account. If these numbers are correct, each one of the estimated average of 586 Uber cars that induces demand generates US$ 30.35 per hour in gross revenue for its driver and US$ 7.59 per hour for Uber, while imposing externalities that equate to a US$ 50.65 loss per hour[14] - in other words, under these conditions, Uber costs more to society than it provides to its drivers and users, yielding a negative *social product*.

Furthermore, Uber's own pricing scheme differs from that of taxis. Taxis only charge a time-based fee when the vehicle is stopped or moving below a certain speed. Uber's pricing model is different: it also charges a time-based fee, but it is lower and applies whether the car is moving or not. This means that, as traffic gets worse and cars spend more time stopped or moving slowly, Uber becomes comparatively cheaper than taxis. A 7-mile, 20 minutes ride in NYC, for instance, currently costs US$ 24.72 (including a 15% tip). The same ride with Uber would cost US$ 26.05, or 5% more. If the same trip took 30 minutes instead, due to traffic delays, the taxi fare would rise to US$ 31.47, while Uber's would cost US$ 30.05, or 5% cheaper. This shows a dual, perverse incentive: as Uber gets more popular, traffic gets worse; and as traffic gets worse, Uber becomes comparatively cheaper than taxis and thus gains more market share. It could be argued that the lower fares might lead drivers to avoid working during rush hour, resulting in longer waiting times and lower demand. However, Uber often offers a 'rush hour guarantee', covering an income of US$ 20 or 25 per hour if the driver made less than that in the period as long as he has driven a certain number of hours[15].

[13] This takes into account the total number of hours saved by those who benefit from shorter wait and trip times from the added cars.
[14] Komanoff's spreadsheet is massive and uses several different data inputs to reach results like this one. It can be downloaded, studied and tuned according to different premises. As more data becomes available, it tends to become more accurate; the fact that its author makes it available as a spreadsheet, rather than publishing cherry-picked results according to his ideologies, is a good testament towards open data in general.
[15] Although this policy is not publicly posted on Uber's website, third-party websites often reproduce their e-mail announcing such guarantees, such as http://www.driveubernj.com/amrush/ (access on 28/09/2015).

The same dynamic applies to all but one city in a list of 23 American cities for which we have compiled official taxi and Uber rates. Furthermore, this policy is often more pronounced in cities that actually have worse traffic. In Washington, D.C., for instance, where commuters spend a yearly average of 82 hours stuck in traffic (Shrank, Eisele, Lomax, & Bak, 2015), the Uber-to-taxi fare ratio[16] drops from 0.77 when there is no traffic to 0.65 with a half-hour delay for the same trip, or a drop of 15.6% in Uber's relative price. Conversely, in Cleveland, where yearly delays due to traffic are of 38 hours per driver (55th in the country, compared to Washington's 1st place), Uber's relative price drop in the same conditions is of just 4.3%.

In the table below, we have compared the cost of an Uber trip to that of a taxi trip in free-flow conditions for a 7-miles, 20-minutes, trip, and then multiplied the trip duration by the Travel Time Index[17]. We then compared the latter ratio to the former to measure how much cheaper Uber gets, compared to taxis, during rush hour in each city.

Figure 4 shows a significant, negative correlation ($r = -0.42$ $p = 0.047655$) between the intensity of traffic in each city and the change in Uber's trip cost compared to taxis (which often have publicly-regulated rates). This means that not only Uber pricing policy makes it relatively cheaper than taxis during peak periods, but that this policy is more aggressive in cities where traffic is worse (and therefore the marginal social cost for each new car at rush hour is higher).

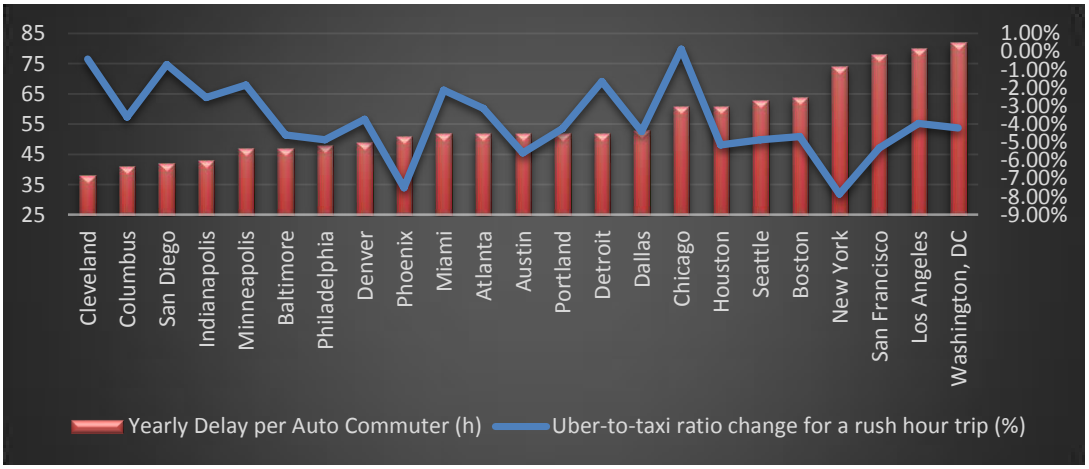

Figure 4. The number of hours each commuter spends in traffic per year in each city (bars; higher means worse traffic – extracted from Shrank, Eisele, Lomax, & Bak, 2015), and the relative change in price for an Uber trip at rush hour when compared to taxis (line; lower means Uber fares get cheaper than taxis when there is traffic). *Source:* The bars' information extracted from Shrank, Eisele, Lomax, & Bak, 2015, and Fares extracted from each city's web site on September 18th, 2015.

Use value vs exchange value

This study helps put in context some of the discussions involving Uber lobbying that aims to make sure the company can operate unregulated. They have spent almost US$ 1 million on lobbying in California alone (Kokalitcheva, 2015). According to an article in The Washington Post, 'Uber's approach is brash and, so far, highly effective: It launches in local markets regardless of existing laws or regulations. It aims to build a large customer base as quickly as

[16] Considering the same trip cited above (7 miles, 20 minutes).
[17] The average trip delay increases for peak hours compared to free-flow hours, taken from the same report cited above.

possible. When challenged, Uber rallies its users to pressure government officials, while unleashing its well-connected lobbyists to influence lawmakers.' (Helderman, 2014). This makes sense, since, from a strictly individual standpoint, Uber is mostly advantageous in nearly every city, and more so during peak times. So we read that 'this big, aggressive company is using the almost $6 billion it has raised from venture capitalists and other investors to subvert the democratic process', but 'the biggest, scariest lobbying machine in the nation is hard at work lobbying to make most Americans' lives a little bit better' (Fox, 2015). As we have seen, for this view to be true, externalities, present and in the long-term, must be ignored.

Effectively measuring these externalities requires data; we have tried to estimate these numbers as accurately as we can with what information we currently have. What we have found is that Uber can result in a positive social product, by offering a platform that cuts waiting time for passengers and idle time for drivers; or a severely negative one, when it offers incentives for drivers at times when the marginal social costs for each new car are significantly higher than what Uber makes for itself, its drivers or its users, as is the case for the CBD in New York City. Knowing which end of this spectrum is in place on each city, at each time of day, depends on data we currently do not have. What little information we have about Uber's operation was either leaked or made available through studies financed by the company itself. The platform is also closed in its 'upstream' sense, that is, Uber's policies are not directly influenced by users or drivers – most notably price policies, which are unilaterally defined by Uber with no possibility of discounts or additions on the part of the driver[18]. As we have seen from our studies, pricing policy plays an important part in determining the social outcome of Uber's operations.

It is apparent, however, that moving towards the 'open' end of the open data spectrum, both by giving up detailed information about its operation and by letting users, drivers and regulators have a say in its pricing policy, would hurt Uber's profits. Its current business model naturally aims at striking a balance between drivers' revenue and trip costs in order to optimize its revenues, regardless of the social impacts; opening this up for society would certainly have no effect in increasing revenues further, and would, in many cases, hurt them.

Conclusion

> (…) stop to consider how the so-called owners of the land got hold of it. They simply seized it by force, afterwards hiring lawyers to provide them with title-deeds. (…) they were quite frankly taking the heritage of their own countrymen, upon no sort of pretext except that they had the power to do so (George Orwell, 1945).

Common land did not have much value in feudal times, since they were not protected by a lord, as was the case in the fiefs. As populations grew and societies transitioned from feudalism into national states, common land became increasingly useful for planting crops and raising cattle; that is, it went through a steady increase in its use value, though, being common, it had no exchange value. As that value became apparent, lords and owners of small parcels of land gradually enclosed common land, either through purchase or through the passing of laws, and often through some form of political influence (Thompson, 2002). Thus, common land became private property and gained exchange value. It stopped having use-value for the general population, but started generating profit for its owner – in a process

[18] If, for instance, externalities in different hours of the day and different parts of the city were incorporated into Uber's fares and then used to subsidize public transportation, its long-term effects might turn out to be positive and self-regulated; people in need of individual transportation, such as the disabled and the elderly, could be exempt from those externality surcharges.

that Karl Marx has called 'the expropriation of the agricultural population from the land' (1889, p. 740).

Every city has an abstract layer of information that was, until very recently, hard to access, except by government agencies through heavy investment for specific purposes. The last few decades have seen the development and popularization of technologies such as the internet, GPS devices and smartphones, which play an increasingly ubiquitous part in harnessing that information and turning it into actionable data. This process presents a unique step for urban planning, which can now use this data to design policies that will transfer to the people decisions that were hitherto guided by broad political and ideological orientations rather than on case-by-case, democratic processes. From this standpoint, ideology alone is an inadequate tool for making complex decisions. Though 'smart' technologies have been widely praised for making this process possible, we have tried to show that even if the process of turning information into data necessarily generates value, it does not necessarily result in a positive-sum result for the common good.

What we have found is that smart technologies fall somewhere in a spectrum between completely open, where information is accessible and actionable upon by everyone; and completely closed, where the process of gathering information still happens but serves the purpose of designing a closed product.

The *paradox of value* plays an important role in this process: a graph of availability and total value of a commodity generally follows a curve in which scarcity results in a high per-unit exchange value, but a low total value (such as diamonds). As that commodity becomes more widely available, its marginal exchange-value decreases, but the total value increases (as with, for instance, oil, which is worth much less than diamonds per unit, but much more as a total industry). After a peak, its marginal value becomes negative and the total value of that commodity decreases, eventually nearing zero – as with atmospheric air. Air is more useful to mankind than oil, but, because it is so widely available, its total exchange-value is lower than that of oil; and oil is more useful to mankind than diamonds, tough individually much less valuable.

Our hypothesis is that smart technologies follow a similar curve. Platforms closer to the *open* end of the spectrum, such as OpenStreetMap, appear to generate abundant use-value while having nearly no exchange-value, resulting in incontrovertible, if limited, common good. The OpenStreetMap Foundation has a little over £140,000 in equity and generates no direct profit[19]. It has over 2 million registered contributors, with about 10 thousand new registrations per month. As we get closer to the middle of the spectrum, such as with Waze, there is both use-value and exchange-value being generated; Waze was sold in 2013 for US$ 1.3 billion. It generates some profit by displaying ads and by providing information to its parent company, though the exact amounts are not disclosed by Google. Uber is nearer the closed end of the spectrum, since it barely releases any data nor does it take direct input from either driver or users for the main decisions and rules over its platform. It is currently valuated at over US$ 50 billion (MacMillan & Demos, 2015) and expected to generate over US$ 2 billion in net revenues in 2015, with gross revenues up 271% from 2014 and expected to rise 141% in 2016, according to their own predictions (Zhang & Shih, 2015). It is already one of the biggest companies in the world. Although it has not yet opened its capital and therefore does not release quarterly balance sheets, recent bond term sheets show that it is operating at a

[19] It has, on the contrary, contributed to the vanishing of profits in the mapping industry. It has, on the other end, arguably contributed to the operation of for-profit companies that are allowed to use its data freely (as long as they do not profit directly from it).

loss of over US$ 400 million (per quarter, presumably) (Biddle, 2015). This loss is reportedly due to investment in expanding operations, mostly with the heavy subsidies it offers for users signing up or inviting others to sign up. In other words, Uber has been investing heavily in acquiring control of its business.

One very important aspect to take into consideration is the propensity for monopoly or oligopoly in industry sectors that deal with information. This is largely due to each platform's improvement brought about by the added number of users. Waze, for instance, gets more accurate as its number of users and map editors increases, meaning that its leadership in the sector tends to self-reinforce.

We conclude, then, that the urban data that sat largely unused in an abstract plane is, as with the common lands, now being turned into use- and exchange-value – this time, by smart technologies. There is no opposition to that; that is, 'no one says "I don't like the smart thing and I prefer to be dumb"' (Sterling, 2014). But there is no guarantee that the way towards smart cities necessarily yields a positive social product; in some situations, this process might do more harm than good. This is, in economic terms, similar to the surplus value brought about by the industrial revolution – the distribution of which between capital and labour still animates political discussions to this date. The crux of the matter is not whether new technologies should exist, but rather how its benefits should be distributed (between capital, workers, users and the common good). Rolling back the wheel of time and uninventing smart technologies, such as the Luddites have tried in the beginning of the 19th century, is hardly a viable answer; a more productive path is, rather, making sure that the smart city serves not as an end in itself, but as a tool towards an open and collectively managed city.

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Mechanisms of the Smart City: A Case Study of Smart City Búzios, Brazil

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The concept of the smart city is emerging as a topic of interest. Since the implementation of technology in urban space it is becoming the present reality in many cities globally. This study investigates how the smart city project, known as The *Smart City Búzios*, in Brazil affects everyday life in terms of habits in, and relationships with, urban public spaces. The *Smart City Búzios* project involves the implementation of a smart grid infrastructure which purports to achieve energy efficiency for the city. The study also explores the different 'smart' mechanisms used in this city, and attempts to understand the process of implementing the Internet of Things (IoT) infrastructures. This exploration includes the identification of both the groups of actors who were involved in the project, and the societal groups who benefited from it. To do this, a case study approach has been applied to investigate how the technological platforms that are used in the *Smart City Búzios* project could be considered as a process of 'smartness', and consider if these tools have the potential to change the urban sector. The analysis searches traits of changes in the living spaces and in the lifestyles with the inception of new technologies. The focus is on the project's results since its implementation, explaining how these results are articulated in relation to the urban image portrayed in the project's marketing strategies, based on extracts of media news and interviews. The analyses showed that that the strategies of marketing surrounding the project played a key role in the consolidation process. This study thus holds that urban intelligence must simultaneously be a process and a purpose, and that organizations from the public, private and voluntary sectors that are directly affected by the project should be partnered with and brought into inclusive processes of dialogues.

Keywords: smart city, internet of things, smart grid, Búzios.

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Cities, technologies and associated concepts

The interaction between cities and technologies is not a recent phenomenon. Ellul (1980) explains that technology has always been present in all parts of the world, however the main difference now is that current society can be considered a 'technological society'. Within this societal framework, the city is the centre stage of all human actions and interactions (Mumford, 1937), which are linked by technological networks. In this context, technological revolutions such as the Information and Communication Technology (ICTs) revolution impact both the city and the configuration of urban space. Whilst the urban space shapes - at various levels - human actions and interaction (Willis, 2008), we cannot disassociate the influences of technology on the city.

Graham (2010) argues that the growth of cities is connected to an increased need for technologies, in order to satisfy larger distribution demands for water, energy and food. This requires that trains, railways, ports, airports, and roads are set up in an endless technological circle. In the last few decades the proliferation of satellites, televisions, and telephones, has meant that new ICTs have a strong influence on the economic, social and cultural growth of cities around the world. At the same time, several urban concepts were developed, such as: 'Cyber Cities' (Graham & Marvin, 1999), 'Digital Cities' (Ishida et al., 1999), 'Smart Cities' (Nam & Pardo, 2011) and 'smart urbanism' (Wigg, 2013). These terms have in common references to the intensive use of ICTs as a basis for all the processes, strategies, plans and development modes in cities. Reinforcing this idea, Graham (2001) affirms that the world is increasingly connected and informational, and that networks of ICT and connections to the internet play a key role in this. The internet age – which emerged in the 1990s – brought a revolution in information and communication, which has impacted many areas of the city, including the nature of urban planning. Web 2.0 – as the new age of the internet is known – uses three bases: technology, institutions and human capital.

Glaeser (2011) supports this argument stating that human capital has a direct influence on technological development, but that in the twentieth century the rise of the internet changed this. Thus, the role of communication on societal relations and processes is reinforced, and other related concepts begin to emerge – such as the Internet of Things (IoT). For INFSO (2008), the IoT means a global network of interconnected objects-things though codes and protocols that significantly changes the interaction between man and technology. However, there are some complex problems relating to the indiscriminate use of technologies. Several authors have been critical of its unregulated use highlighting some important implications in terms of privacy and jurisdiction. Lyon (1994) argues that one of the many issues surrounding the use of technology is focused on surveillance and control. Gandy (1993) argues that the use of technology in this way is classificatory and discriminatory, because it uses databases to segregate social groups – not by race or beliefs, but for financial reasons. Graham (2001) also raises the issue of technological segregation through a critique of urban infrastructure, and argues that technology is used to build selective and discriminatory infrastructures. The authors argue that smart systems should be public and open access, as opposed to private and available only to a select group. The authors also highlight how technological infrastructures could be used as a type of bargaining tool within the capitalist system.

In the last five years, the 'smart city' concept has gained attention amongst researchers, in public policies and in the business sector. In a smart city, urban systems are supported by technological processes and the city becomes a mechanism for technological data and information flow. One of the most widely used definitions of smart cities is proposed by

Vienna University of Technology (TUVIEN, 2015), which outlines six key pillars for building a smart city:

- a smart economy, generating competitiveness and innovation meanings;
- a smart governance, that provides efficient management and services to citizens, ensuring transparency and public participation in decision-making;
- a smart environment, which generates attractive, environmentally healthy and intelligent management features;
- intelligent citizens who embrace ethnic and social pluralism, cultural openness and active participation in public life;
- a smart mobility, which allows accessibility for all and a sustainable transport infrastructure; and, finally,
- a smart life, which allows social cohesion through the provision of quality services and institutions.

In reviewing all the developments involving smart cities and the IoT, the energy sector is a key area. The 'Smart Grid' is an emerging approach found in the intersection between smart city and IoT in the energy sector. According to Boccuzzi (2012), the smart grid is a network of technological mechanisms that seeks to improve energy services, using systems of sensors for measuring, monitoring and transmitting information. In this context, technology and its established relations constitute a paradox. This paper intends – by means of a case study – to understand the technological mechanisms underlying the electricity infrastructure of a smart city project in Brazil. The city of Búzios was selected for this research because it was considered one of the top ten projects of urban infrastructure in the Infrastructure 100 World Market Report by KPMG (2012). The project was initiated in 2011 with a public-private investment of over 40 million Reais (about 12 million Euros), and it was developed by the Brazilian Agency of Energy (ANEEL - Agência Nacional de Energia Elétrica). It is considered one of the most innovative projects in the world within the energy sector (Cidade Inteligente Búzios, 2013).

This study investigates how the technological platforms used in the *Smart City Búzios* project could be considered as a process of 'smartness' and how these tools have the potential to change urban sectors, as well as governance, the natural environment and physical infrastructure. Not only could all these sectors be affected by technological systems, consumption could also be transformed. In the case of Búzios Smart City, the implemented technological system consists of smart and automatic infrastructures of energy efficiency.

In order to effectively analyze the project, the paper takes the following approach. First, we present an analysis of how 'smart' mechanisms are used in the city; and this is then contextualized with a study of the implementation of IoT processes in Smart City Búzios. We then identify which social groups were involved in smart energy implementation, and which social groups are benefited in this process. Finally, we review what results have been achieved since the project's implementation; and if the project actually achieved the proposed aims of optimization of urban resources, sustainability and energy efficiency. It is important to note, that we studied the *Smart City Búzios* project at a particular point during the process of implementation, when only one of the phases had actually been realized. Therefore, this analysis discusses the project in terms of its aims, and the possibilities for the city; by identifying the leading points and attempting to understand how the next steps of the project might be realized. Clearly, the outcomes of the initiative could only be studied following the full implementation of the project.

This paper first introduces a brief discussion in relation to the concept of smart cities and its relationship with the concept of the IoT. This association guided the choice of research methodology, presented in the second section. The third section describes the Búzios project, highlighting the eight main principles of the initiative, the project investments, and a consideration of which social groups might be involved. The fourth section is a discussion about which smart tools are already implemented in the city, referring to interviews that were undertaken in order to answer the aims of the research. Finally, the paper presents a brief summary of the main points, as well as an overview of the conclusions and final considerations.

Smart Cities and the Internet of Things

The concept of smart city is often associated with an idea of a futuristic city, permeated by automation and high technologies. This concept derives from the emergence of terms such as cyber cities and digital cities, which were introduced in the 1990s and 2000s as a response to the advent of the internet. However, in the last decade the smart city concept has emerged as a new way to define the relationship between cities and technology (Kitchin, 2014). Authors such as Hollands (2008), Nam and Pardo (2011), Giffinger and Gudrun (2010) and Greenfield (2013), among others, argue that the multifaceted and complex nature of the smart city means that critical analysis is urgently needed in order to understand the implications of this emerging area. For Calzada and Cobo (2015), it is important to deconstruct the idea of a smart city and present it simply as a range of ICTs capable of promoting change. Kitchin (2014) outlines how smart cities are configured as high-density urban networks, where ICTs enable monitoring and management mechanisms, and automated regulation. He argues that

> A smart city is not a vision of a future city, as often depicted in the media; it already exists in practice through the millions of interconnected, digital socio-technical assemblages embedded into the fabric of cities that frame how people travel, communicate, manage, play, consume, work, and so on (Kitchin, 2014, p.12).

So, the smart city can be understood as a convergence of several mechanisms which intend to solve increasingly complex urban problems. The smart grid is one of the components in the set of initiatives that are characterized as the smart city, and it is important to the understanding of this research. The concept has been increasingly used around the world, since the energy sector is an important part of an increasingly technological society (Erol-Kantarci & Mouftah, 2015). According to Castañeda (EBC na Rede, 2013), a smart grid system consists of smart technologies applied to a smart network. According to Bulkeler *et al.* (2016), a smart city focused on intelligent energy systems is one of the key concepts of a smarter urban system. Kumblar *et al.* (2012) understand the concept of smart grid as a simplified nomenclature of a very complex process, in which energy systems use modern ICTs of transmission and control. The purpose of these systems, according to Amin & Wollenberg (2005), is to reduce emissions and pollutants, translating this process into reliability relationships.

However, physical and digital space (created with digital technologies and WiFi) are both often described as opposites, overlapping and non-unified. This makes it necessary to rethink the way we think and design urban structures (Willis, 2008). Thus, it is essential to understand what the real role of technology in urban activities is; do they exist only as means to serve as a support for decisions or do they contribute to helping to decide and shape urban practices? Among the many possibilities is the role of automation processes within decision-making in the city. In this context, the IoT is an important concept. Ashton (2009)

first introduced the concept of the internet of 'Things'; and proposed that when IoT connects objects or things to people they start to set up a new relationship with them. According to Veja-Barbas *et al.* (2012) the IoT is a new communication model, which changes the relationship between physical and virtual objects, and can be considered as a new informational paradigm. Lemos (2013) argues that the IoT expands the ability of info-communication objects, making them 'alive' and susceptible to decision-making, behavior changes and adaptation without, necessarily, human control. In other words, all objects have a communication characteristic, but in the IoT objects answer to algorithms, demands, mediations and stabilizations. The IoT is also used for building control networks in machine-machine interaction. According to Atzori et al. (2010), the IoT is a paradigm that establishes a new relationship between physical objects, sensors, systems and data.

The authors affirm that the internet is everywhere, and the popular demands for new technologies made the IoT grow: '[...] providing them with an always higher degree of smartness by enabling their adaptation and autonomous behavior, while guaranteeing trust, privacy, and security' (2010, p. 2788). This new paradigm can be applied in various areas: industrials, hospital use, mobility or intelligent development of systems. This study however dwells on, first, Caragliu *et al.* (2009) who affirm that ICTs and these processes of automatization are the future of the urban spaces, and second, Schaffer *et al.* (2011) who affix that the interaction between artefacts and urban space is not only a technological issue, but also a human, social, cultural, and economic question. In this context, technologies build a territorial system with knowledge and innovation, a collective and cooperative environment.

Methodology

The approach used in this paper is to present the implementation of the Armação dos Búzios city project as a case study. According to Yin (2001), a case study is performed in order to evaluate real and contextualized phenomena, which permits answering questions such as 'how' and 'why' this phenomenon occurs. In considering the Búzios city project as a potential case study choice the following four contextual factors were considered: the temporal dimension of the project; the geographical location of the city; the focus on the implementation of the smart city in terms of energy/smart grid; and the national and international relevance of the project. The methodology is also based on a single case study, which is present below the corpus of this research.

The empirical data was collected through the following main sources:

- Master Plan of the city;
- Two reports about the project, one national and one international;
- 4 Municipal Reports;
- 28 Reports on important Brazilian media vehicles ('G1', 'O Globo', 'Folha de São Paulo');
- Papers about the project, written in 2014 and 2015;
- Interviews with important actors from the project, published on Youtube.

The data was collected between January 2011 (the beginning of the project) to January 2016. This particular period was chosen because all other phases of the project were already completed. Other important aspect is the validity and reliability of the collected data. Paiva and colleagues (2011) argue that these aspects become particularly important in qualitative research and that the researchers' interpretation of the collected data is also relevant in this process. For this study, the validity and reliability of collected data were evaluated based on the source of data. Only the documents hosted on the official websites of Búzios Major, Rio de Janeiro State and other associated institutions were collected. Furthermore, all reports

and interviews were collected from Brazilian journals and newspapers that have large circulation numbers and daily editions.

Búzios Smart City Project

The city Armação dos Búzios is a coastal area in the state of Rio de Janeiro (Figure 1). It is a tourist resort with about 31,000 habitants, according to the population projection for 2016 made by Brazilian Institute of Geography and Statistic. (Instituto Brasileiro de Geografia e Estatística).

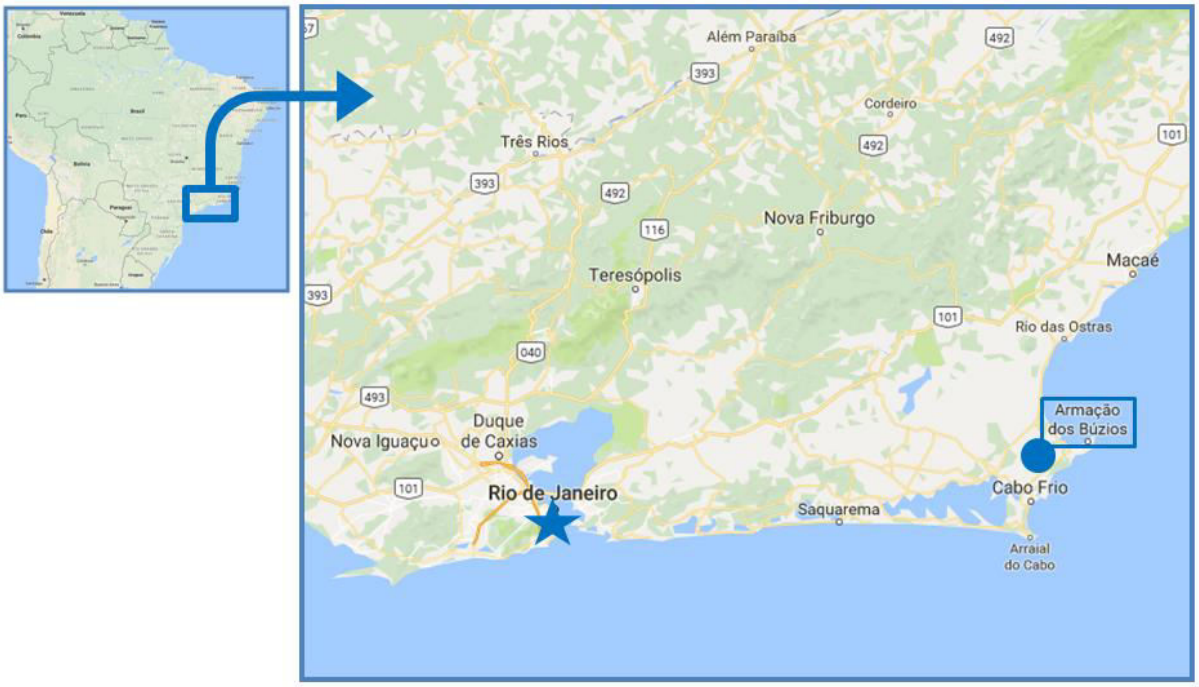

Figure 1. Location of city of Armação dos Búzios.*Source:* Drawn by the authors, based on Google Maps.

The *Búzios Smart City* is a current project being developed by the multinational group ENEL, and funded by ANEEL (National Agency for Electric Energy), in partnership with the electricity company Ampla. The project seeks an optimization of the energy resources in an energy-processing model where each citizen is made responsible for the control of their own energy use (Cidade Inteligente Búzios, 2013). The construction of a new electrical infrastructure involved the installation of 67km of medium voltage lines to supply 10,000 clients and with annual capacity consumption of 55GWh.

The different features of the project included the use of renewable energy sources, the control of individual energy consumption in real-time, the construction of a new electrical infrastructure to optimize energy resources, a system for the remote control of energy network, the implementation of a more economic public lighting system, and the introduction of different cost rates for the supply of electricity. One of the main goal of the project is the constitution of a Smart Grid, which combine the following eight initiatives:

- Smart energy management – which is associated with the energy consumption preferences of the customer with the potential to adopt different tariffs throughout the day, which are priced according to peak times and the possibility of remote management. Persons who consume energy from 10pm to 5pm could pay a cheaper tariff (about 220 reais/MWh) - on

the other hand, the tariffs become more expensive between 6pm and 9pm (about 660 reais/MWH).
- An energy storage system - for use in consumption peaks;
- Smart energy generation – with the use of renewable resources;
- Smart vehicles – incorporating a pilot project of electric vehicles with charging points throughout the city;
- Smart public lighting – replacing light bulbs for lower-consumption lamps, and the ability to control brightness according to the movement of people in the streets;
- Smart buildings – with technological solutions for the control and measurement of energy consumption;
- Telecommunications, control and internet – with automatic answering possibilities in case of failure of the electricity supply system; and
- Conscious and informed citizens – to promote engagement from participation in workshops and discussions.

At the beginning of this research, the *Smart City Búzios* project was in a phase of implementing energy measurement mechanisms in more than 2000 houses. At that stage, some solar panels and wind generators had been installed, as well as making electric bikes available to rent and use on the streets and electric cars for the Municipal Guard. The replacement of 70 street light bulbs saved 69% of electric energy, compared to previous rates (Correia, 2013). In this phase of the project, these initiatives were not implemented throughout the entire city, but favoured coastal neighbourhoods like *Alto de Búzios*, *Tartaruga* e *Manguinhos*. In order to better analyze the advances and demands of the project it is necessary to identify the different groups of actors involved in and responsible for the project, as well as to consider the potential social groups that may have benefited from the initiatives. It is important to pay attention to the role, demands and responsibilities of each group. It was established that four groups were essential in triggering the initial deployment process: the government (public sphere), responsible for the initiative, financing, bureaucracy and process control; the industrial secondary sector, responsible for producing the necessary technological infrastructure; the tertiary sector, which conducts the supply and distribution of this infrastructure in the form of customer service; and finally, a social sphere, the group of beneficiaries (Figure 2).

These groups or ‘pieces’ are both independent and interdependent at the same time, because each one has autonomy in the process, although they may not be solely responsible for it. The relationship between these four groups cannot be disjointed or operate only according to economic interests, under penalty of invalidating or hindering the progress of the project as developers improve the quality of life. The actors connect more or less according to self-provisions, and according to the local share of actions and situations. Some factors that influence the internal cohesion of social groups include similarities, approaches and compatibility (Netto, 2014).

Figure 2 shows a link between several social groups around the same project that aims to transform urban space. The Ampla company appears simultaneously in the secondary sector, producing infrastructure, and in the tertiary sector, offering the energy service. Klauser et al. (2014) argue that the relationship between public and industrial actors can cause transformations in urban space, based on specific interests of particular companies and warn that this could be a risk factor. Kitchin (2014) also warns of the potential problems associated with this process, which the author calls 'smart city commercialization', and describes a process in which the city begins to relate in a more specific and more intimate way with economic interests.

Figure 2. Relevant groups and institutions identified in Smart City Búzios project. *Source:* Authors.

This process of the 'disposal' or 'commercial negotiation' of urban space is what Harvey (2005) calls 'entrepreneur city'. In his text, Harvey explains this model of the city equates to a business model of free competition, based on: a) public-private partnerships, b) speculation, which is a natural process in entrepreneurship, and which exposes urban environments to risks and uncertainties, and c) political economy, placed in greater prominence than territorial constraints. Kumbhar et al. (2012) affirms that smart grid projects tend to be closely related to this type of process. In their paper, they argue that although there is a focus on well-being, it is common to have intense competition related to the sale of these projects between companies.

(Not so) smart tools?

An analysis of the collected material allows us to identify nuances of greater or lesser use of smart tools. It is not always clear which spaces or initiatives are actually becoming 'smart', but is possible to make some analytic measurements based on the collected material. From this analysis, it is possible to return to the main question of this research, forming a response based on an analysis of the data. The question is how technological platforms that are used in the *Smart City Búzios* project could be considered as a 'smartness' process, and consider whether these tools have the potential to change urban sectors such as governance, urban

infrastructures and the natural environment. In this sense, the first change that can be summarized is about the implementation of the technological system itself. It is possible to observe that in this project there is a potential and gradual application of the IoT concept, particularly in relation to the introduction of processes of automation. In this case, a citizen is able to control remotely the energy consumption of their home, using a range of technologies. In the street, the street lamp bulbs are programmed to increase and decrease luminosity according to the flow of people. This automatic function, established between an electric device (bulb) and a remote command, is enabled by communication between objects. In other words, they are dialogues established between programs and computers, an informational network that depends on human action only for supervision, and not directly. The human action still exists, but is not required for each request; it is determined by previous decisions that determine which objects will behave in what way.

These observations take us to another facet of this research: a discussion about how smart are the mechanisms used in the city. This discussion may be a little subjective, because each person may have a slightly different view of what is considered to be smart. But it is possible to observe that there is no one turning the bulbs on or off in the same periods; and previous studies of urban behavior defined a smart function as a standard demand, which is internally programmed. This is what Lemos (2013, p. 268) calls 'acquired info-communicational capability'. The author affirms that in this process, the relationship between the object and the environment and between the human and not-human is changed.

A third intention of this research was to identify which groups were involved in smart energy processes. The previous section showed one of the possibilities of articulation among the sectors responsible for the project. Besides that, the collected data enables the identification of some views - positives or not – from these different groups. One of the positive arguments is of the Brazilian Association of social housing sector ABC (in Portuguese, ABC refers to Associação Brasileira de Cohabs e Agentes Públicos de Habitação). According to ABC (Habitação. 2016, p. 2), this project:

> Is one of the ten best urban infrastructure projects [...] that can make cities livable and sustainable. [...] The report shows how pioneering projects in the area of infrastructure can make a difference, contributing to the emergence of cities of future [...]. Considered one of the ten most important in the world, the Búzios Smart City project was included in the urban energy infrastructure category, and, according to the publication, responds to one of the greatest challenges of the 21st century, which is the development of sustainable urban infrastructure.

According to the technical coordinator of the project, another positive aspect is the relation established between population and energy infrastructures:

> Our main motivation factor is the integration of these technologies with society, giving people access to the equipment that we only see on television, so everyone can see it working and happen in their city (O Globo, 2012, p.1).

The installation of infrastructure to reduce consumption is also seen as an urban enrichment and an opportunity for integration between urban sectors, as affirmed by the president of one of the companies involved:

> They say it's hard to add beauty to intelligence, but in Búzios we managed it (O Globo, 2012, p.1).

> Búzios is a lab where the energy becomes a spark to create an integrative and shared process (Distretto delle energie rinnovabili, 2014, p.1).

Vilaca *et al.* (2014, p. 21) affirm that the project could be a good opportunity for the city, in terms of national recognition:

> This project will have benefits as well as diverse opportunities; we can cite the positioning of the Region of Búzios as a national reference in demonstration of renewable energy sources, as well as how to boost industrial development and areas of research and development, with a view to participation of several universities in this project, and other institutions.

Contrary to these 'success stories' there were questions about the actual role of the citizen in the project, as well as the amount paid for the energy that was being produced. For example, there is a section of the local population that did not have access to all this technological evolution, and these urban areas are susceptible to energy falls and blackouts. One case was reported in Vila Verde community (a Búzios neighborhood) where there were successive energy blackouts, which culminated in protests against the energy company. According to a local newspaper (Folha de Búzios, 2015, p.1), this situation culminated in a protest carried out by the residents. One of them affirms:

> The reason for the protest is: that the street has been without power since yesterday 2:00 pm. We are already tired of calling the company Ampla! About fifty people called them and they did nothing. We were not served!

Freitas (2014), in his dissertation research, interviewed fifteen residents of Búzios (randomly selected) in order to understand the citizens' perception of the project. The author asked:

- Have you heard about the 'Smart City' project? What did you hear?
- How did you hear about the project?
- Do you feel benefited by the initiative?
- Do you know who is responsible for the project?
- Why do you think Búzios was the chosen city?

Through the application of this questionnaire, the author concluded that only two of those interviewed had a complete understanding of what the project was about. Many of those interviewed could not identify what it was that was being transformed. However, it is interesting to note that the author identified that residents do have a list of aspects that would make the city smarter, although they cannot conceptualize what is a smart city. Thus, the desire for a smart city is not visible, because the concept is not fully known.

An informal survey conducted by Lab404 (2015) with tour operators, receptionists and drivers showed that there is a lack of knowledge and awareness regarding the installation of energy meters. However, the installation of free WiFi points seems to be better understood. However, research by Freitas (2014) showed that although at these points the signal is intense, data transmission does not work as expected. The author noticed during the interview process that there appeared to be little involvement of the population in the project, which makes it difficult to fully implement and take ownership of, because the initiatives depend directly on the participation of the population. One of the interviewees, for example, said that despite having seen advertisements for the project, she found them to be of insufficient use and did not feel that the general population was engaged in the initiative.

Some technical and operational aspects of the project were tested by Fortes *et al.* (2015, p.4). The authors analyzed some components of the energy systems, making measurements of device consumption and performance, and found that:

> The power quality of energy produced by the small renewable distributed generation technology installed in Smart City Búzios can be improved. Although the obtained results are not so critical, some improvements should be considered especially regarding the current implementation. Another important aspect is the proper sizing of the distributed generation system. As highlighted by the wind generation system, the oversizing of the equipment brought considerable power quality problems for low velocity conditions. This is not a huge limitation in pilot projects where the technological evaluation is the one of the main objectives. However, in future scenarios considering the installation of a fleet of wind generation systems in a microgrid, the huge number of harmonic sources can compromise the power quality indexes of the distribution grid as a whole.

The analysis of these excerpts and statements allows the identification of a relative segmentation between the positive (corporate) vision and the vision of the people directly affected by the project (a neutral or negative view). This is not an extensive set of studies, but the analysis showed that there seems to be a dichotomy between the part of the project that is reported by project partners and the way that the project is actually experienced by the city's residents. The interviews and surveys show that there is a difficulty in differentiating the smart grid' aspects, which is a core aspect of the *Smart City Búzios* project, and the broader marketing concepts of the 'smart city'. It is also possible to observe that the smart city concept is, in part, a marketing strategy. In this case study of the *Smart City Búzios* project it was found that there was little involvement of the population in the project, which raises difficult questions regarding the appropriateness of the project's implementation, since such initiatives depend directly on the participation of the population.

A large-scale project like this is naturally susceptible to technical issues, due to its complexity, novelty and scope. An important aspect to consider, then, is the dialogue that must exist between the service provider and the beneficiary, to make the process transparent and to improve the flow of information. This dialogue should always consider the complexities between the interests of each group, urban demands and what is desired for the city. Therefore, in a project like this, it is important that public communication strategies facilitate the understanding and engagement of all groups involved. In the advent of computer technology, Johnson (2001) outlined how everybody is able to perceive changes that are gradual or very subtle; and that to fully understand the techno-culture it is necessary to understand how the side effects happen. In this sense, another point to be addressed is related to urban marketing and the form of disclosure and broadcasting initiatives.

This affirmation leads us to the fourth aim of this research, which was to review the results in order to see what has been achieved since the project's implementation. However, it should be highlighted that projects like these require a long-term observation following the implementation of infrastructures. In this sense, this research cannot make inferences about a closed situation. However, it is possible to draw initial conclusions from what can already be perceived from within the city itself, as has already been discussed.

A project of this type, with large-scale coverage and robustness is naturally susceptible to controversies, as authors like Graham (2011), Lyon (1994) and Gandy (1993) call the collateral of underexplored effects of technologies. Firstly, it is possible to identify that the energy metering in domestic housing produces highly accurate data that is controlled centrally through the project. This is part of a process aimed at implementing more energy efficient processes. However, this has implications for citizens in relation to a relative loss of privacy. In this sense, it is important that these processes are transparent and regulated. Moreover, it is possible to note that the urban marketing activities associated with the project were focused predominantly on promoting the urban efficiency aspects of the project - in

terms of preserving the environment and in terms of the beneficial aspects for the citizens. The academic community must observe how the actual urban demands respond to these aspirations. There is a need for clearer governance at all stages of the process, through a clearer role for the public sector in overseeing and regulating the project.

Conclusions

The concept of the smart city is often characterized by utopian language and aspirations. Even in academia, the smart city concept is often treated as a form of technological city, where the role of technology is stimulated and urban innovation encouraged. It is not only as a marketing strategy – where the term 'smart' is associated with concepts such as optimization and efficiency – but also because the smart concept is still in an abstract collective imaginary.

This study sought to analyze different dimensions of a smart city project currently in progress in Brazil. It was discussed that this project shows the potential for the gradual application of the IoT concept, particularly in relation to the automation of infrastructures. It was also discussed that this process could change the relationship between what is human and what is non-human. The excerpts analyzed permitted the identification of a relative segmentation between positive and negative views about the project, according to the specific interests of those involved (corporative, social, economic). Another observation is that this project needs to be considered on a more long-term basis as it does not concern exclusively the technical aspects of energy provision. As it was implemented, the project could raise other social, cultural and economic issues that are not only immediately observable, but may unfold over the years, as the social structure and understanding of those infrastructures are expected to vary over time.

In contrast to the futuristic promises of the *Smart City Búzios* project, in our case study we found that there is an inherent difficulty in identifying examples of the real impact of the technological apparatus in cities. The project is an attempt to integrate public and private sector actors, which is one of the challenges we can observe in the implementation of any smart city project. In addition to this it is worth noting the involvement of research centers from the energy sector, who aim to apply academic knowledge into urban space practices, effectively transforming the city into an outdoor laboratory (or living lab). Another positive aspect identified was the automation and smart process of objects that assumes the role of humans. This paper sought to outline the nature of the multifaceted demands on implementing a smart city agenda, as well as raising new questions about this subject. The case study of the *Smart City Búzios* project reflects the complexity of the topic, due to the number of actors involved, the multiple public and private interests and the differing urban needs. Our analysis of the various phases of implementation of the project gives us the possibility of being more accurate and critical, in relation to the integration of new technologies in cities. In this sense, we note an assumption that reveals a relative dichotomy: it is important that these urban transformation processes are - at the same time - innovative and naturally adaptable to each reality, and the demands and resources of each location. It is also important to recognize that urban intelligence as a purpose, but also as a process, is looking for consistent and conscious articulation of the sectors involved.

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Build It and They Will Come: Analysis of an Online Deliberation Initiative

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Public and private investments are increasingly being directed towards the development of ICTs for the construction of more inclusive and connected communities. Labelled as Collective Awareness Platforms (CAPs) under the European Seventh Framework Program, these initiatives explore the possibility of tackling societal issues relying on digitally-mediated citizen cooperation. As their diffusion increases, it is important to critically reflect on the extent to which they can effectively trigger forms of engagement and sustainable collaboration within and through digital artefacts. Among the associated risks is the furthering of a technocratic understanding of how collaborative processes work, based on the assumption that the introduction of CAPs would be a sufficient condition for the construction of inclusive and engaged communities. In this respect, this contribution investigates a case in which a digital platform was implemented with the aim of promoting citizens' deliberation on urban-related issues. This experiment is analyzed by 1) assessing whether the platform functioned as a deliberative space; 2) tracking the negotiation processes of the digital artefacts' functionalities occurring among initiative's organizers, platform developers, and participants. The goal of the paper is to understand how different understandings and unexpected usages of the digital platform affected the deliberation process and therefore the initiative's outcomes.

Keywords: Online Deliberation, CAP, Civic Engagement, Smart City, Social Innovation.

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Introduction

Over the past twenty years, the commercial Internet has undergone a profound transformation. From a network through which retrieving and sharing information, potentially turning *'every author into a publisher'* - as Vinton Cerf argued in the forewords of one of the first Internet manuals ever published (Gilster, 1993) - to a communication infrastructure fostering participation, interactivity and social networking (Flew & Smith, 2014, p. 21). The shift to the so-called Web2.0 paradigm in the early 2000s (ibid.) not only brought a quantitative escalation in the amount of circulating data, but also to a substantial change in the design and use of technologies. Indeed, this shift was accompanied by the emergence of new applications, which exploited the network effects of the Web, trying to harness the crowds collective intelligence (Flew & Smith, 2014, p. 21). From Wikipedia, to ReCaptcha through to GalaxyZoo and OpenStreetMap, the meaning of *participation* has been changing constantly, and so have the contexts in which these supposed *participatory* technologies have been employed.

Online civic engagement is one of those contexts which has seen a prolific development of participatory applications. This loosely defined field is composed of projects, artefacts, associations and practices that leverage on the collaborative power of the Web for addressing social challenges (Bria et al., 2014). Such cascade of innovations has so far generated more than one hundred digital tools and methodologies tested in over four hundred civic-engagement initiatives worldwide (Fung & Warren, 2011). Examples are urban experiments such as Participatory Chinatown in Boston[20] (Reed, 2014, p. 124), MiMedellin in Medellin[21] (Colombia), TalkVancouver in Vancouver[22] (Canada), and large international projects, such as those promoted by the Icelandic Citizens Foundation[23], or the recent crowdsourcing initiative aimed at drafting the new Mexican constitution.[24] From virtual town hall meetings, to citizens consultation experiments, participatory budgeting and collective urban planning, these projects have prompted public institutions, private companies, NGOs, and the civil society organizations to further experiment with new usages of ICTs for the construction of inclusive, digitally connected and sustainable societies (Bria et al., 2014).

Given the popularity that these initiatives have gained over time (Pacini & Bagnoli, 2016), it deems necessary a critical and reflexive evaluation of the role ICTs have played in such projects, the models of participation they promoted, and the ways in which these technologies have been appropriated by citizens. This evaluation can be helpful to collectively make sense of what has been developed to date, and of what kind of reactions these initiatives have raised among the public. As part of this reflexive process, this paper employs David Lane's (1995) theory of technology adoption and innovation. This perspective furthers a conception of ICTs as underdetermined objects (Feenberg, 1999, p. 79), whose meanings are open to multiple, and even contrasting, interpretations emerging from the interactions that they have made possible (Bijker, Hughes, & Pinch, 2012, p. 34). Therefore, when defining and evaluating the effectiveness of online civic engagement initiatives, the complexity of technological appropriation cannot be overlooked, as it is inherently uncertain.

This paper is based on a case study performed in 2014 in the city of Cesena, Italy. During a one-month project, an online platform was designed to allow citizens to contribute in one of

[20] http://www.participatorychinatown.org/
[21] http://www.mimedellin.org/
[22] https://www.talkvancouver.com/
[23] http://www.citizens.is/
[24] https://www.constitucion.cdmx.gob.mx/

the candidate mayor's future agendas for the years 2014-2019. Three groups of agents gravitated around, and projected their expectations towards, the new digital platform: (1) *developers*, (2) *organizers*, (3) *participants*. Information about the groups' attributions towards the tool, and its actual use by project's participants was gathered by means of interviews, participants observation, and secondary documents analyses. The aims are to understand to which extent this initiative was capable to create a deliberative space, and how the platform's functionalities had been negotiated among groups.

The paper is structured as follows: the ensuing background section combines two theoretical rationales, online deliberative theories and studies on the emergence of artefacts' functionalities. The former provides an operational definition of deliberative processes, drawing concepts from theories on democratic conversation and strong democracy. The latter traces the complexity of interaction processes through which agents come to imagine new uses of available technologies. The data analysis combines a qualitative analysis of interviews, participants' observations notes, and secondary documents related to the tool's development and implementation, with Social Network Analysis and descriptive statistics, displaying the participants' types of interaction within the platform. By framing data through the theoretical lenses, the discussion and conclusion part show some of the shortcomings of technology-mediated engagement initiatives, further defining an agenda for future research.

Theoretical background

This paper is rooted on two theoretical rationales. Deliberation theory, inspired by the writings of James Fishkin and John Gastil (Fishkin, 2009; Gastil, 2008), provides an operational definition of deliberation, which is later employed in the analysis section for the evaluation of the case study. Instead, Lane's approach to innovation and uncertainty (D. A. Lane, 2011, 2016, D. A. Lane & Maxfield, 1995, 2005) is used to make sense of the initiative outcome, by focusing on the misalignment between the functionalities inscribed by design on the platform - negotiated between developers and organizers - and the participants' actual use of it.

An introduction to Deliberation

Providing a single universally accepted definition of deliberation is challenging, since the topic has been addressed by several and often incommensurable viewpoints. The *Rational Choice Theory* perspective considers deliberation as a process in which a defined group of agents, endowed with an immutable set of preferences, analyzes a causally independent number of alternatives for a given issue, with the objective of generating an ordered list of viable solutions. Such a view stems from a *liberal conception* of deliberative democracy, according to which public reason emerges from the aggregation of personal interests within an institutional framework designed to foster and control these confrontations (Mouffe, 2000; Rawls, 1993).

Instead, theories of *democratic conversation* and *strong democracy* describe the deliberative process as discursive, open ended, inclusive and free flowing. Deliberation is a discussion characterized by an informal dialectic, in which talk does not chart distinctions, but rather creates commonalities amongst participants (Barber, 2003). This approach traces its origins in *Critical Theory*, from the writings of Habermas (1985) until the recent studies of Dryzek (2000). According to the latter, deliberation is a means of achieving an informed decision, and a process along which participants become aware of the dimensions involved in the issues at stake (Dryzek, 2000). It is first of all a discovery and learning process, rather than a method for achieving a rational consensus on universal principles (Mouffe, 2000, p. 73).

To summarize, while the liberal approach deems deliberation as a tool for aggregating and streamlining collective decision-making, the critical perspective highlights its capacity to collectively uncover the latent dimensions of the problems under public scrutiny, which were not necessarily taken into consideration by single individuals.

In this paper, the term *deliberation* is used in accordance with the definition provided by John Gastil (2008). His description, while maintaining a critical perspective, is schematic enough to allow a clear operationalization of the process for the analysis. A deliberative process begins with the creation of a knowledge base, i.e. a set of background information on the issue under investigation that participants are invited to analyze, fostering in this manner a first shared understanding of the problem. This information base is created by the promoters of the deliberation, or by an appointed committee, which usually combines professional expertise with personal experiences (Gastil & Black, 2008). Subsequently, each participant should identify the values at stake (equivalent to the dimensions aforementioned) and formulate potential solutions to the problem. In opposition to the liberal conception of deliberation, values and solutions are not pre-given and composed of a fixed input to which each participant contributes. Rather, solutions emerge and change throughout the deliberation process, as a consequence of confrontation. During this phase, participants are supposed to develop an *enlightened understanding* of the issues at stake and of their own perspectives, at the same time empathizing with the hopes, fears and motivations of others (Gastil, 2008). Through the informed and reflexive comparisons of solutions with values, a trade-off for each option is identified and evaluated by participants, thereby generating a list of prioritized solutions. A final decision on which solution to adopt is achieved either by mutual agreement or through a poll, depending on the context. During elections, for instance, the final decision is based on participants' votes, while in other situations the deliberation might culminate with the production of a set of recommendations representing the participants' irreducible viewpoints.

A bird's-eye view of this convoluted process would reveal two main components: the *opinion creation* and the *opinion aggregation* stages. The former is the collection and comparison of participants' values and solutions; the latter regards the reconciliation of different ideas into a single final agreement (Fishkin, 2009). This deliberative scheme can be applied to several contexts, from small organizations to web-based communities, up to local and national scales. In an ideal situation, mass participation would allow community members to actively contribute to the deliberative process, granting political equality through their engagement in the opinion formation and selection processes. However, the scale of the initiative matters: to have an enlightened understanding of the potential solutions to a problem, all participants should explore the others' values. This means that the larger the participants number, the greater the amount of information each of them must evaluate to come up with an informed opinion. Fishkin (2009), argues that medium and large-scales deliberation (i.e. more than 200 participants) is affected by *rational ignorance*, i.e. the tendency to avoid a systematic inquiry of the issue under investigation when the amount of information to be considered outstrips the individual capacity for elaborating it. To overcome these limits, democratic institutions often rely on simpler forms of members' involvement (e.g. referenda, polls), directly engaging a community in the decision-making process. However, if in democratic contexts these solutions may grant political equality, they often fail to stimulate a systematic reflection on the issue at stake, by removing the *opinion formation phase* and by considering citizens' votes as an approximation of informed decisions.

In light of this, the gap between deliberation and participation seems unfillable. However, can the introduction of new communication means extend the *opinion formation stage* to larger groups? Since its inception, Internet has been a place for deliberation, in the prosaic meaning of the term. E-mail, mailing lists, bulletin boards, online chats, forums, instant messaging and lastly social networks: the history of Internet is punctuated by the appearance of digital artefacts that have increasingly enlarged the public involved in online conversations. Thanks to the development of protocols, interfaces and connections, Internet has prepared the ground for strong deliberative communities (in the critical acceptation of the term) to flourish. From the cybernetic utopia of the 1970s (Medina, 2011), to the democratic dreams promoted through the pages of the People's Computer Company (Dean, 2005), to the emergence of Web2.0 in the early 2000s, there has been a gradual experimentation in the field of computer-mediated engagement supported by both governments and private organizations (Fung & Warren, 2011).

Sustein (2001) was among the first scholars to analyse this phenomenon and to warn against the drawbacks of online communities. Internet stimulated the adoption of deliberative behaviors, and allowed people to interact, but at the same time it fostered group polarization, extremisms, and the emergence of an enclave form of deliberation carried on by a group of close-knit members (ibid.). Through participants' self-selection and ideas' homogenization, enclaves may endanger the possibility for users to engage in an *enlightened understanding* of different positions and opinions. Sunstein's hope for a deliberative Internet relied on the possibility that hyperlinking would put these enclaves in communication, easing the migration of users from one community to another and thus increasing the heterogeneity of ideas. Today this vision appears to be no longer actual, since the emergence of social media has redefined the same concepts of online participation and collaboration, less relegated within rigid enclaves, but rather fluid and extemporaneous as the connections amongst activists collaborating within a social network (Rheingold, 2010).

However, recent models of participation have often been approximations of the deliberation funding principles, leveraging on participants' gut feelings and boiling down motivations and ideas into one, single, click. In their simplicity, initiatives like digital petitions and online polling systems have sometimes achieved wide visibility but, lacking the *opinion formation stage*, they have failed to stimulate deliberation in its critical acceptation, and in some cases, they have led to depoliticized forms of participation (Dean, 2005).

A theory on technology adoption and innovation

To understand the complexity of technological appropriation processes and their consequences in terms of the emergence of new artefacts' functionalities, we rely on the *innovation theory* developed by Lane and Maxfield (1995, 2005), further explored by Russo (2000), Villani et al. (2007) and Read et al. (2008), among others. According to Lane (2016, p. 2), 'Innovation processes inextricably entangle the introduction of new artefacts[25], transformations of social organization, and changes in attributions people make about the identity of agents (i.e. both individuals and organizations) and the functionality of artefacts'. This theory argues that the functionalities of an artefact are not unilaterally and once and for all determined by its designers. Indeed, they are the outcome of a negotiation process during which designers' materially inscribed attributions of functionality are interpreted by

[25] By *artefact*, Lane and Maxfield mean any object or service around which economic activity is organized— in particular, those designed, produced, and exchanged by economic agents. *'"Objects" are not intended just as cars, movies, and telephones, but also as software systems, architectural blueprints, and financial instruments'* (Lane & Maxfield, 1997:170).

participants and then further translated and put into actual uses. These negotiation processes occur in *cascades*, since they can cause iterative sequences of changes in agents' identities (what they do and how they do it), artefacts' functionalities (their uses, who uses them and for which purposes) and in the relationships amongst agents and artefacts (D. A. Lane & Maxfield, 1997, p. 192).

The negotiation process unfolding from the introduction of an artefact can be synthetized as follows. At the beginning, the new artefact (material/immaterial) is designed to address some attributions of functionality (including what it should be used for, by whom, and how), which usually reflect the designers' views. When the artefact is introduced in a specific context (*space*), this may generate patterns of interactions around its use, not only amongst agents, but also amongst artefacts (e.g. new complementary technologies or adjustment of existing ones). These patterns can subsequently modify and alter the meaning(s) of the artefact's uses, generating new attributions of functionality. All along this cascade of changes, the recently attributed functionalities may activate different uses of a particular technology, serving as a basis for the development of artefacts designed to fulfil them (Bonifati, 2010; Villani et al., 2007). The cycle reiterates when these novel artefacts are again introduced in the *space* (D. A. Lane & Maxfield, 2009). The recursive process through which an artefact is exploited to fulfil functionalities and needs not previously considered as relevant is called *exaptive bootstrapping* (D. A. Lane, 2011), and it has an inherently unpredictable nature: agents cannot foresee which attributions will gain relevance along the unfolding cascades of consequences resulting from their own and the others' actions. An example of this process is the French telephone system Minitel (Feenberg, 1992). In the early 1980s, the French government distributed, for free, millions of video terminals to telephone subscribers. Once connected to the phone line, the Minitel terminal allowed everyone to access information services. However, one year after its introduction, people realized that it was relatively easy to *hack* the system. Therefore, they turned an apparently boring information terminal into a means of communication. Eventually, the symbol of French modernization became an on-line chatting system, used to look for amusement, companionship, and sex (Feenberg, 1999, p. 126).

It is important to notice that even acknowledging the possibility for a participant to recognize the emergence of a new attribution of functionality associated with an artefact (D. Lane, Pumain, van der Leeuw, & West, 2009, p. 29), the current formulation of this innovation theory does not explore in details the mechanisms through which a *functional novelty* is shared and accepted as relevant by the group of participants involved in the interaction patterns around an artefact (i.e. how users negotiate and influence others' attributions of functionalities, and how attributions diffuse and are enacted through use). To widen the scope of the theory, this research studies the processes of negotiation and emergence of functionalities in a context – such as an online deliberative platform – that is both a shared artefact and an interaction space. Differently from previously analyzed cases of *bootstrapping dynamics*, digital artefacts allow users' attributions of functionalities and actions to be self-evident and intelligible in the same moment they interact within the digital space.

Empirical study

Case study: an online deliberation project

In February 2014, the city of Cesena, a mid-size city located in Italy with approximately 95.000 inhabitants, launched an initiative aimed at engaging citizens in the co-construction of the political agenda of the then-mayor who was running for re-election. Citizens were asked

to collectively substantiate the seven lines of actions, chosen by the mayor and his staff. These lines were aimed at constructing a more secure, transparent, fair and cohesive city. In detail:

- Public services: This area was open to ideas on how to improve or change the essential urban public services, to make it more respondent to citizens' needs. Some of the citizens' proposals concerned public health services, social housing and public schools.
- Technology and innovation: How to improve the city's life quality by means of technological interventions. Some of the ideas discussed suggested the extension of the public Wi-Fi network to the peripheries, the extension of the door-to-door garbage collection to the entire city, and the digitalization of basic services (e.g. register office).
- Security: This debate was aimed at collecting ideas on how to improve the city's security. The discussion led to the proposal of new bike lanes and the improvement of existing ones, to reduce car traffic and some of the associated dangers. Citizens also asked for an increased level of police surveillance in the peripheries.
- Participation: This line regarded civic participation and citizens' involvement in the city administration. Participants asked for the creation of new district-based civic committees, the publication of interim results concerning the new administration's initiatives and the digitalization of the call for tenders.
- Local identity: This area focused on small, local, interventions aimed at reinforcing the connections within and among neighbourhoods. Participants asked for the institution of *walking school buses*, for the development of new bus routes connecting the peripheries, and for the preservation of the rural areas surrounding the city.
- Labor and employment: This discussion was aimed at collecting proposals on how to reinforce the local economy. Participants asked for easier access to credit, for the development of new initiatives connecting the local university with industry, and the relaunch of agriculture through the reorganization and modernization of farming practices.
- Regional identity: In this discussion, citizens were invited to suggest how to improve or rethink the connections between the city and the larger region of Emilia Romagna. People asked for improved integration between the region's public health service providers and the development of new, conjoint, cultural activities (e.g. synergies between museums).

The whole initiative encompassed a series of events held across the city and the installation of a web-based platform designed to collect citizens' ideas and to stimulate public dialogue. Specifically, the Mayor's communication committee relied on Deebase, an already existing Content Management System (CMS) aimed at supporting online communities with enhanced forum functionalities. However, the original CMS was not used as it was, but it was adapted to the necessities of the committee. Even if their purpose was to construct a deliberative online space, at the same time they wanted to prevent the initiative turning into a political backlash in the hands of the opposition. Therefore, the platform's functionalities were negotiated between the committee and the Deebase IT team: for instance, the former asked to maintain control over the seven areas of debate, thus inhibiting users from creating new discussions autonomously.

Once the platform was ready to be launched, a public meeting was organized by the communication committee to explain the citizens (mainly those belonging to the candidate's political party) the initiative's aim and the platform's functionalities. Throughout the one-month experiment, participants were invited to substantiate the topics with their ideas, to extend and discuss those of their fellow citizens, or to simply cast their votes for their favorite ones. Each debate was substantiated by *opinions,* which in turn were developed into *motivations*. Users had the option to add and rank both *opinions* and *motivations*, allowing each debated issue to be separated into many facets, and then to rank them for relevance. Despite the emphasis posed by the organizers on the platform's deliberative aspect, citizens limited their actions to the submission of their personal views, or to the support of those

submitted by someone else. Very little or no interest was shown in debating others' ideas. However, at the end of the initiative, most of the content emerged from the platform was translated into goals in the mayor's electoral programme.

Methodology

The evaluation of whether this tool was able to provide a deliberative space requires two parallel analyses. On one side, an investigation on the different understandings of *deliberation*, as negotiated between the initiative's *developers* and *organizers*. This analysis should reveal how these different interpretations were inscribed into the digital artefact throughout its design and implementation. On the other side, the information generated by the CMS helps to understand how the platform's inscribed functionalities were further negotiated by *participants* through its use, and which consequences this negotiation had on the deliberative experiment.

The platform design process had been closely monitored through weekly meetings with one of the three platform *developers*. This respondent was chosen because of his role in the project, as he was the main interface between the *developers* and the mayor's communication committee. Additional written material on the design process (email exchanges and meeting notes) was made available by the *developers*' team. Besides these interactions, researchers attended the public event where the platform was publicly presented and formally launched by the mayor and the *developers*. This occasion was informative to understand how the initiative was communicated, especially which importance was given to the online tool and to the whole deliberative experiment. Informal meetings' transcripts, field notes and secondary documents were analyzed using a content analysis software (Nvivo 10), highlighting the attributions of functionality expressed by different agents in time towards the initiative and the platform. The deliberation process was instead analyzed through the public Log File released at the end of the initiative for public use. The Log File recorded all the interactions taking place within the platform, thus allowing a reconstruction of their unfolding over time. In detail, the CMS log file kept track of:

1. Logins and logouts;
2. New opinions submitted;
3. Opinion votes; change of opinions;
4. Submission of a new comment as explanation/motivation for the chosen opinion;
5. Submission of a reaction, i.e. commenting on others' comments.

This information was mapped using a Social Network Analysis (SNA) software (Pajek). While SNA alone cannot prove the degree of deliberativeness of the initiative, it nevertheless provides a good qualitative representation of actions and reactions chains that took place within the platform. It shows how the different discussions branched out and which functions of the platform where mostly used. Combining these data with the content produced by *participants* within the platform and with the feedback information collected by *developers* at the end of the initiative (who independently conducted a simple users' survey on the experience), was crucial to reconstruct participants' attributions of functionality, despite the lack of unrestricted access to the users' base. All data were anonymized by removing usernames, which were replaced with a unique identifier, thereby preserving the confidentiality, but not the full anonymity, of the research.

The *case study* method has been employed because it is one of the most appropriate research designs for conducting idiographic studies (Babbie & Benaquisto, 2014; Eisenhardt, 1989). This methodology is recognized as having several advantages, for example that of

providing opportunities for identifying complex interaction effects, and of being useful both for testing hypotheses, conceptual refining, and thus for theory development (George & Bennett, 2005; Yin, 2009). A clear limitation of the analysis relates to the clustering of participants in three groups. Indeed, the inherent danger in the use of such broad categorizations is social groups reification, which might neglect to account for all the ways different people interpreted the initiative, the platform, and others participants' moves.

Analysis and discussion

Rooted on the aforementioned theoretical frame, the analysis assesses whether the digital platform employed by the municipality functioned as a deliberative space where citizens could actively discuss and deliberate on city-related issues. Moreover, it tracks the negotiation processes occurring among the three major actors' groups (initiative's *organizers*, platform *developers*, *participants*) around the digital artefacts' functionalities.

Assessing the deliberation process

According to Gastil (2008), a deliberation process is composed of two phases. At the beginning, participants are invited to express their opinions on the topics, and to compare their own values and solutions with those of others. This comparison may lead to a change of values and opinions, and to the emergence of new ones. If a negotiation is possible, in the subsequent phase opinions are aggregated and included in an agreed-upon statement. By applying these concepts to the case study, an online debate can be considered as *deliberative* if participants, in a discussion topic:

a) Insert a new *opinion* or vote on an already submitted opinion;

Figure 1. Adding new opinions to the debate

b) Add a *comment* for the chosen opinion or vote for an already submitted comment;

Figure 2. Adding a new comment

c) Add a *reaction* to someone else's comment.

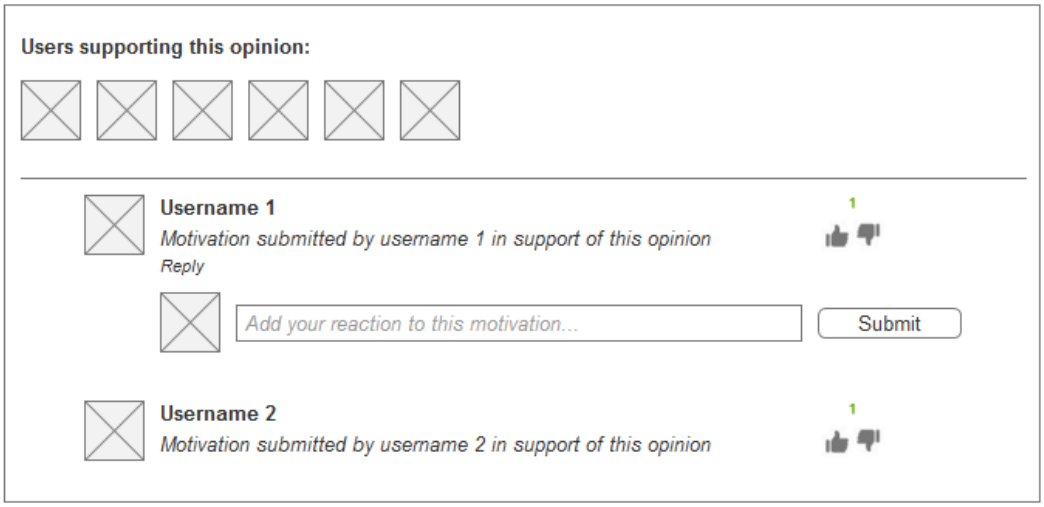

Figure 3. Adding a reaction

In conjunction, actions a, b and c represent both the *opinion formation* and the *opinion aggregation stages*. Their co-occurrence at the level of a single participant can be considered as the minimum acceptable level for assuming a glimmer of deliberation, as they presuppose both the evaluation of different opinions available (*opinion creation stage*) and their selection (*opinion aggregation stage*). In our case, since the unit of observation is the single discussion, this co-occurrence should be checked for each of the seven topics presented in the platform, as independent from each other. Below are the results of this first analysis.

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Table 1. Overall data collected on the platform

Action type	Public services	Labor and employment	Technology and innovation	Regional Identity	Security	Participation	Local Identity	Total
Opinions	5	4	8	5	3	5	8	38
Comments	5	13	18	11	13	12	23	95
Vote to opinions	4	5	7	9	8	9	8	50
Vote to comments	4	6	7	4	8	5	9	43
Reactions	0	0	0	0	1	0	0	1
	18	28	40	29	33	31	39	218

As can be seen in Table 1, the average number of new *opinions* per topic is around five, while the average number of *comments* is fourteen. The topics "*Local Identity*" and *"Technology and innovation"* greatly outperformed other topics in catalyzing participants' attention. The least participated topic was *"Labour and employment"*.

Table 2. Number of participated topics by single participant

# topics	# partecipted topics x participant
7	0
6	2
5	5
4	1
3	7
2	2
1	22

Table 2 shows how many participants had been contributing in one or more topics (the total number of participants was 139). None had been following all of them, and the majority of participants followed just one topic. Moreover, it should be noted here that 18% of participants just logged onto the platform, but never performed any actions at all.

Table 3. Number of actions types performed by users

# actions types performed	3	2	1
Public services	0	9	0
Labor and employment	0	9	0
Technology and innovation	0	12	3
Regional Identity	0	8	6
Security	0	7	4
Participation	0	12	2
Local Identity	0	14	2

Table 3 clearly indicates that none of the participants performed all the possible actions available within a single topic. The vast majority of participants performed only two actions, despite all the possible permutations available; these were:

- a+b: Voted or submitted a new *opinion* and voted or submitted one or more *comments*
- a+c: Voted or submitted a new *opinion* and added one or more *reaction* to other's *comments*

The b+c combination was not possible in accordance with the platform's rules, since the b action requires a. In fact, in order to submit a new *comment*, a user had to first support or add a new *opinion* to the debate.

These descriptive statistics already provide a clear indication of the *non-deliberativeness* of the debate, as they show how participants did not engage with the ideas submitted by their fellow-citizen, e.g. using *reactions*. However, to gain a more comprehensive understanding of what happened within the digital space, it is necessary to explore the interactions structure.

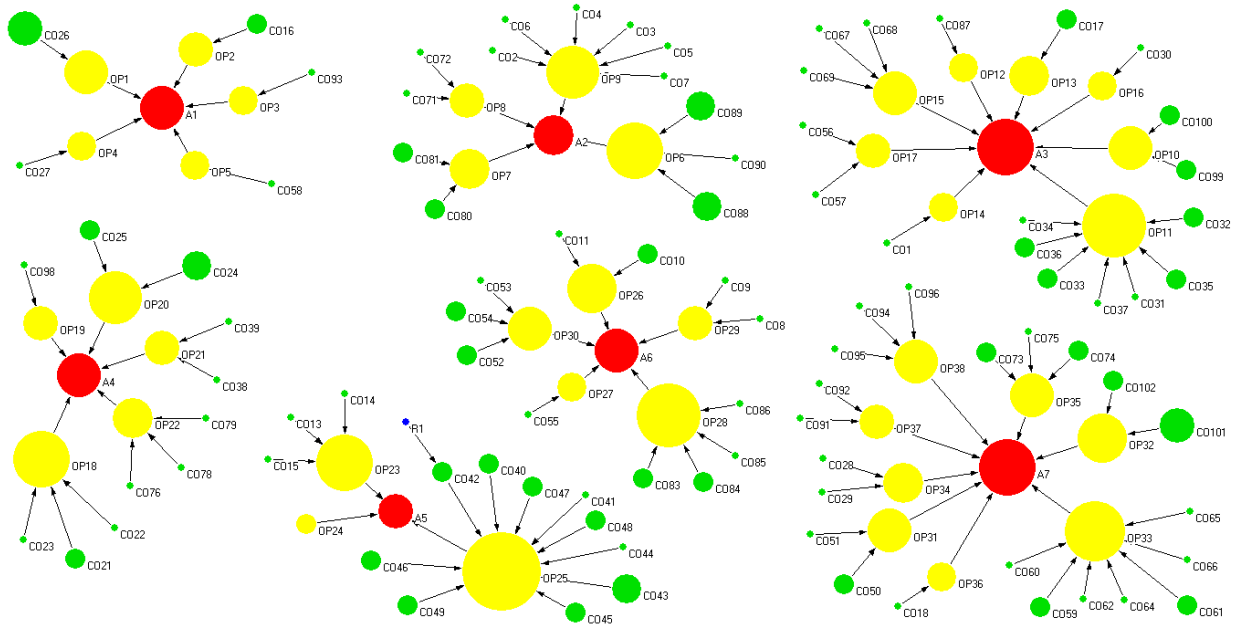

Figure 4. SNA of the overall topics discussions

Figure. 4 represents the deliberation activity for each topic. Red nodes represent the *topics*, yellow the *opinions*, green the *comments,* while *reactions* are blue. The size of each node reflects: for *topics*, the number of opinions inserted; for *opinions*, the number of votes received and the number of comments inserted; for *comments*, the number of votes received. The graph shows to what extent some *topics* stimulated the submission of several *opinions*, which in turn branched-out into multiple *motivations* (e.g. A7 and A3), while some others triggered polarized responses with relatively few *opinions* and various *comments* (e.g. A1 and A5). What is striking is the near absence of *reactions* (action c, performed only once, in Topic A5), i.e. replies to others' *comments*, which proves the lack of interactions among users supporting different *opinions*.

Following the operationalized definition provided above, it could be largely concluded that the initiative's participants only slightly developed discussions in a deliberative fashion, since supporters of one opinion did not engage with the ideas proposed by others. This lack of the *opinion formation stage* can be measured by the absence of *reactions* (action *c*), i.e. users' reactions to other comments. This absence stands for the inability of the initiative to foster discussions between citizens with diverging ideas on the issue being debated.

Negotiation process of the online platform's functionalities

Notwithstanding the fact that the initiative did not produce a sufficient level of discussion among participants to be considered a deliberation process, it is important to critically reflect

on what might have been the possible causes. One way of understanding it is by reconstructing the platform's negotiation processes occurred among the different groups of agents taking part in the initiative. Specifically, the process of attributions of functionalities formation and enactment in a digital environment, and the frictions arising among different attributions towards the platform. What emerges from the collected empirical data is a substantial discrepancy between the functionalities the platform was designed to fulfil according to the *organizers*, and those enacted by *participants*.

The *developers'* goal was to create an instrument capable of supporting structured online discussions. Their expressed aim, as emerged from interviews and through the analysis of the company's promotional material, was to go beyond traditional forum platforms and to develop an online software capable of fostering complex and articulated opinions' exchanges. In this respect, Deebase embodied a conception of deliberation which resembled Gastil's definition: a process though which people interact and collectively discover hidden dimensions of the issues at stake. Accordingly, the platform allowed users to explore new ideas, submit their own proposals and extend those of others. The process culminated with a democratic vote, which produced an ordered set of ideas, ranked according to their level of acceptance. This process, as prescribed by the original platform, entailed both the *opinion formation* and the *opinion selection* stages.

Organizers were interested in the opportunity to include citizens in the writing of the candidate's agenda. However, according to the *developers,* they proved to be not sufficiently willing to face the consequences of such openness. The fear of not being able to adequately and promptly control the interactions that could have emerged from the platform, brought them to negotiate with *developers* the artefact's characteristics: new features were added, others were removed. Basically, the *organizers* limited the allowed interactions to seven pre-defined topics, and asked *developers* for advanced content moderation tools to be implemented. In the *developers'* notes on one of the first meetings with *organizers*, we can read the following requests:

> The admin roles should be expanded. First of all, each new user should be manually activated by the administrator, only after having checked her profile. Moreover, it would be useful to have the possibility to manage each single contribution, in order to remove offensive contents and, in case, to ban those who do not behave according to the rules (cit. *organizers'* spokesperson).

The *developers*' spokesperson revealed the frustration that they were experiencing while adapting the technology to the *organizers*' attribution of functionality. In fact, the latter conceived the platform not just as a deliberative space, but also as a propaganda instrument for the candidate. A specific episode reveals the misalignment between the two groups. 17 days into the experiment, a user posted an inflammatory comment, unrelated to the discussion and in open contrast with the candidate's program. The *developers*' spokesperson informed the *organizers* about the event:

> Today we have noticed some "frictions" within the platform. I noticed that the content was removed almost immediately. I don't know if you had the chance to contact this user, but I was wondering if it was more appropriate to publicly post a "reaction", explaining why this kind of contributions are not productive for the discussion, and also advising the user to better articulate his oppositional stance (cit. *developers*' spokesperson).

The *organizers* replied confirming the user's ban from the platform:

> Before removing the contents, we sent an email to the user, explaining why his comments were removed. We have invited him to participate only in case he is willing to submit proposals that truly reflect his perspectives (cit. *organizers*' spokesperson).

This passage is evocative of the different attributions carried by *developers* and *organizers* toward the platform: the former privileged content production over control (which was instrumental to demonstrate that the platform 'was working' as a deliberation tool, i.e. that it was collecting contributions from the citizens, even polemical ones), while the latter favored control over deliberation (as a way to preserve the candidate's image and program coherence). Therefore, it can be argued that the *organizers*' attributions towards what does it mean to provide a context for public online deliberation configured the degree of freedom they ended up granting to the platform's future *participants* (Woolgar, 1990). In envisaging the *participants'* roles, *organizers* projected their own identity (i.e. supporters of the candidate) into the design of the platform's functionality (Bardini & Horvath, 1995).

Finally, *participants*, when accessing the platform, were carriers of their own personal attributions towards the initiative, the platform functionality, and what their role was supposed to be within it. These attributions were mediated by the information received from the *organizers* during the live event, through the initiative website's content, and the *Graphic User Interface*. Moreover, since in a digital space *participants*' attributions of functionality are *visible* to others - as they become *self-evident* in the same moment their actions take place - when accessing the platform, they also found the traces left by the actions of those who preceded them, and that had inscribed their attributions in the form of contents.

The almost exclusive reliance on *opinions* and *comments* downplayed the relevance that *reactions* had within the platform. However, these were also the only means available to participants for comparing their ideas with those of others and, hopefully, to discover new ones. In Gastil's conception of deliberation, *reactions* were an essential component of the *opinion formation stage*. The visible attributions towards the platform made by former participants and the absence of confrontations among participants with different ideas might have reduced what Lane and Maxfield (1997) describe as the *permissions to act,* i.e. the degree of freedom that agents arrogate themselves to create their own attributions of functionality and to enact them in practice. In the case analysed here, some of these *permissions* were formally established by *developers* and *organizers*, at the beginning of the initiative. However, throughout the progressive inscription of attributions made by other *participants*, with their actions in the platform, they were informally redefined, thus narrowing the permissions of subsequent newcomers. In a way, the community itself restricted over time the range of *allowable* actions in the platform. This reduction does not necessarily coincide with a convergence of possibilities: at any point in time, the attributions inscribed in the platform could have been reinterpreted by *participants*, thus fostering the exploration of new functionalities (even those previously discarded). The result is not an inexorable process of closure (Bijker et al., 2012, p. 39), but rather a complex interplay of attributions, which may sometimes push towards a common understanding of the technology, and other times towards a clash of different attributions, unable to generate new meaningful and shared interpretations of available technologies.

In the analysed cases study, this dynamic converged towards a functionality different from those envisaged by *developers* and *organizers*. Despite the information provided by the *organizers,* and the values inscribed within the artefact through the *Graphic Users Interface* and the interaction rules, *participants* adopted a rather passive role. This behavior, observable since the very beginning, was reinforced by new users when, joining the platform, they conformed to the behaviors of those preceding them, i.e. they limited their contributions

within the boundaries of their own opinions, without exploring and contributing to *competing* ideas. This led to a self-reinforcing dynamic that determined the failure of the deliberative initiative, as envisaged by *developers* and *organizers*.

Conclusions

Collective awareness has been gaining momentum over the past years. The pervasiveness of Internet connections and the accessibility of digital devices in the *Global North* have created the opportunity for experimenting with civic engagement on a large scale. This unprecedented opening in some cases revives a rather instrumental approach to technology, combined with utopian (or dystopian) dreams of hyper connected and smart communities. This research provides two theoretical insights, helpful to evaluate these kinds of initiatives. The first is rooted in the critical conception of deliberation provided by Fishkin and Gastil (Fishkin, 2009; Gastil, 2008), and it can be used to assess the deliberativeness of computer mediated communications. The second is Lane and Maxfield's approach to innovation (D. A. Lane, 2016; D. A. Lane & Maxfield, 2009, 2005), which provides a grammar to detect the emergence of unforeseen attributions of functionalities towards deliberations tools and these initiatives.

In this regard, this study is about a process of construction of an online deliberation space, and about how its functionalities changed as a consequence of the interactions among the involved groups of agents. While software *developers* designed the platform to be a digital collective deliberative space, it turned out to be a means of political propaganda and a digital suggestions box. For the initiative's *organizers*, it was the opportunity to promote their candidate and engage new segments of voters. For *users*, it was a place where to post their ideas, and not where to talk and discuss them with their fellow citizens. The interactions among the three groups brought to a clash of attributions, which did not generate the outcomes envisaged by *developers* and *organizers*. E*x-post*, it is possible to reflect on what could have been done to align *participants, developers* and *organizers'* perspectives. A possible option could have been the introduction of mediators along with the deliberation process. Their role should not be that of driving *participants* in the direction envisaged by *organizers* and *developers* - as this would privilege one attribution of functionality over others. Instead, it should be to detect novel usages of the technology over time, and to inform *organizers* and *developers* of new emerging needs, which may lead to modifications in the online deliberation space and in the whole initiative (Anzoise & Sardo, 2016).

Indeed, the complexity and uncertainty stemming from the introduction of technologies even in controlled environments, should remind us of the impossibility to predict every possible attribution, and therefore any potential functionality, which an artefact can acquire once in use. In fact, the attributions development and the interactions among agents is also influenced by cultural and *localized* aspects, which take the form of existing practices and networks of users and devices. These uncertainties constitute a threat to one of the pillars of digital civic engagement initiatives - and of Collective Awareness Platforms more generally - namely the possibility to leverage on the network effects, and on the *collective intelligence* stemming from it, for tackling social issues (Sestini, 2012). The concern here is not to identify and reduce the sources of uncertainty, but instead to deal with their existence and to learn how to include them in a continuous process of technological design. This can start, for example, by recognizing participants not just as mere users, but as agents capable of changing the rules inscribed in the technological artefacts.

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Let's play urban planner: The use of game elements in public participation platforms

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Through the provision of digital tools, government institutions aim to counter the growing alienation of citizens towards institutional politics and overcome traditional barriers of participation. However, as yet this approach has not shown the desired effects of increasing public participation in political decision-processes. In an attempt to encourage more citizens to make use of e-participation tools, some of these platforms hope to use the leverage and motivational effects of games by incorporating game-inspired elements. This research provides an overview of the current practice of applying gamification in public participation as well as preliminary insights into the effects of this approach. We review a selection of commercial applications as well as research projects, for which we list the included game elements and a critical discussion of the approach. Our results show that most projects focus on communicating accomplishments to users that are based on their quantity of participation. While little work has yet analyzed the concrete effects of individual game elements, up to now evaluations have mostly focused on the acceptance of specific gamified public participation platforms. The contribution of this research is twofold. Firstly, it offers relevant insights for the design of future e-participation platforms. Secondly, this work helps to establish a common terminology for game research.

Keywords: Urban Planning; Gamification; Game Elements; Motivation; Public participation; E-participation

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Introduction

With the emergence of technical innovations (e.g. Web 2.0, mobile technology) traditional barriers of participation (e.g. spatial and temporal, lack of interest, distrust) cannot only be overcome but the process of engaging can be made faster and easier (e.g., Linders, 2012). Hopes in this respect are put into what is summarized as electronic (e-) government. Industry, authorities and academia alike have developed a plethora of systems for public participation. The vast majority of these allow citizens to raise their voice or request information from authorities. Recent evaluations however have shown that these platforms have not yet been successful in raising the level of public engagement (e.g. Digital Democracy Commission, 2015).

Considering that the main reason for the original low level of engagement is a lack of knowledge of how to (= with what means) but also why to engage (Bohøj et al, 2011), an explanation as to why these digital efforts have not yet borne fruit, could arguably be that citizens have not yet caught up with all these new forms of e-government participation methods. Another explanation could be found in the design of these digital engagement platforms. After all, the most common critique has been that merely offering information or providing a one-way channel is not engaging enough for people to become active (e.g. Lukensmeyer & Torres, 2008).

One approach that targets the design of more engaging platforms is gamification. Promising the increase of system usage through the integration of game aspects, this strategy has already proved to be partially successful in a variety of domains such as e-commerce, education and health. By incorporating game elements into participatory platforms, the core objective is to add additional motivational factors that will in turn result in increased involvement. In context of a wider research in conjunction with other scholars and research projects, this article provides an overview of platforms that have already experimented with gamification, detailing their approaches and - where available - describing their findings. By analyzing the included game elements in relation to the underlying purpose of the tool, we offer a critical assessment of the gamification approach as a way in which to foster public participation. We further explore the question of whether adding game elements to participation platforms has the potential to improve current participatory processes through a more engaging design of the tool employed. Practitioners could benefit from using this overview as a collection of examples of implementations of gamification in e-participation. We conclude with a presentation of our findings and a look at the possibilities of future work.

Public participation

E-government is the manner of providing public services via electronic means. Its sub-form, e-participation aims to facilitate interaction and communication between citizens and city administration. It can further be distinguished between *political* e-participation where citizens engage in public affairs with the aim of influencing political outcomes (Brady, 1999) and *civic* e-participations where citizens act for the public good (Jordan & Taylor, 2004).

The success of participatory processes can be defined and evaluated in terms of the relevant stakeholders. In general, success is highly dependent on the goals and objectives of participation. In case the objective is to merely inform the public about plans, decisions or structures, criteria for success could be that more citizens know about these aspects than they did before. On the other hand, participation that achieves a broader awareness is generally not enough, instead input in the form of ideas and opinions coming from a broad

spectrum of citizens is sought. For what is commonly called “true” participation a key factor determining the success of a participation method or strategy is the active involvement of the public in processes and decisions that usually lie in the hand of authorities. It is commonly agreed upon that an active involvement (= getting insights, opinions) from a diverse group of citizens yields better plans and implementations (Burby, 2003) that are also more likely to be accepted and supported. Apart from these outcome oriented criteria, Brown and Chin (2013) further advocate process criteria for evaluating the effectiveness of public participation. These describe the participatory tool itself, focusing on representativeness, type of involvement as well as user experience.

Gamification

Gamification has been defined as the usage of game elements in non-game contexts (Deterding, 2011b). Several (empirical) studies have reported positive effects of gamification in various domains, including increased levels of motivation and user activity as well as greater enjoyment (for an overview see Hamari et al., 2014). The impact mentioned the most is an increased motivation of users to participate in tasks or the general usage of the service (Deterding, 2011b). One should note that negative effects of gamification have also been reported. Gamification not only adds additional issues for system designers to consider (Wiggins, 2012), but can also alienate people who are not affine with games (Prestopnik & Crowston, 2012). While gamification might work for one group of users (e.g. the younger generation), it might cause negative effects for others. Games and game-like systems are prone, more than other systems, to cause unwanted behavior such as cheating (e.g., Kohn, 1999). Another related and unwanted side-effect that could arise with gamifying participation is a decrease in (content) quality. At this point we want to highlight the difference between *participation* and *engagement* specific to this context. Engagement refers to the contribution of content or other interactions that are relevant to the overall purpose of the platform. When interactions from users do not align with the concept of the platform or do not advance discussions in any way, these users merely *participate* but do not *engage* with the topics. A question relating to the integration of game aspects in e-participation is hence whether gamification fosters engagement or only participation. And if so how is the quantity and quality of participation affected?

In a nutshell, gamified participation platforms can be defined as successful when it leads to an increase in the quantity of participation without negatively impacting on the quality. At best, the quality of deliberation and argument is increased as well. Failure on the other hand is when either the quantity has not been increased or the quality has decreased as well as any combination of these two factors.

Game elements

Investigating the effects of game elements in any domain implies that one knows what game elements are and therefore what (e.g. features, interface elements, concepts, rules) to look for. With game and gamification scholars all using a variety of differing terms (e.g. mechanics, atoms, blocks, aesthetics), it can be noted that a clear distinction between and definition of individual game aspects is still missing. For the purposes of this article, we resort to the common umbrella term ‘elements’. Where applicable, we understand the distinction between element and mechanic as elements being more concrete aspects of an application that are mostly part of the interface (e.g. leaderboards, badges), while mechanics describe concepts (e.g. rules) or impacts of using the application (e.g. education).

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A central objective of gamifying participation is to strengthen citizens' motivation to become involved in public decision-making. The composition of motivational factors leading to engagement has been found to be quite complex (Crowston & Fagnot, 2008). We argue that investigating game elements based on their motivational affordances provides a fair indication of whether they are suited to foster participation. Accordingly, we chose *Octalysis* as framework to help structure as well as compare gamification strategies for public participation services. Established for use on theories regarding motivation, Chou's (2015) Octalysis classifies elements according to whether they influence intrinsic ('inspiring and motivating') or extrinsic ('manipulative and obsessive') motivation. Providing an indication as to whether game elements appeal or strengthen someone's initial (intrinsic) motivation or offer an additional, external stimulus, this framework appears well-suited to analyse gamification strategies. Game elements are summarized into categories, which are referred to as 'core drives'. The Octalysis framework distinguishes between 'right brain' and 'left brain' core drives. Left brain core drives are associated with motivations that can be associated with logic, whereas the right brain core drives relate to emotional and social aspects. This categorization matches to a great extent the distinction between intrinsic (right brain) and extrinsic (left brain) motivation.

Table 1. Overview of how core drives can be linked to concrete game elements (adopted from the Octalysis website26)

CORE DRIVE	DESCRIPTION	ASSOCIATED GAME ELEMENTS/ MECHANICS
Epic Meaning & Calling	This applies when players believe that they are doing something "greater than themselves" or were "chosen" to do something.	Coins (virtual currency)
Development & Accomplishment	Refers to an internal drive of making progress, developing skills and mastering challenges.	Challenge; Points; Missions; Badges; Leaderboards
Empowerment of Creativity & Feedback	When the system allows users to engage in creative processes where they receive feedback.	Progress bars; Customization
Ownership & Possession	Gives users the feeling that they own something, also applies when they can customize parts of the system (e.g. profile).	Incentives; Rewards; Items
Social Influence & Relatedness	Social aspects that drive people (e.g. acceptance, companionship)	Chat; Levels; Profiles; Teams
Scarcity & Impatience	Based on the phenomena that we want something even more if we cannot have it (right away).	Time constraint; Time dependent rewards
Unpredictability & Curiosity	Refers to human's innate curiosity of wanting to find out what is happing next.	Easter eggs; Branching choices; Unlockable content
Loss & Avoidance	Refers to the drive of wanting to avoid something negative to happen.	Lifetimes

Table 1 provides an illustrative overview for how core drives can be linked to concrete game elements. The list of game elements is non-exhaustive and should merely illustrate how the core drives can be satisfied. For a better readability, in the remainder of the article we abbreviated identifiers for core drives (e.g. *Empowerment* for 'Empowerment of Creativity and Feedback').

[26] http://www.yukaichou.com/gamification-examples/octalysis-complete-gamification-framework/#.Vge0UOztlHw

Case studies

Relevant projects were gathered by searching for recent literature on public participation, urban planning and gamification through the use of Google Scholar and extended by references of found articles. The list of commercial applications is also an outcome of this literature review, which was completed by findings from a screening of online articles and news concerning e-participation and public participation.

The criteria for being selected for this review included that the system is relatively recent (no later than 2010), includes at least one game-related aspect, is either web-based or a mobile application and aims to support (public) participatory processes. We thus omitted tools that had a more educational notion or represented entire games. For the purpose of this analysis we considered aspects (i.e. concepts, features) of an application as game-related when either the authors or owners clearly marked them as such or when they have been previously marked game-related in literature. For each tool their functionalities, concepts and elements that can in some way be related to games are listed. Whenever the connection to games might not be obvious, we provide a short discussion on why we included them in our analysis. Identified game elements are categorized using the framework Octalysis introduced in the previous section. We do not claim that this review is exhaustive; but rather that it is a snapshot of the platforms somehow linked to public participation that were available at the time of writing.

Commercial platforms

Commercial projects were the first to experiment with game elements. Whether this was done with the objective of increasing the motivation of users to become involved, to make the usage of the system more enjoyable or had simply been a design choice without further intended implications is unknown. This section provides an overview of commercial projects that incorporate at least one game-related element. By commercial we mean that the tool has no (apparent) connections to academia and was thus either developed by a company, institution or an official authority.[27]

HunchBuzz[28]

Designed as an innovation software, *HunchBuzz* seeks to manage ideas and feedback from different stakeholders (e.g. citizens and city officials). Participation within HunchBuzz can be broken down into four phases: challenge, innovation, collaboration and execution. In short, first a topic is proposed (challenge), then ideas on that topic are collected. During collaboration those ideas are openly discussed, decided upon and then implemented (execution).

Table 2. Analysis of elements used in HunchBuzz.

DESCRIPTOR	EQUIVALENT IN OCTALYSIS
Challenge	Accomplishment
Points	
Incentives	Ownership
Competition	Accomplishment

[27] We made an exception for Community PlanIt, which has been developed by the Engagement Game Lab at Emerson College. We still allocated it under commercial projects as it resembles more a finished product than a prototype implemented to test a concept.
[28] http://hunchbuzz.com/

Challenge: Challenges serve as discussion starters and introduce topics. A challenge does not necessarily need to have a specific goal or a defined end, it can be broad or specific and can be limited by time or open ended.

Points: Users can earn points for contributing to the system by posting their own ideas or voting on other people's suggestions.

Incentives: Authors of challenges can choose to incentivize contributions. In that case, users are rewarded with points and win prizes. Collected points can be redeemed for a variety of goods at any time.

Competition: The progress of other users can be viewed on a leaderboard.

Focusing on ideation and innovation processes, this tool requires the active involvement of its users (= responding to challenges by proposing ideas and commenting). Formulating topics as challenges brings the required action and desired outcome of the participatory process into focus, making it clearer for participants on how to contribute. Setting a time limit further communicates a priority ranking and a sense of urgency. Incentives might add to a users' motivation to contribute, but will arguably not add to the quality of the contribution. The same applies to points that without an underlying meaning might only lead to users cheating (= trying to earn more points) the system. Also, whether competition in an innovation platform that seeks effective solutions for problems leads to those solutions being better is debatable. In case the competition (and points) are dependent on the quality-based ranking of contributions instead of on quantity, these game elements might be more effective in leading to the success of the platform.

Community PlanIt[29]

This platform seeks to 'make community-planning fun, while providing a context for learning and action'. When used for a case, an instance of the platform (called 'games') is deployed for a certain time frame. A game comprises of several challenges that participants need to complete. Each challenge serves the purpose of seeking people's opinion or ideas on a specific topic. During this ideation process interaction with authorities and other citizens is limited to a chat room, which is not necessarily linked to specific input from citizens or challenges.

Table 3. Analysis of elements used in Community PlanIt.

DESCRIPTOR	EQUIVALENT IN OCTALYSIS
Coins	Meaning
Challenges	Accomplishment
'Mission Map'	
The 'Soapbox'	Social influence

Coins: Taking part in the game by for instance completing challenges or missions earns the participants' credits. These credits (here represented by coins) can be pledged to a selection of causes. After the game, the cause with the most credits receives real-world funding.

Challenges: During each game participants can complete missions on topics related to the overall case. Each challenge consists of multiple missions. Before advancing to a new

[29] https://communityplanit.org/

challenge each mission must be fulfilled. In addition, a trivia question needs to be answered to unlock new challenges.

'Mission Map': In the application, all challenges are visualized as buildings on a horizontal axis. A sun behind a building symbolizes which mission a user is currently viewing. This allows the user to see his or her progress in the game.

The 'Soapbox': While the game itself is isolated from other players, users can interact with others by posting messages in the 'Soapbox'. Highly ranked posts get promoted to the *Buzz*, which acts as a news feed for the entire community playing the game.

While the content gathered in all games is publicly accessible on the webpage, the evaluation of it is not. This is due to this platform being part of an ongoing research project. Consequently, we cannot provide insights into how participants perceived the gamefulness of the platform or whether this increased their willingness to participate.

The mission map provides users with a structured overview of where in the participatory process they are and what is left for them to do. Challenges divide the topic into smaller, easier to understand units, instead of expecting citizens to differentiate between different aspects of a topic. While the coin system can again spark competition among users, it might also be an additional incentive for those citizens that are genuinely interested in the cause.

NextSuisse[30]

This platform concerns ideation processes regarding the future of towns in Switzerland. Participants are encouraged to articulate how their home town should evolve and what aspects (e.g. public transport, greenery) need to be present in order to guarantee the satisfaction of the population. To the best of our knowledge this platform is rather unique in two aspects. Firstly, it is the only public participation platform that – apart from standard registration procedures – requires a certification that a user is indeed a citizen of a particular town or city. Secondly, it is the first to apply the game mechanic expression.

Table 4. Analysis of elements used in NextSuisse.

DESCRIPTOR	EQUIVALENT IN OCTALYSIS
Town configurator	Empowerment
Playing the game	Accomplishment
Time constraint	Scarcity

The actual game has two phases. The first is what we call the town configurator and the second mimics the live mode.

Town configurator: In the first game phase, users can design the town to their liking. For this they have a toolkit consisting of urban elements such as public transportation systems, schools, residential buildings and greenery. In a similar way to the game SimCity these elements can be placed on a simplified plan of the town.

Playing the game: In the second game phase, users can test whether their adaptations lead to a high living quality and high satisfaction of the town's population. These two factors are indicated on multiple dynamic scales that change according to further modifications of the town's layout.

[30] http://www.nextsuisse.ch/

While the tool NextSuisse certainly allows citizens to make suggestions as to how their home town should be developed in the future, it remains unclear how their designs are fed into and considered in decisions processes. Although calculations in the second phase are based on forecasts, the assets available in the toolbox as well as the scenery itself are highly simplified making it questionable whether users can actually link the designs to reality and thus consider feasibility in the real-world (e.g. available space). This could lead to users *playing* with the tool rather than participating in urban planning processes.

mySidewalk[31]

Founded by urban planners, *MySidewalk* seeks to facilitate communication and build stronger communities in civic places. The platform sees its focus more on the evaluation of data gathered through public participation, but also includes an interface where input can be provided. Users can create new projects, or contribute to projects by posting comments or voting on ideas.

Table 5. Analysis of elements used in mySidewalk.

DESCRIPTOR	EQUIVALENT IN OCTALYSIS
Point system	Accomplishment
Competition	
Incentives	Ownership

Point system: In-app activities such as commenting, posting ideas and voting are rewarded with points.

Competition: mySidewalk includes a highscore, which consists of a page listing top contributors based on various criteria (e.g. top commenters, top idea generators).

Incentives: Points gathered for in-app activity can be exchanged for small products in the reward store.

As argued before, gamification strategies building on accomplishment systems that assess success based on quantity instead of quality of content are more likely to decrease the quality of participation than fostering sustainable engagement. In mySidewalk the top list seems to distinguish between quality (e.g. number of comments) and quality (= relevance of ideas), however it remains unclear how this top list is constructed and whether it only considers the number of awarded points.

Academic projects

The vast majority of research regarding gamifying participation has been in the domain of urban planning. In most cases, the objective was to develop complete games rather than incorporating specific elements for concrete purposes. It is worth mentioning that the distinction between ‘what is a game’ and ‘what is an artifact with game elements’ is not always easy. As Deterding et al. (2011b) noted this line can sometimes not only be blurred, but it is also empirical, subjective and social. Therefore, depending on someone’s focus and (usage) intentions one would rate something a game or an application with game elements.

[31] https://rebrand.mysidewalk.com/#

Love Your City (Stembert et al., 2013)

The interactive platform *Love Your City* aims to establish a more direct communication between citizens and the local authority by enabling citizens to propose and shape their ideas, help authorities plan the public domain as well as organize communal activities with other habitants. Although not explicitly mentioned, the tool uses a variety of game-related elements.

Table 6. Analysis of elements used in Love Your City.

DESCRIPTOR	EQUIVALENT IN OCTALYSIS
Emotions	/
'Fading date'	Scarcity
Heart points	Accomplishment
Profile	Social influence
Statistics	Accomplishment

Emotions: In the very first step of the participation process, users are asked to state how they feel about a situation by choosing from a selection of icons that represent different emotions. These icons further have the objective of making it easier for others to sympathize with the person who posted the message.

'**Fading-date**': In Love Your City! each post comes with an initial lifetime that reflects its relevance. Other users can influence its relevance by adding or removing days. When a post runs out of lifetime (i.e. reaches its fading date) it fades away and is no longer visible in the system. This mechanism was introduced to establish norms and values between citizens, it does not help to find consensus.

'**Heart points**': For each post (regardless of the participation path chosen) the user receives 'heart points'. While it is not explained how these credits benefit users, it is assumed that they are displayed in the user's profile and allow for comparison (i.e. competition) among users.

Profile: Each user has a profile that provides additional information about the user (e.g. demographics).

Statistics: The system further provides the user with some information about his or her progress by displaying statistics of usage. These statistics for instance inform how many solutions as part of co-creation processes a user has proposed.

For this platform neither the influence nor the acceptance of the game-inspired elements added were analyzed in any way. Thus, we cannot give insights into how these were perceived let alone how they affected participation.

While the objective of emotion icons is detailed above, we are sceptical that the statement of feelings can increase the perceived relevance of a post and thus make others more willing to respond or discuss the matter. It could be argued that the interest of people is evoked, when a topic is tagged with a particularly strong positive or negative emotion. However, not everyone reacts the same way to similar topics and people might grow annoyed with others using these strong emotion tags to attract interest. In the long run, it might even be that those posts in particular will be ignored by other users. Here the 'fading date' implements a better mechanism to control the quality of participation by the community rating a post's relevance. The statistics further help users reflect on the impact and relevance of their contributions.

NAIST photo (Ueyama et al., 2014)

The participatory sensing application *NAIST photo* was developed as a Foursquare[32] application and allows people to 'check-in' to locations (stating that you were/are somewhere). Aiming to tweak the reward mechanism for check-ins, they introduced three schemes to the already present game elements.

Table 7. Analysis of game elements used in NAIST photo.

DESCRIPTOR	EQUIVALENT IN OCTALYSIS
Points	Ownership
Badges	Accomplishment
Status	Social influence
Ranking	Accomplishment
Mission	

Points: For every check-in users are awarded points that can be exchanged for real-life money at any time.

Badges: Whenever a user check-in and fulfils a certain condition he or she is awarded a badge. There are different badges for various conditions. Badges are visible to all users and thus represent a title of respect in the community.

Status: Status levels depend on the number of earned reward points. The more a user has, the higher his or her status level. Higher status levels receive more reward points for check-ins.

Ranking: This game mechanic does not have an impact on the amount of rewards gained, it only sorts users based on the number of rewards already gained and since this ranking is visible to all users allows for a comparison between users.

Mission: This game element was not further explained in the source used for this analysis. It is assumed that missions are tasks that users can fulfill in order to gain badges or points.
This extension mainly incorporates game elements that build on the mechanic achievement. By rewarding users for completion of activities, it is anticipated that users will keep doing those activities. As the motivation is hence dependent on rewards and is not based on intrinsic interest, people might be inclined to contribute only to receive gratification and not because they truly want to engage in the topic. Again, this might negatively influence the quality of participation.

B3—Design your Marketplace! (Poplin, 2014)

Rather than incorporating a selection of game elements into the system, the designers choose to implement a serious game for their real-world use case. Due to its focus on urban planning and support for ideation, we still included the system in this review. The created tool aims to provide a 'playful' digital environment for both learning about a city's district, designing a marketplace, voting on other people's designs and discussing designs with urban planning experts as well as other participants.

[32] https://foursquare.com/

Table 8. Analysis of game elements used in B3.

DESCRIPTOR	EQUIVALENT IN OCTALYSIS
Marketplace CONFIGURATOR	Empowerment
Design Ranking	Social influence
Top designs	Accomplishment
'Little Helper'	Empowerment

Marketplace configurator (expression): The main component of the B3 game is a 3D/2D representation of a marketplace. By choosing elements from a tool box (e.g. park benches, playgrounds) and placing them on a virtual landscape, users can design the marketplace to their liking and according to their perceived requirements.

Design ranking: Users can vote on designs by giving up to five stars for each design. As designs are also associated with the player, who created the design, this voting system can also be regarded as a way of ranking individual users.

Top designs: Being based on the concept of leaderboards, this feature displays the designs that have been ranked the highest.

'Little helper': (help and progress) A fictional character, displayed in a corner of the game view, guides and communicates with the player in the form of text-bubbles. The character's appearance can be chosen by the player. The humorous depiction (i.e. design and language) of the character aims to contribute to the playful environment.

The tool was evaluated by two diverse groups of participants: university students and a group of senior citizens. Although the senior citizens appeared to appreciate the game as a new form of engaging with urban planning, their comments were often more related to affordances connected to the advantages of e-participation in general (i.e. being able to participate anywhere and anytime) and did not necessarily link to game aspects specifically. Poplin (2014) stressed the need to investigate the reasons behind users' motivation to 'play' such games, which includes an analysis of the effects of specific game elements. Her evaluation showed that users were more playing around (exploring what is possible) with the tool instead of reflecting on the feasibility of designs. As the tool did not provide feedback on factors such as costs or required resources, estimating whether a design could be implemented and thus rating the quality of contributions was difficult, unless users were experts in urban planning. However, for collecting input on what assets were generally desired in a marketplace, the tool could arguably be beneficial.

Reports Forum (Crowley et al., 2012)

Crowley et al. propose a framework for citizen reporting that incorporates a number of game elements. The framework consists of a forum and a mobile application. While users can post physical, social and amenity issues in the forum, the mobile application is meant for creating posts about social issues. A post contains a short textual description (also tags), an optional picture and a geo-reference. Where applicable, users can further indicate fixes to existing reports.

Table 9. Analysis of game elements used in Reports Forum.

DESCRIPTOR	EQUIVALENT IN OCTALYSIS
Points	Accomplishment
Tasks	
Badges & Trophies	Accomplishment & Unpredictability
Extrinsic rewards	Ownership
User roles	Social influence
Leaderboard	Accomplishment
Reputation system	Social influence
'Group endeavor'	

Points: Posting new reports or applying a fix to an existing report earns users' points.
This application incorporates all four types of incentives identified by Zichermann and Cunningham (2011): status, access, power and stuff (marked in italics).

Badges & Trophies for tasks: When completing a task defined in the application (i.e. cleaning up litter) users receive virtual badges, which can be seen as a *status* symbol. While for most tasks the user knows upfront that he or she has gained a reward, there are also badges that are hidden and are more difficult to attain (so called 'Easter Eggs').

Extrinsic rewards: Apart from virtual rewards, users can also be rewarded with *stuff* and *access* (i.e. coupons, reduced fees).

User roles: The assignment of user roles are nor explained in any more depth. It is only mentioned that they are similar to those roles attainable in Foursquare[33]. Representing the *power* reward, we assume that these roles will allocate certain powers to users.

Leaderboard: Aiming to add additional competition among users, player statistics can be viewed on a leaderboard.

Reputation system: Users can express their opinion on the perceived importance of an issue by using up or down voting posts. The number of votes a user has gained are then used to compute a user's reputation.

'**Group endeavor**': Multiple users can team up to collaboratively fix issues.

Merely proposing a design for a mobile reporting application, this source did not report on any results from the deployment of the tool. The authors stress that the incorporated game elements have to lead to a fun and socially engaging user experience where users can choose between a competitive or collaborative playing style. By including the mentioned game elements, it is anticipated that users will be intrinsically motivated to use the application. The game elements building on accomplishment, might be able to motivate users to become (more) active (= increase quantity of participation). Considering that merely the reputation system and the teamwork are said to be able to foster intrinsic motivation (Chou, 2015), it seems questionable whether this gamification approach can maintain a reasonable level of participation, let alone increase its quality.

Täsä (Thiel & Lehner, 2015)

This mobile application has been developed in the context of a project that aims to foster public participation in the city and enhance the communication between citizens and city

[33] https://foursquare.com/

officials. Like many other e-participation platforms Täsä is also based on the participatory sensing approach. As such, the main interface is a map where contributions (geo-referenced pieces of content) are visualized.

Table 10. Analysis of game elements used in Täsä.

DESCRIPTOR	EQUIVALENT IN OCTALYSIS
Area of Influence	Accomplishment
Competition	
Profile	
Progress	
Missions	
Time constraint	Scarcity

Area of influence: Users are rewarded with points for in-app activities (e.g. posting, commenting). These points are measured in square meters and represent the area of influence a user has acquired.

Competition: Users can compare their progress with other by viewing either the leaderboard or the high score list. The leaderboard always displays two users ranked higher and two users ranked lower than the current user.

Profile: The leaderboard, the high score list and the size of a user's influence area (amount of points) can be viewed in the profile. It further contains information on how much input the user has already created.

Progress: The profile also lists what activities a user has recently been awarded points for.

Missions: While Täsä is mostly designed to allow bottom-up approaches, missions were added for city officials to gather input on specific topics. Later on, they were also opened for citizens. Missions are usually framed as a question (e.g. where are more bike lanes needed) and are often connected to a specific development project.

Time constraint: Each contribution starts with an initial lifetime, which means that they will die (= disappear from the map) when they run out of this allotted amount of time. A lifetime can be increased if it is commented or voted on.

As the main field trial with the application has only recently been finalized, meaning results are still limited. Like many of the other reviewed projects, this application also mainly focuses on accomplishments as a way to spark motivation. Findings from earlier user studies with Täsä suggest that this strategy only works to begin with, where game aspects added to initial motivations to engage. Receiving feedback from the authorities remained the key motivational factor for contributing. The lifetime element ensures that a certain quality within the posts is kept and that the game aspect isn't encouraging increased but poor-quality contributions.

With several study participants not having been aware of or having ignored the game elements, preliminary insights from the long-term evaluation suggest that game elements do not have an impact on overall participation (Thiel & Ertiö, 2016). Furthermore, participants reported their main motivation of engaging with the tool to be that they were intrinsically interested in how their city might be planned, and that only in a few cases did the game aspects contribute towards their motivation to engage.

It is also noteworthy that almost all of the previously discussed applications included functionalities that allow social interaction. In some, they are dedicated chat rooms, in others users can be contacted by using the comment function of existing posts. In some frameworks and papers on gamification, social interactions are listed as another game element (e.g. Lehner et al., 2014; Bowser et al., 2014). One reason that social interaction could be viewed as game-related might be related to teamwork that can be organized via chat rooms or private messages. Moreover, considering that humans are social beings, an application that offers opportunities for social interaction might be perceived as more fun. On the other hand, Koster (2005) noted that fun in games tends to arise from mastery and comprehension, rather than interacting with other people. As social interaction is such a universal term and concept that is applicable to many domains, we chose to not include this element in our analysis.

Discussion

Only very few of the reviewed projects specifically aimed to investigate the effects of particular elements of gamification or the mechanics of e-participation systems, but rather sought to leverage gamification in order to foster engagement with the system. Some of the reviewed projects did not evaluate their gamification strategies at all, either using game elements blindly or just proposing them as an approach. Most of the discussed and evaluated cases did however report on a high acceptance rate of the gamification elements among its users. While achieving a high acceptance is arguably a necessary first step towards a successful use of novel concepts, the next step should be to investigate whether the introduced concept does actually achieve the intended goals, in this case encouraging people to become more involved in political decision-processes. In this respect, the effects on both the quantity and quality of participation should be investigated. For the development and design of future public participation platforms and other related systems it is important to explore which of the added game elements caused particular behavior changes (= increase motivation).

It would appear to date that most studies that specifically targeted public participation purposes have more or less blindly applied the gamification strategy, meaning that they did not go through an elaborate process of choosing game elements. Only a few, most published recently, have focused on the intermediate step and started investigating the impacts of applying gamification in more detail. Due to this lack of focused evaluation regarding the effects of individual game elements, we do not feel confident in making general statements on which game elements have which type of impact on various aspects of interaction and overall participation. The results presented at the end of the project reviews provide some insights into possible effects but should be considered carefully.

While all the reviewed projects applied multiple game elements, some used more (and different) core drives than others. Table 11 shows which core drives defined in the Octalysis framework have been used in the ten reviewed projects. The platform Reports Forum for instance makes use of five different core drives. Whether the number of incorporated game elements, the associated motivation type or what mix of core drives/game elements is the most successful, is another very relevant question to be addressed in future evaluations. After all, the interrelations of game elements remain unexplored as well, which means that theoretically elements could counter-balance each other. If true, this could explain why some studies did not find any effects of gamification in their public participation tools.

Table 11. Overview of used game elements in reviewed projects.

OCTALYSIS	# OF PROJECTS (COMMERCIAL)
Development and Accomplishment	9 (5)
Ownership & Possession	4 (2)
Scarcity & Impatience	2 (1)
** Social influence & RELATEDNESS*	4 (1)
** EMPOWERMENT OF CREATIVITY & FEEDBACK*	1 (1)
** Epic MEANING AND CALLING*	1 (1)

Core drives marked with a * are said to evoke intrinsic motivation.

The core drive *accomplishment* is used the most often. Whereas game elements belonging to *meaning, unpredictability* and *empowerment* were only used once. In four of the reviewed projects users could gain something, usually coupons or real products. Even though we did not include a social interaction feature in our review, half of the projects reviewed comprised elements that could gain a user *social influence* (e.g. user roles, teamwork).

All the reviewed gamified public participation tools build on the common human yearning to collect things, both virtual (i.e. badges) and material (i.e. small items). Rooted in democratic principles, public participation ought to come from the people (intrinsic) and should not (have to) be incentivized (extrinsic). Among scholars it is controversially discussed whether it is ethically right to offer rewards for democratic activity. Those critical of the practice argue that "imposed" contribution activities might not accord with a person's actual opinions. This could lead to false conclusions regarding planning and decision making. Overall, content posted in the tool might not be representative, making its use questionable. In order to avoid a decrease in participation relevancy (i.e. quality), accomplishment systems should not only be based on the quantity of activities, but also reflect on the relevance of contributions for the platform's purpose. A way to accomplish this could be to not only rate individual users (i.e. performance based on activity), but also rate their posted content by for instance letting the community rate its quality and relevance.

Elements that communicate accomplishment are often linked with the ability to compete with fellow users. Whether encouraging competition among citizens goes against democratic principles, where decisions and accomplishments should be reached via consent, is debatable. It is further not clear whether this game element has an impact on participation or motivation. Another seemingly important or at least well used core drive is social influence. The vast majority of these respective game elements allow users to place themselves within the community. Although not having been empirically confirmed, Harding et al. (2015) argue that including a reputation system in e-participation systems would allow users to better judge people's trustworthiness and hence increase users' willingness to engage with those users.

Only one project made use of game elements that are linked to meaning. Various studies stress the importance of clearly communicating the main purpose of public participation tools (Poplin, 2014; Thiel & Lehner, 2015). As a strategy to both communicate this goal to users and achieve the goal(s), we suggest that gamification strategies should be designed in such a way that game aspects mirror the intention of the participatory process. For instance, points could only be awarded when a contribution has reached a certain relevance rating from the community or was accepted for implementation by authorities. In order to advance in the

game (in this example gain points), users would need to ensure that their content is of good quality.

The majority of work exploring gamification in e-participation focuses on the effects of the overall concept rather than analyzing which element caused or promoted a specific behavior. While the individual influences of elements and their interrelations are still unclear, it cannot be said for sure that gamification as a concept will increase participation or effect it at all. Thom et al. (2012) put the effects of gamification into perspective by stating that it 'can encourage some people to use an application more often' – some, but not necessarily all. Coronado and Vasquez (2014) stress that the success or failure of utilizing game aspects comes down to the right stimulation of motives. Indeed, scholars agree that motivation (or interest) is one of the main factors influencing participation (Zichermann & Cunningham, 2011).

Conclusion

This article presented a review of both existing commercial and research projects targeting public participation tools which make use of gamification. We utilized Chou's Octalysis model in order to structure our review and later on compare different gamification strategies with the objective of identifying patterns. While only a few research projects have strategically investigated the impact of incorporated game elements, the vast majority of them report a good to high acceptance of game aspects among users. However, whether this acceptance is sufficient to also increase or at least spark people's motivation to engage (rather than just participate) with public participation tools remains unclear. Our review showed that most gamification strategies focus on reward-based gamification. This type of gamification is said to only spark extrinsic motivation, potentially leading to an increase in the quantity of participation but not necessarily improving/maintaining the quality of participation. That the success or failure of gamification approaches cannot be generalized and is dependent on the implementation of individual game elements, can be seen by the comparison of two projects, where one reported an increase in participation and the other project indicating that gamification did not have an impact on the level of participation.

The initial objective of including game elements was to encourage public participation. As it is yet mostly unknown whether this objective has been achieved, future work should focus on investigating the impact of gamification not only on user acceptance of game aspects (as this has already been studied) but rather on engagement within the tool, where the quantity as well as quality of participation is analyzed.

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Open Access Journal

Delving Deeper: Considerations on applying empirical research methods to infrastructural urban technology projects

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Urban technologies are increasingly designed to support ubiquitous computing, which now includes different forms of digitally-augmented interactions in public space. This shift is underpinned by the development and management of digital infrastructures in metropolitan cities – a paradigm often rhetorically dubbed 'smart cities'. Because the cityscape is uneven and characterized by diversity, this reconfiguration could be seen as a welcome opportunity to renegotiate the issue of agency in relation to the new technologies embedded in the built environment. Since the Urban Screen project was launched in 2005, digital art installations commissioned for public space have offered propitious terrain for rethinking this issue. Developing appropriate research methodologies, which could better support democratic practices within the infrastructural approach to urban technology design still stands out as pressing and necessary to facilitate the engagement of all concerned. This essay argues in favour of multidimensional approaches over unidimensional ones. To ground this discussion, it first describes the results of a unidimensional study carried out in 2015 in Montréal's Quartier des Spectacles and then highlights some of the salient differences it presents with a multi-sited field study conducted on the same site from 2012-15. It finally concludes that a multidimensional approach seems more robust.

Keywords: digital infrastructures; interactive urban technologies; public space; research methods; case studies.

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The Infrastructural Approach to Urban Technology

Twenty years ago, Rem Koolhaas (1995) was lamenting architecture and urbanism's failure to keep up with urbanization. Cities, he claimed, were constituted by formidable forces far beyond the reckoning of experts, who, rather than assuage their lust for power by attempting to make and control them, should learn to humble themselves to becoming their mere subjects and supporters. To achieve this, the expert was to 'no longer aim for stable configurations but for the creation of enabling fields that accommodate processes that refuse to be crystallized into definitive form…*no longer be obsessed with the city but with the manipulation of infrastructure for endless intensifications and diversifications, shortcuts and redistributions* [emphasis added]' (p. 969).

The celebrity architect was not unique in taking this stance. In the early days of the postmodern architecture movement, the Belgian architect, Lucien Kroll, had made this approach the *raison d'être* of his own practice by undertaking major design projects that continuously mutated as a result of the lived experience of those who used the buildings. Kroll's (1997) vision was that architecture was a political enterprise that should strive to amicably reconcile design contradictions without allowing them to obscure one another. He believed that his plans remained mere three-dimensional images until residents appropriated the spaces to develop their own designs through use and actions; embodied disorder, he wrote, was the only rational means of producing landscape and place. For Kroll, design should be an ongoing process; and buildings were to serve as living laboratories for this process.

The underlying assumption behind these perspectives is that infrastructure was needed for design to make possible what Koolhaas (1995) calls the 'staging of uncertainty', the 'irrigation of territories with potential', and the 'reinvention of psychological space' for it would provide the framework upon which artistic experimentation could take place (p. 969). Today, the emerging corpus of research on digital infrastructures may prove to be foundational to the daunting task of fully integrating technology into the built environment. Much like Koolhaas and Kroll, Dourish and Bell (2011) argue that the digital infrastructures that support today's ubiquitous computing are inherently messy, heterogeneous, and locally shaped by power relations between people. Indeed, as Forlano's (2006) work suggests, the development of a user-centered, participatory approach to the design of interactive systems can actually be facilitated by access to such infrastructures. But agency in the design process is never a given; it must be unrelentingly negotiated over and over again. Accordingly, in the dawn of so-called 'smart cities', appropriate research methodologies are needed to harness the full potential of an infrastructural approach to urban technology design – approaches that support democratic design.

Empirical research undertaken from 2012-2015 within the Quartier des Spectacles' one square-kilometer digital infrastructure provided a favorable context to assess these approaches (Fortin, 2016). The following reflects on some of the lessons learned from this three-year doctoral research program. It does so by first, describing the site and introducing the Common Space project under study in this essay; second, briefly discussing a few approaches currently being used to include the input of citizenry in urban technology design; third, describing a new, multidimensional methodology that was used in a field study undertaken in the Quartier des Spectacles; fourth, presenting the findings of the Common Space study later conducted with a unidimensional methodology; and fifth, concluding by assessing the main differences between a multidimensional and a unidimensional methodology.

Open Access Journal

Montréal's Quartier des Spectacles: Digital Infrastructure or Urban Laboratory?

Located in Montréal's central business district, the Quartier des Spectacles is a site administered by the Quartier des Spectacles Partnership ('Partnership'), a non-profit subsidiary of the municipality. It comprises a digital media architecture infrastructure made up of nine digital media façades used to showcase public art and deploy urban interventions. A web of ten kilometers of fiber optic cables are laid out below ground level throughout the whole area to connect the master control room with the interactive artefacts located in various emplacements within the site. Because it can support real time transfers of massive data flows, this robust permanent setup has the capacity to facilitate all kinds of new media artistic experimentations in outdoor urban settings. As a result, the Partnership announced in 2014 their intention to make their site available to creative talent as a digital urban laboratory.

Several empirical studies were conducted on this site between 2012 and 2015. Each provided a unique opportunity to examine the way digital technology might be used to support more participatory models of social and civic interaction in public spaces, but more importantly, to put to the test different methodologies that could serve this purpose. The aim of these studies was also to identify some of the design challenges that may arise when digital creativity is supported by an infrastructural approach. While a three-year multidimensional field study was the main subject of the author's doctoral thesis, in the last leg of her research program, she conducted a three-week study that is presented for the first time in the last section of this essay. Its object is *Common Space*, a project that offered local and international artists an opportunity to ideate, develop, and create eight digital artworks, which were then deployed within the Quartier des Spectacles district from October 1st to 18th, 2015. Co-produced by the Partnership, the National Film Board of Canada (NFB), and MUTEK – a Montréal-based organization dedicated to the development and dissemination of digital artistic works – Common Space was the Canadian offshoot of HUMAN FUTURES: SHARED MEMORIES AND VISIONS, an international collaboration between several cultural partners: FACT in Liverpool, PIT/CAVI at Aarhus University in Denmark, the Public Art Lab in Berlin, the Media Architecture Institute in Vienna, as well as the Quartier des Spectacles, the NFB, and MUTEK in Montréal. Under the aegis of the HUMAN FUTURES initiative, Common Space received financial support from the European Union's Culture Programme and the Conseil des arts et des lettres du Québec (Viau, 2015).

The HUMAN FUTURES initiative saw, over the course of a year, thirteen artists from seven countries matched into teams to produce public artworks that would interrogate the relationship between people and technology within the project's four different spatial themes: cognitive space, living space, networked space, and urban space (Human Futures, 2014). An international endeavour with programmed local outcomes, the Montréal chapter of HUMAN FUTURES became the opportunity to showcase eight publicly commissioned artworks that were deployed in the Common Space video projection circuit illustrated in Figure 1. The artists were simply asked to design digital installations that could provoke reflections, dialogues, narratives, and new ways of imagining urban environments among the general public when encountered in the Quartier des Spectacles. More specifically, the press release that announced the launch of this event states: 'Through technology, video projections and interactive tools, they [the artists] set out to reconceptualise our perception of that environment, which rather than remaining a grouping of imposed structures becomes a pliable entity that can be changed through design and creation [*sic*]' (Lamoureux, 2015, para. 2).

Figure 1. Map showing the location of the eight *Common Space* artworks deployed in the Quartier des Spectacles district, Montréal, Canada, October 1, 2015. *Source:* The Quartier des Spectacles (© 2015). Used with permission.

These bold rhetorical claims were made by the cultural partners and co-producers who directly and collaboratively managed the digital infrastructure within which the artists were given space to artistically interpret this thematic vision. While these claims are repeated throughout all of the promotional material and public presentations, it is noteworthy that none of these cultural partners made plans to obtain feedback from the general public or any of the participants who did engage with the interactive artworks – a fact corroborated by the Partnership's incumbent programming director during the interview conducted a few days after the deployment (P. Daigle, interview, October 21, 2015).

Some Methodologies in Support of the Infrastructural Approach

In the case of urban digital co-productions between the Partnership and the NFB, this is by no means unusual. As a matter of fact, since the inception of their media architecture infrastructure in 2008, the Quartier des Spectacles Partnership has deployed scores of interactive art installations for the benefit of the general public without ever taking steps to collect the latter's feedback. For instance, although both organizations have a mechanism through which they can invite people to contribute comments on their respective websites, neither have actually ever made arrangements to have trained experts conduct quantitative or qualitative evaluations of their deployments in public space to gather inductive data that would help them assess how successful these are. Figure 2 shows the means through which people can communicate with the Partnership from its website; the NFB has a very similar intake tool at the bottom of most of their web pages.

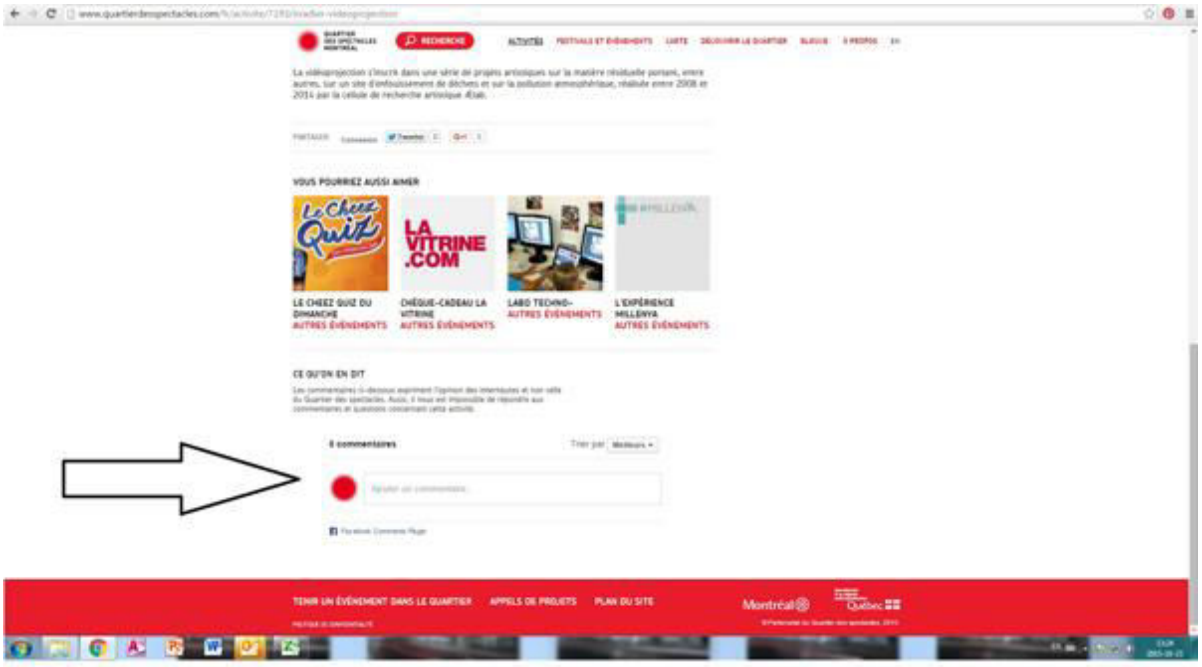

Figure 2. Screenshot of the generic online feedback form on the Quartier des Spectacles website, captured online on October 22, 2015. *Source:* The Quartier des Spectacles (© 2015). Used with permission.

Beyond the more mundane issue of lacking basic statistics to efficiently measure the popularity or participatory nature of the works, this information gap has at least one other far-reaching consequence. It implies that some public institutions involved in delivering digital infrastructures and their artistic by-products do not scientifically study their impacts, namely, how people outside their institutions receive, perceive, and experience the artifacts during the deployments. How then can they identify their strength and weaknesses? How can they learn lessons from their design-in-use? How can they evaluate whether they meet a public need? How can they know whether these artworks foster a public sphere? How can they determine what the design challenges and opportunities are for the different stakeholders involved? And finally, how can they build on a body of empirical knowledge that would allow them to improve their digital infrastructure in order to lead to innovations that are more cutting-edge and meaningful to all?

User-centered ethnographic approaches to ubiquitous computing are typically advocated by design practitioners in the field of human-computer interaction. However, they are also often criticized for simply producing an 'implications for design' laundry list that is meant to generate 'requirements for systems development by providing a clear sense of "what users want"' (Dourish & Bell, 2011, p. 64). Rather than being instrumentalized this way, it is argued that when ethnography is used to produce a generative account of cultural practices, rather than a taxonomic one that emphasizes streamlined data, the analyses generally yield a broader scope and longer shelf-life, which can better support a sense of collective responsibility and participation in the practice of design, and of course, in design-in-use. This is in part, because, as participant observers, engaged ethnographers are equally as accountable to their informants, as they are to institutions and experts. But it is also because – even though it is bias by design – the analytical component of an ethnography makes

arguments that go well beyond general facts; it reaches into the details of specific instances of what actually happens.

A case in point is the three-month field study of *Mégaphone* conducted in fall 2013 (Fortin, 2016); it was conducted more than two years before the Common Space case study. The object of the Mégaphone ethnography was the interactive 'Speakers' Corner' shown in Figure 3, which was created by the Moment Factory multimedia design studios and co-produced by the Partnership and the NFB. Although these three stakeholders agreed to fully collaborate with the author of this essay who was the principal investigator (PI), none had thought of commissioning a study or devising a means to collect qualitative feedback prior to being approached by a doctoral student eager to do this as a graduate research project. Some of these stakeholders have since expressed that the empirical and analytical materials produced from this study has provided them with valuable insights on design-in-use and live site attendance. Yet, none has had a qualified social scientist collect data and conduct analyses for any of the deployments that have followed since.

Figure 3. View of the **Mégaphone**'s 'Speakers' Corner' with the monumental media façade in the background, interactive public art installation, created by Moment Factory, conceptualized by Étienne Paquette, and presented by the National Film Board of Canada and the Quartier des Spectacles, Promenade des artistes, Montréal, Canada, October 2, 2013. *Source*: Claude Fortin (© 2013).

The fact that no record or report exists of how users receive and experience digital artifacts deployed by these stakeholders supports Gazzola and Baltazar's (2015) remark in reference to Yona Friedman's work: 'the infrastructure model…is the paradigm that still dominates current approaches and that it only gives limited freedom for the user, which is subject to a limited design space within the boundaries defined by the proposed infrastructure' (p. 47). Differently put, it dismisses the idea of the users as designers and disregards the actual needs of the very population they seek to provide services and culture to. More problematically, this omission turns the design process into a closed loop that excludes the end users as a stakeholder, thus limiting the potential for innovation that can emerge

between stakeholders espousing opposing views. In fact, one could say that the term 'end users' would only be appropriate in the context of such an exclusion because once they are consulted and actively involved in this design loop, end users effectively become design stakeholders in their own right (Latzko-Toth, 2014).

Three Years in the Making: The Mégaphone Research as a Multidimensional Field Study

This was the hypothesis that drove the Mégaphone field study, which was conducted with inductive research methods. This included producing field documentation of human behavior and interactive artifacts onsite by taking hand-written notes, photographs, and video recordings. It also involved conducting short, unstructured interviews with scores of participants onsite, and longer semi-structured one-hour interviews with over twenty study participants recruited onsite or through the snowballing technique. Finally, experts such as designers, computer scientists, technicians, producers, and others involved in the planning and maintenance of the display infrastructures were also interviewed. This wide sampling approach was supported by previous research on the design of interactive display-based digital urban technologies, which emphasizes the importance of identifying and aligning the interests of the multiple groups of stakeholders involved in large-scale public installations (Dalsgaard & Halskov, 2010).

Figure 4. Multi-sited ethnographic methods were adopted to conduct the **Mégaphone** field study, Promenade des artistes, Montréal, Canada, October 4, 2013. *Source:* Vincenzo Fibbiani. Used with permission.

However, in keeping with the recent drive to reinvigorate the idea of the user as designer in order to harvest the potential of democratic design, the Mégaphone study tended to focus more on participants and what took place during the deployment. Every evening from 7-11 pm, on Wednesdays, Thursdays, Fridays, Saturdays, and one Monday, the PI was immersed within the installation space (see Figure 4), at times participating in the interventions, and at

other times, adopting the ethnographer's 'fly on the wall' approach to make observations about how people used the Mégaphone. Conducted during 37 days over a period of ten consecutive weeks, this field work saw at least 4,800 people occupy the installation space to participate in the installation either as speakers or as observers. Out of all those, well over 1,000 of them were seen interacting with the system by speaking into the microphone, which was the only input interface that could be used to interact with this urban technology.

The Mégaphone research protocol cannot be categorized as participatory design because users were not involved during the ideation and design phase (Williams, Lindtner, Anderson, & Dourish, 2014). The design team delivered the technology as a finished product, and although they did make fine adjustments based on the odd end user comment made to the onsite technician during the deployment, these improvements were purely cosmetic (i.e. sound levels, color rendering, brightness, etc.). The Mégaphone study research design also does not meet the objectives proposed by Gazzola and Baltazar (2015) which consists in using applications that are free of human judgment – such as parametric modelling tools – to allow users to add metrics to an existing system, and thus suggest contributions during design-in-use; in Gazzola and Baltazar's research model, in keeping with Latour, agency 'is not a responsibility of a single "actant" but of the collective action…[of users acting autonomously]…in the production of the city' (p. 45).

While both these approaches strive toward design democratization and an understanding of agency as a collective, political responsibility, by contrast, the Mégaphone study was primarily concerned with assessing whether a multi-sited design methodology might provide an effective tool to help bridge the gap between the expert top-down approaches to new media technology design and the bottom-up community digital practices that shape *in situ* usages (Fortin, 2016). Specifically, Chapter Six titled, 'Appropriating the Mégaphone: The user as designer' sets out to demonstrate that participant observation is a research method that can be used to stage and frame opportunities for innovation that come about *during the deployment*. Here, agency in the design process did not emerge as one collective action, but rather, as clusters of collective actions that met the needs of not one, but of many micro-publics and communities of practice; after all, ethnography finds it legitimacy in the assumption that process and experience can be studied to produce knowledge from the exchange of meaning between informants – a world view that supports the collective production of meaning. However, just as the public sphere can be said to be fragmented into multiple public spheres, so may the needs of 'end users'. Moreover, the findings were triangulated from field observations, audio-visual recordings, and interview data, and as such, the resulting analyses were not generalizable since they were the PI's personal, subjective interpretations of the empirical material collected in the field (Fortin, 2016).

Aside from this last limitation, the most important consideration about adopting a multi-sited approach to conduct the Mégaphone study was the danger of inadvertently instrumentalizing this methodology for the purpose of top-down urban technology design. For instance, in architecture and urbanism research, Post Occupancy Evaluation (POE) has been used for several decades now to collect data on how occupants experience the buildings they live and work in (Preiser, Rabinowitz, & White, 1988). This methodology consists of interviewing occupants individually or in focus groups to obtain feedback on their experience through a mix of quantitative and qualitative methods. The main critique of this approach is that, although an assumption is made and set forth that interviewing and observing occupants will provide valuable data that will be used to improve the design of a given building, in fact, the research results can often be compiled to legitimize the idea that occupants have been consulted – and following this, be co-opted to endorse a particular view that existed prior to

data collection. Indeed, some say that this approach can be rhetorically used to support gentrification and exclusion rather than help designers work beyond it; this is mainly due to how interviewees are recruited, but also because of how researchers draw the composite portrait in alignment with the class interest of the expert stakeholders. This might also be a fair critique of the Mégaphone study were it not for the fact that the PI, on the one hand, had no prior ties with the stakeholders, and on the other hand, became deeply involved in the research process as a participant observer by collaborating with diverse stakeholders in epistemic partnerships across class, gender, and racial distinctions, including activists that were highly critical of the Quartier des Spectacles. This is both the strength and weakness of multi-sited ethnography: by hinging on the subjective engagement of the PI, it places the onus of knowledge translation onto the person of the ethnographer.

Common Space: A Unidimensional Study of the Infrastructural Approach

Two years after the three-month Mégaphone deployment, the Quartier des Spectacles programmed the three-week Common Space project. Accordingly, following the Mégaphone longitudinal field study, the PI conducted one last empirical research project in the context of her doctoral program to further investigate the development and impact of urban technologies designed under an infrastructural approach: the Common Space study. Since the two Partnership-sponsored events offered the public a wide variety of ways to interact with urban art installations in the Quartier des Spectacles, both studies presented the PI with occasions to identify some of the challenges that come up when urban technologies are designed and implemented in a context involving a digital infrastructure at its core.

But contra the Mégaphone study which was multidimensional in that it juxtaposed the perspectives of a diversity of stakeholders, the Common Space study was unidimensional in that it was based on collecting data from a single stakeholder, namely, the Partnership. Two days into the deployment, on October 3, 2015, the PI attended a two-hour public talk hosted by the co-producers in downtown Montréal, during which time each artist had fifteen minutes to present their artworks and answer questions on their creative process in relation to the Common Space deployment. Then, a few days after the end of the deployment, the Partnership's programming director and production coordinator – two key members of the Common Space co-production team – were interviewed in person together in their offices for a period of one hour. Their administrative assistant subsequently sent the PI all of the promotional material tied to this project, which included a press kit, press releases, photographs, and links to promotional videos. The following discusses the three major challenges identified from the triangulated analysis of the PI's personal notes, of the interview data, and of the promotional material.

Public Space Cohabitates with Private Space

The first challenge that the Partnership reported was the difficulty of negotiating private space within public space. The Quartier des Spectacles district can be described as a managed public space that spans one-square kilometer. However, within its perimeter, there are private residential buildings, housing co-ops, city housing complexes, public institutions such as university campuses and public libraries, and of course, commercial businesses that are occupied by both tenants and propriety owners. When the Partnership made a call for projects that would use the district as a laboratory to reconceptualise urban space, they did not realize the extent to which artists might want to use spaces that were beyond the Partnership's jurisdiction. During the interview, the co-producers explained that they kept an open mind about approaching the private stakeholders listed above to obtain permission to

use their territory for the duration of the Common Space deployments, but not all those approached gave their permission. Further, asking permission required time and resources that went beyond the agreed engagement. One of the lessons the Partnership learned from this project was the importance of parsing the management of private space and public space: 'this deployment made us realize that trying to obtain authorizations from private occupants can quickly become too much to manage' (L. Montmarquette, interview, October 21, 2015).

There were several examples of similar disjunctures between private and public space in the context of the Common Space project. In particular, Sébastien Pierre and Daniel Canty's **Îles Invisibles** posed many problems in this regard. First, in their original artwork, the artists wanted to situate some of the offnet terminals and boxes shown in Figure 5 in remote places that had a clandestine feel to it – such as one hidden corner in an alleyway – to bring participants into intriguing locations that gave depth to the narrative. However, this would have involved asking city-dwellers to access and supply electrical facilities from their own private properties, a proposition that the Partnership found untenable, not to mention the fact that identifying the parties to contact for authorization would have represented a great deal of effort on the part of the co-producers. The Partnership could easily have obtained such assistance from local theatrical venues, but the locations that the artist had in mind were small businesses and private condos. Thus, they negotiated a compromise with the artists. As an alternative, the Partnership proposed specific locations where they already had an existing electrical facility for deployments (L. Montmarquette, interview, October 21, 2015).

Figure 5. View of one of the terminals and blue stenciled graffiti of **Îles Invisibles,** *Common Space* interactive offnet art installation, created by Sébastien Pierre and Daniel Canty, Quartier des Spectacles district, Montréal, Canada, September 30, 2015. *Source:* Martine Doyon (© 2015). Used with permission.

Second, the blue marks shown on the ground around the terminal shown in Figure 5 were conceived as graffiti that played a crucial part in the narrative of **Îles Invisibles**. In the original proposal, there were graffiti and stickers that would contain symbols – which would

allow people to follow the narrative thread – and codes which participants would use to discover some of the content as they navigated their way through the narrative in public space. The graffiti was presented as a point of focus. However, the city of Montréal has by-laws against graffiti. To override these for the purpose of an artistic production in public space, the Partnership had to make a special request with the municipal body in charge of this more than six weeks in advance. More problematically, the artists wanted to draw some of these graffiti on private property. In drafting these requests, the Partnership had to precisely list exactly how many stenciled graffiti would be produced and their exact location, a procedure that does not necessarily support a spontaneous artistic approach. In the end, to obtain the required permissions, the Partnership had to make the graffiti themselves, which fell outside of their usual expertise – with, for instance, having to find a paint that could wash off after a month (L. Montmarquette, interview, October 21, 2015).

Third, the artist also wanted to include a box of chalks at each station which participants would use to write codes or comments for other participants to find. Again, the Partnership would have been left with making sure there was always a fresh supply of chalks and that people didn't use them for other purposes or to write inappropriate messages in public space. For instance, the Partnership was concerned that some people might use the chalk to deface local condo properties. For this reason, they asked the artists to design the artwork without the chalks; for they did not have the resources to provide these services, nor monitor emerging content on the ground, while they also had to manage the seven other artworks at the same time (L. Montmarquette, interview, October 21, 2015).

Figure 6. View of the storefront window displaying **A Side Man 5000 Adventure**, *Common Space* public art installation, created by Darsha Hewitt and Nelly-Ève Rajotte, Goethe-Institut in the Quartier des Spectacles district, Montréal, Canada, September 30, 2015. *Source:* Martine Doyon (© 2015). Used with permission.

Another example of tension between private space and public space occurred with Darsha Hewitt and Nelly-Ève Rajotte's **A Side Man 5000 Adventure** seen in Figure 6. In the original proposal, the project included a video projection onto the Goethe-Institute building where it was deployed. However, the production had not been notified that there were classes

scheduled in this building during the same hours as the video projections. As a result, the project had to be rethought at the last minute because the façade used for the video projections was located outside this classroom. Further, the special display that was deployed included a sound component emitted by a beat box, which became highly problematic because the Goethe-Institute has had many complaints from local residents in the past, which has forced them to comply with low sound levels when their speaker units are used in the evening. In the end, the artists were disappointed with their artwork because it could not be shown and rendered in the way that they had planned (P. Daigle, interview, October 21, 2015).

The above examples illustrate how part of the artist's creative process for **Îles Invisibles** and **A Side Man 5000 Adventure** came to either be changed, shared or transferred onto the Partnership due to the legal constraints that apply to an infrastructure where the boundaries between public space and private space are at times fuzzy. The next challenge also highlights how the Partnership's involvement in the Common Space project went well beyond managing and producing the deployments; they also came to exercise some degree of creative agency.

The Ethics of Technical Support

The issue of the maintenance and the restoration of the eight digital artworks was the second new challenge the co-producers faced. This was an unusual scenario for the Partnership; typically, during the deployment of digital artifacts, it is the artists themselves that maintain electronical components or fix bugs in the code. But with Common Space, most international artists came to the Quartier des Spectacles to set up their work and then immediately left for Europe. As a result, it was not possible for them to trouble-shoot the technical problems that came up onsite. Because their ability to intervene at such a great distance was limited, the Partnership was obliged to undertake repairs when breakdowns required rapid, onsite presence. This meant that the Partnership sometimes had to make judgment calls about repairs that overlapped with issues of artistic license (L. Montmarquette, interview, October 21, 2015).

For instance, each of the fifteen terminals of the **Îles Invisibles** installation had to have a custom-made box, which contained the electronic hardware (i.e. circuits and antenna) that would deliver the offnet content to participants. Against the advice of the Partnership who recommended having the boxes made in industry, the artists insisted on using a 3D printer to produce those boxes themselves. Further, the Partnership strongly suggested that they be made of polyvinyl chloride resin (PVC) in order to be as weatherproof as possible, but the artist chose to produce them in another material. When it rained during the onsite testing phase, the boxes got soaked and consequently became unusable. Just one day before the deployment, the Partnership handled this problem by covering the boxes in plastic freezer bags after having obtained the artists' approval (L. Montmarquette, interview, October 21, 2015).

Problems with the telephone booth in Sam Meech and Marilène Gaudet's **We're All Friends Here** installation presents another good example of how the Partnership was obliged to intervene well beyond its usual mandate. For this piece, the artists had interviewed Montrealers to get a sense of what it feels like to live downtown; these experiences were then visually translated into jacquard knit patterns that were video projected on media façades while people could listen to each interview by picking up the handset in the telephone booth shown in Figure 7. The interactive affordance of this piece was that

pedestrians could add their own contribution to the audio database and the knitted forms by leaving a voice mail message when they used that telephone (Tremblay, 2015).

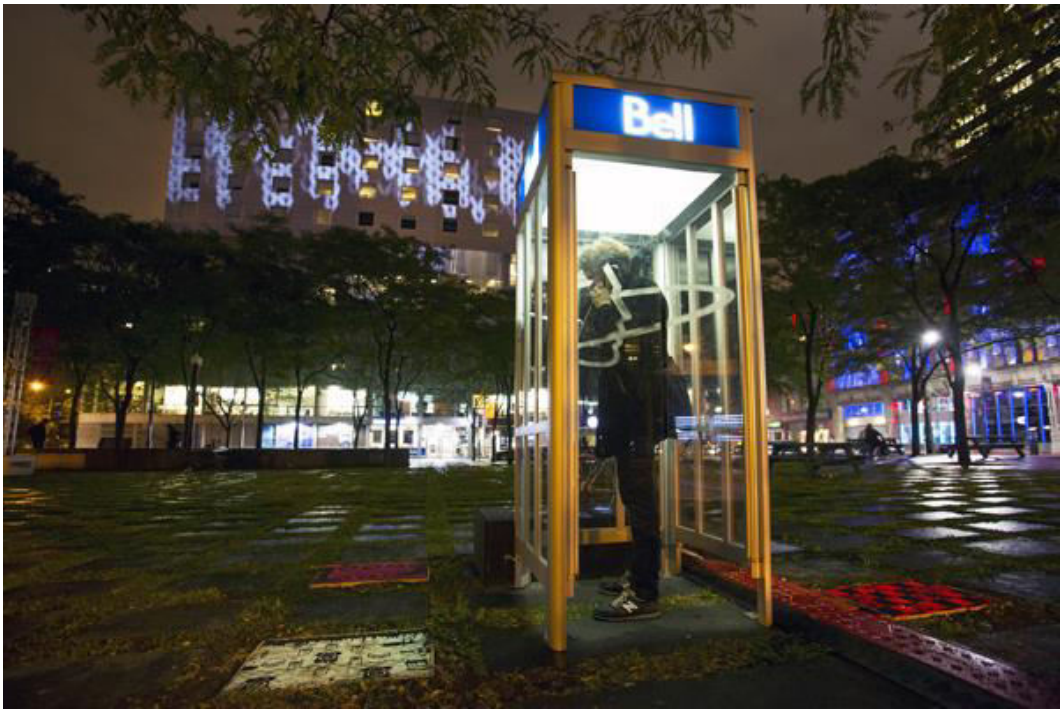

Figure 7. View of the telephone booth and one of the media façades designed for **We're All Friends Here**, *Common Space* video projections and interactive public art installation, created by Sam Meech and Marilène Gaudet, Quartier des Spectacles district, Montréal, Canada, September 28, 2015. *Source:* Martine Doyon (© 2015). Used with permission.

A few days after the launch, once Sam Meech had returned to the UK, his system malfunctioned. People couldn't hear any of the interviews when they listened into the handset. The Partnership contacted the artist and they were able to collaborate with him remotely to fix the problem with the system. However, shortly after, the telephone booth was severely vandalized. The telephone was completely destroyed, thus making this part of the installation defunct. Given that the artist had bought the handset in an antique store, it was a unique component that couldn't be replaced as it was. Because Meech was in Liverpool at the time, the Partnership had to find, buy, and install a new telephone within 48 hours, and then solder a new microphone and other electronic components inside what was left of the handset. This restoration process – which is generally the resort of conservation practitioners in museums – was quite beyond the expertise of the Partnership's personnel (L. Montmarquette, interview, October 21, 2015).

Further, a situation like this requires the artists' consent, which can be problematic with a breakdown that necessitates a quick response. Indeed, the Partnership had to make their own assessment of how to handle the situation, while making sure that the artistic intention behind the work was respected; the ethical standard they used to do this was to remain within technical changes that wouldn't alter the nature of their work (P. Daigle, interview, October 21, 2015). But in this case, Meech was actually interested in the idea that the vandalism would become part of the artwork on display; he asked that the telephone not be repaired at all. In fact, he wanted the vandalized telephone booth to be shipped back to Liverpool once the deployment was over. Against the artist's intention, the Partnership dismissed the idea of leaving the telephone broken; for in their own words, 'the show must go

on' (L. Montmarquette, interview, October 21, 2015). The Partnership also hesitated in paying for its shipping cost because, in their opinion, it was a waste of money since the apparatus was too damaged to work. Meech insisted on having it back, however, because he felt that it could be exhibited elsewhere in future as a more mature work that would broadly speak to the unpredictable character of public space: the deterioration of his work was part and parcel of his own creative process and artistic intention. In the end, the Partnership and the artist negotiated a compromise on this issue, and the booth was shipped to Meech in the UK (P. Daigle, interview, October 21, 2015).

These examples suggest that in taking on the maintenance of artworks deployed on its site on behalf of the artists, the Partnership inevitably became involved in their design. This raises a number of ethical questions related to the relationship between digital infrastructures, the artists, and the general public: How does the infrastructural approach change the relationships of power between these stakeholders? Does it provide more or less design agency for artists and end users? Does it have the potential to open up new paradigms for collaboration in the public domain? What are the mechanisms here through which stakeholders can negotiate decisions? The next and last example further examines the ethical implications of such tensions.

Think Globally, Legislate Locally

The third challenge that came up for the Partnership in the context of the Common Space project was also related to the issue of artistic license but this time, the constraint was due to differences on how laws are applied to public space around the world. The HUMAN FUTURES initiative may be an international project, but when it comes to deployments in public space, its legal frameworks remained local. Artists had to conform to the existing laws and regulations applicable within the national jurisdiction of each of its cultural partners. Some European states, for instance, do not legally forbid the display of personal device ID Codes in a public artwork. Current laws in Montréal, however, do make such an act illegal. This became an issue during the development phase of **Unintended Emissions** created by three members of The Critical Engineering Working Group: Bengt Sjölén (Sweden), Julian Oliver (New Zealand), and Danja Vasiliev (Russia).

Established in 2011 and based in Berlin, the Critical Engineering Working Group works toward raising awareness around the new ethical issues that arise in the context of ongoing technological innovations. Their mission is summarized in an online manifesto translated into sixteen languages (Oliver, Savičić & Vasiliev, 2011). Their members produce artworks and projects that calls into question the top-down paradigm of technology design. For instance, to denounce the 'corporatization of the Internet', they might advocate off-the grid and alternative DIY networks (Tremblay, 2015). Some of their members – such as Julian Oliver, a renowned activist hacker who has received three Prix Ars from Ars Electronica – have won prestigious international prizes for their controversial digital artworks.

Accordingly, many members of the Critical Engineering Working Group conceive projects that are critical of existing norms and practices. In particular, one of the themes they wish to draw attention to is how portable devices are routinely used by large corporations for data mining and geotracking purposes. Raising awareness around this matter – which they refer to as instilling a 'healthy paranoia' – was the rationale behind their Common Space artwork, **Unintended Emissions** seen in Figure 8. Here, the original artistic intent was to make pedestrians aware that personal information is being captured from their mobile devices as

they move in the vicinity of the artwork – the main assumption being that most people emit this information unintentionally.

Figure 8. View of the media façade of **Unintended Emissions**, *Common Space* interactive video projections, created by Bengt Sjölén, Julian Oliver, and Danja Vasiliev, Quartier des Spectacles district, Montréal, Canada, September 28, 2015. *Source:* Martine Doyon (© 2015). Used with permission.

The graphics for the video projection proposed by the Critical Engineering Working Group consisted of a minimalistic monochrome template made up of two display screens placed side by side, on which appeared computer code, identifiers and text, moving and cascading incredibly fast (Pop, Toft, Calvillo, & Wright, 2016, pp. 378-381). Some might say that it looked like two computer screens running a program with a bug in it. Or perhaps, to *aficionados*, this is what programming code looks like as it is executed. In any case, the hacktivist style was convincing. In its test version, the graphic displays were changing so fast that they were almost illegible. Still, the ID code of each mobile device detected in the area was automatically displayed by the system programmed by the artists. The three members of the Critical Engineering Working Group were, in fact, hoping that people would recognize themselves when they would see their device ID code appear on the media façade; this was the point of the artwork. The problem that they ran into is that displaying this data publicly is illegal in Montréal.

In the end, the co-producers had to insist that the artists replace each number in the device ID codes with the letter 'X' (P. Daigle, interview, October 21, 2015). When asked how she perceived this alteration of the artwork, the Common Space project coordinator commented, 'the video projection was so visually busy and incomprehensible that it would have been impossible for people to understand what they were looking at anyway' (L. Montmarquette, interview, October 21, 2015).

It is highly possible that most observers would not grasp the full meaning of the artwork. But do people ever really do? Is legibility and clarity what mattered in this artwork? More

importantly, did the work lose its purpose once the codes were anonymized with 'X' marks to satisfy the demands of Montréal's legal framework? Such questions can only be answered by conducting interviews with the artists and with the audience. This can be said in fact, for all of the examples cited in this case study. Reporting the perspective of the artists via third parties, namely the programming director and production coordinator interviewed on October 21, or while the artists spoke in person under the tutelage of the Partnership during the official Common Space public talk delivered on October 3, can only provide limited information. While the findings above might be somewhat useful to researchers, the PI found them lacking in critical depth in comparison with the research outcomes of the Mégaphone field study.

Assessing Multidimensional vs. Unidimensional Approaches

Due to time constraints, the PI was not able to devote as much attention and resources to the Common Space study as to the Mégaphone study: the former had to be conducted in three weeks, while the latter was undertaken over three years. Upon completing the Common Space study and assessing its differences with the Mégaphone study, the PI concluded that a multi-sited methodology offers a more powerful tool – and thus a more relevant means – to support the research of urban technology designs made in the context of an infrastructural approach. While the reasons for this are multifold, the main consideration in this appraisal is that an iterative approach that takes place over the course of an extended period ostensibly affords a wider range of research strategies and more time to collect data, perform deeper analyses, and take stock of all the stakeholders' perspectives and needs.

For instance, neither the study participants, nor the artists were interviewed for the Common Space study because a few weeks is not enough time to instigate and process a research ethics protocol. As a result, the design problems that are raised only reflect the Partnership's views and interests. Drawing from different stakeholder groups – and by extension, a greater diversity of perspectives – the Mégaphone interviews could, conversely, rely on critical theory to represent some of their diverging interests; such an analytical approach arguably supports a constructionist epistemology that is more inclusive because it builds on situated knowledges 'being constructed in and out of interaction between human beings and their world, and developed and transmitted within an essentially social context' (Crotty, 1998, p. 42). More importantly, it better reflects the *interdependency* of actors bound by distinct needs, interests, and roles. What purpose does the Partnership serve without 'end user' participation? What is the relationship between artistic intention and audience reception? How does the Partnership's responsibility over the coordination and control of a digital infrastructure circumscribe the designers' creative processes and artistic license? In describing the connections between stakeholder groups, the multi-sited ethnographer substantiates each of their individual contributions.

While a unidimensional approach focuses on the design problems encountered by one stakeholder group *vis-à-vis* others, a multi-sited design approach allows the investigator to better demonstrate that design problems are the result of different intentions and forces that are mutually constitutive of a broader sociotechnical structure. With such a tool, it is the context of design itself that can be called into question to be updated and reformed. Although this was not the research agenda of the Common Space study, it nevertheless remains a key factor when innovation and agency are the end goal because these typically come about through the push and pull of a dialectical process. While it is understood that different stakeholder groups are not, and can likely never be equally influential in shaping final outcomes, multi-sited design can position each of these groups *inside the design loop*.

In the Mégaphone study, this was achieved by writing up case analyses in the form of short narratives that described study participants as characters carrying out acts of creative appropriation that went well beyond the baseline use that the interactive 'Speakers' Corner' had been designed for. These five international conference proceedings and three academic journal articles were not only presented and published in academic venues, they were also circulated in each of the stakeholder groups over a period of a year. By sharing these essays with each stakeholder groups, the PI made the results of this design research project widely available to the micro-publics that, in effect, were legitimized as the Mégaphone study's epistemic partners. In contrast, due to the lack of time, resources, and funding, the Common Space study yielded a cursory report describing a series of anecdotes told by a single party. Moreover, the only two potential publics that the study addresses are academia and the Partnership. When faced with logistical limitations, a unidimensional approach can provide researchers with a quick and dirty set of methods to identify a narrow design issue, but its outcome is just a *post-mortem* report.

In conclusion, the main insight of the research program undertaken in the Quartier des Spectacles from 2012 to 2015 has been the realization that a complex object of study such as a digital infrastructure – and its ancillary deployments – is best studied with a robust and far-reaching longitudinal methodology because it can provide more nuanced descriptions: a multi-sited approach wherein the ethnographer is given the possibility of developing relationships with stakeholders over time, building bridges between them through publications and events, and using critical theory to look outside the box with these epistemic partners can support the reconciliation of multiple perspectives.

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