CommunityCrit: Inviting the Public to Improve and Evaluate Urban Design Ideas through Micro-Activities

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ABSTRACT

While urban design affects the public, most people do not have the time or expertise to participate in the process. Many online tools solicit public input, yet typically limit interaction to collecting complaints or early-stage ideas. This paper explores how to engage the public in more complex stages of urban design without requiring a significant time commitment. After observing workshops, we designed a system called CommunityCrit that offers micro-activities to engage communities in elaborating and evaluating urban design ideas. Through a four-week deployment, in partnership with a local planning group seeking to redesign a street intersection, CommunityCrit yielded 352 contributions (around 10 minutes per participant). The planning group reported that CommunityCrit provided insights on public perspectives and raised awareness for their project, but noted the importance of setting expectations for the process. People appreciated that the system provided a window into the planning process, empowered them to contribute, and supported diverse levels of skills and availability.

ACM Classification Keywords

H.5.m. Information Interfaces and Presentation(e.g. HCI):

Author Keywords

Civic Technology; Publics; Urban Design; Crowdsourcing

INTRODUCTION

Timely and effective public engagement is critical for urban planners to address the needs of a diverse public [31]. However, urban planning is a complex process that takes place over a long period of time and involves numerous stakeholders, politics, and bureaucracy [76]. The process requires time and skills that preclude many people from participating [6]. Traditional community consultation methods, such as public workshops, can help the public understand key design principles, constraints, and the possible impact of key decisions, however they have many limitations and may be counterproductive [41]. People must devote significant time and arrange transportation in order to attend. Physical meetings limit the number of participants and are often dominated by outspoken individuals [87], preventing others from voicing concerns.

Many researchers discuss the importance of effectively scaling public participation to address civic challenges, and have introduced novel online technologies to engage the public [44, 74, 82, 90]. Such technologies complement traditional public workshops and increase access by allowing more community members to get involved [8, 33]. Ruggeri and Young argue that the flexibility and adaptability of online tools allows visitors to engage at their own pace [77]. Some technologies employ crowdsourcing mechanisms to gather input without requiring a large time commitment (e.g. [48, 67]). However, they often only solicit opinions and, ideas [79], or specific information, such as infrastructure issues (e.g. [1, 32]). These approaches often treat the public like "sensors" [15, 58], and miss the opportunity to engage people in the more complex stages of urban design, such as elaborating, evaluating, and creating proposals.

This paper explores how to engage the public in complex urban design activities by integrating practices from architectural crits – where student designers present ideas for feedback – and from crowdsourcing – where an online, distributed crowd performs short tasks in parallel to accomplish larger jobs. The notion of a "crit" informed our design decisions on how to solicit asynchronous dialogue around generating, building on, and evaluating ideas. CommunityCrit [4] offers "micro-activities" to help community members make meaningful contributions without significant time commitment. In order to lower the barrier for the public, CommunityCrit simplifies urban planning documentation into quickly consumable excerpts, works on a variety of devices, and allows people to login with guest accounts.

To design and evaluate CommunityCrit, we partnered with a local planning group working to redesign a major intersection in San Diego, CA. The planning group envisioned a pedestrian destination and a place of social gathering. Their overarching goal is to help create a more sustainable, walkable area while connecting neighborhoods surrounding the intersection. In order to gain a better understanding of the planning group's process and their public engagement strategy, we observed two public design workshops. We surveyed workshop participants to understand their specific needs, their challenges with participating in face-to-face meetings, and their willingness to

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use an online tool. Following an iterative design process, we conducted several pilots and developed a final version of CommunityCrit. As part of a four-week deployment, we seeded the tool with ideas from the in-person workshops and worked with local community organizations to recruit participants.

Our results demonstrate how CommunityCrit's micro-activity workflow helped to engage members of the public at their convenience and led to contributions comparable to in-person meetings. Participants appreciated the ability to contribute, especially given the difficulty of attending workshops, and expressed interest in using the system again. The local planning group said the tool provided insights on public opinion and helped raised awareness for their effort; they also raised concerns about setting proper expectations around the process.

This paper makes several contributions: 1) a review of literature on existing civic technologies, and digital urban planning with an eye towards improving urban design through public engagement, 2) design and development of a novel system called CommunityCrit that breaks down urban design complexity into micro-activities to productively engage people to elaborate and evaluate ideas in short amounts of time, 3) insights from a real-world deployment about the advantages and trade-offs of civic participation, and 4) design considerations.

BACKGROUND

In this section, we describe current methods for community consultation in urban design. We review online technologies for civic engagement, discuss their shortcomings, and highlight how crowdsourcing methods could advance civic engagement. Finally, we synthesize a list of guidelines for civic engagement to support urban design.

Community Consultation Methods in Urban Design

Urban planning is a complex and multifaceted process. As Rittel and Webber point out, planning a community is challenging "because there is no opportunity to learn by trial-and-error, and every attempt counts significantly" ([76], page. 139), as each attempted solution leaves "traces" that communities must live with. Often the only way to know these effects is to muddle through [60, 61, 72]: build the project and then respond to the next series of problems that result. While urban planning concerns itself with city-scale issues, urban design typically focuses on designing places at the scale of neighborhoods or blocks of urban land [9,17]. There are many approaches to the urban design process, but it typically involves gathering information, identifying issues and opinions, generating alternative designs, and evaluating the impacts [14, 35].

Many urban designers use community consultation methods to help uncover concerns before implementation [19, 80]. However, the general public often finds it difficult to comprehend and engage in a process that involves numerous stakeholders, legalese, politics, and bureaucracy [41, 76]. Traditional community consultation methods, such as town halls, public workshops, and design charrettes, help members of the public understand the context, principles, constraints, and impacts of important decisions [21], but they do not scale effectively. Many people cannot attend due to jobs, dependent care, or social lives [23]. Since civic involvement often depends on physical attendance, traditional approaches typically engage just a fraction–and often not a representative sample –of the affected population [59].

Even when residents do attend public workshops, social dynamics can prevent effective exchange of ideas and concerns. Whether due to shyness, dominant personalities or poor time management, many participants do not get an opportunity to voice their perspective during public meetings [13]. Perhaps the most active participation happens during design charrettes where skilled facilitators lead the discussion and structure design activities for small groups [35]. These rich interactive sessions help those in attendance form a deeper understanding of the design objectives and constraints and often yield sketches and alternative solutions [96]. However, the verbal and tangible aspects of design charrettes make them difficult to capture and playback for people who cannot attend [81].

Researchers in the HCI community have proposed technologies aimed to enhance design charrettes, such as tangible interaction and tabletop interfaces that allow people to take part in co-design activities [37, 68, 69, 91]. While such technologies have collaborative and capture-playback capabilities, they are still inherently limited in terms of the scalability and accessibility to a broader public.

Online Technologies for Civic Engagement

Online technologies can complement traditional face-to-face methods. A number of technologies enable people to report issues (e.g. [1,32]) or share their ideas (e.g., Give a Minute [89]) directly to government officials. For instance, Foth et. al. [32] designed a mobile application that allows residents to take geotagged photos of broken street furniture and public property requiring repair and submit maintenance requests to the local government. Other mobile applications support participatory sensing and sharing between residents. For examples, Waze users report accidents and traffic to other commuters [2], the Tiramisu app gives transit riders a means to report waiting times and bus capacity [100], and Cyclopath enables the bicycling community to share bike paths [73]. CycleAtlanta enabled bike riders to track their paths, which in turn, directly influenced the City's decisions affecting cyclists [57].

Gathering Opinions through Polls and Online Forums

Public opinion polls and surveys are a common way to collect community input, but often take too long to complete. Researchers have explored how to make surveys quicker and more accessible to the broader population [27]. To enable respondents to contribute as much or as little as they want, Wikisurvey [79] offers a pairwise voting approach for ranking options. While surveys provide a way for governments to gain knowledge of existing issues, but they do not help residents stay aware of other community members' perspectives.

Online forums, on the other hand, are intended to help people connect to each other. For example, NextDoor.com is an online social network designed to facilitate local communication and build stronger neighborhoods [3]. Similarly, PlaceSpeak is an online platform designed to connect people with issues affecting their local communities [38]. Deliberation tools like Deliberatorium [53], OpenDCN (Deliberative Community

Networks) [26], and Open Town Hall [93] provide people online forums to discuss policies in a way that can supplement in-person meetings. Consider.it is a deliberation technology that explicitly structures community discussion around the pros and cons for a specific issue [54]. While many surveys succeed in getting people to express their opinions, they do not explicitly involve the public in the broader process of designing, developing, and implementing civic proposals.

Online Tools Designed to Support Urban Design

A number of technologies seek to support community engagement specifically for urban design. For example, CommunityViz [24] is a visualization tool designed to help planners interact with the public to explore alternatives and to simulate the potential impact of urban design decisions. Similarly, tools like PlanYourPlace [85] and Urbane [83] engage the public by allowing them to post news/images about the project, to provide comments, and to vote on others' posts. Typically, however, urban design tools require a certain amount of expertise or time commitment that excludes everyday residents from participating in the process.

Other tools attempt to lower barriers through user-friendly interfaces and quick response methods to gather information for urban design decisions. For example, MetroQuest [67] collects values and priorities through short and simple questions, but it does not support the more formative stages of urban design, such as elaboration and evaluation of ideas. Furthermore, it does not support social interactions between community members. People provide their own opinions for elements of proposals and prioritize individual options, but they are not exposed to others' viewpoints. Our paper explores how we can support broad participation and social interaction on activities that span different parts of the urban design process, without requiring significant time commitment or expertise.

Crowdsourcing as a Method to Improve Civics

Several researchers have advocated using methods from crowdsourcing to engage the public without requiring too much time commitment or expertise [8, 18]. As one notable example, Aitamurto and Landemore used a crowdsourcing system to gather ideas for a law regarding off-road traffic in Finland [8]. Through an endorsement by the Ministry of Environment in Finland, this case study demonstrated broad participation and created an educational exercise for about 700 citizens. While this method yielded nearly 4000 contributions, the researchers noted how this created a new problem: how to synthesize all the opinions and suggestions in order to reach consensus [7].

Recent research has offered novel interaction mechanisms and incentive structures towards achieving more creative and complex outcomes from crowd work [51]. The typical model for crowdsourcing is to assign short "microtasks" to many independent workers [63]. Early research also explored how to compose the crowd into complex work flows [52, 55, 62]. Critics have argued that these methods treat people like invisible replaceable modules, and have sought to uncover worker conditions [70] and improve labor rights [43]. Recent research have sought to produce more complex work outcomes [51], and also to improve worker conditions by exploring novel mechanisms for self-government [92, 97], team formation [66, 78], subcontracting [88], expert facilitation [20], and feedback [30]. For example, CrowdCrit hires workers from a micro-task marketplace to provide critique on visual designs and supplements their lack of knowledge using structured rubrics [65]. Further, several researchers have investigated how to improve transparency by showing crowd workers how their contributions fit into the overall project (e.g. [25, 40, 49, 50, 86]).

Crowdsourcing has also been applied to existing community structures to help incentivize participation in common projects. For example, the Cobi project created authorsourcing [10] and attendeesourcing [16] to improve conference scheduling. University classes have employed learnersourcing [46] to improve educational material. Citizensourcing introduces the idea of applying these techniques to civic processes [71] and addressing hard societal challenges [42]. For example, the BudgetMap project encouraged the public to classify budget items by using a micro-task approach [47]. In this paper, we consider how crowdsourcing techniques can improve public engagement in an urban design process.

Design Principles for Civic Engagement

Towards improving public engagement and building trust in policymakers, a number of scholars have advocated for *transparency*, *accountability*, and *inclusiveness* in civic processes [22, 34, 75]. Building on this in an exploration of crowdsourced policymaking, Aitamurto and Landemore also introduce concepts of *modularity*, where processes are divided into smaller modules to better support ad-hoc participation, and *synthesis*, where input is collated and summarized for public consumption [8]. Due to inherent diversity in the public sphere, civic engagement technologies should strive to support *accessibility* and consider factors such as language fluency, technological literacy, design expertise, as well as physical, mental and social disabilities.

CASE STUDY: REDESIGNING EL NUDILLO

To explore the potential for a platform to support public engagement in urban design, we partnered with a local planning group in San Diego who had been meeting regularly since 2016 to lead a redesign effort for a major downtown street called the "14th Street Promenade". The local planning group is an unofficial organization comprised of professional planners and concerned citizens dedicated to developing the street into a pedestrian-friendly and more sustainable green space. Situated next to the downtown, the area is slowly transitioning into an innovation district with new condos and coffee shops.

The local planning group met every three to four weeks and hosted two public workshops (June and August, 2017). During the June workshop, approximately 42 residents toured the area on foot and then gathered to sketch ideas for the area. A major design question concerned the southern terminus at the intersection of 14th Street, National Avenue and Commercial Street, called **El Nudillo**, Spanish for "the knuckle" (see Figure 1). The intersection sits next to a bus terminal and train tracks, gets little foot traffic, and marks the transition between two culturally-different neighborhoods.

The June workshop produced four distinct ideas for how to activate the area around El Nudillo: a fountain, a tower, an art

Figure 1. Bird's eye view of El Nudillo – the intersection at the corner of 14th Street, National Avenue, and Commercial Street in San Diego, CA.

exhibit, and a roundabout [4]. For the August workshop, the planning group invited a smaller group of designers, planners, and experts. This group built on the earlier ideas and produced sketches and 3D renderings for seven additional ideas. For example, one idea was to build a platform connected with bridges to transform the area to an attractive, safe and engaging destination, or to build a transit hub because of its close proximity to trolley and bus stations.

The 14th Street Promenade served as an ideal use case for CommunityCrit. The project aligned with our interest and background in designing tools to support public participation in urban design. We connected with the planning group early in their process, which gave us time to design, develop, and deploy our system before it was too late to affect key design decisions. Our involvement began after meeting a key member of the local planning group in Feb 2017. We observed the smaller planning group meetings, collected data at the public workshops, and collaborated closely with the planning group throughout the design and development of CommunityCrit.

During the June workshop, we distributed a survey to participants; out of 42 workshop participants, 21 filled out the survey. All showed a willingness to participate in online urban design activities and had the means to do so. had the technological means of using an online tool. Survey respondents also described some of the common challenges of face-to-face workshops, such as time constraints, scheduling difficulties, and ensuring their voice is heard. A leader of a historically underrepresented community also expressed interest in our tool for its potential to help his community members who typically cannot attend workshops. These results drove our decision to create a mobile online tool and gave us confidence in the potential to engage underrepresented community members.

SYSTEM DESIGN AND DEVELOPMENT

Building on the prior work and design principles for effective public engagement, we designed and developed a novel system called CommunityCrit. While we did not follow a strictly participatory design process, we did work in close collaboration with the planning group and residents to get feedback during our iterative design process.

Iterative Design Process & Lessons Learned

Our first prototype explored how to breakdown a complex urban design plan into smaller units that the public could understand in a short amount of time. Our team reviewed all written plans and guidelines related to the project (around 200 pages) and dissected this into small topic paragraphs. Each topic (e.g. street lighting) was expandable and linked to the actual document. Through early pilot testing, we learned that the topic paragraphs helped to reduce the complexity, but that we needed to do more to engage everyday people.

Our second prototype was a simple online survey seeking input on specific questions about redesigning 14th street. The survey provided a glimpse of the overall project, asked people to choose the most interesting aspect to them, and then offered a set evaluation questions about the chosen aspect. Five people filled out the survey. While most participants encouraged our efforts and appreciated the questions that got to the point, others asked for more background on the project, more pictures, and more flexibility around the chosen activities. Therefore, a key design tradeoff for CommunityCrit was how to balance between sending people directly into quick and accessible activities, versus enabling people to first explore the context, design alternatives, and input by others.

Implementation

We developed CommunityCrit to be responsive and mobile-friendly using the Laravel framework. The backend is implemented in PHP with a MySQL database and the front-end UI using HTML, CSS and Javascript. The system logs every time a user views a new activity and then records all interactions, i.e. bouncing (no action), skipping, submitting, and returning to the main menu. The system records the total time spent on each activity and the portion of time spent typing.

User Experience

CommunityCrit first provides a project summary and invites people to register or continue as a guest, and then offers a workflow that solicits meaningful input through "micro-activities." A "micro-activity" is the combination of a submitted idea, a task type, a response form, and, in some cases, a reference or a question posed by community members. Some activities simply include a question and ask for a text response. Others display a reference someone already submitted, such as a story or example, and then ask the user to consider this when critiquing the idea. This workflow stems from observations, analyses of existing digital civics platforms, and multiple pilot evaluations with community members and experts.

Welcome, Project Overview, & Registration

It was important for CommunityCrit to convey the project context and to set the right tone and expectations. The landing page states, "CommunityCrit allows the public to participate in the urban design process." It goes on to explain the system features and the design challenge and ends with the appeal, "What do you think El Nudillo should be?" Then users can register or continue as a guest. From there, users see an overview with information about the platform, the planning group, the project goals, a picture of the intersection in question, and a section called "Here's Where You Come In", which explains

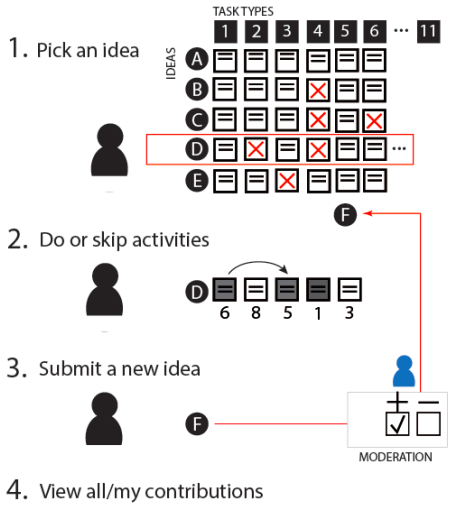

Figure 2. CommunityCrit's workflow: Users can 1) pick an idea, 2) do or skip an activity (the system offers five tasks compatible with the selected idea), 3) submit a new idea , 4) view all/my contributions. These steps are non-linear: people can exit the workflow, pick another idea, submit a new idea, view all/my contributors at anytime. After moderators approve ideas, they are visible to the community.

how users' contributions will be used and provides a timeline showing the current phase in the context of the larger initiative.

Micro-Activity Workflow

The micro-activity workflow consists of four steps and draws from a pool of different tasks, such as critiquing the idea, sharing a related story or real-world example, rating the idea, evaluating the idea along specific perspectives, and posing a question for others to consider. Figure 2 shows the four main steps of the workflow: 1) pick an idea, 2) do or skip an activity, 3) submit new idea, 4) view all/my contributions. The workflow is flexible (i.e. people may skip tasks, exit the workflow, or switch to another idea at anytime), and transparent (i.e. they can look at others' submitted ideas anytime).

1) Pick an Idea: Ideas are displayed in sets of three. Users may select an idea from the first set or ask for another (see Figure 3-1). The system offers ideas with a low, medium, and high number of contributions made so far. A separate section displays ideas already worked on by the user.

2) Do or Skip An Activity: After the user selects an idea, they see a more detailed description of the idea and a series of five "tasks"; tasks pair with ideas to form "micro-activities"(See Figure 3-2). The system tries to ensure coverage by prioritizing tasks that need input, i.e. Mobi [98]. Tasks cannot pair with ideas if the certain components have not yet been submitted, such as references or questions (e.g., answering a community question requires another user to pose a question first). Within the set of eligible tasks, the system selects five and orders them randomly. Users are free to skip over a task. After five tasks, their contributions are displayed and then can exit to a post-survey (to provide feedback on the tool), pick another idea to work on, or submit a new idea. Throughout the workflow, users always have access to a expandable pane with a map of the intersection and a description of the design challenge.

3) Submit a New Idea: If the user decides to submit their own idea, they describe it, give it a name, and optionally upload images (See Figure 3-3). After a user-submitted idea is accepted by a moderator, it becomes visible for future users.

4) View All/My Contributions: After each completed activity, the system increments a counter in the navigation bar next to "My Contributions". Selecting this link displays all the user's contributions, regardless of moderation status, sorted by the idea. This recognition is an important motivator for many crowdsourcing platforms [39, 99]. Users could also select "View All Contributions" to see a list of all ideas submitted by the community (See Figure 3-4). For each idea, the number of contributors and contributions is displayed. Users can view an idea detail page to see all contributions or to perform an activity for that idea. Each contribution includes the contributor's first name and the amount of time since its posting. This page also offers users the option to "Share Your Thoughts On This Idea" with an open-ended text field.

EVALUATION

To evaluate CommunityCrit *in the wild*, we deployed the system online for four weeks and worked with the local planning group to recruit participants. We reached out to other community organizations including a residents group, a planning council, and a neighborhood association striving to support and promote businesses. This recruitment strategy allowed us to reach a very diverse range of people including residents, planners, designers and business owners. All participants signed an online consent form during the registration process. We did not offer renumeration to contribute to the CommunityCrit system, but we did offer a $5 gift card to those willing to spend an extra 5-10 minutes filling out a survey to provide feedback on the system. We also offered registered users an opportunity to do a 30-minute interview for a $10 gift card, and three people participated. After the live deployment period, to understand the perspective of the local planning group, we held a focus group interview. Eight members of the local planning group reviewed the system and the community contributions, and discussed the pros and cons of the system.

CommunityCrit Yielded Substantive Contributions

During the four-week deployment, 76 people created an account as a registered user (56.6%) or as guest (43.4%), and 39 people made at least one contribution (i.e., answered any question or submitted an idea). People who registered made slightly more contributions (61%) compared to those who used a guest account (39%). In total, participants made 352 contributions. The first author served as moderator and only rejected incomplete submissions or those with offensive language. The approval rate was high (88.6% approval rate), and many contributions were insightful and detailed (See table 1).

Most participants provided either 5 contributions or 1 contribution, while one person submitted 69 contributions (see Figure 4). Since the workflow offered five activities as a set, ten participants did exactly five without skipping activities or switching to another idea. In general across all contribution types, submissions were an average of 109 characters (min=2, max=713). New ideas submitted by participants were on average 395 characters (Min= 68, Max=1603).

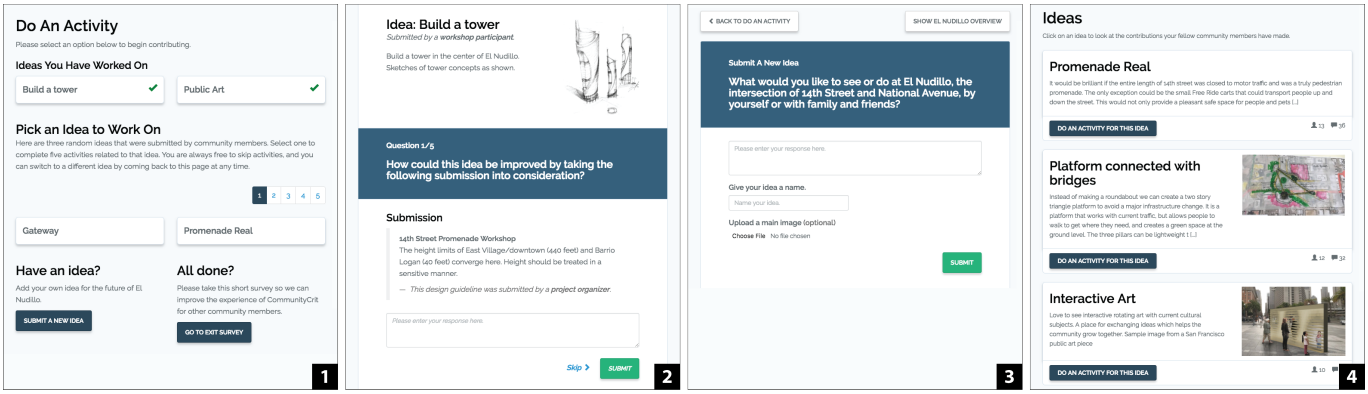

Figure 3. This figure shows the user interface for the main steps of the workflow: 1) "Do An Activity" where users pick an idea, 2) one sample activity, 3) the "Submit a New Idea" interface, 4) "View all Contributions" where people can see all the submitted ideas and associated comments.

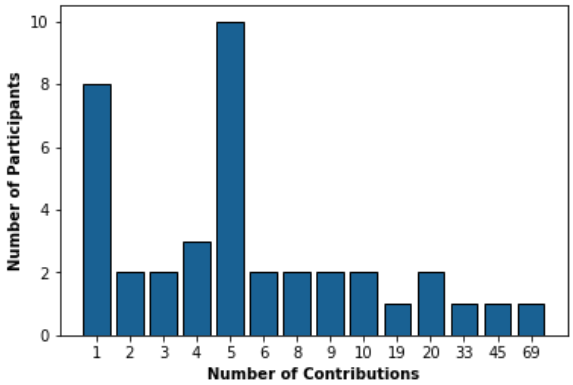

Figure 4. This graph shows the number of contributions per person. Most participants provided 5 contributions with the min of 1 and max of 69 contributions.

Online Ideas Comparable to Workshop Concepts

We initially seeded CommunityCrit with the 11 ideas generated during the June and August workshops. Ten new ideas emerged during the online deployment and were comparable to those from workshops. For instance, one participant submitted an idea called "Promenade Real":

> *It would be brilliant if the entire length of 14th street was closed to motor traffic and was a truly pedestrian promenade. This would not only provide a pleasant safe space for people and pets to walk, but would also create space for outdoor seating, more trees and greenery, safer play areas, as well as more food places with real sidewalk seating that is not disrupted by air pollution and motor noise. Think of places such as Kensington in London, with its lovely white facades and black ironwork.*

Another participant suggested an idea for an open-air farmer's market, which yield 24 (mostly positive) comments from the community. Another submitted an idea for El Parquecito (a densely landscaped small urban park), while also making the point he does not want a large sculpture or a bridge.

Participants Tried all Activities, Preferred Evaluating

To understand participants' preferences for different activities, we looked at the ratio of completed vs. skipped activities. Figure 5 indicates that users preferred tasks like "Rate an Idea" and "Evaluate Feasibility". "Share a Story" was the most skipped activity. Participants never skipped "Submit an Idea" since this was separated from the main workflow.

Participants Made Contributions in Short Bursts

Contributors spent an average of 14.2 minutes on the website (min=1:34, max=49:11). The average time per activity varied between 5.1 (Submit an Idea) and 0.8 minutes (Critique the Idea) (see Figure 5).

Public Feedback on the CommunityCrit System

To gather insights from the community we posted a survey on the CommunityCrit system and conducted a few think-aloud interviews. Out of 39 contributors, 14 people (6 female, 8 male) filled out the survey. Survey respondents' ranged in age from "25-34" to "64+". While the three think-aloud participants (2 female, 1 male) and 14 survey respondents are not necessarily representative of the overall region, their perspectives provide a good glimpse of contributer experience.

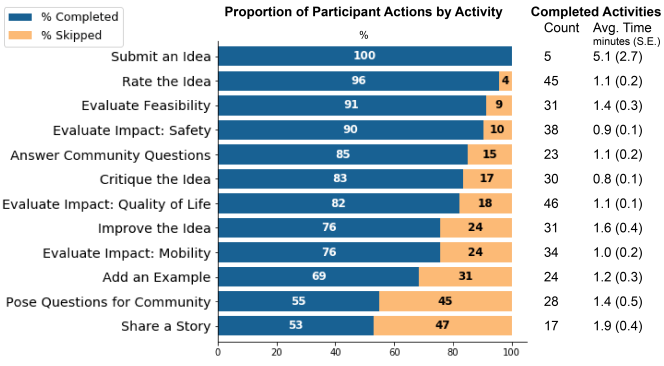

Figure 5. The ratio of completed vs. skipped activities along with counts and average time spent on completed activities. Participants preferred tasks like "Rate an Idea" and "Evaluate Feasibility".

Micro-Activity	Micro-Activity Instruction	Example Participant Contribution
Submit an Idea	What would you like to see or do at El Nudillo, the intersection of 14th Street and National Avenue, by yourself or with family and friends?	"The knuckle is a confluence of communities, histories, activities. The chosen design solution will have to address this reality. I doubt any of the ideas presented can succeed on their own. Likely a market with a transit hub designed to recognize and respect the history of the site and the city could generate enough conceptually to truly engage and support the community." *-P65*
Share a Story	Share a story or personal experience related to this idea.	"I bike by this area on my way to cycle the South Bay loop - I typically ride with my husband as I do not especially feel safe as a woman on my own here" *-P70*
Add an Example	Share an example of a place, installation, or project that could inform or improve this idea.	"This could mimic the 3rd street promenade in Santa Monica. It's closed to cars and only open to pedestrians. There are shops and restaurants lining both sides of the street, street performers, small kiosks and general fun in the area. It provides a place for live music as well." *-P66*
Improve the Idea	How could this idea be improved by taking the following submission into consideration? e.g. "While not a street - this example provides a great model for community programming collaboration. Governors Island in NYC..." *-P77*	"Great idea but I would concentrate on one thing and my preference would be a green street. We have the climate to do this. New York does not." *-P10*
Critique the Idea	What do you think of this idea based on the following reference? e.g. "Make a street with a high density of commercial activity a promenade." *-P13*	"Whatever is built should accommodate tiny mom and pop merchants. Not just vendors that can put tens or hundreds of thousands in a lease or license." *-P31*
Evaluate the Idea	Feasibility How feasible do you find this idea?	"Not feasible, as much as I would love this. Perhaps a portion of the green street could be closed to traffic" *-P11*
	Impact: Safety How do you think this idea might impact safety in the area?	"Pedestrian crossing as well as confusing vehicle directions should be improved." *-P68*
	Impact: Mobility How do you think this idea might impact mobility in the area?	"The [nearby] public transportation will facilitate access without needing a lot of parking" *-P12*
	Impact: Quality of Life How do you think this idea might impact quality of life in the area?	"It could have a positive impact by connecting bus and trolley service, even more so if commercial and residential development were included" *-P28*
Rate the Idea	Rate this idea on the following dimensions: [likelihood to visit, enjoy spending time here, be positively impacted]; add a justification.	"The uniqueness of space created would be very positive and desirable. Homeless issue could prove challenging." *-P65*
Pose Questions for Community	Submit a question you want to ask other community members about this idea.	"How would an EV/Barrio Market impact living and working in your community?" *-P65*
Answer Community Questions	[question text as submitted by user] e.g. "Should we instead install a monument?" *-P13*	"Absolutely not. What would be the draw to bring people down in that area? A small monument? The USS Midway is our monument. The beach is our monument. We're not a NYC or an LA. It would look great for a year, then no one would go down there to see it. If you put a monument up, put it in the East Village Green Park." *-P64*

Table 1. This table shows the micro-activities with instructions, along with an example contribution for each.

Support for micro-activity workflow

The survey included questions about contributors' preferences for the length and types of activities. Most contributors felt the length of activities was "just Right" (85.7% said), with only a few saying they were "too long" or "too short". Overall, 78% of respondents expressed that CommunityCrit was "easy to use". Respondents commented that the system offered a "fairly straightforward survey," and that they were "happy with the sequence" and "liked the streamlined approach".

When asked what types of activities they find most engaging, 50% of respondents reported that "providing input on others' ideas" was most engaging. One person explained this preference by saying "commenting and elaborating on ideas [helps] to narrow down the conversation." Only 8% preferred sharing a story, while 17% liked to provide a new idea. Another participant mentioned that she liked the "impact mobility" activities, because the "variety of feedback, the openness is really great"(*P3*). Reflecting on the activity workflow, one participant said "I was happy working on one idea 'cause [it] allows you to think a bit deeper about that specific idea" (*P78*). Another commented:

> *"I liked only having to answer 5 questions. I have conducted lengthy surveys myself and thought them to be excessive to the point of endangering the quality of data collection (respondents get bored, distracted, only want the "reward" etc."* (*P2*)

One participant said "Don't ask me the same question twice" (*P13*). Interestingly, this participant had spent 49 minutes on the tool and had provided 69 contributions, so they had virtually cycled through all activities. Another participant suggested "I believe it would be more fruitful to have participants evaluate several ideas rather than one idea." (*P17*) Taken together, the respondents seem to lend support to our design decisions to streamline participants towards a short but deep dive into a specific idea.

A convenient way to express one's voice

When asked to describe their experience, most participants were quite positive about CommunityCrit. Participants reported activities to be "thoughtful", with one person saying "It is pretty straightforward, overall pretty well designed. I will come back to work on other ideas" (*P22*). One respondent commented, "as an East Village resident, having a chance to offer my input (along with others) is important" (*P2*).

Others commented about the convenience and opportunity to add their voice, " I was able to get involved from my iPad in my home at a good time for my schedule" (*P12*). One respondent said she made her comments at 2am. Others talked about how this provides an alternative to attending workshops, saying "I don't have time to go to workshops so it provides opportunity to get and give feedback". Some commented how it's difficult for a "70 year old" to attend workshops and how "I have kids and a family so I can't make it to the workshops but I still want to contribute." Another complained that "participants at the workshop are not representative of the population".

People wanted more social interaction

Many participants appreciated the social aspect, like this person who said, "I like being able to comment on others ideas or submit my own suggestions" (*P70*). One participant wanted more social interaction, like "a live forum so I could hear others' ideas... that would create more synergy and we all get more creative and energized in that type of venue" (*P11*). Respondents also called for more information about the other community members, saying "each person has their own identity... I think it is interesting to know where those ideas are coming from, what they do... artist, designer, architect". Another contributer wished they could "see a graph that shows which demographic and geographic info, and which group were responding the most" so that they could get a sense of how the data represent different stakeholder groups.

Many suggested practical improvements

While 85% of survey respondents said they would like to use the system again in the future, several people offered concrete suggestions for how to improve CommunityCrit. For example, one respondent wanted a better preview of what to expect "I didn't know how many ideas I was supposed to respond to, or how many more ideas were still out there (and I did not schedule the proper amount of time to be able to review all ideas)" (*P72*). One respondent wanted "a way to make it easy to share the survey with others through social media" (*P70*).

Perspectives from the Local Planning Group

After the four-week deployment, we attended the local planning group meeting and gave a short presentation about CommunityCrit. The planning group is comprised of working professionals in areas of urban planning, marketing, design, architecture and development. Approximately 15 people participate in the planning group, although only 9 members attended that evening. After we presented CommunityCrit, our research team conducted a focus group interview and audio recorded the session. We discussed the community ideas and comments, the benefits and downsides of this sort of digital engagement, and ideas for summarizing the public perspective. Six people spoke during the focus group (3 female, 3 male), identified below as E1-E6.

Potential for capturing public sentiment

The planning group appreciated the value of CommunityCrit as a complementary method to their public workshop strategy. The group commented on the significant number of contributions in a relatively short amount of time, as one urban planner stated: "I looked at [CommunityCrit] on my phone a week and half ago...it's amazing this thing is changing like daily" and "What's really interesting is that you get a lot of perspectives" (*E1*). A designer in the group speculated on what contributed to this success, saying "the user experience is quickly consumable bite-sized engagement. I mean in every industry this is how people engage, really easily and quickly, people can chat about it, they can use it on the bus." (*E3*) The group saw the potential for this to scale since many people are accustomed to engaging services on their phones and other devices.

Valuable for relationship-building and marketing

When asked about the value of a system like CommunityCrit, one member of the planning group–an expert in marketing–summarized three key benefits:

> *"one, providing more tools for community outreach and for people to participate; two, building a relationship between university researchers and residents to work together on online technology; and three, presenting ideas that came out of CommunityCrit back to the public during the next workshop and facilitating a discussion around them." (E2)*

The lead urban planner described the benefit as bringing awareness around the project: "people know we are talking about El Nudillo [...] the word is out there, the more people know about a project..there are less people to say we never heard the damn thing about it, this is planting the seed." (*E1*). This perspective offers the point that a primary benefit is not necessarily the ideas and comments themselves, but the long term awareness and momentum necessary to see a project through to fruition.

Challenge to synthesize the community's perspectives

One of the challenges mentioned was around synthesizing and reporting people's overall reactions to each idea. While some members suggested a yes-no voting mechanism for ideas, as one designer said "that's a tiny sample group of the community, so if we start weighting this many Yes or No, we have a totally skewed perspective" (*E3*). In response, another member said "our workshops are even more skewed in terms of representation, we had around 42 people at the workshop" (*E6*). While the number of people attending the public workshops and making contributions were comparable (39 people), not everyone who attended the workshop got a chance to contribute.

Going beyond simple voting mechanisms, especially with such a small sample size, the planning group agreed that the comments and interpretations of those comments mean more. One member described the importance of surfacing the key themes in the data, asking if the system could provide "a common thread running through comments was X..." (*E2*). The urban developer in the group suggested we develop an "algorithm that analyzes the comments and takes the temperature of it" adding "as one of the sponsors, I would like to know how the community reacts to these ideas; I need some kind of metrics that says how things are going, positive or negative" (*E5*). This point of view aligns with his belief that it's the job of architects and developers to inspire, not to cater to everyone (*E5*).

Potential to derail project

When asked about the potential downsides of CommunityCrit, especially if it scales up and attracts more contributions from the public, many in the group talked about properly setting expectations. The marketing specialist said "[a key] challenge is everybody [must] understand that it is an open process and nothing has been decided" (*E1*). The system could potentially give the public the wrong impression about the status of the project unless it carefully explains how the current activities fit into the larger process. The lead architect expressed his concern, saying:

> *"one, it gives a voice to people who are too lazy to get off the couch and come to the workshop, and two, to do this it right, you need to get beyond people making decisions based on a picture, they need to understand what it is, how it works, and people need to spend 15 min before even typing." (E4)*

As an expert in understanding the constraints and design details, he knows what it takes to refine a project and remains skeptical of what he called "drive-by comments" (*E4*). A key consideration is how to best leverage public input to constructively support the experts who see projects through.

DISCUSSION

Building on prior work in civic technology and following our own iterative design process, we introduced a novel system for engaging the public in ideation, elaboration, and evaluation within the domain of urban design. Our key design considerations included: 1) designing questions based on relatable metrics (e.g. impact on quality of life), 2) providing a quick, flexible and focused workflow (offering five brief activities on a single idea), and 3) providing people a summary of their contributions, and a view of others' contributions to expose people to diverse viewpoints and promote social interactions, 4) sending people directly into quick activities, versus enabling people to first explore input by others to eliminate biases and maximize creativity. We discuss how CommunityCrit played a role in encouraging participation and enabling people to take part in the complex urban design process.

Engaging & Empowering Diverse Community Members

The four-week deployment of CommunityCrit received a wide range of contributions from 39 people. Our results indicate that CommunityCrit engaged a diverse slice of the public, including residents, city planners, and business owners. Our work provides a case study in leveraging online technology to empower residents to actively engage in urban design [77], make connections across social groups, and reach people who could not attend in-person meetings [31]. CommunityCrit empowered people who had not been previously involved in the project, such as working mothers and older adults who had wanted to participate but could not.

Supporting Activities Beyond Ideation

Arnstein's widely cited "ladder of citizen participation" shows public involvement as a spectrum [11]. She argues that citizens need to move from simply being consulted (e.g. through opinion polls) to feeling empowered to enact change. In response, many researchers have sought to empower different voices beyond providing data and identifying issues (e.g. [12, 36]). While prior research has emphasized the importance of engaging the public, our work provides a lightweight way for people to reflect and contribute meaningfully in a short amount of time. CommunityCrit's flexible workflow gave people an opportunity to participant as little or as much they wanted. Further research is needed to evaluate this approach, to provide mechanisms to engage broader audiences, and to improve the usefulness and quality of public feedback (e.g. rubrics for feedback, providing list of constraints, design guidelines).

Social Interaction Promotes Engagement

CommunityCrit supported social interactions to facilitate dialogue about the community's needs and preferences. The system invited newcomers to share ideas and exchange opinions, supporting a form of legitimate peripheral participation [56] that improved public awareness about the project. The social interactions between participants allowed them to filter out many ideas that were not useful. Our system also utilizes social interactions [36] to build trust and to help the community understand the impact of their ideas on others. The planning group discussed how creating this awareness could be the most important benefit, even more than contributions.

Increasing the Value of Online Community Input

Some members of the local planning group questioned the value the public's input. Previous research also indicates that some planners view public contributions as "inherently inefficient but important to building trust and relationships" [36]. In our work, we sought to improve the value of public input by providing relevant resources and asking questions that are both answerable based on local knowledge and reflective of community values and needs. Our findings contribute to the literature on open and distributed innovation by removing barriers to entry to everyone including non-experts [45, 94, 95]. According to Sanoff [80], a key principle behind community participation is that "expert" ideas are not necessarily better than novices'. However, we need to provide information in an accessible manner to enable people to submit informed comments and ideas. Our formative research revealed the importance of ensuring the community understands the design context, its history, the potential value to the community, and how their contributions would be put to use. This contextualizing helps to encourage participation, establish trust, and avoid the perception of government as a black box.

Key Design Considerations

Our research also reveals a number of design considerations for technology to support public engagement in urban design. A key tradeoff for CommunityCrit was how to balance between sending people directly into quick and accessible activities, versus enabling people to first explore the context, design alternatives, and input by others. On one hand participants appreciated seeing others' ideas, but prior research points to the importance of asking individual opinions first to reduce cognitive biases and maximize creativity [29]. Likewise, technology for public engagement must carefully consider the extent of upfront reading and training. In CommunityCrit, we sought to balance for this tension between extracting key excerpts from lengthy and complex proposals (in order to lower the barrier for contributions) and providing a holistic understanding of the problem which could be necessary in order to reach consensus.

Another key tradeoff has to do with privacy and community insight. On one hand, many of our participants contributed without providing their name or demographics. On the other hand, both experts and community members wanted to know where the ideas and comments came from (i.e., the commenter's expertise, their location, etc).

A key tradeoff for planners is how much time and money to invest in digital versus in-person engagement methods. Online tools require planners to advertise the URL, moderate contributions, and seed early ideas, while public workshops also need to be organized, advertised, and facilitated.

CONCLUSIONS AND FUTURE WORK

This paper introduces a novel system for engaging the public in early-stage urban design processes. In collaboration with a planning group, we observed public workshops and developed a system to engage the public in ideation, elaboration, and evaluation. A key design consideration was how to yield valid contributions given that most people have limited time and bandwidth. We designed a flexible workflow that allows the public to choose the ideas and activities that interest them and offers five activities per session. Through a four-week deployment, CommunityCrit gathered 352 contributions from 39 people and produced new ideas that were comparable to those generated during the face-to-face workshops.

CommunityCrit was successful in engaging people to elaborate on and evaluate ideas, rather than merely voicing issues or submitting ideas. However, our work explored a single urban design project within a fairly early stage in the process. Our outreach was limited to few weeks. We studied an urban design use case for one particular intersection. More work is required to understand how our approach can be adapted to other contexts and broader scales. We have identified several key areas for future work.

Our research team played an active role in recruiting participants for the CommunityCrit deployment. In order to scale up participation the future, we will need better recruitment strategies and incentive mechanisms. As the contributions increase, further research will be needed to meaningfully organize results. The interface could be designed to support different ways to view contributions (e.g. newest, most/least popular, most/least comments, etc.) and visualize large numbers of ideas with list views or network graphs. Both organizers and community members will need tools to make sense of the collected input, including how to represent different stakeholder groups and how to extend the approach into more convergent stages of the urban design process, such as enabling deliberation and consensus building (e.g. [5, 28, 84]). For instance, recent research points to the benefits of identifying and visualizing points of disagreement to help with consensus building process [64], and to providing a clear causal link between public input and its impact on decisions and outcomes [80].

Finally, future work can focus on creating an authoring interface to allow planners to adapt the tool for other contexts. We also plan to explore the benefits of using adaptive algorithms to personalize activities based on people's interests, skills, and other contextual details, such as where they live and their relationship with the project.

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REFERENCES

1. 2002. Get it Done. (2002). https://www.sandiego.gov/get-it-done
2. 2006. Waze. (2006). https://www.waze.com
3. 2011. Nextdoor. (2011). https://renaissancesd.nextdoor.com
4. 2017. CommunityCrit. (2017). https://cc.ucsd.edu
5. 2017. MiVote. (2017). www.mivote.org.au
6. 2017. Participatory Approaches to Planning Community Interventions. (2017). Accessed 18 September 2017.
7. Tanja Aitamurto, Helene Landemore, David Lee, and Ashish Goel. 2014. Crowdsourced off-road traffic law experiment in Finland. Report about idea crowdsourcing and evaluation. *Publications of the Committee for the Future, the Parliament of Finland* 1 (2014), 2014.
8. Tanja Aitamurto and Helene E Landemore. 2015. Five design principles for crowdsourced policymaking: Assessing the case of crowdsourced off-road traffic law in Finland. (2015).
9. Lincoln Allison. 1986. What is urban planning for? *Town Planning Review* 57, 1 (1986), 5.
10. Paul André, Haoqi Zhang, Juho Kim, Lydia Chilton, Steven P. Dow, and Robert C Miller. 2013. Community clustering: Leveraging an academic crowd to form coherent conference sessions. In *First AAAI Conference on Human Computation and Crowdsourcing*.
11. Sherry R Arnstein. 1969. A ladder of citizen participation. *Journal of the American Institute of planners* 35, 4 (1969), 216–224.
12. Mariam Asad, Christopher A Le Dantec, Becky Nielsen, and Kate Diedrick. 2017. Creating a Sociotechnical API: Designing City-Scale Community Engagement. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. ACM, 2295–2306.
13. Solomon E Asch. 1955. Opinions and social pressure. *Readings about the social animal* 193 (1955), 17–26.
14. American Planning Association. 2006. *Planning and urban design standards*. John Wiley & Sons.
15. Mara Balestrini, Yvonne Rogers, Carolyn Hassan, Javi Creus, Martha King, and Paul Marshall. 2017. A city in common: a framework to orchestrate large-scale citizen engagement around urban issues. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. ACM, 2282–2294.
16. Anant Bhardwaj, Juho Kim, Steven P. Dow, David Karger, Sam Madden, Rob Miller, and Haoqi Zhang. 2014. Attendee-sourcing: Exploring the design space of community-informed conference scheduling. In *Second AAAI Conference on Human Computation and Crowdsourcing*.
17. Geoff Boeing, Daniel Church, Haley Hubbard, Julie Mickens, and Lili Rudis. 2014. LEED-ND and livability revisited. (2014).
18. Daren C Brabham. 2009. Crowdsourcing the public participation process for planning projects. *Planning Theory* 8, 3 (2009), 242–262.
19. John M Bryson, Kathryn S Quick, Carissa Schively Slotterback, and Barbara C Crosby. 2013. Designing public participation processes. *Public administration review* 73, 1 (2013), 23–34.
20. Joel Chan, Steven Dang, and Steven P. Dow. 2016. Improving crowd innovation with expert facilitation. In *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing*. ACM, 1223–1235.
21. Caron Chess and Kristen Purcell. 1999. Public participation and the environment: Do we know what works?. In *ACS Publications*. 2685–2692.
22. Soon Ae Chun, Stuart Shulman, Rodrigo Sandoval, and Eduard Hovy. 2010. Government 2.0: Making connections between citizens, data and government. *Information Polity* 15, 1 (2010), 1.
23. Stephen Coleman and John Gotze. 2001. *Bowling together: Online public engagement in policy deliberation*. Hansard Society London.
24. Patrick M Condon, Duncan Cavens, and Nicole Miller. 2009. *Urban planning tools for climate change mitigation*. Lincoln Institute of Land Policy Cambridge, MA.
25. Laura Dabbish, Rosta Farzan, Robert Kraut, and Tom Postmes. 2012. Fresh faces in the crowd: turnover, identity, and commitment in online groups. In *Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work*. ACM, 245–248.
26. Fiorella De Cindio and Cristian Peraboni. 2009. Fostering e-participation at the urban level: Outcomes from a large field experiment. In *International Conference on Electronic Participation*. Springer, 112–124.
27. Kevin C Desouza and Akshay Bhagwatwar. 2014. Technology-enabled participatory platforms for civic engagement: the case of US cities. *Journal of Urban Technology* 21, 4 (2014), 25–50.
28. Bob Dick. 1997. Dialectical processes. *Online: http://www.scu.edu/schools/sawd/arr/dialectic.html* (1997).
29. Michael Diehl and Wolfgang Stroebe. 1987. Productivity loss in brainstorming groups: Toward the solution of a riddle. *Journal of personality and social psychology* 53, 3 (1987), 497.
30. Steven P. Dow, Anand Kulkarni, Scott Klemmer, and Björn Hartmann. 2012. Shepherding the crowd yields better work. In *Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work*. ACM, 1013–1022.

31. Amir Ehsaei, Thomas Sweet, Raphael Garcia, Laura Adleman, and Jean M Walsh. 2015. Successful Public Outreach Programs for Green Infrastructure Projects. In *International Low Impact Development Conference 2015: LID: It Works in All Climates and Soils*. 74–92.
32. Marcus Foth, Ronald Schroeter, and Irina Anastasiu. 2011. Fixing the city one photo at a time: mobile logging of maintenance requests. In *Proceedings of the 23rd Australian Computer-Human Interaction Conference*. ACM, 126–129.
33. Joel Fredericks and Marcus Foth. 2013. Augmenting public participation: enhancing planning outcomes through the use of social media and web 2.0. *Australian planner* 50, 3 (2013), 244–256.
34. Archon Fung and David Weil. 2010. Open government and open society. *Open government: Collaboration, transparency, and participation in practice* 105 (2010), 106–08.
35. Cynthia L Girling. 2006. Informing Design Charrettes: tools for participation in neighbourhood-scale planning. *Integrated Assessment* 6, 4 (2006).
36. Eric Gordon and Paul Mihailidis. 2016. *Civic Media: Technology, Design, Practice*. MIT Press.
37. Jan Halatsch, Antje Kunze, and Gerhard Schmitt. 2009. Value Lab: A collaborative environment for the planning of Future Cities. In *Proceedings of eCAADe*, Vol. 27.
38. Colleen Hardwick. 2012. GeoSocial: Shifting the Paradigm with PlaceSpeak. (2012).
39. Mokter Hossain. 2012. Users' motivation to participate in online crowdsourcing platforms. In *Innovation Management and Technology Research (ICIMTR), 2012 International Conference on*. IEEE, 310–315.
40. Shih-Wen Huang and Wai-Tat Fu. 2013. Don't hide in the crowd!: increasing social transparency between peer workers improves crowdsourcing outcomes. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 621–630.
41. Judith E. Innes and David E. Booher. 2004. Reframing public participation: strategies for the 21st century. *Planning theory & practice* 5, 4 (2004), 419–436.
42. Joshua Introne, Robert Laubacher, Gary Olson, and Thomas Malone. 2013. Solving wicked social problems with socio-computational systems. *KI-Künstliche Intelligenz* 27, 1 (2013), 45–52.
43. Lilly C Irani and M Silberman. 2016. Stories We Tell About Labor: Turkopticon and the Trouble with Design. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. ACM, 4573–4586.
44. Nassim JafariNaimi. 2015. MRx as a participatory platform. *Digital Creativity* 26, 3-4 (2015), 207–220.
45. Lars Bo Jeppesen and Karim R Lakhani. 2010. Marginality and problem-solving effectiveness in broadcast search. *Organization science* 21, 5 (2010), 1016–1033.
46. Juho Kim and others. 2015. *Learnersourcing: improving learning with collective learner activity*. Ph.D. Dissertation. Massachusetts Institute of Technology.
47. Nam Wook Kim, Jonghyuk Jung, Eun-Young Ko, Songyi Han, Chang Won Lee, Juho Kim, and Jihee Kim. 2016. BudgetMap: Engaging Taxpayers in the Issue-Driven Classification of a Government Budget. In *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing (CSCW '16)*. ACM, New York, NY, USA, 1028–1039. DOI: http://dx.doi.org/10.1145/2818048.2820004
48. Nam Wook Kim, Chang Won Lee, Jonghyuk Jung, Eun-Young Ko, Juho Kim, and Jihee Kim. 2015. Budgetmap: Issue-driven navigation for a government budget. In *Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems*. ACM, 1097–1102.
49. Peter Kinnaird, Laura Dabbish, and Sara Kiesler. 2012. Workflow transparency in a microtask marketplace. In *Proceedings of the 17th ACM international conference on Supporting group work*. ACM, 281–284.
50. Peter Kinnaird, Laura Dabbish, Sara Kiesler, and Haakon Faste. 2013. Co-worker transparency in a microtask marketplace. In *Proceedings of the 2013 conference on Computer supported cooperative work*. ACM, 1285–1290.
51. Aniket Kittur, Jeffrey V Nickerson, Michael Bernstein, Elizabeth Gerber, Aaron Shaw, John Zimmerman, Matt Lease, and John Horton. 2013. The future of crowd work. In *Proceedings of the 2013 conference on Computer supported cooperative work*. ACM, 1301–1318.
52. Aniket Kittur, Boris Smus, Susheel Khamkar, and Robert E Kraut. 2011. Crowdforge: Crowdsourcing complex work. In *Proceedings of the 24th annual ACM symposium on User interface software and technology*. ACM, 43–52.
53. Mark Klein. 2011. How to harvest collective wisdom on complex problems: An introduction to the mit deliberatorium. *Center for Collective Intelligence working paper* (2011).
54. Travis Kriplean, Jonathan Morgan, Deen Freelon, Alan Borning, and Lance Bennett. 2012. Supporting reflective public thought with considerit. In *Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work*. ACM, 265–274.
55. Anand P Kulkarni, Matthew Can, and Bjoern Hartmann. 2011. Turkomatic: automatic recursive task and workflow design for mechanical turk. In *CHI'11 Extended Abstracts on Human Factors in Computing Systems*. ACM, 2053–2058.
56. Jean Lave and Etienne Wenger. 1991. *Situated learning: Legitimate peripheral participation*. Cambridge university press.

57. Christopher A Le Dantec, Kari E Watkins, Russ Clark, and Elizabeth Mynatt. 2015. Cycle Atlanta and OneBusAway: Driving innovation through the data ecosystems of civic computing. In *International Conference on Human-Computer Interaction*. Springer, 327–338.

58. Matthew Leighninger. 2006. *The next form of democracy: How expert rule is giving way to shared governance–and why politics will never be the same*. Vanderbilt University Press.

59. John M Levine and Richard L Moreland. 1994. Group socialization: Theory and research. *European review of social psychology* 5, 1 (1994), 305–336.

60. Charles E Lindblom. 1959. The science of "muddling through". *Public administration review* (1959), 79–88.

61. Charles E Lindblom. 1979. Still muddling, not yet through. *Public administration review* 39, 6 (1979), 517–526.

62. Greg Little, Lydia B Chilton, Max Goldman, and Robert C Miller. 2009. Turkit: tools for iterative tasks on mechanical turk. In *Proceedings of the ACM SIGKDD workshop on human computation*. ACM, 29–30.

63. Greg Little, Lydia B Chilton, Max Goldman, and Robert C Miller. 2010. Exploring iterative and parallel human computation processes. In *Proceedings of the ACM SIGKDD workshop on human computation*. ACM, 68–76.

64. Weichen Liu, Sijia Xiao, Browne Jacob T., Ming Yang, and Steven P. Dow. 2018. ConsensUs: Supporting Multi-Criteria Group Decisions by Visualizing Points of Disagreement. In *ACM Transactions on Social Computing*.

65. Kurt Luther, Amy Pavel, Wei Wu, Jari-lee Tolentino, Maneesh Agrawala, Björn Hartmann, and Steven P. Dow. 2014. CrowdCrit: crowdsourcing and aggregating visual design critique. In *Proceedings of the companion publication of the 17th ACM conference on Computer Supported Cooperative Work & Social Computing*. ACM, 21–24.

66. Ioanna Lykourentzou, Shannon Wang, Robert E. Kraut, and Steven P. Dow. 2016. Team dating: A self-organized team formation strategy for collaborative crowdsourcing. In *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems*. ACM, 1243–1249.

67. Susanna Haas Lyons, Mike Walsh, Erin Aleman, and John Robinson. 2014. Exploring regional futures: Lessons from Metropolitan Chicago's online MetroQuest. *Technological Forecasting and Social Change* 82 (2014), 23–33.

68. Narges Mahyar, Kelly J. Burke, Jialiang Ernest Xiang, Siyi Cathy Meng, Kellogg S Booth, Cynthia L Girling, and Ronald W Kellett. 2016. UD Co-Spaces: A Table-Centred Multi-Display Environment for Public Engagement in Urban Design Charrettes. In *Proceedings of the 2016 ACM on Interactive Surfaces and Spaces*. ACM, 109–118.

69. Valérie Maquil. 2015. Towards understanding the design space of tangible user interfaces for collaborative urban planning. *Interacting with Computers* 28, 3 (2015), 332–351.

70. David Martin, Benjamin V Hanrahan, Jacki O'Neill, and Neha Gupta. 2014. Being a turker. In *Proceedings of the 17th ACM conference on Computer supported cooperative work & social computing*. ACM, 224–235.

71. Taewoo Nam. 2012. Suggesting frameworks of citizen-sourcing via Government 2.0. *Government Information Quarterly* 29, 1 (2012), 12–20.

72. Donald A Norman and Pieter Jan Stappers. 2016. DesignX: Complex Sociotechnical Systems. *She Ji: The Journal of Design, Economics, and Innovation* 1, 2 (2016), 83–106.

73. Katherine Panciera, Reid Priedhorsky, Thomas Erickson, and Loren Terveen. 2010. Lurking? cyclopaths?: a quantitative lifecycle analysis of user behavior in a geowiki. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 1917–1926.

74. Chrysaida-Aliki Papadopoulou and Maria Giaoutzi. 2017. Crowdsourcing and Living Labs in Support of Smart Cities' Development. *International Journal of E-Planning Research (IJEPR)* 6, 2 (2017), 22–38.

75. Suzanne J Piotrowski and Gregg G Van Ryzin. 2007. Citizen attitudes toward transparency in local government. *The American Review of Public Administration* 37, 3 (2007), 306–323.

76. Horst W. Rittel and Melvin M. Webber. 1973. Planning problems are wicked. *Polity* 4 (1973), 155–169.

77. Deni Ruggeri and Deven Young. 2016. Community in the information age: Exploring the social potential of web-based technologies in landscape architecture and community design. *Frontiers of Architectural Research* 5, 1 (2016), 15–26.

78. Niloufar Salehi, Andrew McCabe, Melissa Valentine, and Michael Bernstein. 2016. Huddler: Convening Stable and Familiar Crowd Teams Despite Unpredictable Availability *(CSCW '16)*. ACM, New York, NY, USA.

79. Matthew J Salganik and Karen EC Levy. 2015. Wiki surveys: Open and quantifiable social data collection. *PloS one* 10, 5 (2015).

80. Henry Sanoff. 2000. *Community participation methods in design and planning*. John Wiley & Sons.

81. Donald A Schon. 1984. *The reflective practitioner: How professionals think in action*. Vol. 5126. Basic books.

82. Dimitri Schuurman, Bastiaan Baccarne, Lieven De Marez, and Peter Mechant. 2012. Smart ideas for smart cities: Investigating crowdsourcing for generating and selecting ideas for ICT innovation in a city context. *Journal of theoretical and applied electronic commerce research* 7, 3 (2012), 49–62.

83. Swapnil Shrivastav. 2017. Urbane: Community Driven Architecture and Planning Through a Mobile Social Platform. In *E-Democracy for Smart Cities*. Springer, 487–508.

84. Alina Siegfried. 2014. From Occupy to online democracy: the Loomio story. (2014).

85. Stefan Steiniger, Mohammad Ebrahim Poorazizi, Coral AM Bliss-Taylor, Ehsan Mohammadi, and Andrew JS Hunter. 2012. PlanYourPlace: Merging social networks and participatory GIS for participatory planning. *Knowing to manage the territory, protect the environment, evaluate he cultural heritage* (2012).

86. Colleen H. Stuart, Laura Dabbish, Sara Kiesler, Peter Kinnaird, and Ruogu Kang. 2012. Social transparency in networked information exchange: a theoretical framework. In *Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work*. ACM, 451–460.

87. Cass R Sunstein. 2002. The law of group polarization. *Journal of political philosophy* 10, 2 (2002), 175–195.

88. Ryo Suzuki, Niloufar Salehi, Michelle S Lam, Juan C Marroquin, and Michael S Bernstein. 2016. Atelier: Repurposing expert crowdsourcing tasks as micro-internships. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. ACM, 2645–2656.

89. Linda Tischler. 2011. Looking for Bold Ideas to Fix the City, New York Turns to Crowd Sourcing. (Jan 2011).

90. Jordanka Tomkova. 2009. E-consultations: New tools for civic engagement or facades for political correctness. *European Journal of ePractice* 7 (2009), 45–55.

91. John Underkoffler and Hiroshi Ishii. 1999. Urp: a luminous-tangible workbench for urban planning and design. In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems*. ACM, 386–393.

92. Rajan Vaish, Snehalkumar Neil S Gaikwad, Geza Kovacs, Andreas Veit, Ranjay Krishna, Imanol Arrieta Ibarra, Camelia Simoiu, Michael Wilber, Serge Belongie, Sharad Goel, and others. 2017. Crowd Research: Open and Scalable University Laboratories. In *Proceedings of the 30th Annual ACM Symposium on User Interface Software and Technology*. ACM, 829–843.

93. Robert Vogel, Evelina Moulder, and Mike Huggins. 2014. The extent of public participation. *Public Management* 96, 2 (2014), 6–10.

94. Eric Von Hippel. 1994. "Sticky information" and the locus of problem solving: implications for innovation. *Management science* 40, 4 (1994), 429–439.

95. Eric von Hippel. 2017. Free Innovation by Consumers–How Producers Can Benefit: Consumers' free innovations represent a potentially valuable resource for industrial innovators. *Research-Technology Management* 60, 1 (2017), 39–42.

96. Jason B. Walker and Michael W. Seymour. 2008. Utilizing the design charrette for teaching sustainability. *International Journal of Sustainability in Higher Education* 9, 2 (2008), 157–169.

97. Mark E. Whiting, Dilrukshi Gamage, Snehalkumar S Gaikwad, Aaron Gilbee, Shirish Goyal, Alipta Ballav, Dinesh Majeti, Nalin Chhibber, Angela Richmond-Fuller, Freddie Vargus, and others. 2016. Crowd guilds: Worker-led reputation and feedback on crowdsourcing platforms. *arXiv preprint arXiv:1611.01572* (2016).

98. Haoqi Zhang, Edith Law, Rob Miller, Krzysztof Gajos, David Parkes, and Eric Horvitz. 2012. Human computation tasks with global constraints. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 217–226.

99. Haichao Zheng, Dahui Li, and Wenhua Hou. 2011. Task design, motivation, and participation in crowdsourcing contests. *International Journal of Electronic Commerce* 15, 4 (2011), 57–88.

100. John Zimmerman, Anthony Tomasic, Charles Garrod, Daisy Yoo, Chaya Hiruncharoenvate, Rafae Aziz, Nikhil Ravi Thiruvengadam, Yun Huang, and Aaron Steinfeld. 2011. Field trial of tiramisu: crowd-sourcing bus arrival times to spur co-design. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 1677–1686.