Understanding the Space for *Co-design* in Riders' Interactions With a Transit Service

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ABSTRACT
The recent advances in web 2.0 technologies and the rapid adoption of smart phones raises many opportunities for public services to improve their services by engaging their users (who are also owners of the service) in *co-design*: a dialog where users help design the services they use. To investigate this opportunity, we began a service design project investigating how to create repeated information exchanges between riders and a transit agency in order to create a virtual "place" from which the dialog on services could take place. Through interviews with riders, a workshop with a transit agency, and speed dating of design concepts, we have developed a design direction. Specifically, we propose a service that combines vehicle location and "fullness" ratings provided by riders with dynamic route change information from the transit agency as a foundation for a dialog around riders conveying input for continuous service improvement.

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Transit, service design, public service, research through design, social computing, web 2.0.

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Design

INTRODUCTION

Current research on service design for *public services* indicates the importance of *co-production*: where the consumers—who in the case of a public service are both consumers and owners—materially participate in the production of the services they consume. Service research claims this is an effective approach for improving the quality of public services, since these services are often monopolies and are therefore not driven to improve through competition [5]. Further, service design research indicates that *co-design*, a type of co-production where the consumer and service provider engage in dialog about the types of services to provide, is an effective and desirable type of co-production for public services [2]. In order to create an environment that supports both co-production and co-design it is important to establish some type of ongoing dialog and collaboration between the users and the service providers.

The emergence and rapid adoption of social computing technology such as web 2.0 applications like Wikipedia and Facebook, along with the increasing adoption and use of smart/web enabled phones, which allow people to interact with web 2.0 applications while out in the world, present a new kind of *material* for designers. Public services currently practice co-design through surveys, focus groups, and community workshops. These techniques are very labor and time intensive and thus often produce a shallow and intermittent impact on the service. We propose that social computing technology would allow more citizens to engage in a deeper and ongoing dialog with service providers around conceiving and refining the services they desire, allowing the citizens to exert considerably more influence on the services that are provided. New social computing services, such as *ParkScan* [21] that allow residents in San Francisco to report problems with a city park and *iBurgh* [12] that allows citizens in Pittsburgh to report city infrastructure problems such as potholes, provide some evidence that both citizens and public services are willing to participate in the co-production (and possibly co-design) of public services using social computing technology. These systems allow consumers to participate in service delivery by taking on the role of "sensors," monitoring the infrastructure of the different services, and reporting on problems and problem locations as a method of improving the services.

While commercial examples of social computing applications intended to improve public services have begun to emerge, there has been very little research and development of applications that support *co-production* through *co-design* and *dialog* between service providers, citizens and various stakeholders. In addition, there has been no research on how to effectively combine service design and HCI practice approaches to stimulate the co-design of public services. To better understand this design space, we took a *research through design* approach [27],

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beginning a design inquiry around a dialog system as a method of gaining insights on how to build this type of system. Specifically, we investigated how to create a web 2.0 system that could stimulate dialog between transit riders and a transit agency.

Through our user-centered design approach we evolved the preferred state we are seeking as an intentional outcome (Figure 1), moving from a focus on riders feeling *ownership* of services to riders feeling they can *influence the details* of service offerings, such as the location of stops and the times of services. We also evolved our framing, moving from an initial proposal on *riders reporting problems*, to include *riders reporting the locations and "fullness"* of transit vehicles. This new framing focuses on the combination of information from riders and information from the transit service on route changes, such as the need to temporarily move service locations to support events like parades, water main breaks, construction, etc. Our hypothesis is that this daily information exchange between riders and the service will provide a foundation for co-design by creating a virtual "place" where riders can express preferences around modifying the details of current service offerings and better understand the implications of their requests.

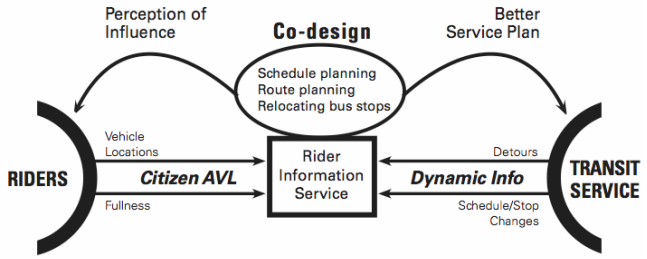

Figure 1. Diagram of our evolved problem framing and preferred state for an informational system intended to support co-design between riders and a transit service.

In reflecting on our process, we noted several design implications relevant for others who attempt to use web 2.0 technologies to stimulate the co-design of public services. These include our observation that not all public services are the same. In addition, we noted the need to improve service design tools so they better handle the complexity of relationships between all stakeholders involved in service delivery and consumption of public services.

RELATED WORK

Related work falls into three distinct areas. First, we provide a brief overview of co-production and co-design as intentional outcomes of service design. Second, we provide a brief background on emerging research topics in social computing. Third, we provide a brief overview of HCI research in support of public transit services.

Co-production and Co-design in Service Design

Co-production has recently emerged as a "hot topic" in the service design community. Co-production (collaborative production) happens when consumers participate in the production of the services they consume. In a review of service design research, Kuusisto details four distinct types of co-production: *consume*: customer makes use of services and passively co-produces by creating the perception of value; *co-perform*: customer performs some of the tasks of a service; *co-create*: consumer used resources from a service to create value, generally about the sense making work a consumer does to draw their own conclusions and insights based on information a service provides; and *co-design*: dialog between consumers and service providers around the types of service and form of service to provide that leads to new services [13].

Many in the service design community have noted the importance of co-production for public services [20, 2]. They note that competition does not often work to motivate service improvement, due to the fact that many services are monopolies. In addition, they note that competition may not be the best approach for public services, as it can easily cause groups such as elders, low-income, and disabled to be ignored, even though these groups often have the greatest need for the services and were often the motivation for initiating these services [5]. Researchers have noted seven distinct ways a public service can improve: *quantity of outputs*: more transit stops, more people moved; *quality of outputs*: speed and reliability; *efficiency*: more outputs for less money; *equity*: general sense of fairness towards citizens in terms of costs and benefits; *outcomes*: increased usage of a service by the citizens or by a percentage of the citizens; *value*: cost per unit of outcome; and *consumer satisfaction*: often a result of several of the previous improvement dimensions [5].

Public services present several challenges in terms of co-production. In general, design teams must address technical challenges, which prevent the service provider from participating in co-production; economics, where the cost of co-production might be too expensive for public services that must work with increasingly shrinking budgets; and institutional challenges, where the cultural of the service provider or critical stakeholders makes the use of co-production inappropriate [20]. In addition, researchers have noted the complexity of relationships between the various stakeholders as an additional challenge design teams face [5]. A system designed to stimulate co-production and co-design must address these challenges.

Looking specifically at co-design with public services, researchers have noted three distinct beneficial outcomes: services that are more responsive to the changing needs of citizens; increased trust of the government through more positive engagement with services; and building of social capital through an increased sense of community [2]. In addition, an international survey on co-design for public services revealed that people generally trust the government to keep personal information, but not to provide effective informational services [2]. Finally, service design researchers have noted that many public services initially

focus on automation as a means for improvement, without engaging consumers in the process; however, when service providers do take a consumer perspective, they quickly learn citizens want different services, not automated services [2]. In a sense, public service providers are now learning the lesson that the HCI community has been championing for several decades—the need to engage the users in the process of making better products and services.

Social Computing

Social computing refers to the intersection of communication technology capabilities and interfaces, and the social effects they produce on individuals and groups. Researchers in this area look to both better understand human behavior by studying how new communication technology changes how people connect with one another and to apply behavioral theory in the process of inventing new technology that supports communication [26]. For the purposes of our research, we are focusing on new technology commonly referred to as web 2.0, that includes wikis, blogs, social networking applications, and collaborative bookmarking services, which have all been used to create and support online communities [26]. One interesting outcome from the adoption of web 2.0 technologies is a shift in influence from official institutions to the emerging online communities [26].

Designers working to create social computing services face several challenges; however, three stand out for our design case. First, design teams have traditionally worked within organizational boundaries, but social computing often moves the discussion of the topic outside of the organization it refers to [19]. This motivates designers to work across an organization's boundaries, uniting resources from within and from outside. Second, design teams need to motivate participation. In general, people's motivation for participation is social and not commercial, challenging many of the underlying assumptions more application-focused processes bring to this task [19]. Third, many social computing products and services allow anonymous participation, allowing people to communicate more freely, but also allowing for inappropriate behaviors that can negatively impact a service [19].

Web 2.0 technologies have recently been identified as an approach for service design and co-production, generally referred to under the heading eGovernment [18]. It appears that when governments make information available in a form people can manipulate, individuals quickly discover new ways to make this information valuable [18].

Transit in HCI

Most of the HCI research regarding transit has focused on trip planning, vehicle arrival predictions, and other rider information systems. Information appears to be a very important factor for transit riders. Obtaining accurate scheduling, route information, and real-time information on estimated arrival times is essential to provide a positive user experience [16]. Information also has a known impact on ridership. Non-transit users have reported that accurate vehicle arrival time information significantly impacts their willingness to use public transit [1]. The addition of real-time arrival information in some cases appears to increase ridership by as much as 40% [6]. Transit information websites have also been shown to be important. For regular transit patrons, there is strong evidence that such websites are perceived to be useful and will be used on a continuous basis [10].

A number of groups have explored delivery of transit information via mobile devices [e.g., 15, 14] and mobile devices have been used to support overall system navigation for riders with cognitive disabilities [22]. There has also been concerted effort to support the general wayfinding needs of people who are blind or low vision using GPS [e.g., 11, 17] and directional LED beacons [8].

At the service level, there has been very little work on enhancing the information exchange between transit agencies and their riders. In particular, better methods for acquiring input from people with disabilities have been highlighted as pressing need [25]. This project advances the previous work by connecting rider's desire for accurate arrival information with their willingness to produce the information they desire in a co-production relationship with the transit authority. In addition, this work looks at the needs of transit users with disabilities as a key stakeholder in co-design that improves the service by improving the perception of fairness in the services provided.

PROJECT OVERVIEW

We began this project with the goal of designing a social computing service that supports co-design between riders (particularly riders with disabilities) and their public transit service. We viewed the *current state* as riders feeling powerless, and beholden to the services the transit agency chose to offer. Through our design, we intended for riders to gain a sense of ownership of their transit service by materially participating in the design of the services, including helping to decide on purchases of new vehicles, infrastructure improvements, strategic planning, the design of new routes, and the times and locations for various stops.

Inspired by services such as ParkScan and iBurgh, we began with an initial framing around problem reporting, where riders work as sensors in the transit system, reporting the problems they encounter and receiving rich feedback on how these problems get addressed. In this model, the transit agency benefits by reducing the need to constantly monitor their own infrastructure, saving time and effort of current employees. The riders benefit by feeling "listened to." Our sense was that if a service could begin communication between the riders and the transit agency around infrastructure breakdowns, then this would provide a platform needed to begin a dialog (co-design) around the types of services to provide, allowing a sense of ownership to emerge.

COMPETITIVE ANALYSIS

In order to better understand the basic structures of online problem reporting systems, we conducted a brief competitive analysis, looking at twenty different systems ranging from software bug reporting services to online customer forums, to corporate blogs where consumers could leave comments. In addition, we took a look at ParkScan, a system that allows people to report both problems and things they like about parks and playgrounds in San Francisco. The service routes the information to the relevant department that can address the maintenance issue. In addition, the information collected from citizens is provided to the parks and recreation department to help support their budget requests [21]. As we looked at each example system, we generated an informational flow model similar to the flow model used in contextual inquiry [4].

Findings and Insights

We consolidated the individual flow models, revealing the life cycle of online problem reporting; how information moves between multiple stakeholders. The model reveals communication patterns between four roles: *user*, who observes and reports the problem; *service rep*, who is an intermediary; *assignee*, who has knowledge to diagnose the problem; and *technician*, who fixes the problem. Most systems lack a direct channel for users to communicate with technicians. We also identified two important communication breakdowns observed in the examples. First, users can fail to provide critical information needed to identify the underlying problem, and this sometimes happens because the interface uses system centric instead of user centric language. Second, we observed breakdowns in feedback from service reps when again they used system centric language and acronyms.

The competitive analysis also revealed four design issues connected with our project. First, we observed that many systems lacked any feedback that would allow users to monitor the status of their request. We suspect that without feedback, problem reporting systems can easily appear to be "black holes" where complaints go in and nothing happens.

Second, many systems direct users to search if a problem has previously been reported; apparently to prevent the same problem from being reported twice. However, we imagine that collecting the number of overlapping reports could provide insight to service providers on the significance of problems, helping to prioritize actions. And with a good feedback loop, the multiple reports of the same problem might work like current letter writing campaigns to save TV shows from cancellation; another example of the consumers directly informing a service's offerings [23].

Third, it was often a challenge for users to know where to submit a problem report. For example, in ParkScan, users reported problems with the sidewalk, but since the sidewalk was not the responsibility of the parks department, the problem could not be directly addressed by the ParkScan system. We suspect this same issue will affect the design of our system, as most riders will not know which government entity has responsibility for the problem they wish to report. Our design will need an effective method for either connecting the problem reporter to the correct entity or we will need to conceive of a system that interconnects the many services and responsibilities within a municipality.

Finally, social sites have difficulty impacting the organization. In informal discussions with officials of one major transit system, employees told us they felt threatened by newspapers that constantly complained about quality of service. When presented with the idea of a social site to improve service, these employees immediately perceived the site as simply another dumping ground of problems. However, when the social site was reframed as a method for demonstrating transit employees ability to reduce the time to repair problems, the site was perceived as helpful.

RIDER INTERVIEWS

In order to better understand the opportunity for a system to engage transit riders in dialog, we conducted interviews and ride-alongs with 10 people who regularly use the local transit system. In connection with Boyne's claim that service providers measure their performance in terms of equity (fairness) [5], we chose to focus on users with disabilities who have more dependency issues on the transit service in addition to riders without disabilities. We recruited 3 wheel chair users (mobility-impaired), 3 vision-impaired, 1 hearing impaired, and 3 non-disabled commuters.

We visited participants in their homes or places of work. We asked general likes and dislikes about the service; their experience as a regular commuter; specific issues they have encountered; what their reactions were regarding the issues; and what the reactions were from service providers. To more clearly identify the points of interaction between the riders and the transit service, we used directed storytelling, asking participants to recount specific instances of the following:

- Their most recent commute
- An opportunistic ride where they went to a new location
- A breakdown in service they had experienced
- A time when they reported a problem with the service

In order to better understand their interactions with the transit service, we mapped their "customer journey" using the service blueprint model [3]. This model has design teams note each point of interaction between a service provider and a customer, physical evidence associated with the service, and the underlying support processes that supports service execution.

Following each interview, we arranged a time to ride the transit system with each participant. We chose to do ride-alongs in order to better understand how the riders engage with the relevant informational resources among the

different touch-points. In addition, we wanted to gain some insights on the different ways the changing context of this journey was experience by riders both with and without disabilities.

At the close of each interview or ride-along, we generated service blueprints for the journeys they had described or for the journey we had observed. In addition, we created a flow model [4] for each participant, showing interaction between a transit rider and onstage service providers such as drivers and customer service representatives. Following all of the interviews and ride-alongs, we consolidated service blueprints among each type of rider, revealing the commonalities and differences in their use of public transit. In addition, we consolidated the individual flow models into a single model.

Findings and Insights

From our interviews and observations we identified two major issues that motivated us to change our framing from problem reporting. First, participants reported that they rarely, if ever, encountered problems or infrastructure breakdowns that they felt were important enough to justify the effort of reporting. Second, participants' "customer journey" experiences revealed that they repeatedly encountered a breakdown in accessing information for *actual*, instead of *scheduled*, arrival times.

The few participants, who had reported problems to the transit authority, expressed some distrust for the process, claiming they did not think their efforts made a difference. One participant without a disability made a phone call to complain about a driver misbehaving. He waited on hold for approximately 45 minutes but was never able to speak to a customer service representative. He left a voice message with his personal contact information, but he was never contacted by the transit service. He claimed this bad experience motivated him to quit trying to report problems. Another participant, a vision-impaired rider, wrote a letter to complement a driver. After a few months he ran into the driver again and asked if she was rewarded for her good service. She told him she had never heard about this letter. This participant also claimed to have stopped communicating with the transit service. Beyond the few participants who had reported problems, most participants claimed to not report problems because they were content with the quality of service. They perceived it to be "good enough" and that it was "the best the locals can provide." This suggests a kind of learned complacency suppresses rider desires for service improvement.

All ten participants shared experiences where they wanted to know if they had just missed a bus or to know how soon a bus would be coming. One participant without a disability described waiting for a bus in the snow. Waiting 45 minutes after the scheduled arrival, he called the customer service department and was told that the bus was stuck in the snow. He ended up abandoning the bus and instead drove. In another example, a participant without a disability was waiting at a bus stop with her groceries. After waiting for an hour she finally called customer service to find out what was happening. Surprisingly, the service representative told her that her bus had passed her bus stop just 5 minutes ago. But the participant swears she never saw a single bus pass by. She abandoned the stop and walked a block to take a bus on a different route.

Our fieldwork also revealed two more secondary challenges in terms of the riders' customer journey that could inform the design of a new service. First, several participants mentioned the disappointment they felt when they spotted the bus they wanted approaching them, only to have it pass them by, presumably because it was too full. Our mobility-impaired participants also discussed a slightly different case of this where the bus would stop because it had room for riders who could stand, but there was not enough space to accommodate their wheelchair.

Second, most participants mentioned they occasionally had trouble knowing when to get off the bus. This would happen when they went to new places and did not recognize landmarks or know the name the transit service used to refer to the specific stop they wanted. Our hearing-impaired participant mentioned often not being able to see the stop-announce-sign within the bus due to crowding. Mobility-impaired participants also mentioned the difficulty of seeing both out the window and seeing the stop-announce-sign. Finally, vision-impaired participants mentioned the difficulty of hearing stop announcements over the engine and crowd noises. Interestingly, riders with disabilities mentioned that they would often tell the driver as they entered the bus where they wanted to get off, and that they had great success with the drivers letting them know when to disembark.

In describing their daily commutes, planning for opportunistic trips, and problem reporting, all participants described their main interactions with the transit service as being over the phone. They called to get schedule information, to plan trips, and to find out why a bus was late. With the exception of a few instances, they all seemed happy and comfortable with the phone interaction. They liked the feeling that a person had heard their words. They mentioned their dislike for automated phone information systems and voicemail. One participant stated he would only use the website to report problems if it could engage in a "chat" with a dispatcher. While the participants liked the phone, several complained that the service closed at 7pm on weekdays even though the need for information continued 24 hours a day. Disabled users expressed concerns around security issue, especially at night. Additionally, participants pointed out that the service closes at 4:30 pm on weekends and holidays when many sudden route changes take place; times when they most need access to the operators.

The poor perceived cost-benefit associated with reporting problems strongly indicates that this may not be the best trigger for stimulating repeated interaction between riders

and the transit authority in support of a larger dialog and co-design of services. Instead, it seems that information about the actual location of vehicles and the relative "fullness" of vehicles might be a better motivator to get riders to engage with a service. Additionally, for some riders, there might be a willingness to continue to engage with a service while riding if it could help them know when to disembark. Finally, based on the interviews, it seemed the use of an online service that can be accessed by mobile phones 24hrs a day would both reduce the efforts currently being made by the phone customer service representatives and give access to needed information more of the time.

TRANSIT WORKSHOP

As part of our investigation, we conducted a one-day workshop with managers of a municipal transit service; a key stakeholder in the design of any service intended to support co-design. We had three goals for this workshop. First, we wanted to encourage them to commit to a partnership with us in design of a pilot system. Second, we wanted to understand their perceptions of both information riders possessed that they would like access to, and information they wanted to more effectively provide to riders. Third, we wanted to identify any cultural challenges to co-design within the organization.

During the workshop, we engaged in several activities. We began with a semi-structured interview to better understand the communication flows and managers perceptions' of rider issues. Next, we shared the service blueprints, getting detail on how the different groups within their organization support different steps along the riders' journeys. Finally, we had a brief brainstorm, where we worked to generate ideas around the kinds of information riders and transit service might exchange.

Findings and Insights

During the initial interview, the transit managers stated that their goal for their service was to be recognized as one of the best agencies in the country. This claim caught our attention because it speaks to how they view competition. The managers shared details on the complex relationships they had with the different local and regional governments as well as the state and federal governments. Each institution provided some of the funding to run the transit system and each pot of money had restrictions on how it could be used as well as a set of expectations for the services to be provided. We initially suspected they would be more competitive with the other local government services, as they literally compete for the same tax dollars. However, it seems that in terms of marketing themselves to the various institutions that provide their funding, the perception of their performance in terms of other transit services is much more important.

In the interview we talked about problem reporting, and the managers mentioned a challenge of reporting problems or compliments related to a driver. They said the main issue was getting enough information to identify a specific driver as the information for the rider reporting the issue was often not enough to make an unambiguous identification. They noted that especially in the case of complaints, the union would push back on any reprimands unless managers could meet a high-level of proof.

From the interview and service blueprints we were able to create a flow model showing how information moves within the service. The key issue we noted was that when they experienced a service breakdown, such as a bus being too full, running late, a mechanical failure, or the unscheduled need to close a bus stop; this information moved from many sources to the customer service representatives. Riders could then access this information if they called in to inquire about a problem. This view of their process helped us see that there might be a value in pushing critical information out to riders based on the routes and buses they were likely to encounter. This observation is supported by the agency's recent use of Twitter for service announcements.

In describing their processes, the managers shared that roughly 85% of all calls were riders asking, "Where is my bus?" Sometimes these were simply requests for schedule information, but often the calls came because the rider could not reconcile the schedule they had with the buses they saw or did not see arriving at a stop. One way other transit services have addressed this problem is through the use of bus tracking systems, commonly known as an AVL (Automatic Vehicle Location) system. When we inquired if they had any plans to install AVL, the mangers shared that it might happen, but not in the near future. Once again the budgetary constraints and inner tension between the managers and the union was revealed. They said that not only are the systems expensive, but more importantly, there was union resistance to an AVL system.

In brainstorming ideas where riders provided bus location information using GPS enabled phones, the transit managers expressed distrust of user-supplied information. They indicated they would strongly object to a system that did not make a clear distinction between "official" reports from the transit service and user generated data. They also felt that a few malicious contributors would poison the informational resource, making everyone lose trust.

In brainstorming ideas on pushing information to users, they had a strong positive reaction to having the ability to push out more dynamic schedule changes than the paper schedules would allow. They then told a story about a parade forcing them to make many routing changes. In order to prevent riders from waiting at stops that buses would never get to, they literally sent their employees out on the street to find stranded riders and send them towards the closest, temporary stops.

Throughout the workshop, we discussed the issue of route planning. The transit service said they were working with an outside consultant on this issue. In addition, they

mentioned two issues with planning. First, they mentioned they had incomplete information on riders. They could track the number of people entering and exiting a vehicle, but they did not know where individuals were going. They did mention that some ticketing systems that have people swipe cards as they both enter and leave can automatically collect this information. Second, they mentioned that whenever they announced routing changes, the only people to speak up always called to complain that things had changed. They seemed very interested in a system that could capture people's call for changes, and seemed interested in the general idea of co-design with the riders.

SPEED DATING

To better understand the intersection of the needs and desires we observed in both riders and the transit service, we chose to conduct a needs validation session; one of the two methods used in speed dating [9]. Needs validation helps reveal the overlap between the needs observed during fieldwork and needs target users perceive themselves. This method also helps to reveal invisible social boundaries design concepts can easily cross, which would cause the target users to reject a new product.

Participants in a needs validation session look at many different storyboards. These stories begin with common experiences the design team has lifted from fieldwork; however, they also include technology interventions that address these common situations. The general idea is that the stories help participants connect with their own experience of being in these same situations, helping them imagine if the future described is the one they desire. While documenting future concepts, the main purpose of this method is not to evaluate any individual concept, but instead to identify the problems that seem worth solving, and hopefully revealing new insights from across several concepts that allow design teams to better frame the problem and propose a preferred state.

We began by first identifying four important themes from the previous research. We then performed a brainstorm for each theme. First, we investigated on the issue of riders providing bus location information using GPS enabled phones, basically riders becoming their own AVL system. Second, we explored how a system might push dynamic routing information from the transit service to riders in the field, such as buses running late, relocation of a bus stop, temporary detours on routes. Third, we generated concepts around problem reporting. Finally, we explored how riders can engage in co-design, collaboratively engaging in decision making with the transit authority. Based on these themes we generated 85 concepts as scenarios involving users at specific touch-points along their journey.

Then through a process of critique, we filtered and combined the different concepts, resulting in a subset of 15 concepts that gave a broad coverage of the problem space. We documented these as storyboards and generated a lead question to be used to direct the conversation with participants towards the underlying need the concept was based on and away from the specific solution.

We produced 4 storyboards around riders functioning as an AVL that included features like alerts when a bus was near, the ability to see the fullness of oncoming vehicles, and location based reminders to disembark. In addition, these covered both opportunistic journeys and daily commutes.

We produced 3 storyboards around dynamic information push. These included changes in routes due to public events such as 4th of July fireworks, estimates of significant delays that helped riders change plans, and the ability to easily capture the drivers identity.

We produced 2 storyboards of problem reporting that address breakdowns at stops and broken seats on a bus.

We produced 5 storyboards about co-design including riders having stops move closer to their home by reporting the specific times they would regularly travel, riders asked to approve the purchase of new buses that are more environmentally friendly, riders reporting non-standard needs before a ride, and riders influencing the location and time of stops based on the number of rides they had taken.

We conducted needs validation sessions with 11 regular commuters without disabilities, in 4 group sessions. In addition, we conducted individual sessions with 2 mobility-impaired users and 1 vision-impaired user in their homes. At each session we showed the scenarios one at a time and then ask the leading question to focus the discussion on need being expressed in the story.

Findings and Insights

Participants had a mixed reaction to the idea of riders generating their own AVL data. The participants clearly wanted access to this information in terms of knowing accurate wait times and fullness for vehicles. They all felt this would significantly improve the quality of the service. However, they noted two challenges to this approach: free riding and malicious intent.

Several participants indicated that they would be willing to provide information initially; however, they did not trust that they would continue to do this over a long period of time or that they would do it for every ride. This reveals the tendency toward free riding [19], but also points to the issue of critical mass. Motivating riders to not be "free riders" who only access information and do not share, might be handled through the interaction design. If riders are willing to access the service via a mobile phone, in order to receive the wait times for a specific set of routes, the effort to report the location of a specific vehicle could be as easy as a single button press. In terms of critical mass, it might not take too many participants to get a somewhat accurate view of vehicle locations, but more work needs to be done to investigate how many would be "good enough."

Interestingly, several participants revealed suspicions that people, not necessarily riders, might purposely provide

incorrect information in order to make the service fail, mirroring the statements of the transit managers. This finding appears to contradict the theory that social computing systems move people's trust from institutions to communities [7]. However, it is hard to tell if riders feel the same sense of community with other transit riders as they might experience in an online community focused on a topic of interest. One way to address this is to require users to register for the service using their name or mobile phone number, thereby enabling filtering after repeated submissions with inaccurate information.

Participants resonated strongly with concepts around the transit service pushing dynamic routing information out to riders. Participants immediately recognized that knowing this information would significantly improve the quality of their experience. They shared that even though these events are infrequent, when they happen people currently have very few options in how to react. In reflecting on this idea, it seems that it could work effectively in two ways. First, riders could share a list of their regular routes, stops, and travel times, and when an event intersects with a place they are likely to be, they could receive the information through an alert or text message. This would be real-time and personalized, rather than the existing mass-mailing lists the agency maintains for scheduled detour announcements. Second, if riders were to subscribe to a service, their phones could search for alerts based on their physical location and alert them on the rare occasion an event forced a rerouting to happen near by. This is in contrast to the system-wide Twitter announcements currently in use.

Participants had mildly negative reactions to the scenarios around problem reporting. When looking at the scenarios on graffiti and the broken seat, several participants claimed that it was not their responsibility to report these problems. Instead, they expected the transit service to take responsibility and to constantly monitor the conditions of the service's infrastructure. A few participants also mentioned that if the problem was serious enough to report, then other people would probably have already reported it.

This lack of interest in problem reporting confirmed our suspicion that the catalyst for creating frequent interaction between riders and the transit service should not be problem reporting. It also gave us a first indication that riders might not want to experience a feeling of *ownership* for their transit system and reinforces the notion that riders are generally unaware and wish to remain unaware of the challenges in service delivery experienced by transit agencies.

Finally, participants had mixed reactions to the scenarios around co-design of new services. They reacted much better to the scenarios around influencing the location and timing of stops, but they had a negative reaction to becoming involved in voting on issues like the purchase of new vehicles. In reflecting on their reaction to these scenarios and to the scenarios around problem reporting, it seemed that participants did not want to take on the responsibilities that with ownership. Instead, they seemed very happy with taking on the role of a consumer, especially if the agency offered "good enough" service.

DISCUSSION

In our initial attempts to design a web 2.0 service that supports co-design between riders and their transit agency, we focused on finding a source for continued interaction and information exchange. We felt that if we could create this virtual "place", then it would provide a foundation for dialog and for co-design. Initially we framed this repeated interaction around problem reporting. However, our findings from the interviews, workshop, and speed dating session suggest this is not adequate in itself. Riders rarely encounter infrastructure problems that meet the perceived cost-benefit threshold for reporting, and they also did not feel it was their responsibility to report issues.

After the interviews and even during the workshop, we began to focus more on how the riders might become an AVL system, generating the data they desire. After the speed dating sessions it seems there is a place for a system that creates more repeated interaction by providing the AVL data and also dynamic routing information. However, several challenges remain around whether enough riders will work to provide enough data to make a "good enough" AVL system. We suspect that with appropriate interaction design, riders will view the cost to provide AVL and fullness of vehicle data as low enough to merit their effort. In addition, if the service uses the GPS in rider's phones to trigger reminders of when they should disembark, this will also help to create accurate location traces of the vehicles moving through the city.

We feel this approach would work for both transit services that currently have AVL and services that do not. For cities with AVL, the riders could still provide fullness information. This might be especially useful for subways and trains, helping riders know where to stand in order to increase their chances of getting a seat. Related work by the team suggests that riders are positive to the idea of reporting that they were not able to get on a bus due to overcrowding [24].

When we began this project we also focused on creating a sense of ownership of the transit service among riders as a preferred state to come from the co-design interactions. However, the speed dating findings show that riders currently do not desire to take on this level of responsibility. In reflecting on this, we have identified two important factors that may be influencing their behavior.

First, public services are not all the same. In the ParkScan example, the residents of San Francisco use this system to drive actions taken around parks and playgrounds. However, we suspect that the users' perception of park services is quite different than public transit. Parks and playgrounds are the "ends" that users seek in their pursuit

of experience. The transit service on the other hand feels more like a "means". In a sense, riders engage with this service not for the specific experience of the ride, but in order to efficiently achieve a different goal that requires them to move within a city.

Second, riders of public transit services interact with the service much more like a consumer than do visitors to public parks. Riders pay a small amount for each journey or they repeatedly purchase passes. This constant financial transaction may frame their thinking of the service being more as a consumer than as a taxpayer. Interestingly, people may want to feel more ownership of their parks because they do not pay for them for each use. It would be interesting to see if riders in regions with free transit would have similar views.

Riders showed no interest in taking responsibility for the larger infrastructure decisions involved in improving the quality service as a whole. However, they expressed a strong interest in gaining more influence on the details of the service that could make their use more efficient and convenient. This leads us to shift our framing of the preferred state as an outcome of co-design from *responsible owner* to *influential customer*. The system would need to allow riders to easily express the details of the service changes they desire. Once individuals become comfortable communicating their own desires, the system might allow several riders to band together in order to exert more influence, pushing riders to build consensus in small groups. In addition, if a service can create the ongoing interaction around AVL, fullness, and dynamic route changes, it could also allow for the infrequent need to report problems and provide opportunities for expressing preferences. This approach gives riders many different reasons to re-visit and remain engaged in an ongoing dialog with the transit service.

In reflecting on our process, we found that two important stakeholders are missing. First, co-design involving citizens and their transit service should not focus exclusively on riders. It should also engage citizens who regularly drive. On one level, it should engage drivers simply because they are taxpayers, but more importantly, it should engage drivers because they have a vested interest in others using the transit service. By increasing ridership, car drivers benefit from experiencing less traffic and fewer constrictions in parking. Of course, the whole community benefits through a healthier environment.

The second important stakeholder we did not engage in this process is other government entities, including local, regional, state, and federal. The transit service has a financial dependency on all of these entities and all of these entities are motivated more to less by the local citizens (most influence on local and least on national). A well-designed service would need to address how this stakeholder is addressed through co-design.

In thinking about these missing stakeholders, we note that current service design tools fail to support the complexity of relationships when dealing with a public service. Methods like service blueprints focus on a single organization engaging with a customer. This model has no place for drivers and the government. Additionally, methods like value constellation, which show all of the different stakeholders across many organizations needed to support a single activity also do not currently support the complexity of relationships we encountered in addressing public transit. Thus, we call for the development of new methods. We need methods that better support the complexity of relationships among the stakeholders; methods tailored to the design of public services.

CONCLUSION

This paper documents a research through design project investigating how a new service might support the co-design of public services between riders and a transit agency. Over the course of our design activities, we were forced to change our framing on how a service might stimulate repeating interactions between riders and the transit service; moving from a focus on problem reporting to a new focus on riders and the transit service providing real-time information on the state of vehicle locations, vehicle fullness, and route and stop changes. We also narrowed our focus from co-design as a way for citizens to feel ownership of their transit service to co-design as a way for citizens to feel they can individually influence the design of services they receive.

Our research through design approach allowed us to gain insights on how the type of service and the form of consumer interaction with the service might influence the desire to feel ownership and invest the effort needed to take responsibility to larger infrastructure challenges a service faces. In addition, this process helps us identify current service design tools do not yet support the complexity of stakeholders involved in service delivery of public services.

Future Work

This paper documents the result from year 1 of a 5-year research project. In moving forward, we are beginning to develop a rider generated AVL system that incorporates universal design. This includes issues of how we can motivate riders to share this information either through manual input or through agreements to allow their phones to automatically stream information.

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