

# Working Across Boundaries in Smart City Research

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## ABSTRACT

In this paper, four early career researchers discuss and reflect upon the unique research space offered by Smart City projects. We do so in an attempt to publicly reconcile some of the tensions and difficulties that we encountered while collaborating across organisational boundaries during three “Smart City” projects, which we briefly outline in the paper. We focus our discussion on four types of tensions that we encountered: *motivations*; *accountability*; *participation*, and; *qualifying success*. We believe that the tensions we encountered in our projects, and that we discuss in this paper, might be experienced similarly by other early career researchers. By sharing our tensions, raising our questions, and proposing some preliminary answers to those questions based on our experiences and reflections, we hope to provoke a discussion amongst our dg.o peers that will lead to improved future collaborations, a supportive community environment and, ultimately, smoother Smart City research projects.

## CCS CONCEPTS

• **Human-centered computing** → **Field studies**; *Empirical studies in HCI*;

## KEYWORDS

Citizen-centric projects, Smart City Cases, Interorganisational collaboration, Participation, Reflections

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## 1 INTRODUCTION AND MOTIVATION

The “Smart City” has become an important headline for and driver of collaboration between public institutions and researchers. On one hand, the Smart City offers an opportunity space where different actors can engage in exploring and tackling large societal

issues (e.g. European H2020 programme), with an emphasis on the roles digital technologies can play in improving public participation, transparency, open governance, and agile or experimental approaches to urban development. On the other, it represents a highly saturated rhetorical space where ideals resonating with city management (e.g. efficiency, cost, optimization) meet the technological constructs championed by technology companies and researchers (e.g. big data, Internet of Things, blockchain, artificial intelligence).

For researchers working in this space, the Smart City concept simultaneously raises concerns and critique (e.g. [22, 26, 36]) whilst offering unique opportunities for engaging with social and technical issues, people in their everyday urban settings, and new partners in research, private, and public sector organisations (e.g. [30]). This unique research space often makes Smart City projects a matter of professional and personal concern, since many projects evoke desires for making direct and local contributions, through local participation and community connections.

In this paper, four early career researchers (ECRs) discuss and reflect upon the unique research space offered by Smart City projects. We do so in an attempt to publicly reconcile some of the tensions and difficulties that we encountered while collaborating across organisational boundaries on the broad and wicked problems addressed by many Smart City initiatives. Specifically, we focus our discussions and reflections on four themes: *motivations*; *accountability*; *participation*, and; *qualifying success*. By exploring the tensions we encountered within these themes, we see our paper as complementing the many contributions highlighting the strengths and challenges of Smart City initiatives and research [11, 26, 30]. We also see our paper as a starting point for a discussion amongst fellow ECRs in the dg.o community. We believe that the tensions we encountered in our projects, and that we discuss in this paper, might be experienced similarly by other ECRs, and we hope that our public reflections might help to establish additional support mechanisms or improved training for our peers. In addition, the tensions we describe here go well beyond the experiences of ECRs and are typically inherent to multidisciplinary research; we therefore discuss our tensions in the “Working across boundaries” section.

We begin with a brief introduction of three cases—which we each contributed to in some research capacity—that serve as examples and main reference points for our reflective discussion. Following the case studies, we introduce the themes that serve as guidelines to our reflection. After each theme, we discuss how these themes were addressed and interpreted in our case studies. We close the paper by offering a series of question-based reflections on how the tensions have influenced and affected us as ECRs. By sharing our tensions, raising our questions, and proposing some preliminary answers to those questions based on our experiences and reflections, we hope to prompt a discussion amongst our peers that will lead to improved

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future collaborations, a supportive community environment and, ultimately, smoother Smart City research projects.

## 2 CASES

In this section, we describe three unique research projects that we have contributed to in the last five years. We selected these cases specifically because they represented a diverse range of the types of Smart City projects: from large-scale, multi-stakeholder research projects to small-scale, single-researcher-initiated endeavours. We offer a brief description of each project, so that we can return to them while discussing our themes. Many other types and scales of Smart City projects exist, and we cannot—nor do we wish to—claim to represent the experiences of researchers working on other types and scales of projects. Rather, we hope that our discussion of these specific cases inspires other researchers to contribute ECR-specific insights from their projects.

### 2.1 b-Part

'Building Pervasive Participation' (b-Part) was a project which received funding as part of the Joint Programming Initiative Urban Europe and span over three and a half years (September 2013 - December 2016). From a research perspective, the project was highly interdisciplinary involving researchers from social sciences (Finland), political sciences (Sweden) and Human-Computer-Interaction (Austria). Its main objective was to explore the requirements, opportunities, and impacts of implementing pervasive citizen participation concepts in urban governance [5, 7, 15].

As part of the project, a sophisticated mobile participation prototype was designed and tested using the living lab approach: with a real community of users and relevant stakeholders participating in real urban planning cases [19, 40]. The mobile participation prototype, named Täsä, was trialled in a field study in Turku, Finland over the time span of five months. The application centered around so-called contributions, which were pieces of geo-located content on a map, representing the main interface of the application. Taking the shape of either an idea, issue or poll, contributions were visible to all users and could be commented or voted upon.

The research team collaborated closely with city officials and urban planners as well as citizens, community groups, and non-profits before, during, and after the trial. This collaboration entailed various workshops and smaller scale studies, which informed the iterative design and development of the prototype (see details in [2, 6, 16, 45]). The workshops with city planners sought to identify planning topics to which citizen input was requested. The field studies ('walkshops') gave citizens the chance to test earlier versions of the prototype and suggest features. In an attempt to promote active use of the app and activate previously less engaged groups (e.g. youth), components characteristic to games were integrated into the application (i.e. gamification; e.g. achievement system, user profile). In addition to bottom-up participation where citizens could raise their own issues and propose ideas, Täsä also implemented top-down participation, where both planners and citizens could create 'missions' (discussion topics) in the app. This feature allowed the identification of ideas and discussion around the themes identified. A more detailed description of the prototype can be found in [45].

### 2.2 Drive now

The second case study was a design-oriented research project situated within a larger Smart City initiative in Aarhus, Denmark. The project involved a few of the researchers already involved in the Smart City initiative, representatives from the municipality and the newly created open data platform, also a collaboration between the stakeholders involved in Smart Aarhus. One important aspect of the initiative was to explore and prototype smart city technologies within the local context (see also [27]). Thus, the primary goals of Drive now was to explore and develop an example application of open data within the local context. As such the project and the outcome served several agendas. From a research perspective, the participating researchers were interested in exploring the process of opening up public sector information as open data and how these data could be useful for citizens in their daily life. From the perspective of the open data initiative, the project would help in making more data accessible on the platform and provide a compelling use-case for open data. Within the Smart City initiative, it was promoted as a concrete outcome of the initiative and branded as part of the city's push to become "*smarter*".

The project involved three interlinked challenges related to the data: First, identifying of a dataset that would be accessible and feasible to release as open data without having the risk of exposing confidential information or involve a lengthy development process on top of municipal systems. Second, identifying a dataset that could serve as the foundation for a design that could be implemented and deployed within a relative short period. And third, find data that could have relevance to the everyday lives of citizens. Through a lengthy process exploring and balancing these challenges, we settled on a real-time traffic data measuring congestion collected from a sensing network along a majority of the roads in the city. Based on this, we (researchers) developed a small application in collaboration with the traffic department and the company servicing and developing the sensing network.

The mobile application developed focused on providing citizens with a relatively simple way of querying complex data in a way that it would be relevant as well. The application allowed citizens query travel times based on their frequent locations (e.g. work and home). It was designed around the question "Should I drive Now?" to maintain the focus on data-inquiry. Upon posing the question, the application would query the real-time data and provide relevant information here and now, as well as simple recommendations. An example reply could be "Yes, but consider driving 15 minutes before tomorrow to beat the traffic" or "Yes, although cycling would be faster than driving at the current time".

### 2.3 Accessible Vancouver

One of the authors of this paper is in the middle of a multi-stage mixed methods research project that she initiated, which centers around a "public washrooms" dataset released by the City of Vancouver [43]. The dataset itself is quite novel; very few major cities publish open data related to their public washroom infrastructure, and even fewer include wheelchair accessibility information within those datasets (e.g. no other Canadian city provides information about wheelchair accessibility in their "public washrooms" data

sets). In the unique case of the City of Vancouver's dataset, information about the name, location, hours, and wheelchair accessibility of 105 public washrooms is provided in XLS, CSV, and KML formats.

According to the most recent version of the dataset - as well as the version that our researcher encountered in early 2017 - merely fifteen of Vancouver's 105 public washrooms are wheelchair accessible, just over fourteen percent. Vancouver is renowned for its wheelchair accessibility [32, 44], so the low percentage of accessible toilets listed in the dataset appeared unlikely. It appeared to be so unlikely that the researcher decided to visit all 105 washrooms during a trip to Vancouver in July 2017. She mapped five cycling routes to follow over the course of five days so that she could visit and verify the accessibility of every single toilet in the dataset. The researcher also spoke with two occupational therapists about the infrastructural requirements for wheelchair accessible toilets (e.g. door width, arm supports, accessible sinks, etc.), just in case she wanted to take any measurements or document specific details about the facilities she encountered.

By the time she completed her verification process, the researcher had identified over two dozen issues with the dataset. She found that fifteen additional wheelchair accessible toilets had been mislabeled as inaccessible, two inaccessible toilets had been labeled as accessible, eleven appeared as if they might have met the criteria for accessible toilets, and numerous community centres (with public washrooms) had been inexplicably excluded from the dataset. Beyond these data validity issues, she also encountered numerous on-the-ground ephemeral issues. For example, one accessible toilet was temporarily closed for cleaning, whereas another was closed due to filming. At least one wheelchair accessible toilet was temporarily inaccessible due to a water main break, and another was chained with no posted reason as to why or for how long.

The researcher contacted the City of Vancouver about their inaccurate dataset, and has exchanged emails with their open data team about updating the dataset. This process has been quite slow. According to an email from an open data team member, City of Vancouver employees would need to re-verify the information submitted by the researcher—despite the fact that the researcher submitted an updated and annotated excel spreadsheet, as well as an interactive Google Maps instantiation with photos for all of the mislabelled toilets. In the next stages of her project, the researcher intends to run shortest path calculations to demonstrate how much more difficult it is for non-able-bodied people to reach accessible toilets than it is for able-bodied.

### 3 WORKING ACROSS BOUNDARIES

Smart City initiatives and research projects almost always involve multiple stakeholders from different organizations. Whether following formalized approaches like the triple or quadruple helix model [30] or public-private partnerships [22], being situated in a living lab-like construct [19, 40] or following a more loosely coupled bottom-up approach [11, 39], a project is the common meeting point between multiple disciplines, people, and organizations. Projects exist in an overlapping space between different organizational cultures that carry with them different expectations, motivations, management traditions, approaches to participation, and measures regarding project ambitions and outcomes. This is

evident on a practical level in how we approach a project, engage with participants and envision the process and outcomes, as well as on a more fundamental level in how we see and understand technology, the role of participation, and imaginaries of the city.

When public institutions see technology primarily as a solution and the city partly as an operational challenge, we, as researchers, might come with different conceptualisations—rooted in historical, contemporary, and ever-shifting theories about urban phenomenon and objects of inquiry. These professional differences can be a great asset in how participants see and contribute to a project, with specific competences and organizational knowledge. At the same time, it can also be a source of tension throughout a project. This tension can present itself at all scales and have a significant impact on the project and its outcomes, from small technology-centric pilots to participatory design processes and larger policy initiatives. Navigating these professional differences requires additional work in the form of project management and communication, as well as via an ongoing process of negotiating and aligning expectations and objectives. While projects usually proceed and arrive at an endpoint, our experiences tell us that the negotiations and compromises can have an impact on the project and its outcomes from a research perspective. We call this the challenge of *working across boundaries*.

In discussing our experiences in the above cases, we found a range of common themes where differences in organizational cultures and professional positions had a significant impact on the case, the work we did as researchers, and our personal motivations and commitment. In the following sections, we discuss four of those common themes: *motivations*; *accountability*; *participation*; and *qualifying success*. We selected these themes based on our experiences, our familiarity with relevant literature discussing those themes, and how the areas lend themselves to a subsequent reflective discussion.

#### 3.1 Expectations and motivations

Smart City projects are often motivated by a real or perceived need to adapt to international or urban challenges, such as population increase, public safety, infrastructure deficits, lack of housing, energy security, health issues, and inclusiveness. City governments often decide to meet these challenges by adopting and implementing novel digital technologies, in part due to the growing presence and dominance of those technologies in our daily lives. Many Smart City initiatives include diverse stakeholders, such as: city government departments or public agencies, research organizations (e.g. universities, research institutes), companies, non-profit organizations, citizen-led organizations (e.g. community groups), and individuals. These diverse stakeholders have similarly diverse motivations for becoming involved in a project, ranging from a desire to test new technologies, challenge organizational structures and processes, test research hypotheses, or improve aspects of daily life. For example, in some cases, including our own, public officials have expected to receive—and have been motivated by the idea of receiving—a piece of software or a physical device as an output of a Smart City project, whereas researchers have been motivated by exploring a new application domain. The choice of words highlights the difference in focus; while public institutions and companies tend to aim for a rather "tangible" *output* (e.g. product or service), researchers

are more interested in *outcomes* (i.e. understanding backgrounds, relations and processes).

When starting a project with multiple stakeholders, it is important to communicate about and set expectations and motivations. This helps to establish a common ground amongst participants by identifying common objectives and defining the scope of the overall project—all of which helps to increase the project's chances of success [46]. In cases where motivations and expectations of a project go in different directions or clash, collaboration might become difficult and put the success of the project at risk [34]. Unmet expectations might result in stakeholders feeling frustrated and/or disillusioned, which might mean that their *trust* in such projects—and the promises that come with them—might also plummet. Hence, expectation management is crucial from the outset of a project through to its conclusion. Stakeholders' understanding of issues that a city is facing and their causes might differ as well. Even in case of a common understanding, entities might have different ideas and approaches as to how to address and attempt to solve a particular issue. Solution approaches usually relate to previous experiences, the community of practice or discipline one feels affiliated with (e.g. researchers vs. public officials) as well as current agendas (e.g. a researcher looking for funding opportunities for a concrete topic). These biases can influence the directions that a stakeholder wishes to see a project take [18], and the complexity of these biases can scale as a project becomes more interdisciplinary.

### 3.1.1 Expectations and motivations in our cases.

*b-Part*: Ever since the funding proposal for the b-Part project, the city administration expressed interest in participating in the research and testing the mobile prototype. During the actual living lab and occasionally in the preparation meetings, the research consortium came to realize that despite repeatedly highlighting the fact that we would be testing a *prototype*, both the civil servants and citizens were expecting a fully developed, polished *product*. Having this expectation, they were unforgiving when it came to glitches in the application. We tried to countervail this by emphasizing the term "prototype" whenever talking to partners of the b-Part project as well as including a disclaimer in the app highlighting the experimental character of our research. From interviews with non-users (i.e. citizens who created an account in the app but did not create any content), we learned that some had abandoned usage because of shortcomings in the technology [16]. On the other hand, when we surveyed users about their experiences of using Täsä, users seemed satisfied (over 55 % rated the overall functionality 3 or higher on a 5-point Likert scale). Users had even provided suggestions on how to improve a future application [16], indicating that they would be willing to test an improved version of the prototype.

Half-way into the Täsä trial, citizens approached the research team and public servants about the option to participate through a webpage. Although the research team stressed that this particular project investigated the potential of *mobile* technologies for participation, we implemented a webpage visualizing the content from the app. We still stressed that participation took place within the app but that we were responsive to users. In the survey we conducted after the trial, 80 % of respondents indicated that they prefer interacting with the city via a web platform, while the mobile app only gathered strong support among 65 % of respondents.

As researchers, we hypothesized that enabling commenting options (similar to social media platforms) citizens would engage in dialog and debate each other's ideas. Instead, we encountered a more individualistic usage, with citizens mainly motivated to participate so as to make their ideas known to public officials [16].

*Drive Now*: The development of the Drive Now project and application was strongly motivated by several related initiatives wanting a locally developed Smart City case. The parent initiative, Smart Aarhus, needed to demonstrate ability to develop something across the partnership (a "helix" setup involving the municipality, region, university and local companies) and the sister-initiative, the local open data platform, needed an example on the usefulness of publishing municipal data and how people might benefit from open data. The intention (and expectations from the city partners) was to deliver *something* that would create visibility and be of value from a citizen perspective. In the project two challenges emerged related to the expectations of the partners. The city officials expected a full application that would be made available to the public (without having discussed issues related to maintenance and dealing with platform updates etc.) and would be something that could be part of a launch event involving the mayor and local press. We focused more on the research challenges (visualising complex real-time data in a useful way) and the data analysis throughout the development process and in the final application. It was our impression that the expectations of the partner focused more on having an application to show where the visual design mattered more than the actual features of and use of real time data.

*Accessible Vancouver*: The Accessible Vancouver project was initiated by one researcher who was curious about the veracity of an open data set released by the City of Vancouver. Although the City of Vancouver indirectly influenced the researcher's expectations for up-to-date and accurate open data sets, the researcher herself set her own expectations and had her own motivations for conducting this project. Mainly, she expected to: visit all of the toilets in the dataset to confirm its accuracy; inform the City of Vancouver of her findings and have them respond by updating the dataset accordingly, and; use the updated dataset in a study exposing how much easier it was for able-bodied people to reach public washrooms in Vancouver. She was motivated to do this because she was challenged to pursue an interesting data science project. She was also motivated by her long-standing interest in using her digital technology skills in various efforts to address and redress social, spatial, environmental, and economic injustices and inequalities in cities; this includes through using civic open data to expose those injustices and inequalities. Because the researcher initiated this herself, the City of Vancouver's open data team were surprised when she reached out to them—they had NOT expected anyone to pursue such an endeavour and their institutional approval structures prevented them from quickly updating the dataset based on the researcher's interactive Google maps submission, which included photos of the mislabelled toilets.

### 3.2 Approaches to accountability

Engaging in Smart City research projects with public institutions introduces different levels of accountability and mutual responsibilities. Here we are not only concerned with the formalized approaches to accountability (e.g. oversight and answerability [1]) introduced by the project governance and/or funding model, but also what Suchman terms *located* accountability [41]. This view holds that our sense of accountability is situated and shaped by our personal experiences and relationships. We participate in a project as a representative of an institution, a discipline, a research agenda, a personal view, ambitions and ideals etc., and this shapes the accountability relationships and negotiation thereof in the project. We see this happen on three levels: first, there is the *project accountability* that includes responsibilities toward the project, partnership, participants, and objectives. This is often formalized and managed through mutual agreements such as a governance model or a consortium agreement. Second are the multiple *institutional accountabilities* representing the approaches to accountability within the participating institutions, e.g. a city department, research organization, private company or NGO. While they are implied in the collaboration and present on the project level, institutional accountability is often managed by the individual participants, and requires ongoing negotiation throughout the project. Last, we have the broader sense of accountability toward the place, citizens and societal frame wherein the project is situated. This *civic accountability* encompasses a broader set of responsibilities, from legal and ethical concerns to more personal motivations and ambitions toward betterment of society.

While others have discussed challenges introduced by different accountability relations on the project level (see [1]), we are more concerned with the tensions introduced between the different institutional accountabilities and how these are negotiated (or not) throughout a project, and the sense of civic accountability as a motivating factor driving our participation in smart city projects.

#### 3.2.1 Approaches to accountability in our cases.

*b-Part:* The b-part project did not have formal specifications detailing levels of commitments of the various stakeholders apart from the consortium agreement. Research partners' tasks were defined in man hours, the involved municipality had pledged their commitment as in-kind work in a generic manner and also co-financed the project. During the initialization phase and the living lab, both urban planners and city officials repeatedly assured us they were both aware of and prepared to spend the required resources. Upon our advice, the municipality appointed a person who would be the main contact for both citizens and internal queries. The idea was that this *participation ombudsman* would re-direct queries to the responsible city department. Over the course of the trial, we came to learn that responsibilities were not always clear (to the ombudsman) and in some cases no city department was responsible as tasks had been outsourced to private companies (i.e. fixing potholes).

We, as the research team also made an effort to respond to citizens' queries to the best of our ability. However, more often than not, we could not provide an answer as we were lacking the special knowledge only available to city officials. A second, rather practical reason of why we could not uphold our project accountability to a full degree was that, except for the Finish team, other project

members were unable to speak Finish. Being remote and not having local knowledge made it often difficult to respond to or even relate to issues. This is obviously not a challenge specific to this project, but applies to all initiatives attuned to a specific local context and culture and with an international and remote project team.

*Drive Now:* The complex stakeholder setup around Drive Now introduced several levels of accountability, both in terms of project management and deliverable. The city officials wanted to make sure that we delivered on the case, in particular as they wanted the applications to promote the local smart city initiative (see above). The open data initiative wanted to make sure that we, as part of the process, made the data available to their platform, and the third-party company collecting the data introduced technical requirements related to the load on their systems. This introduced a significant overhead in meetings across the stakeholders, where each party would voice specific concerns, often not communicated directly to us, but rather through the different municipal departments. It was a significant challenge for the project that the city officials was accustomed to a more top-down way of managing projects, something that is difficult when collaborating across organisations.

*Accessible Vancouver:* The limited number of stakeholders in this project meant that issues related to accountability were relatively minimal and straight-forward: the researcher who initiated this project was accountable to the project plans and deadlines that she set for herself, whereas the City of Vancouver was accountable for owning, updating, and maintaining its dataset. In emails with the City of Vancouver's open data coordinator, the researcher learned that different departments within the government were accountable for maintaining different datasets, at different times, and to different degrees. This varying accountability within the government shifted the researcher's expectations for seeing the dataset updated quickly, but it didn't affect the overall accountability dynamics. Perhaps the most important aspect of accountability that this researcher must navigate is in terms of sharing her research; she has an ethical and moral accountability to disabled scholars and disabled residents of or visitors to Vancouver, in terms of accurately and usefully presenting and sharing her work.

### 3.3 Participation

Intrinsically linked to the technological component of Smart Cities is the participatory culture they enable. While citizen participation has a long tradition in urban governance, digital technologies enhance the communication between officials and citizens and among citizens. Which users participate is an important question both for issues of social equity and legitimacy of the decisions reached. Traditionally, civic engagement by public bodies sought the inclusion of marginalized groups. Failure to attract them equated with failure of participation: at times, inclusion became a window-dressing endeavor, but many projects and plans provided sustained effort to broaden participation. It is important to stress that mere invitation has rarely sufficed to activate certain demographics, who have not previously participated. Unless invitation is coupled with capacity building for those involved and evidence how their views expressed have been considered, participation is likely to remain low.

The literature on citizen participation is filled with the tension between civic engagement and effects on policy. When public participation is understood as redistribution of power (cf. [4]), those who engage the public serve as *gate-keepers*, that is they are in a position to share their professional power with the larger public. The examples of planners and architects struggling to include citizen feedback into their (full-fledged) plans is eloquent for the transformation the public sector undergoes. On the other side of the spectrum lies self-selection. Citizens no longer wait to be engaged, but use technologies to organize around a cause or concern [48]. In these instances, it matters fairly little whether they are novices or pundits to public participation, but rather the effort and resources they can commit to further their causes. Self-selection is mediated by a series of factors including education, digital skills and income. This holds true for both traditional participation (public hearings) and electronic participation (e-government services, GIS). Tying in with the literature on the digital divide, while the access to technology gap has been closed (many, but not all, own either computers or phones connected to the Internet), there are still considerable gaps in usage and skills [47]. Thus, to design citizen-centric "Smart Cities" it becomes crucial to strike the right balance between targeted recruitment and open, self-selected participation [20].

Parallel to approaching citizens as users of technology, citizens are also actively shaping the participatory technologies. Living labs are predicated on citizen involvement early in the process. Similarly, citizens participate in application contests and create apps using public, open data. This adds depth and range to participation in Smart Cities, and highlights the transformations to civic engagement brought about by new institutional practices.

### 3.3.1 Participation in our cases.

*b-Part*: In the b-Part project, we tried to make a point of stressing the importance of participation and what that meant for each stakeholder prior as well as during the living lab. As researchers, we made sure the app was available on all three major application stores including video tutorials on how to download, install and use the app. We designed and ran 'walkshops' with citizens to gather feedback on the features and functionalities of the app we developed, in line with the living lab prerequisites. Additionally, in the meetings we have had, everyone agreed that it was crucial for a lively and ongoing conversation between the city and its citizens that the officials respond to citizens' input.

After the first months of the trial, the responsiveness of city officials declined. In order to help them in their task, we researchers compiled a list of open requests and questions from citizens that was sent weekly to city officials. Yet, this exercise did not seem to significantly affect the level of deliberation within the app. Interestingly, Täsä users considered receiving feedback from the city only fairly important; the same was true for feedback from other users in the app [16]. While Täsä attracted young professionals with good mobile usage skills, every second user learned about how to apply them to urban planning context [16]. The research team tried to boost participation throughout the living lab period by raising awareness of its existence: distributed flyers, showcased the app at local events, gave community talks and made media appearances, both traditional (articles in local newspapers, radio) and social media. The city administration also advertised the app through their

communication channels. The app attracted a demographic missing from traditional participation (young professionals; 72% of users) with youth and senior citizens participating in small shares [16].

*Drive Now*: Although envisioned as a citizen-centric application, we did not involve citizens in the design of the Drive Now application, the evaluation, or provided any means for the citizens to engage with stakeholders from the planning department, city operations or the political level. At best, the participating stakeholders, mainly people from the traffic department and researchers, brought in the "citizen" as a generic archetype based on personal experiences and multiple perspectives related to the topic of traffic and congestions in local media, anecdotal conversations and expert knowledge from both the traffic planners and researchers. In retrospect, involving citizens in any part of the development of the application might have challenged the idea that there was a need for an informative application and implied that commuting citizens just needed more information to change behaviour to help mitigate urban congestion. Ultimately, not involving citizens in discussing and exploring the problem-space, could be seen as a way of gate-keeping the technology-centric focus of the project and avoid discussing and challenging the planning aspects of the issue.

*Accessible Vancouver*: The data-centric sole-researcher-initiated nature of the Accessible Vancouver project influenced the project's participation. The primary researcher conducted all of the data verification work. Alongside this, she tweeted about the project, which led to some brief yet worthwhile interactions with news reporters and other members of the public on Twitter. After she had finished verifying the dataset, the researcher exchanged several emails with a member of Vancouver's open data team. She is currently in the process of running shortest path calculations for the final analytical phase of the project, and will likely ask some colleagues to review her findings before she publishes the work. The researcher made all of these decisions according to her own ideas about the project, and as a result of the fact that she had a limited amount of time as a tourist in Vancouver to conduct her research. If she lived in Vancouver or had been able to spend more time there, she would have reached out to local inclusivity or disability groups for their thoughts, feedback, and broader participation; however, she does not and did not live in Vancouver—or Canada, at the time—so decided not to reach out to any local groups. Although this choice did not affect my data collection process, it has likely influenced the long-term advocacy-related potentials of my project.

## 3.4 Qualifying success

Evaluating the success of a project is important for various reasons: financial (i.e. proper use of public or institutional money), practical (i.e. learn from mistakes), ethical & moral (i.e. ensure fairness and avoid deception), research/theoretical (i.e. contribute to knowledge) [37]. With success being a highly subjective matter, different stakeholders have different conceptions of success and approaches to evaluate Smart City projects. A project might be deemed successful if it mobilizes citizens around a specific issue throughout its life-cycle, if the intervention is useful and/or improves the quality of life to specific groups of citizens, if outcomes address operational

issues within the city, or if it provides a good foundation for additional project funding and research publications. These differing visions and versions of success all compete and co-exist in Smart City projects. It might be argued that agreeing on a set of success indicators already presents a pre-condition of a successful and potentially even effective project/initiative. To achieve this scholars have established criteria and processes to define success (see [42]). It should further be noted that criteria are likely to differ depending on whether *outcomes* (i.e. usually towards the end) of an initiative or the *process* is evaluated [37].

Literature establishing success indicators for e-government initiatives hence include availability and accessibility (of services and products; [3]) but also high user acceptance, high sustainability performance and market success as essential criteria for citizen-centric projects [31]. Holzer et al. further add information dissemination, a two-way communication between the stakeholders (e.g. through the service/product), security, integration and political participation as vital factors for the success of democratic interventions [23]. Collaboration plays an important part in the success of many citizen-centric initiatives, thus scholars distinguish elements impacting collaboration. Carley et al., for instance, stress the role of social capital, which is defined as the construction of social relations and networks of trust and reciprocity [12]. On the other hand, connection rates or network connectivity have been described as only being a limited measure of success [22].

Existing work on citizen-centric interventions (e.g. living labs, Smart City projects), shows that despite the increasingly acknowledged importance of the role of humans, user aspects are still largely neglected when evaluating those interventions. Recognizing that, people, in the end, are the receivers and users of products and services developed in citizen-centric projects, some frameworks also include citizen-oriented success criteria where scholars vindicate the critical role of people and communities (e.g. [14, 33]). For the most part, they advocate that outcomes (here products or services) should be utilizable and understandable by their target groups [17]. Evans further notes that citizens should have the skills and literacy to make use of those outcomes. e-Participation initiatives are only considered successful if users use the service(s) [38]. Hollands stresses that *“progressive smart cities must seriously start with people and the human capital side of the equation, rather than blindly believing that IT itself can automatically transform and improve cities”* [22, p. 315]. He further argues that technology should foremost be used to *empower people* to participate in debates that will affect their lives and their urban environment. In that respect, factors that are based on democratic principles such as transparency and representativeness are considered as success criteria [8, 21]. Joss [25] and Houghton [24] further took into consideration that humans are also conducting those projects, making psychological factors such as perceived success important as well. Moreover, also subjective values such as fairness might be considered when evaluating citizen-centric projects [13, 35].

#### 3.4.1 Qualifying success in our cases.

*b-Part:* While the b-Part project had defined objectives, there was no formal evaluation of the project nor had we defined specific measures of success. We assessed various aspects of the project that were important for our research, including outreach, collaboration

with the city as well as user experience with Täsä. Accordingly, we analysed how *inclusive* our app was (i.e. whether it succeeded in activating those missing from previous participatory exercises; young and senior citizens were under-represented in our app but we attracted a fair share of the young professionals), how we collaborated with the municipality (overall the collaboration went well), how the application performed and was experienced by citizens (the sample was split: some abandoned use because of technical challenges, while others were eager to use a reworked app and at the end of the trial suggested how to improve it). We detailed the potential of mobile participation as well as the encountered challenges in [2].

*Drive Now:* The project ended up delivering a smartphone application as a demonstrator for the local Smart City initiative. The application proved useful to commuting citizens; on its release in 2014, it got almost 5000 users and an average of 90 daily overall requests in the first six months. The underlying real-time traffic data was made available through the local data platform as part of the project and is still available. From the perspective of the stakeholders from the city it proved to be a great success and helped brand Smart Aarhus through media attention and the relative large number of downloads. The project also succeeded in making the real-time dataset available on the open data platform. From a research perspective, the project and outcome did not amount to any publications, partly due to the relative simple data analyses and application design, and partly because developing the application ended up consuming the time of the involved researchers.

*Accessible Vancouver:* Once again, the criteria for success in this project was set by the primary researcher. She had specific success criteria for the verification stage (i.e. to personally verify the dataset by visiting each toilet, and then to have the City of Vancouver update their dataset based on her findings) and for the in-progress shortest path calculations (i.e. that her calculations demonstrate if it is easier for able-bodied people to get to public toilets or not; if so, how much easier it is for able-bodied people to get to public toilets in Vancouver). Those criteria have not all been met yet, in part due to personal time constraints and in part due to institutional constraints within the City of Vancouver. However, from a research perspective, this project already appears to be on a path to success; the researcher has already delivered one presentation about this project at an academic, computational social science conference.

## 4 REFLECTIVE DISCUSSION

Academia can be a highly competitive industry to carve out a career, at any stage. Early career researchers face a number of specific demands and must respond to countless pressures if they wish to establish their reputation and pursue a future in this industry [9, 28]. When we, the authors of this paper, first met to discuss the content we wanted to include, we came together—from across our diverse experiences in the Smart City domain—because we felt we had encountered specific struggles with the identified and discussed themes.

In this section of the paper, we return to our early discussions and reflect on some of the challenges posed by our themes to fellow

	Expectations and Motivation	Approaches to Accountability	Participation	Qualifying Success
<b>b-Part</b>	Polished product <i>versus</i> research prototype. Anticipated dialogue <i>versus</i> individualized use of the app.	Organisational coordination and response to citizens' input <i>versus</i> researchers monitoring input.	Marketing the app <i>versus</i> creating new or being responsive to existing content in the app. Focus on mobile participation <i>versus</i> wish for multi-channel tool.	No formal evaluation of the project <i>versus</i> analysis of few aspects of interest to researchers.
<b>Drive now</b>	Develop local open data demonstrator <i>versus</i> research challenges in visualising complex data. Smart city application <i>versus</i> research prototype.	Top-down project management <i>versus</i> more agile/open design activities. Inter-organisational coordination <i>versus</i> direct communication.	Expert-led design <i>versus</i> citizen participation and evaluation.	Public communication and uptake <i>versus</i> foundation for research publications.
<b>Accessible Vancouver</b>	Expectations and motivations set by sole researcher (no one else <i>needed</i> to be involved) <i>versus</i> partnership approaches to Smart City projects.	Researcher accountable and responsible <i>versus</i> City of Vancouver responsible for accurate dataset. Inaccuracies and accountability issues were primary motivation for initiating the project.	Researcher as primary participant and instigator (local disability rights organisations could have been participants) <i>versus</i> City of Vancouver responsible for the dataset as indirect participants.	Criteria for success defined by researcher <i>versus</i> shared and/or coaligned criteria for success. Emphasis on research and publication <i>versus</i> addressing issues with inconsistencies in the open data sets.

**Table 1: Summary of the salient tensions across cases and themes**

ECRs (cf. Table 1). We do so in the form of questions directed at dg.o conference attendees and community members, and we do so for a few reasons. First and foremost, we wish to align ourselves with existing reflective paper traditions that use and include questions (e.g. [9]). Secondly, the questions represent some of our own inner tensions about operating within the Smart City domain and, as such, it would feel disingenuous if we presented them in any sort of definitive or declarative manner. Lastly, we would like these questions to be seen as the start of a dialogue amongst members of our community, especially amongst fellow early career researchers and any other researchers with whom the questions resonate.

**How do these tensions affect early career researchers?**

The themes that we outlined in this paper have challenged us in ways that we were not expecting when we agreed to join or undertake Smart City research projects; they have challenged us to think about our previous training, the future of our careers, our priorities, and our expectations. We had each joined or pursued our Smart City research projects equipped with a multidisciplinary academic background (e.g. computing and urbanism, participatory design and systems engineering, software development and public administration) and some degree of non-academic work experience. Despite these foundations, we each struggled with aspects of the complex, multi-stakeholder demands of Smart City research.

In our experiences, we had to learn—sometimes quickly, and sometimes through painstakingly slow effort or error—that we were engaged not only in conducting ‘research’, but also in expectation and stakeholder management (see Table 1). At times, this included trying to convince other project partners to commit to—what was in several instances—OUR research project whilst encouraging them to feel and take ownership of the process and its success. The ability to do so is a delicate skill set to learn, develop, manage, and nurture in *any* industry, including academia. But training and Smart City literature directly related to developing and nurturing this skill set is sparse. Few of us felt we had received enough previous training or encountered enough literature to help us confidently navigate such complex multi-stakeholder projects, whilst also trying to juggle our research career demands. Indeed, sometimes the research aspect of our work needed to be pushed aside.

Project management and logistical coordination also became an urgent issue in many of our projects, rather than following up on research questions. In dynamic Smart City projects, the contexts that we work in are often changing, both in terms of on-the-ground issues (e.g. unexpected emergencies or disasters, unexpected construction, changes in community members) and organisational issues (e.g. unexpected organisational restructuring, unexpected political pressures due to an election shift certain project outputs, research deadlines pass by due to unexpected and complex stakeholder coordination issues). Trying to accommodate the ever-shifting and new circumstances that arise as the project progresses can make it difficult to meet research objectives. This is particularly challenging for PhD students or postdocs whose careers depend on meeting those objectives.

Meeting, missing, or changing research objectives often affect the types of tools we design and the data we are able to gather throughout a project, which influences the amount and quality of publications we are able to produce. Given that publications are one of the pillars of academic careers, we have come to believe that ECRs should carefully consider the potential opportunities and challenges before choosing to engage in complex Smart City projects as it might affect one’s academic career. Although the work is oftentimes very rewarding personally, the saturated nature of the Smart City research domain and the complex nature of Smart City projects can make it difficult for establishing your early career.

Of course, overall, participating in these types of complex, multi-stakeholder projects opens one’s eyes to other perspectives and new challenges. And this is precisely what we think interesting academic projects should do. So by openly reflecting on the challenges of working as ECRs in this complex domain, we do not wish to discourage other researchers from pursuing projects. Rather, we hope to spark a conversation about what can be done.

**How might we mitigate the risks involved with undertaking or joining Smart City research projects?**

As noted in our reflections to the previous question, there are risks for ECRs related to pursuing or initiating Smart City research projects. In particular, there are risks related to being able to publish our work on these complex projects. In many cases, the easiest way

to mitigate this risk is to work with more senior and experienced researchers to ensure that useful angles on research can be found for the purpose of publishing papers. But, more broadly, we suspect that some minor changes at academic publishing venues might help, too. For example, conferences could make space for more overtly reflective papers, like this one, which allow for researchers to share some of the challenges and tensions they encountered during their projects. A need for spaces and venues that allow researchers to publish openly reflective papers about their experiences and conundrums has been noted by others (e.g. [10, 29, 49]).

There are other ways to mitigate the risks that ECRs face during Smart City research projects, too. In our experiences, learning from others and *their* past mistakes helped us understand what we reasonably could and could not achieve. Because literature on these issues is so limited, we often learned from others' past mistakes during informal discussions, conferences and during workshops. Formal events at conferences and during workshops could help facilitate this knowledge-sharing. We also suspect that having workshops with Smart City project participants and stakeholders right at the outset of a project—or even before it commences—could be a useful way of sharing knowledge amongst those involved. These types of workshops could also help to establish a common ground for expectations, accountability, and definitions of success across project stakeholders, as well as to create a shared understanding of the goals of the project.

Ultimately, no project is risk-free, and we would love to see more senior researchers supporting ECRs in embracing the risks of Smart City projects. We hope that other ECRs can be encouraged to learn by doing, and we suspect that better preparation might be of help.

#### **How can we help prepare early career researchers for the tensions they might encounter during Smart City research?**

As noted in our response to the previous question, having workshops with Smart City project participants and stakeholders at the outset of a project might be a useful way to prepare everyone involved in a project—including ECRs—for the work ahead. These workshops could be particularly helpful if they create a shared understanding of the organisational cultures that everyone is bringing to the project (e.g. if discussions explore academic publication related pressures, organisational structures and decision making processes, accountability, expectations, etc.). In addition, establishing an online forum for ECR to share their experiences, tensions and successes, might also support learning and guidance.

We believe it might also be useful to teach early career researchers about project management and risk assessment before they join any Smart City research projects. In our experiences, we spent a considerable amount of time reading about theories related to urbanism, smart city development, and technology co-design, as well as some of the methods to support those theories and processes. Although these theories and methods are useful and important for our academic careers, they did little to prepare us for the on-the-ground experiences we faced during Smart City research projects. On reflection, we agreed that learning about expectation management, project management, and risk assessment as formal parts of our academic training would have likely helped prepare us for the tensions we encountered during our project.

Of course, it seems obvious that academics would think more training or more knowledge acquisition would be the solution to this issue. But perhaps what we really need is the time, space, and community support to learn slowly through practice. Perhaps what we need is permission to fail—fail at managing the risks of or tensions in our projects, fail at meeting deadlines, fail to “get” the context we’re working in—while we work, to learn from our failures, and to receive nurturing mentorship while learning from our mistakes. This might be calling for a major culture change in academia—especially in certain academic workplace cultures, which put incredible pressures on ECRs [9, 28] and push innovation for innovation’s sake.

#### **Can we escape innovation for innovation’s sake?**

Grant proposals and publications are often judged (amongst other criterion) by their innovativeness, novelty, and “contributes” to the academic knowledge. As a consequence, we researchers seek and explore ever new approaches. In turn, we often have to deal with novelty effects, particularly when evaluating our interventions. Reflecting on the tensions and challenges we encountered in various projects, we posit that sometimes it might be more prudent to further explore traditional approaches and their issues than introducing something novel. Especially for the sake of citizens, who are usually invited to participate over and over in small trials potentially resulting in participation fatigue, sometimes it might be better to stick to stable aspects, for good and bad, of collaboration. Naturally, this also means that we likely need to explore which aspects are worthwhile to keep and where to introduce new ones. Similarly, it is necessary to consider the concept and scope of novelty in research. We suggest making room for cases and work emphasising a *local* perspective on novelty. By that we mean: work that explores and integrates approaches and technologies that might not be novel to a global research community, but might introduce aspects of novelty and innovation in the local context.

## **5 CONCLUSION**

In this paper, we discussed and reflected upon the unique research space offered by Smart City projects. We did so in an attempt to publicly reconcile some of the tensions and difficulties that we, as ECRs, encountered while collaborating across organisational boundaries during three “Smart City” projects. By sharing our tensions, raising questions about those tensions, and proposing some preliminary answers to those questions based on our experiences and reflections, we hoped to have provoked our dg.o peers as well as other interested readers to consider some of the tensions that they have encountered in their projects, especially if they are fellow ECRs.

Ultimately, we hope that our paper will lead to improved future collaborations, a supportive community environment and smoother Smart City research projects. But for that to happen, we believe we need to open up this dialogue even further. We hope to have inspired fellow ECRs to reflect upon their experiences and practices, and we hope to discuss these issues further at the dg.o conference in 2018.

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