

Crowdsourcing Designs: A Synthesis of Literatures

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Abstract

Crowdsourcing is a phenomenon emerging in various sectors and industries that provides an opportunity for governments to collaborate with the public to generate information, deliver public services, or facilitate policy innovation. This review paper synthesizes prior research and practices on crowdsourcing from a variety of disciplines and focuses on the purpose, crowd, motivation, process design and outcomes. A process map for governments to design crowdsourcing is generated and three key actions are highlighted, namely incentive design, communication, and information aggregation.

1. Introduction

Crowdsourcing is the act of a company or institution taking a function once performed by internal employees or contractors and outsourcing it to a group of people through an open call on the Internet (Howe 2006). In the public sector, since 2015, the Director of the Office of Science and Technology Policy had issued memorandums to the executive departments and agencies regarding the adoption of citizen science and crowdsourcing projects (OSTP 2015). As part of the recent Open Government movement, governments have begun to outsource projects to the public that have been traditionally done within the government, such as the Peer to Patent initiative by the US Patent and Trademark Office, which has the public taking part in the patent review process (Noveck 2009), or Challenge.org operating an open call for innovative policy solutions (Mergel and Desouza 2013). Meanwhile, public agencies and research institutions, such as NASA, have engaged the public to perform simple research tasks to improve scientific research. Recently, studies showed how government can use technology and the Web to enhance governance and the capacity of the public in order to gather information, solve public problems, facilities innovation and enhance policy making through citizen-sourcing (Nam 2012; Brabham 2015).

However, managing and implementing crowdsourcing in the public sector presents several difficulties, including attracting the right crowd, avoiding manipulation by special interest groups, controlling the quality of contributions, and information overload (Lampe et al. 2014). Dalal et al. (2011) also highlights three main challenges of implementing crowdsourcing, namely the difficulty of gathering information from large and diverse groups, facilitating meaningful communication and interaction among contributors, and aggregating information so that the thought process of the group can be revealed. These difficulties create barriers for the public managers to adopt crowdsourcing in their operation.

The goal of this paper is to synthesize prior research across a variety of disciplines on and practices of utilizing crowdsourcing. The common themes across a diverse body of literature identify useful practices and reveal appropriate questions for future crowdsourcing opportunities in government. If crowdsourcing efforts are to become more common, how can academics, practitioners, and public administrators better understand this trend? What are the required design components to make crowdsourcing efforts effective?

2. What is crowdsourcing?

The diversity of existing definitions illustrates the variety of possible starting points for studying the concept systematically. Crowdsourcing is first identified by Howe (2006), as "the act of a company or institution taking a function once performed by their own employees and outsourcing it to an undefined network of people in the form of an open call." Examining the existing literatures on crowdsourcing, Estelles-Arolas and Gonzalez-Ladron-de-Guerva (2012) further proposed crowdsourcing as "a type of participative online activity in which an individual, an institution, a non-profit organization, or company proposes to a group of individuals of varying knowledge, heterogeneity,

and number, via a flexible open call, the voluntary undertaking of a task." For the purpose of this paper, it is useful to begin with the following definition based on both Howe (2006) and Estelles-Arolas and Gonzalez-Ladron-de-Guerva (2012): *Crowdsourcing involves outsourcers creating incentives for the crowd to voluntarily contribute to and generate the desired outcomes of the outsourcers through an open call on the Internet.*

This definition is consistent with Estelles-Arolas and Gonzalez-Ladron-de-Guerva (2012), who identified eight unique characteristics of crowdsourcing, namely, (1) the existence of a clearly defined crowd; (2) the existence of a task with a clear goal; (3) a clear recompense received by the crowd; (4) a clearly identified crowdsourcer; (5) a clearly defined compensation to be received by the crowdsourcer; (6) an online assigned process of a participative type; (7) the use of an open call of variable extent; and (8) the use of the Internet (p.197).

By the end of 2015, a search for "crowdsourcing," "crowd source," "crowdsourced," and "crowdsource" in the Web of Science database resulted in 1,123 articles. Given the focus of this paper, our team selected articles focusing on design, strategic and management of implementing crowdsourcing rather technical papers about crowdsourcing. Our team also conducted a Google Scholar search to ensure that the inclusion of high impact articles. In sum, 218 articles were selected for our review.

It is important to note that crowdsourcing share certain characteristics with other similar concepts like wisdom of the crowd, open innovation, and collective intelligence. But, due to the space, we cannot discuss all of them in our review. Also, we acknowledge that the review is not comprehensive, given a fast growing in the number of publications on crowdsourcing in conference proceedings and other working papers.

Most of the discussed crowdsourcing projects in the literature can be broadly classified into two types. First, *innovation-driven crowdsourcing projects* focus on tapping the crowd for innovative ideas. This type of crowdsourcing replaces the traditional research and development (R&D) departments with the crowds' knowledge through an open call for ideas or solutions to a complex problem, such as in InnoCentive (Blohm, Leimeister, and Krcmar 2013; Lakhani et al. 2007), Dell's IdeaStorm (Bayus 2013), and Challenge.gov (Desouza 2012). Second, *service-driven crowdsourcing* focuses on getting the crowds to complete complex or large tasks through an open call for the accomplishment of smaller tasks assigned to individuals within the crowd, such as Galaxy Zoo for galaxy image classification (Tokarchuk, Cuel, and

Zamarian 2012) and Peer to Patent for patent review (Noveck 2009). Service-driven crowdsourcing projects utilize crowds' abilities and knowledge to help the outsourcers improve or carry out services originally conducted by the outsourcers. Table 1 presents the selected prominent and well-studied cases from the research on crowdsourcing, categorized by service and innovation driven crowdsourcing projects.

Table 1 Selected crowdsourcing projects classified by service and innovation purpose

Platform/Case	Purpose(s)	Selective References
<i>Service Driven Crowdsourcing Project</i>		
Amazon's Mechanical Turk (Private)	An internet marketplace that enables individuals, businesses and organizations to find workforce to complete human intelligence tasks (HITS), which are tasks that can be done better by humans than computers.	Kaufmann et al. (2011); Tokarchuk et al. (2012); Behrend et al. (2011); Chandler and Kapelner (2013)
Galaxy Zoo (Nonprofit)	Astronomical projects hosted by Zooniverse and the Cornell Lab of Ornithology aimed at mobilizing online volunteers to visually classify billions of images of galaxies drawn from NASA's Hubble Space Telescope archive. These classifications provide scientists with valuable information on the formation of galaxies.	Tokarchuk, Cuel and Zamarian (2012); Franzoni and Sauermann (2014)
Peer-to-Patent (Government)	A pilot project between the New York Law School and the U.S. Patent and Trademark Office, ask the online volunteers to undertake review and research of about 1000 patent applications.	Noveck (2009); Brabham (2010)
Goldcorp (Private)	A Canadian gold mining company, inviting people from all around the world to examine the geologic data and help identify potential sites where millions of ounces of gold will be found.	Marjanovic, Fry and Chataway (2012); Blohm, Leimeister and Krcmar (2013)
<i>Innovation Driven Crowdsourcing Project</i>		
Dell's IdeaStorm (Private)	An online brainstorming community in which participants are asked to keep on proposing big or small ideas that might improve Dell's products and services	Bayus (2012)
Innocentive (Private)	An online platform in which to bridge a community of solution seekers, usually companies who are unable to solve their problems internally, who issue challenges to be answered by an online community of solution providers who receive cash awards. The platform thus provides research and development solutions for a broad range of well-defined and scoped, scientific and engineering challenges.	Marjanovic, Fry and Chataway (2012); Lakhani et al. (2007); Blohm, Leimeister and Krcmar (2013)
Next Stop Design Project (Government)	A project between the Federal Transit Administration and the Utah Transit Authority focused on the application of crowdsourcing to bus stop design at the neighborhood scale by allowing participants in Salt Lake City to submit and select design for their ideal bus stop shelter.	Brabham (2010); Brabham (2012); Brabham (2014)
Threadless (Private)	A Chicago-based company that call for tee shirt design submission online. Users can submit their own designs to Threadless, where they are voted on for a 10-day period by other users in the community. Winning designers will get their designs print on the tee for sale.	Brabham (2010); Tokarchuk, Cuel and Zamarian (2012); Li and Hongjuan (2011)

Furthermore, from our review, crowdsourcing and its outcomes vary in terms of who, why, how, and what, thus this paper adopts a simple framework, displayed in figure 1, elaborating on these key components by focusing on crowds, motivation, process design, and outcomes. These categories are developed through reviewing extant frameworks and review articles on crowdsourcing in different fields (e.g., Albors, Ramos, and Hervas 2008; Malone, Laubacher, and Dellarocas 2010; Brabham, 2013; Hosseini et al. 2014). This framework provides a structure for exploring the existing research about crowdsourcing across disciplines but is not intended

to convey relationships and direction among the categories. Each component of the framework highlights the important findings and debates from the existing literature so that instructive lessons can be generated.

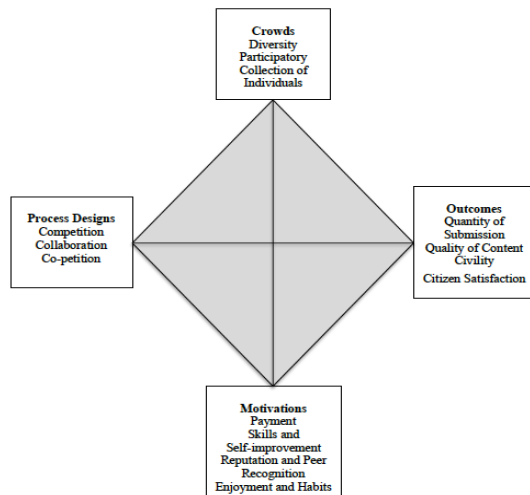


Figure 1 Conceptual framework for crowdsourcing literature review

2.1. The crowds

The crowds demonstrate diverse, participatory, and collective characteristics. First, *diversity* is one of the important criteria to form a wise crowd (Surowiecki 2004). Behrend et al. (2011) found that participants recruited from the crowdsourcing sites, such as Amazon Mechanical Turk, were more diverse in terms of education, employment status, and profession than the subjects from the university sample. Second, the crowds practice a *participatory* movement and are used to their involvement with the commercial culture (Kozinets et al. 2008). The crowds empower themselves to share, fund, produce, and even own the content or service generated (Heimans and Timms 2014). Third, the crowd is a *collection of individuals with different backgrounds and abilities*, and its performance depends on collective action. The outcomes of collective action might vary depending on the centrality and concentration of individuals' contributions.

Crowd is an aggregation of individuals with different backgrounds, purposes, capacities, knowledge, and different levels of commitment to contribute to the projects. For instance, Brabham (2012) points out that crowds can be professional and experts who opt in the crowdsourcing process, other than hobbyists or "amateurs." Kozinets et al. (2008) illustrate four types of online participants in terms of the concentration and level of knowledge. They

define that "crowds are large organized groups who gather or are gathered together specifically to plan, manage, and completed the required tasks." He then made distinction between crowds and the other types of online participants: hives, mods, and swarms.

These characteristics highlight the uniqueness of crowdsourcing when compared to the management of a department. First, an open call is on the Internet, which creates uncertainty and challenges regarding participation. Second, voluntary contribution indicates that the relationship is informal and lacks legal constraint for enforcing the agreement between the outsourcers and crowd, thus presenting new challenges when designing incentive strategies. Third, because the crowd is a composition of individuals, generating ideas and works presents new challenges in information selection and aggregation. Finally, because the process of generating desired outcomes is transparent and open on the Internet, using outcomes as end results should be approached cautiously, and additional consideration should be given to understanding and measuring the means that produced the results.

2.2. Motivation

The existing literature shows diverse motivations for participation in crowdsourcing projects. Four frequently discussed motivations are as follows: *Monetary* incentive is important for crowds to participate in crowdsourcing projects because they treat those projects as either full- or part-time jobs for regular income (Tokarchuk, Cuel, and Zamarian 2012). Apart from financial incentives, some crowds are motivated to join crowdsourcing projects because they can *learn new skills and achieve self-improvement* through their contribution to the projects (Crump et al. 2013; Kaufmann, Schulze, and Veit 2011; Kazai et al. 2013; Pilz and Gewald 2013). Others want to *build reputation and gain peer recognition* by interacting with other like-minded persons through crowdsourcing projects, as found in Galaxy Zoo (Tokarchuk, Cuel, and Zamarian 2012), and the Next Stop Design project (Brabham 2012). And still, some crowds contribute to projects *as a hobby for their enjoyment*, like Galaxy Zoo is for astronomy fan (Tokarchuk, Cuel, and Zamarian 2012), while Threadless was for the graphic designers (Brabham 2010). Table 2 shows the selective motivation and incentives discussed in the literature on motivating crowds to contribute.

Existing studies debate how different incentives might induce motivation to just participate or to contribute high quality content. Župič (2013) argues that monetary incentives might increasingly crowd

out the intrinsic motivating factors of productive members. Garcia Martinez and Walton (2014) also find that monetary awards can increase the size of the participation but not directly the quality of the contribution. They argue that monetary awards can only indirectly influence the quality of the ideas because of the increase of the size of the crowd and the likelihood of generating a good idea. Therefore, other studies have shown that intrinsic motivations, such as empowerment, self-improvement, and reputation building can better sustain the contribution as well as improve the quality of contributions.

Table 2 Motivations for participating and contributing crowdsourcing projects

Motivation	Examples & Implications
<i>Payment</i>	
Brabham (2010); Tokarchuk, Cuel and Zamarian (2012) <i>Threadless (prizes)</i>	The winning T-shirt design submissions to Threadless with cash and gift certificates. The participants thus make submissions to get a chance to make money, as well as opportunity for freelance work or full time-design work
Newsom (2013) <i>Manor Labs</i>	Participants receive a made-up currency called Innobucks for their participation and submission of ideas in the platform (1 innobuck each). Participants thus actively submit ideas in order to get Innobucks, which can be used to make various real-life purchases and for discounts in local restaurants and shops
<i>Skills and Self-improvement</i>	
Brabham (2012) <i>Next Stop Design</i>	Next Stop Design allows private designers to submit their ideas to an online competition for bus stops. Incorporating an online design and bus stop design is new to the public. It requires the designers to rethink about art, public space, and public transit. It is a platform that they acquire new tools and topical domains
Kaufmann, Schulze and Veit (2011) <i>Amazon Mechanical Turk</i>	Some HITs are only available to users with certain qualifications. Participation in these tasks is motivated by participants' desire of their advancement in skills of importance for possible material advantages in the future
<i>Reputation and Peer recognition</i>	
Brabham (2012) <i>Next Stop Design</i>	Next Stop Design allows users to rate and comment the designs. Those who got positive feedback enjoy the facts that their designs, as well as the recognition from other professionals. Also, such peer recognition, as a core of the normal life of the creative professions, serves as a step towards fame and fortune to the designers
Tokarchuk, Cuel and Zamarian (2012) <i>Galaxy Zoo</i>	The Galaxy Zoo designs a peer community and allows the crowd to socialize and communicate with each other. It also features the research and scientific publications that are based on participants' contribution in the Galaxy Zoo and recognize the value of their production
<i>Enjoyment and Hobby</i>	
Brabham (2008) <i>iStockphoto</i>	The crowdsourcing site is new hybrid hobby/workplace where iStockers derive fun and enjoyment from creating, buying and commenting on photographs, videos and illustrations, in addition to the making of real money
Brabham (2008) <i>Threadless</i>	A vibrant online community exists with community members that facilitate interaction among participants. Participants thus derive enjoyment from using the site and from the products they developed, and obsession/ addiction

2.3. Process Design

Communication presents the biggest challenge in building a relationship with the crowd and managing the content generated by collective action. The existing literature primarily examines two processes, namely competitive and collaborative, for information aggregation and communication between

the outsourcers and the crowds as well as among the crowds. There is also an emerging trend of adopting a co-opetition process. These process designs employ a variety of methods:

Competition: (1) Voting and commenting. These are the most commonly adopted methods for crowds to evaluate and improve the ideas and information they generate (Saxton, Oh, and Kishore 2013). For instance, Threadless (Li and Hongjuan 2011) allows members to vote and comment on each post or idea (See appendix C figure 2.3). (2) Appropriate rating system. This is a refinement process of the votes and comments received from the crowds or experts in order to improve the quality and selection of information. An example can be seen in Yelp (Dellarocas 2010), which provides online reviews of restaurants and entertainment. A competitive crowdsourcing process often involves participants competing to win a prize for having the best idea or solution to an open call or challenge. For instance, Innocentive partnered with Prize4Life to call for a solution to measuring the progression of Amyotrophic Lateral Sclerosis (ALS) in patients. In 2006, the award of \$1 million was given to Dr. Seward Rutkove for his identification of a biomarker that can provide information cheaper and quicker for clinical trials of ALS drugs (InnoCentive 2014). With new interactive technology and communication tools, contests have been run through the Internet, where people freely access and rank ideas and make further comments.

Collaboration: Wiki. Participants and contributors can create and modify each other's content online through a technology called wiki. In the case of Future Melbourne (Liu 2016), citizens can use the editing function to modify or add content to the city's long-term development plan. Collaborative process is another alternative design that aggregates pieces of information from each individual in the crowd through a wiki, such as Wikipedia (Boudreau and Lakhani 2013), or open coding, such as Linux (Von Hippel 2005). In Linux, 700 engineers work with hundreds of open-source communities to create a range of software products. Software quality is steadily improved by accumulating the solutions proposed by each individual engineer (Boudreau and Lakhani 2013). Successful collaboration in an online community requires participants to reveal their knowledge in a transparent environment and share the outcomes of their effort jointly (Von Hippel and Krogh 2003).

Co-opetition: Community. Co-opetition is "a situation where competitors simultaneously cooperate and compete with each other" (Hutter et al. 2011, 5). Several studies argue that an effective design should

combine both competition and collaboration and build a community (Bullinger et al. 2010; Hutter et al. 2011; Lampel et al. 2012; Majchrzak and Malhotra 2013; Almirall, Lee, and Majchrzak 2014). Hutter et al.'s (2011) study finds that the winners of the projects are also the top commenters, and the best process design is one that enables a competitive participation with a cooperation climate that allows users to improve the quality of submitted ideas through constructive commenting. Such a community-based approach could optimize openness, allow negotiation of needed resources among participants (such as data information), and internalize the priority setting within the system (Almirall, Lee, and Majchrzak 2014).

2.4. Outcomes

The quality of outcomes generated by the crowd has received much attention in the existing research (Blohm et al. 2011; Boudreau 2012; Leimeister et al. 2009; Majchrzak and Malhotra 2013), yet the findings on the quality of the outputs when compared with those from experts show mixed results. For innovation driven crowdsourcing, the evaluation of outcomes show mixed results. Because idea evaluation takes time, however, crowd members often spend little time in developing their own ideas or give little attention to learning from the others' ideas (Majchrzak and Malhotra 2013). So, little evidence currently supports that crowdsourcing model can drive more innovative ideas. However, studies do show that allowing customer participate in crowdsourcing projects of the company increases customer satisfaction (Dellarocas 2010; Poetz and Schreier 2012; Nishikawa, Schreier, and Ogawa 2013).

On the other hand, for the information and service driven crowdsourcing project, evidences show that crowd contribution can be as good as the ones from the expert (Clery 2012; Anastasiou and Gupta 2011). When simple and clear instruction are provided to the crowds, See et al. (2013) found that the crowds can improve the quality of information faster than the experts. This indicates the importance of designing effective means to aggregate information from the crowds.

3. A design map for crowdsourcing in the governments

Figure 2 shows a design map for implementing crowdsourcing in the public sector. This design map includes the four key components of crowdsourcing

and three key actions that crowdsourcing managers should consider when implementing crowdsourcing. First, the government should *incentivize* the crowd to participate and contribute to the crowdsourcing project. Second, the government should *communicate* with the participants directly or facilitate communication among the participants. Third, the government needs to *aggregate* the outputs from the participant into outcomes.

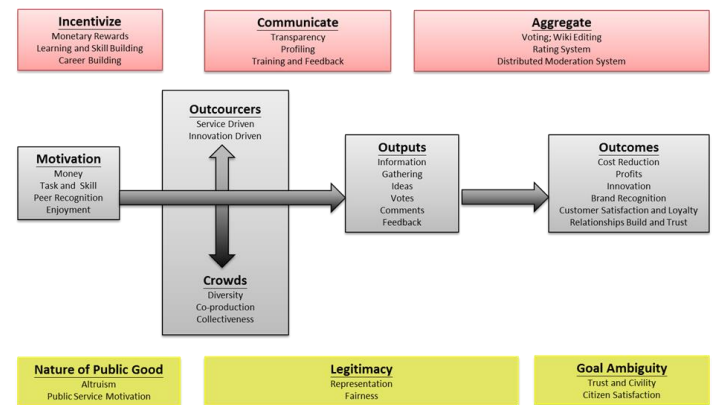


Figure 2 Crowdsourcing design Process

3.1. Strategic design of incentives

The focuses of recent studies have also shifted from “what” motivates people to “how” to motivate people. Studies on monetary incentives start to investigate how money might influence crowds' participation and performance and what amount can induce the desired outcomes (Garcia Martinez and Walton 2014). For instance, they found that money can only increase participation, but not the quality of the idea itself. Therefore, the larger the amount of the monetary incentives provided, the more ideas would be submitted and therefore the greater the likelihood of generating a good idea.

Another important study that discusses strategies on incentive design is by Tokarchuk et al. (2012). Through reviewing the existing motivational factors, they identify four variables that affect the motivation of the crowd and therefore the designers of the crowdsourcing projects should properly design strategies that provide incentives to motivate the crowds. They find that the intensity, direction, and persistence of worker performance are influenced by the goal, the nature of the tasks, the social structure, and the nature of the good. For instance, Tokarchuk et al. (2012) show that Galaxy Zoo and Moon Zoo platforms showed clear goals, low variety and specificity, neutral social structure, public good, and required only low-level skills. The participants were motivated simply by their interests in astronomy and

aided by the capacity of the task dimensions. While platforms like Threadless show clear goals, require specific skills, hierarchical structure with democratic features (i.e., voting), and private good, they find that participants are also motivated by money and skills development.

Similarly, while understanding the importance of peer influence plays a key role of motivating the crowd to contribute, allowing the crowd to constructively post comments and exchange ideas becomes an important design to motivate the crowds. Bayus (2013) shows that posting comments to others who have different ideas is positively associated with the ideas that are selected and implemented in Dell's IdeaStorm. Therefore, it is important for the designer of the crowdsourcing project to incentivize social exchange activities. One way to do so is by making active contributors more visible, providing interaction opportunities in the community, and fostering responses from members in the case of IdeasProject for Nokia's (Kosonen et al. 2013).

3.2. Communication

Earlier case studies treat crowdsourcing as a bottom-up and decentralized process, and focus on how social media can help to enhance the horizontal communication among the members of the crowd (e.g., Bonabeau 2009). Recent studies focus on the implications of crowdsourcing to the firms to enhance their customer relationship because these social media serve as two-way and interactive tools that can foster greater customer engagement and brand recognition (Baron and Warnaby 2011; Djelassi et al. 2013).

For instance, in the Lay's contest of "create your flavor of potato chips," the company involved the finalist on its package cover and shared 1% of the product sales with the finalist for a year (Djelassi et al. 2013). A participant of the contest became a salesman of the company who is committed to promoting the company's value through crowdsourcing (Djelassi et al. 2013).

When consumers have become "prosumers" (Kozinets et al. 2008) and taken part in the production process, the company needs to treat the designing of a crowdsourcing initiative as a managerial question, not a technical one (Saxton, Oh, and Kishore 2013). Adaptation of a managerial control system in crowdsourcing becomes an important step to ensure the flow of communication between the outsourcers and the crowds, and the decision on which technical function (such as online voting or commenting) to be included in the process should be a managerial, rather than based on the IT

package deal of a website company (Saxton et al. 2013).

3.3. Information aggregation

Moving from focuses of how the crowds produce tasks, more recent studies start to pay attention on how to efficiently and effectively aggregate the information and ideas generated from the crowds. From previously discussed public crowdsourcing cases, the public managers play a heavy role of reviewing, evaluating, and selecting of the work done by the crowds. For instance, the Open Government Dialogue consisted of three discussion phases. After the first public consultation on the Open Government policy phase is over, a small Advisory Board was formed to select a week-long discussion and ideas submitted in the platform in order to form potential topics for the Phase II discussion (Trudeau, 2009). Similarly, in the Peer to Patent case, patent review officers were placed at the final stage to review the report and research contributed from the crowds and make the final decision. While crowds in the idea generation competitions can vote for the best ideas, such as Challenge.gov, the crowds did not have input into how the winning ideas are implemented. The capability of crowds can be empowered further to address evaluation, selection, and monitoring.

Incorporating the crowds in the information aggregation process can help the selection and evaluation system to be more effective and efficient as well as enhance the user experiences. Studies have shown that when utilizing the crowd to provide assessment to the crowdsourcing process, the crowd can produce better results than experts in less time and with less cost (Carvalho, Lease, and Yilmaz 2010). Also, allowing the crowd to participate in the process of information selection enhance the experiences of the crowds. For instance, in the case of the Make History Project, run by the 9/11 Memorial Museum, Ellis (2014) argues that contributors don't just contribute narratives and artifacts, but also experience different perspectives when asked to combine stories together, and therefore they experience the sharing of the many stories. However, it also requires the outsourcers to be able to make a distinction between the different individual users within a crowd. The challenge is how to tell different individual's abilities in assessing information and to prevent and resolve disputes (Doan, Ramakrishnan, and Halevy 2011).

4. Conclusions

Crowdsourcing enables governments to empower the citizens to participate in the production of public services and the generation of policy innovations. Crowdsourcing has great potential to help governments reduce costs, bring in innovation, and build trust with their citizens, as this review has found in the private sector. This review accumulates knowledge on crowdsourcing for the public sector by presenting the key design components of crowdsourcing and discussing the evidences of effective designs of crowdsourcing across different disciplines. Given the success of crowdsourcing projects and their potential for the public sector, this emerging field will continue to grow. Table 3 summarizes potential actions under the three key design areas.

However, future studies should further address the transferability of private-sector crowdsourcing experiences and practices to the public sector in the following areas: (1) the nature of the public good. Several studies have addressed how the nature of the good might affect the motivation and incentive design (Tokarchuk et al. 2012) and productivity (Huberman et al. 2009) of the crowdsourcing. In Addition, more studies are needed to explore whether theories like public service motivation can better explain the motivation of the crowds in crowdsourcing in the public sector. (2) Also, legitimacy must be addressed; the method of how content and information are generated in the process and the representation of the final outcomes produced by the crowds are essential as well. (3) Finally, goal ambiguity is a unique characteristic in the public sector. Therefore, the ultimate impact of crowdsourcing should be to help governments achieve the attention they deserve from policy makers and scholars.

Table 3 Suggested Actions

Key Action Areas	Issues to Avoid
<i>Incentive Design</i>	
✧ Provide monetary rewards to attract sufficient participants	✧ Avoid crowding-out effect
✧ Design tasks to build skills or hobbies of the participants	✧ Prevent unfairness perception
✧ Feature abilities of the participants to establish reputation	✧ Unclear objectives
<i>Communication Design</i>	
✧ Make the decision rules transparent	✧ Only for one-way communication
✧ Allow participates to set up profiles and activity logs	✧ No or lack of staff to manage the process
✧ Provide timely feedbacks	

Information Aggregation Design

- | | |
|---|---|
| ✧ Invite peer reviews through voting and wiki editing | ✧ Avoid self-voting or commenting |
| ✧ Establish a rating system | ✧ Prevent cheating or inflating the ranking |
| ✧ Adopt a distributed moderation system | |

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