The Value of Citizen Science to Promote Transit Accessibility

Aaron Steinfeld
Robotics Institute
Carnegie Mellon University
Pittsburgh, Pennsylvania, USA

Jordana L. Maisel and Edward Steinfeld
IDeA Center
School of Architecture and Planning, SUNY at Buffalo
Buffalo, New York, USA

***Abstract*—We propose that citizen science methods can engage riders with disabilities and others in improving public transportation accessibility by documenting and assessing problems and good solutions throughout the system. This will empower riders, resulting in a greater understanding of the transportation system, and improve the feedback loop between rider and provider.**

Keywords-citizen science; public transportation; accessibility; transit riders; disabilities

I. BACKGROUND

Reports of accessibility limitations in existing transit systems demonstrate that the lack of implementation of known best practices is a more serious problem than the lack of technology solutions. Improvements to existing technologies are certainly needed, but, on the short term, the slow adoption rate for best practices has a more significant impact on people with disabilities. Adoption and maintenance of best practices are hindered by the sheer size and complexity of transit systems and the limited effort agencies can dedicate to accessibility problems given their consistent funding challenges.

Likewise, consumers regularly report little to no feedback when filing problems and in many cases it is not clear to the customer service agent where to route the problem. Positive feedback regarding accessibility improvements faces similar barriers. We suggest that two-way feedback between riders and providers is the key to supporting best practices and propose that technology can be used to streamline this interaction. In particular, we see real promise in the use of **citizen science** – rich media evidence for civic advocacy [1].

Accessible public transportation is critically important. It allows individuals with disabilities, especially those with severe disabilities, to have independent access to works sites, educational programs, health facilities, and social and recreational activities. In a mobile culture, full social participation hinges on accessibility of transportation systems. However, the current state of accessible public transportation is a barrier to social participation and, particularly, employment. More than half a million people with disabilities cannot leave their homes because of transportation difficulties [2]. Even when they are able to leave their home, one-third of people with disabilities have inadequate access to transportation [3]. Consequently, four times as many people with disabilities as people with no disabilities lack suitable transportation options to meet their daily mobility needs [4].

Such difficulty leads to numerous consequences. According to one study, 46% of people with disabilities, compared to 23% of people without disabilities, reported feeling isolated from their communities [5]. Individuals with disabilities were five times more likely to report dissatisfaction with their lives than were their non-disabled counterparts, and a majority of those surveyed said that lack of a full social life was a reason for this dissatisfaction. For example, persons with disabilities were about half as likely to have heard live music, gone to a movie, or attended a sporting event or concert over a one-year period [5, 6]. Inadequate transportation limits access to these activities for individuals with disabilities. People with disabilities, both in urban and rural areas, frequently cite a lack of local transportation as hindering their ability to find employment. Lack of transportation (29%) was only second to a lack of appropriate jobs being available (53%), as the most frequently cited reason for being discouraged from looking for work [7].

II. SYSTEM WIDE ASSESSMENT

Transit providers and consumer advocates in many locations are working effectively to develop good solutions to many common problems but these best practices are not being adopted in other locations. For example, the National Organization on Disability published a report entitled “The Current State of Transportation for People with Disabilities” [4]. Of the 11 different problems with fixed route systems identified in that report, seven of them were related to service delivery and policies as opposed to vehicle and building technology issues: reliability of stop announcements, maintenance problems with lifts, compliance with lift operation policies, planning accessibility to stations (i.e. accessibility beyond key stations), wheelchair securement policies, elevator maintenance problems, and continued use of poor accessibility solutions like mini-high platforms. Methods are needed to identify problems as they arise, assess the impact of those problems on people with disabilities, and bring this information to the attention of service providers and policy makers as part of operations and planning.

Systematic research at the local level, implemented as part of continuous quality improvement, can identify problems in a timelier manner and collect rich information on systems, policies, and practices that work. Knowledge re-use comes in

the form of disseminated best practice solutions at a national and international level (e.g., Eastern Seals Project ACTION; Access Exchange International). However, most transit agencies do not have the resources to initiate systematic research using conventional approaches nor do such approaches adequately address their needs and the needs of riders.

Surveys are a common method to assess a metropolitan area but they have limitations. For example, survey methods make it difficult for respondents to define the issues from their own perspective [8], data collection is time consuming and protracted, and there are numerous barriers to independent analysis and advocacy by end users. Options like guided tours, in which end users identify problems and solutions to researchers in naturalistic settings, are extremely valuable because the exposure to real settings and products is very effective in prompting detailed responses from the end user [9, 10]. Interviews and focus groups allow individuals to define issues from their own perspective [11]. However, due to high cost and logistics these methods are often constrained by small sample size problems and are difficult to maintain on a continuous basis. They are more suitable for periodic assessments, as a prelude to other research, and to elicit end user input.

III. Enabling The End User To Make A Difference With Technology

A key limitation of many approaches is that the process of data collection is owned and operated by researchers. While this reduces bias and noise, it does not empower end users nor support their immediate needs. Finally, these methods often do not offer service providers evidence in a form that is directly applicable to their needs. For example, a survey of riders with disabilities or focus groups may identify that lift breakdowns are a frequent problem but not whether some lift models and bus routes are more prone to problems than others. In fact, by the time data is obtained, the problem may already be fixed.

In the transit context, the ideal scenario for accumulating information that can be applied rapidly in practice and policy development is to combine the immediate, personalized, and localized information obtained in guided tours with techniques that are more cost effective than a large sample survey. The widespread availability of personal electronics provides an opportunity to implement this scenario using the end users' very own cameras and mobile phones (Fig. 1). These ubiquitous consumer products are often capable of multimedia recording. Thus, they provide an opportunity for end users to collect data that can be used as a research database. A good participatory action design [12] approach is to go further and enable real time access to the data, thereby enabling continuous interaction between researchers and end users.

There are many examples that demonstrate the value of using this form of data collection. Major network news channels, accident reconstruction teams, courts, and law enforcement routinely utilize information obtained by citizens on camera phones and camcorders. The popularity of YouTube and similar sites demonstrates the potential for using these methods as a means of civic engagement and public

Figure 1. An example mobile phone image of a maintenance problem

discourse. For example, YouTube videos of transit bus features are regularly produced by amateurs and popular enough to accumulate thousands of views each.

Paulos points to citizen science work in air quality and public parks [1]. Multimedia is much more powerful than dry statistical data. For example, a local bicycling advocacy group recorded GPS and air quality levels while riding a circuit of downtown Pittsburgh and documented road sections of the city with heavy pollution and packaged it in a form readily understood by decision makers (Fig. 2). ParkScan.org in San Francisco is a model for the application of citizen science to the improvement of public parks. This domain is a good metaphor for citizen science in public transportation given the similar issues with physical and organizational complexity. In 2007 alone, ParkScan had 425 registered users, 1,531 observations, and 68% of the issues identified by end users were addressed by the City [13].

Rich multimedia evidence provides extremely persuasive evidence for end users to promote change in their communities and in policies at a national level. Likewise, the use of such methods of data collection is very compatible with widely adopted management tools. For example, surveillance video is used widely to maintain security and loss control and facilities managers use digital photography and video to document accidents and other events.

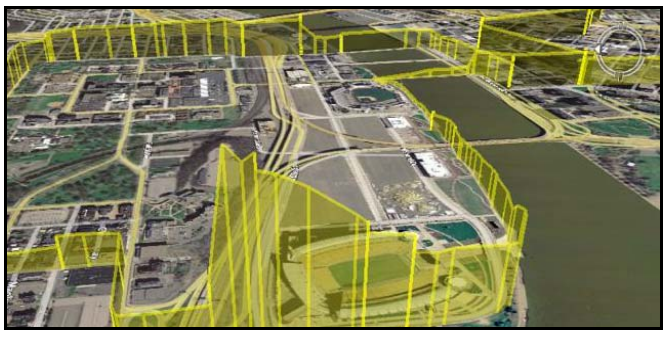

Figure 2. Community gathered air pollution data as the vertical axis overlaid along a route through a 3D Google Earth Pittsburgh scene [14].

IV. Next Steps

The goal of this effort is to evaluate the citizen science model for use in accessible public transportation. It will identify how to implement an organized process of data collection by transportation system riders who have disabilities using personal electronic devices and determine if it is an effective and reliable method for research on accessible transportation systems. The project will culminate in a field deployment and evaluation of a prototype website.

Acknowledgments

The Rehabilitation Engineering Research Center on Accessible Public Transportation (RERC-APT) is funded by grant number H133E080019 from the United States Department of Education through the National Institute on Disability and Rehabilitation Research.

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