

Singapore Management University

Institutional Knowledge at Singapore Management University

Research Collection School of Social Sciences

School of Social Sciences

6-2017

Examination of crowdsourcing as a tool for policy making

Araz TAEIHAGH

Singapore Management University, arazth@smu.edu.sg

Follow this and additional works at: https://ink.library.smu.edu.sg/sooss_research



Part of the [Infrastructure Commons](#), and the [Policy Design, Analysis, and Evaluation Commons](#)

Citation

TAEIHAGH, Araz.(2017). *Examination of crowdsourcing as a tool for policy making*. Paper presented at the 3rd International Conference on Public Policy (ICPP3), Singapore, 2017 June 28-30, Singapore.

Available at: https://ink.library.smu.edu.sg/sooss_research/2376

This Conference Paper is brought to you for free and open access by the School of Social Sciences at Institutional Knowledge at Singapore Management University. It has been accepted for inclusion in Research Collection School of Social Sciences by an authorized administrator of Institutional Knowledge at Singapore Management University. For more information, please email cherylids@smu.edu.sg.



**3rd International Conference
on Public Policy (ICPP3)
June 28-30, 2017 – Singapore**

Panel T01P08 Session 1

Crowdsourcing as a Policy Tool: Co-Production in the Digital Era

Title of the paper:

Examination of crowdsourcing as a tool for policy making

Author

Araz Taeihagh, Singapore Management University, Singapore

Friday, June 30th 10:30 to 12:30 (Block B 2 - 1)

Examination of crowdsourcing as a tool for policy making

Araz Taeihagh¹

Singapore Management University

Abstract – Crowdsourcing is rapidly evolving and applied in situations where ideas, labour, opinion or expertise of large groups of people are used. Crowdsourcing is now used in various policy making initiatives; however, this use has usually been focused on open collaboration platforms and specific stages of the policy process such as agenda-setting and policy evaluations. Moreover, other forms of crowdsourcing have been neglected in policy making with a few exceptions. This article examines crowdsourcing as a tool for policy making and explores the nuances of the technology and its use and implications for different stages of the policy process. The article addresses questions around the role of crowdsourcing and whether it can be considered as a policy tool or a technology enabler.

Keywords: Crowdsourcing, Public Policy, Policy Process, Policy cycle, Policy Instrument, Policy Tool, Open Collaboration, Virtual Labour Markets, Tournaments, Competition,

¹ School of Social Sciences, Singapore Management University, 90 Stamford Road, Level 4, Singapore 178903, Singapore. E-mail: araz.taeihagh@new.oxon.org

Introduction

Crowdsourcing is becoming ubiquitous! And in the words of Lehdonvirta and Bright (2015, p. 263) "If elections were invented today, they would be called Crowdsourcing the Government". Crowdsourcing (Howe 2006, 2008; Brabham 2008) is rapidly evolving and now is loosely applied to instances where a relatively large number of individuals are engaged for their ideas, expertise, opinions, or labour (Lehdonvirta and Bright 2015; Prpić and Shukla 2016). Crowdsourcing has now expanded from focusing on engaging consumers and businesses to non-commercial domains. Furthermore, application of crowdsourcing can increase citizen engagement in policy-making and foster citizen empowerment (Aitamurto 2012, 2016b). Crowdsourcing has now been employed in the policy making in areas such as urban planning (Seltzer and Mahmoudi 2013), transportation (Nash 2009), law reforms (Aitamurto 2016a) and global governance (Gellers 2016). Furthermore, as demonstrated by Prpić, Taeihagh and Melton (2014a), crowdsourcing has the potential to aid in addressing some of the prevailing challenges in data and judgments acquisition for policy design and analysis (Taeihagh 2017b).

Despite the recent advancements in the use of crowdsourcing in the public sector, only a handful of studies methodologically examine the use of crowdsourcing in the policy cycle. Prpić, Taeihagh and Melton (2014b,c; 2015) demonstrated that although the use of crowdsourcing in the policy cycle is increasing, it is still limited and not all of its potentials has been realised. Scholars have mainly used Open Collaboration (OC) platforms in agenda-setting, problem definition and policy evaluation stages and other approaches such as Tournament Crowdsourcing (TC) or Virtual Labour Markets (VLM) have been neglected with a few exceptions.

In the next section, we briefly introduce the concept of crowdsourcing and distinguish between different general types of crowdsourcing. Then we will systematically examine different roles of crowdsourcing in the policy cycle and highlight the nuances of the different types of crowdsourcing and illustrate their similarities and differences and develop a taxonomy of the major types of crowdsourcing to facilitate future studies by distinguishing between procedural or substantive policy tools and front-end or back-end

policy tools and take steps to develop more empirical studies to better understand the efficacy of their use in the policy cycle. This will allow us to distinguish different applications of principal types of crowdsourcing as policy tools.

Crowdsourcing

Crowdsourcing is an umbrella term, and the definition and scope of the term vary among scholars. Crowdsourcing is used for when dispersed knowledge of individuals and groups are leveraged to take advantage of bottom-up crowd-derived inputs and processes with efficient top-down engagement from organisations through IT, to solve problems, complete tasks, or generate ideas (Howe 2006; 2008; Brabham 2008; 2013a).

Crowdsourcing can be done in a closed environment in which “propriety crowds” are utilised through in-house platforms by an organisation, or carried out using third-party platforms crowdsourcing that provides the IT infrastructure and their crowd of participants to the potential pool for organizations to tap into as a paid service (Bayus 2013, Prpić, Taeihagh and Melton, 2015).

In this article we focus on the main three types of crowdsourcing identified in the literature and try to develop a more nuanced understanding of the crowdsourcing concept and how it applies to the policy cycle (Estellés-Arolas & González-Ladrón-de-Guevara 2012; de Vreede, et al, 2013; Prpić, Taeihagh and Melton 2015)². These three general forms of crowdsourcing focus on:

- a) microtasking in VLMs (Prpić, Taeihagh & Melton 2014a; Luz, Silva & Novais 2015; De Winter et al. 2015),
- b) TC competition (Schweitzer et al. 2012; Zhang et al. 2015; Glaeser et al. 2016) and,
- c) OC over the web and social media (Budhathoki and Haythornthwaite 2013; Michel, Gil and Hauder, 2015; Mergel 2015).

² These categorizations are not exclusive or exhaustive but useful for considering different roles crowdsourcing can take in the policy cycle, for a review of the state-of-the-art in crowdsourcing see Prpić (2016).

Virtual Labour Marketplaces (VLMs)

A Virtual Labour Marketplaces (VLM) is an IT-mediated market that enables individuals to engage in spot labour, through conducting microtasks that are offered by organisations, exemplifying the production model of crowdsourcing in exchange for money (Brabham 2008; Horton & Chilton 2010; Paolacci, Chandler, & Ipeirotis 2010; Prpić, Taelhagh & Melton 2014a; Luz, Silva & Novais 2015; De Winter et al. 2015).

Microtasks is best known to be offered by Amazon Mechanical Turk (Mturk.com), and Crowdfunder (crowdfunder.com) include tasks such as document translation, content moderation, transcription, sentiment analysis, photo and video tagging, and categorization (Narula et al. 2011, Crowdfunder 2016). Such tasks can be broken down into different steps (microtasks) that can be carried out at scale and in parallel by individuals through human computational power.

At the moment, these microtasks are better performed by human computation and through collective intelligence rather than by using computational approaches and reliance on artificial intelligence (Taelhagh 2017b). Moreover, the majority of the micro-tasks offered on these platforms are repetitive and require low to medium levels of skill, and thus the compensations per task are low, and the labourers involved in the VLM platforms are employed anonymously.³ In VLM platforms often labourers cannot form teams or groups, and there is only an episodic engagement among them and the platform. This is purely a function of the design of the VLM platforms and can (and will probably) change in future which will enable completion of more sophisticated tasks and more complex interactions among crowds.

Tournament Crowdsourcing (TC)

³ With respect to their offline identities. However, researchers such as Lease et al. (2013) have previously demonstrated that significant amount of information can be exposed about the workers through the VLM websites.

In Tournament Crowdsourcing (TC) or Idea Competition (Piller & Walcher 2006; Jeppesen & Lakhani 2010; Schweitzer et al. 2012; Glaeser et al. 2016) organisations post their problems to specialised IT-mediated platforms (Eyreka or Kaggle) or in-house platforms (Challenge.gov - Brabham 2013b). Here organisers form a competition through the It-mediated platform and set conditions and rules for the competition, and winner(s) prize. Individuals or groups (depending on the capabilities of the IT platform and rules of the contest) post their solutions to the posted problems using the platform to be considered for the prize which can range from a few hundred dollars to hundred thousands of dollars or more.⁴

TC platforms mainly aim to attract and maintain more specialised crowds that are interested in a particular area which is the focus of the platform that can range from open government and innovation (The White House 2010) to computer or data science (Lakhani et al. 2010; Taieb and Hyndman 2014). Tc platforms attract smaller and more specialised crowds that are capable of solving more complex tasks, and at times choose not to be anonymous to gain reputational benefits from their successful participations (Prpić, Taeihagh and Melton, 2015).

Open Collaboration (OCs)

In the Open Collaboration (OC) crowdsourcing, crowds voluntarily engage with the problems /opportunities posted by organisations through IT platforms without expectation of monetary compensation (Crump 2011; Michel, Gil and Hauder, 2015). Starting wikis, and employing online communities and social media to amass contributions, are examples of OCs (Jackson & Klobas 2013; Crowley et al. 2014; Rogstadius et al. 2013; Budhathoki and Haythornthwaite 2013; Mergel, 2015).

The level of engagements from the crowds depends on many factors such the effectiveness of the 'open call' as well as the reach and level of engagement of the IT-mediation platform used by the organisation and the crowd capital of the organisation (Prpić Taeihagh Melton 2015; Prpić and Shukla 2013). As an example, as of June 30,

⁴ <https://www.kaggle.com/competitions>

2016, Twitter has more than 313 million monthly active users.⁵ However, this does not necessarily translate to significant engagement from the active users of a platform.

There are numerous factors influencing the level of traction, diffusion and ultimately success of an open call in an OC platform, a small number of these factors include the level of prior engagement and popularity of the organisation on the platform, number of followers and shares of the content/calls made by the organisation, as well as the popularity and stature of the crowds they engage (e.g. attention from celebrities, Nobel laureates) alongside the quality of the content posted (Cha et al. 2010; Taeihagh 2017a). Furthermore, any number of these individuals engaging in the open call can alter, hijack or amplify the agenda of the organisation with their networks (Prpić and Shukla 2013; Prpić, Taeihagh and Melton 2015).

The three crowdsourcing principal types crowdsourcing described above have different levels of accessibility, crowd magnitude, crowd specialisations, anonymity, and IT structure, as well as Platform framework and interactions (Prpić, Taeihagh and Melton 2015; Taeihagh 2017a - see Table 1). Table 1 demonstrates that different types of crowdsourcing each have unique sets of characteristics while sharing similarities with other types.

⁵ <https://about.twitter.com/company>

Table 1 Comparison of different types of crowdsourcing (based on Prpić, Taeihagh, Melton 2015 and Taeihagh 2017a)

	Accessibility	Crowd Magnitude	Nature of the Crowd	Anonymity	Platform Architectural Framework	IT-Structure	Platform Interactions
Virtual Labour Markets (e.g. Amazon MTurk)	Private	Millions	General	High	Community building and Infrastructure Provision	Episodic	Information, currency, and virtual services
Tournament Crowdsourcing (e.g. Kaggle)	Private	Hundreds of Thousands	Specialized	Medium	Community building	Episodic	Information, currency, and virtual services
Open Collaboration (e.g. Twitter)	Public	Hundreds of Millions	General	Variable	Community building	Collaborative	Information

Crowdsourcing as a Policy Tool

Given the brief description of principal types of crowdsourcing, we now examine crowdsourcing as a policy tool using Hood's NATO model (Hood 1986; 2007; Hood and Margetts 2007). In NATO model, by using the following four types of resources governments can address policy problems (see Table 2):

- Informational advantage through centrality in various networks (nodality),
- legal power to command, regulate, or delegate (authority),
- financial means such as the ability to fund or demand taxes (treasure), and,
- deploying resources to form organisations and markets, provide goods and services (organisation).

The NATO Model does not demand a strict singular dependence of an instrument on one of the four resources. Instead, instruments are categorised according to the primary means

they require for successfully addressing their goals. A second distinction used by Hood in characterising various tools was whether they were used for detecting changes in the environment (detector) or for effecting the outside world (effector). Similar to the effector/detector distinction, Howlett (2000) introduced the positive/negative distinction between policy instruments based on whether they encourage or discourage actor participation in the policy process. Another relevant distinction here is consideration of whether these policy instruments are substantive (directly providing or altering aspects of provision, distribution or delivery of goods and services to members of the public or governments) or procedural (rather than directly affecting the delivery of goods and services, their principal intent is to modify or alter the nature of policy processes at work and indirectly altering behaviour of actors involved in policy making) Howlett (2000; 2010).

Given distinct functions and characteristics of OC, VLM and TC crowdsourcing, they can play different roles as policy tools. Moreover, arguably each of the principal types of crowdsourcing can also play various roles. For instance, OC crowdsourcing can be used for surveys, information collection and release, and advertising, thus considered as an information/Nodality based tool that can act as an effector and a defector, or be used for community and voluntary organization of crowds and be considered an organization based tool that can be used as an effector for community support or suppression or detector for statistics. However, Prpić, Taeihagh and Melton (2014c; 2015) have demonstrated that the use of crowdsourcing in the policy cycle (although increasing) thus far has been limited. Scholars have mainly used OC platforms in agenda-setting, problem definition and policy evaluation stages and other approaches such as TC or VLMs have been neglected with a few exceptions.

Table 2 Example of Policy Instruments by Principal Governing Resources (Howlett, Ramesh and Perl (1995) based on Hood (1986).

Nodality/Information	Authority	Treasure	Organization
<i>Information collection and release</i>	Command and control regulation	Grants and loans	Direct provision of goods and services and public enterprises
<i>Advice and exhortation</i>	Self-regulation	User charges	Use of family, community, and voluntary organizations
<i>Advertising</i>	Standard setting and delegated regulation	Taxes and tax expenditures	Market creation
<i>Commissions and inquiries</i>	Advisory committees and consultations	Interest group creation and funding	Government reorganization

It has been suggested in the literature that Hood’s mode (1986) is no longer applicable to 21st-century tools such as crowdsourcing. However, as Lendonvirta and Bright (2015) point out the use of these tools is not replacing participatory approaches already in place but augmenting them given the enabling power of the new digital technology. This is because the speed and ease with which these participations are happening have increased significantly which in turn has resulted in orders of magnitude increase in the number of participations.

Using Hood's and Howlett's taxonomies at first glance, it appears that all of the principal types are substantive in nature and, OC relates to Nodality and Organization because of dominant thinking about social media (Twitter, Facebook, etc.) and community organisation through voluntary OC platforms (e.g. Enterprise Wikis). Similarly, TC because of the requirement of relatively larger sums of money relates to Treasure and VLMs relate to Organization primarily.

However, a closer look reveals that the picture is much more nuanced. In Table 3 and 4 we highlight the potential for applications of Substantive (Table 3) and Procedural

(Table 4) use of VLM, OC, and TC Crowdsourcing as policy tools based on the NATO model.

Table 3 and 4 highlight that the principal types of crowdsourcing can almost be used as every type of policy tool based on NATO model (1986). Although surprisingly different from current documented application of crowdsourcing in the literature by Prpić, Taeihagh and Melton (2015), we speculate this is because fundamentally IT-mediated crowdsourcing platforms act as technological enablers and catalysts for the participation of crowds in the policy cycle and as such can have almost limitless applications in the policy processes.

Table 3 Potential Examples of Substantive applications of VLM, OC, and TC Crowdsourcing as policy tools based on Howlett (2010) (D= Detector)

Nodality	Authority	Treasure	Organization
Commissions and inquiries (OC) (D)	Census-taking consultants (Local VLM) (D)	Consultants (VLM) (D)	Market Creation (VLM)
Information collection (OC, VLM) (D)	Committees and consultations (OC) (D)	Grants, Loans, and Tax Expenditure (OC, VLM, TC)	Statistics (OC, VLM) (D)
Surveys (OC, VLM) (D)	Standard setting and regulation (OC)	Polling Policing (Local VLM) (D)	Use of community and voluntary organisations (OC, VLM, TC)
		Taxes (VLM, OC)	

Source: Author

Table 4 Potential Examples of Procedural applications of VLM, OC, and TC Crowdsourcing as policy tools based on Howlett (2010) (N= Negative, D= Detector)

Nodality	Authority	Treasure	Organization
Information campaigns And advertising (OC, VLM)	Advisory group creation (OC, VLM) D	Interest group creation and funding (VLM, OC)	Evaluations (VLM, TC, OC) (D)
Information release and notification (OC)	Banning groups and associations (VLM, OC) (N)	Research funding (VLM, TC) (D)	Hearings (OC) (D)
Misleading, information propaganda and	Agreements and Treaties (OC)	Eliminating funding (VLM, OC) (N)	Information suppression (OC, VLM) (N)

censorship (N) (OC, VLM)			
-----------------------------	--	--	--

Source: Author

Table 5 examines these potential roles in different stages of the policy cycle⁶. Here we use the Front-end (agenda-setting, problem formulation and policy formulation) and back-end (policy implementation, enforcement, and evaluations) terminology introduced by Howlett (2009).

The most commonly observed use of crowdsourcing as a policy tool in the literature is the use of OC as substantive front-end nodal tool focused on agenda-setting and policy design stages so far, followed by back-end nodal OC used for policy evaluations and front-end Treasure use of TC (Prpić, Taeihagh and Melton 2015). However, principal types of crowdsourcing as summarised in Table 5 can be used as enablers of almost every application of policy tools according to NATO model.

These examples show that although there are convergences around specific themes in terms of the means used, goals for the use of the principal crowdsourcing types can be completely different. A potential worrying development in case of massive adoption of crowdsourcing such as in the examples highlighted in Table 5 is the difficulty of upholding oversight and keeping organizations accountable in future especially if block-chain technology is used as the level of anonymity increases⁷.

Table 5 Categorization of potential applications of principal types of crowdsourcing (VLM/TC/OC) as policy tools in the policy cycle

F= Front-end ((agenda-setting, problem definition and policy formulation)
 B =Back-end (Policy implementation, enforcement and evaluation)
 D/E= Detector/Effector; S/P Substantive/Procedural; N/P= Negative/Positive

⁶ Various classification attempts, and corresponding models of the policy processes exist of which perhaps the most popular is the use of sequential interrelated stages as a policy cycle. In this article, based on the efforts of Stone (1988), and Howlett Ramesh and Perl (1995), the policy cycle is seen as a sequence of steps in which agenda setting, problem definition, policy design, policy implementation, policy enforcement, and policy evaluations are carried out in an iterative manner (Taeihagh et al., 2009).

⁷ Block-chain technology such as bitcoin is not anonymous however relative to traditional means of monetary exchange (in the hands of expert individuals) it has higher level of anonymity as it does not require sending and receiving personally identifiable information <https://bitcoin.org/en/protect-your-privacy>

Application/Type	VLM	TC	OC	D/E	S/P	N/P	NAT O type	(Potential) Examples
Advisory group creation	B		B		P		A	VLM or OC participation in advisory groups
Agreements and Treaties			F		P		A	Use of Ocs for treaty verification
Banning Groups and Associations	B		B		P	N	A	Identification and banning groups online or locally using volunteers or paid workers
Census-taking consultants	F			D	S		A	Hiring local VLM participants for conducting census
Committees and consultations			F	D	S		A	Use of Ocs for forming online committees or receiving submissions for white papers etc.
Standard setting and delegated regulation			F		S		A	e.g. the Finish experiment
Commissions and inquiries			B	D	S		N	submissions to parliamentary inquiries
Information Campaigns and Advertising	B		B		P		N	advertising using social media, hiring individuals through VLMS to participate in the online (or local campaign)
Information Collection and Surveys	F	F	F	D	S		N	Conducting surveys using social media or VLM platforms and small TC competitions
Information release and notification			B		P		N	Release of information using social media
Misleading, information propaganda and censorship	B		B		P	N	N	Use of VLM and OC for identification and censorship of what is deemed as inappropriate.
Community and Voluntary organisations	F, B	F, B	F, B		S		O	Supporting formation and participation in Nonprofit groups using monetary and nonmonetary means - receiving solutions or evaluations
Evaluations	B	B	B	D	P		O	Use of social media for in OC for receiving crowd feedback, use of VLMS for evaluation of programmes, development of tournaments for evaluation of particular programmes
Hearings			B		P		O	Use of social media for collection of evidence and participation of crowds in hearings
Information Suppression	B		B		P	N	O	Voluntary or paid use of crowds for suppressing information using information obfuscation

Market Creation	B				S		O	Formation of particular forms of online markets that can also have offline functionality
Statistics	B		B	D	S		O	Collection of statistical data by encouraging voluntary participation of crowds in OC or paid participation of targeted crowds using VLMS
Consultants	F			D	S		T	Hiring consultants from experts workers (e.g. platforms such as odesk, upwork and topcoder)
Eliminating funding	B	B			P	N	T	Eliminating previously funded research through TC and VLM platforms
Grants, loans and Tax-expenditure	B	B	B		S		T	Tax expenditure for funding individuals directly through markets or competitions (e.g. research groups) or indirectly by providing support for creating of OC platforms
Interest group creation and funding	F		F		P		T	Funding for creating websites for participation around specific topics or hiring individuals to participate in activities relevant to special interests
Poll Policing	B			D	S		T	Hiring individuals to monitor polls (local VLM (also categorised as sharing economy))
Research funding	B	B		D	P		T	Funding research for large endeavours through TC platforms or use of expert crowds for conducting research using VLMS (e.g. upwork)
Taxes	B		B		S		T	Use of volunteers of paid workers for identifying tax evasion (e.g. identifying pools using aerial photos for water consumption usage or appropriate property tax)

Source: Author

Crowdsourcing in Policy Design

Given the rapid developments in crowdsourcing, and the potential it offers in scale up of the number of individuals involved and rapid acquisition of data and judgements, particularly if expert crowds are involved, which is significant for addressing uncertainties surrounding the policy design and analysis (Taeihagh, 2017b).

Furthermore, crowdsourcing can increase the level of citizen engagement in policy-

making which has particularly been limited in the policy formulation phase (Prpić, Tæihagh and Melton, 2015; Aitamurto 2012, 2016b).

Prpić, Tæihagh and Melton (2014a) examined the viability of non-experts using VLMS in assisting in policy design. Using the results from an assessment of climate change adaptation policy instruments as a benchmark, they created experiments with different crowds; One local to the policy context and the other an at-large crowd with no familiarity with the local context. The experiments showed that a non-expert crowd recruited using VLMS could quickly and cost-effectively sift through a large set of policy measures related to a complicated climate change policy scenario. The results demonstrated that the geographic context mattered and altered the performance of non-expert crowds and the assessments of the at-large crowds of non-experts aligned more closely with the expert assessments.

The results from a recent literature review demonstrate that at present the use of crowdsourcing in policy design is extremely limited (Prpić, Tæihagh and Melton (2014c; 2015). As such further development of new theoretical frameworks and experiments for exploring and exploiting the potentials that crowdsourcing offers in addressing policy issues are important. Tæihagh (2017b) proposes the examination of new roles for both expert and non-expert crowds in different stages of the policy cycle and an integrated use of crowdsourcing with decision support systems. As at present collection, characterization and examination of the interactions among a large number of policy measures are apparent. Using underutilised types of crowdsourcing namely VLMS and TCs potentially can address some of these challenges. For policy design, in particular, crowdsourcing can potentially be used for collection and characterisation of different policy measures, examination of the policy measure interactions as well as evaluation of the proposed and implemented policies Tæihagh (2017b).

Crowdsourcing provides the ability to scale up the level of engagement (by increasing the number of expert or non-expert participant) and as a result increase the speed of conducting these activities when compared with approaches such as organising workshops or conducting offline surveys as the popularity of crowdsourcing in its

different forms increases over time.^{8,9} Furthermore, as TCs become more popular and engage more specialised crowds that are able to address complex tasks and as platforms are further developed more can be accomplished using crowdsourcing. Increasing the ease of use and accessibility of these crowdsourcing platforms will further facilitate their direct integration with decision support system through Application Programming Interfaces (API).

Conclusion

In this article, we first briefly introduced the literature on crowdsourcing and considered the three principal types of crowdsourcing and examined their characteristics. We then presented the notion of a generic policy tool using Hood's NATO model (1986) and Howlett's distinction between substantive and procedural Instruments (Howlett 2000, 2010). Using these models, we examined the potential applicability of principal types of crowdsourcing first as different substantive and procedural policy tools and then systematically explored their applications in the policy cycle tools highlight the discrepancy between their current documented use and potentials for future use. We then focused on the potential new roles for crowdsourcing in policy design stage.

We hope that this study illustrates the new potential use of crowdsourcing to scholars and practitioners and facilitates the development of more empirical studies (VLMs and TCs in particular) to better understand the efficacy and various potentials for their use in the policy cycle.

⁸ Even in the case of online surveys, the speed at which a worker can carry out a micro-task is much faster than an online survey, as demonstrated by Prpić, Tæihagh and Melton (2014a).

⁹ Expert crowdsourcing mainly through competition-based platforms (and in future high skilled VLMs sites once their use becomes more mainstream) and non-expert crowdsourcing through the use of VLMs. OC platforms provide access to both expert and non-expert crowds but require a more sustained effort in attracting and maintaining crowds.

References

- Aitamurto, T. (2012). *Crowdsourcing for Democracy: New Era in Policy-Making*. Publications of the Committee for the Future, Parliament of Finland. 1/2012. Helsinki, Finland.
- Aitamurto, T. (2016a). Collective Intelligence in Law Reforms: When the Logic of the Crowds and the Logic of Policymaking Collide. In 2016 49th Hawaii International Conference on System Sciences (HICSS) (pp. 2780-2789). IEEE.
- Aitamurto, T., & Landemore, H. (2016b). Crowdsourced Deliberation: The Case of the Law on Off- Road Traffic in Finland. *Policy & Internet*, 8(2), 174-196.
- Bayus, B. L. (2013). Crowdsourcing new product ideas over time: An analysis of the Dell IdeaStorm community. *Management Science*, 59(1), 226-244.
- Bicquelet, A., and Weale, A. (2011). Coping with the Cornucopia: Can Text Mining Help Handle the Data Deluge in Public Policy Analysis? *Policy & Internet*, 3(4), 1-21.
- Brabham, D. C. (2008). Crowdsourcing as a model for problem-solving an introduction and cases. *Convergence*. 14(1), 75-90.
- Brabham, D.C. (2013a). *Crowdsourcing*. The MIT Press.
- Brabham, D.C. (2013b). Using Crowdsourcing in Government. IBM Center for The Business of Government.
<http://www.businessofgovernment.org/sites/default/files/Using%20Crowdsourcing%20In%20Government.pdf>
- Budhathoki, N. R. and Haythornthwaite, C. (2013). Motivation for open collaboration crowd and community models and the case of OpenStreetMap. *American Behavioral Scientist*, 57(5), 548–575.
- Crowdfunder (2016). Crowdfunder Inc. Retrieved 20 May 2016 www.crowdfunder.com
- Crowley, C., Daniels, W., Bachiller, R., Joosen, W. and Hughes, D. (2014). “Increasing user participation: An exploratory study of querying on the Facebook and Twitter platforms,” *First Monday*, V(19), N(8).
- Crump, J. (2011). What are the police doing on Twitter? Social media, the police and the public. *Policy & Internet*, 3(4), 1-27.
- De Vreede, T., Nguyen, C., De Vreede, G. J., Boughzala, I., Oh, O. and Reiter-Palmon, R. (2013). A Theoretical Model of User Engagement in Crowdsourcing.

Collaboration and Technology Lecture Notes in Computer Science Volume 8224 (94–109). Springer.

- De Winter, J. C. F., Kyriakidis, M., Dodou, D. and Happee, R. (2015). Using CrowdFlower to study the relationship between self-reported violations and traffic accidents. Proceedings of the 6th International Conference on Applied Human Factors and Ergonomics (AHFE). Las Vegas, NV. Available at <http://ssrn.com/abstract=2592903>
- Estrelles-Arolas, E. and Gonzalez-Ladron-De-Guevara, F. (2012). Towards an integrated crowdsourcing definition. *Journal of Information Science*. 38(2), 189–200.
- Gellers, J. C. (2016). Crowdsourcing global governance: sustainable development goals, civil society, and the pursuit of democratic legitimacy. *International Environmental Agreements*:
- Glaeser, E. L., Hillis, A., Kominers, S. D. and Luca, M. (2016). Crowdsourcing City Government: Using Tournaments to Improve Inspection Accuracy. *The American Economic Review*, 106(5), 114–118.
- Hood, C. (1986). *The Tools of Government*. Chatham, Chatham House Publishers.
- Hood, C. (2007). "Intellectual Obsolescence and Intellectual Makeovers: Reflections on the Tools of Government After Two Decades." *Governance* 20(1): 127-144.
- Hood, C. and H. Margetts (2007). *The Tools of Government in the Digital Age*. London, Palgrave Macmillan.
- Horton, J. J. and Chilton, L. B. (2010). The labour economics of paid crowdsourcing. In Proceedings of the 11th ACM Conference on Electronic Commerce (209–218). ACM.
- Howe, J. (2006). Crowdsourcing: Crowdsourcing: A Definition. Crowdsourcing.com. http://crowdsourcing.typepad.com/cs/2006/06/crowdsourcing_a.html
- Howe, J. (2008). Crowdsourcing: Why the Power of the Crowd Is Driving the Future of Business. *Crown Business*. <http://www.bizbriefings.com/Samples/IntInst%20---%20Crowdsourcing.PDF>
- Howlett, M. (2009). Government communication as a policy tool: A framework for analysis. *Canadian Political Science Review*, 3(2), 23-37.
- Howlett, M. (2010). *Designing Public Policies: Principles and Instruments*. Taylor & Francis.

- Howlett, M., (2000). Managing the hollow state: Procedural Policy Instruments and Modern Governance. *Canadian Public Administration* 43, no. 4: 412-31.
- Howlett, M., Ramesh, M., & Perl, A. (1995). *Studying public policy: Policy cycles and policy subsystems*. Toronto: Oxford University Press.
- Jackson, P., & Klobas, J. (2013). Deciding to use an enterprise wiki: the role of social institutions and scripts. *Knowledge Management Research & Practice*, 11(4), 323-333.
- Jeppesen, L. B., & Lakhani, K. R. (2010). Marginality and problem-solving effectiveness in broadcast search. *Organisation Science*, 21(5), 1016-1033.
- Kao A. and Poteet S.R. (2007). Overview. In: A. Kao and S.R. Poteet (eds.), *Natural Language Processing and Text Mining*. Springer, London. 1-7.
- Krishen, A. S., Raschke, R. L., Kachroo, P., Mejza, M., and Khan, A. (2014). Interpretation of public feedback to transportation policy: a qualitative perspective. *Transportation Journal*, 53(1), 26-43.
- Lakhani, K., Garvin, D. A. and Lonstein, E. (2010). Topcoder (a): Developing software through crowdsourcing. *Harvard Business School General Management Unit Case* (610-032).
- Lehdonvirta, V., & Bright, J. (2015). Crowdsourcing for public policy and government. *Policy & Internet*, 7(3), 263-267.
- Luz, N., Silva, N. and Novais, P. (2015). A survey of task-oriented crowdsourcing. *Artificial Intelligence Review*, 44(2), 187-213.
- Mergel, I. (2015). Open collaboration in the public sector: The case of social coding on GitHub. *Government Information Quarterly*, 32(4), 464-472.
- Michel, F., Gil, Y. and Hauder, M. (2015). A virtual crowdsourcing community for open collaboration in science processes. Americas Conference on Information Systems (AMCIS).
- Narula, P., Gutheim P., Rolnitzky, D., Kulkarni, A. and Hartmann, B. (2011). MobileWorks: A Mobile Crowdsourcing Platform for Workers at the Bottom of the Pyramid. *Proceedings of HCOMP*.
- Nash, A. (2009). Web 2.0 Applications for Improving Public Participation in Transport Planning. In Transportation Research Board 89th Annual Meeting.
- Paolacci, G., Chandler, J. and Ipeirotis, P. G. (2010). Running experiments on Amazon

- Mechanical Turk. *Judgment and Decision Making*, 5(5), 411–419.
- Piller, F. T. and Walcher, D. (2006). Toolkits for idea competitions: a novel method to integrate users in new product development. *R&D Management*, 36(3), 307–318
- Politics, Law and Economics, 16(3), 415-432.
- Prpić, J. (2016). Next Generation Crowdsourcing for Collective Intelligence. *Collective Intelligence*.
- Prpić, J., & Shukla, P. (2016). Crowd Science: Measurements, Models, and Methods. In 2016 49th Hawaii International Conference on System Sciences (HICSS) (pp. 4365-4374). IEEE.
- Prpić, J., Taeihagh, A., and Melton, J. (2014a). Experiments on Crowdsourcing Policy Assessment, Oxford Internet Policy and Politics Conference (IPP 2014), University of Oxford, 26–28 September 2014.
http://ipp.oii.ox.ac.uk/sites/ipp/files/documents/IPP2014_Taeihagh.pdf.
- Prpić, J., Taeihagh, A., and Melton, J. (2014b). Crowdsourcing the Policy Cycle, *Collective Intelligence 2014*, Massachusetts Institute of Technology, June 10-12, 2014 <http://ssrn.com/abstract=2398191>.
- Prpić, J., Taeihagh, A., and Melton, J. (2014c). A Framework for Policy Crowdsourcing, Oxford Internet Policy and Politics Conference (IPP 2014), University of Oxford, 26–28 September 2014.
http://ipp.oii.ox.ac.uk/sites/ipp/files/documents/IPP2014_Taeihagh%20%282%29.pdf.
- Prpić, J., Taeihagh, A., and Melton, J. (2015). The fundamentals of policy crowdsourcing. *Policy & Internet*, 7(3), 340-361.
<http://dx.doi.org/10.1002/poi3.102>.
- Rogstadius, J., Vukovic, M., Teixeira, C. A., Kostakos, V., Karapanos, E. and Laredo, J.A. (2013). CrisisTracker: Crowdsourced social media curation for disaster awareness. *IBM Journal of Research and Development*, 57(5), 1–4.
- Schweitzer, F. M., Buchinger, W., Gassmann, O. and Obrist, M. (2012). Crowdsourcing: Leveraging innovation through online idea competitions. *Research-Technology Management*, 55(3), 32–38

- Seltzer, E. & Mahmoudi, D. (2013). Citizen Participation, Open Innovation, and Crowdsourcing Challenges and Opportunities for Planning. *Journal of Planning Literature*. 28(1), 3-18.
- Stone, D. A. (1988). *Policy Paradox and Political Reason*. Harper Collins.
- Taeihagh, A. (2017a). Crowdsourcing, Sharing Economy and Development, *Journal of Developing Societies*, Vol 33(2): 1–32. DOI: 10.1177/0169796X17710072
- Taeihagh, A. (2017b). Network Centric Policy Design, *Policy Sciences Journal*. 50(2): 317-338 <http://dx.doi.org/10.1007/s11077-016-9270-0>
- Taeihagh, A., Bañares-Alcántara, R., & Millican, C. (2009). Development of a novel framework for the design of transport policies to achieve environmental targets. *Computers & Chemical Engineering*, 33(10), 1531-1545.
- Taieb, S. B. and Hyndman, R. J. (2014). A gradient boosting approach to the Kaggle load forecasting competition. *International Journal of Forecasting*, 30(2), 382–394.
- The White House (2010). Guidance on the Use of Challenges and Prizes to Promote Open Government. https://www.whitehouse.gov/sites/default/files/omb/assets/memoranda_2010/m10-11.pdf
- Uschold, M., & Gruninger, M. (1996). Ontologies: Principles, Methods and Applications. *The knowledge engineering review*, 11(02), 93-136.
- Zhang, Y., Gu, Y., Song, L., Pan, M., Dawy, Z. and Han, Z. (2015). Tournament-Based Incentive Mechanism Designs for Mobile Crowdsourcing. 2015 IEEE Global Communications Conference (GLOBECOM) (1–6). IEEE.