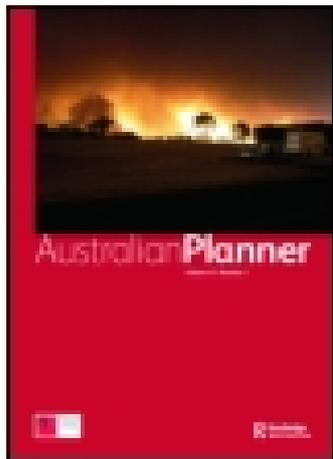


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Engaging the wisdom of crowds and public judgement for land use planning using public participation geographic information systems

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More effective collaboration is a recurring theme to improve public participation in planning. But collaborative processes are constrained by the number of people that can participate, limiting the diversity and independence of planning participants resulting in suboptimal planning outcomes. This article argues that *crowd sourcing* and *public judgement* using public participation geographic information systems (PPGIS) can result in better planning outcomes. The *wisdom of crowds* refers to a phenomenon where collective opinion generates superior solutions to a problem than can be obtained by any individual in the group; *public judgement* refers to high-quality public opinion that is firm, consistent and mindful of consequences. PPGIS is a means to operationalise and translate the *wisdom of crowds* and *public judgement* into spatially explicit information for land use decisions. This article presents the conditions for engaging crowd wisdom and public judgement using PPGIS to collect spatially explicit planning information, followed by examples that illustrate the benefits. Technology exists to expand the use of PPGIS for planning, but there is resistance from influential segments of society that do not trust the *wisdom of crowds*. Innovators within planning practice are encouraged to provide opportunities to test and evaluate crowd-sourced planning solutions.

Keywords: wisdom of crowds; public judgement; public participation GIS; PPGIS; land use planning

Introduction

The purpose and effectiveness of public participation in Western societies have been the source of much academic discourse, prompted by Arnstein's (1969) oft-cited essay on levels of citizen participation. Much of the discourse has focused on the meaning of participation and citizen power in the decision-making process. Innes and Booher (2004) argue that legally required participation methods such as public hearings and review and comment procedures do not meet most basic goals for public participation and often result in anger and mistrust. In their participation strategies for the future, they advocate collaborative participation based on authentic dialogue and the building of social networks and institutional capacity as a pathway to better planning outcomes. Daniels and Walker (2001) similarly advocate collaboration that is grounded in learning theory, systems thinking and alternative dispute resolution. This

article offers a different thesis, arguing that the quality of information collected in the participation process is as important as the level of collaboration, fairness, citizen empowerment or other key variables cited in the literature. If the public participation process is effectively structured to use the *wisdom of crowds* (Surowiecki 2004) and *public judgement* (Yankelovich 1991) for planning decisions, the locus of decision-making (e.g., state/federal, regional, or local) and the need for collaboration assume less importance.

This article describes the concepts of *wisdom of crowds* and *public judgement* and explains how they can be operationalised using public participation geographic information systems (PPGIS) for land use planning. Some examples are provided to illustrate the potential benefits – as well as the challenges – of engaging the wisdom of crowds in planning. The article concludes with a discussion of the need for more trials of PPGIS supported by innovators in the planning profession.

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The wisdom of crowds and planning

The concept of the *wisdom of crowds*, popularised by Surowiecki (2004), describes the phenomenon where a group's collective answer to a question or solution to a problem is found to be as good, and often better than any of the individuals in the group or an expert in the field. The group members need not be exceptionally well informed or rational to reach a wise decision. The crowd can comprise any group of people (the larger the better) that have the ability to act collectively to make decisions and solve problems, even if the people in the group do not know each other or are not even aware of what they are doing (xvii). The view that crowds contain collective wisdom contradicts stereotypical views of crowds as thoughtless (e.g., a herd blindly following a leader) or irrational (e.g., a lynch mob). He describes the four conditions necessary for a wise crowd: (1) diversity of opinion (each person should have some private information), (2) independence (people's opinions are not determined by those around them), (3) decentralisation (people are able to specialise and draw on local knowledge) and (4) aggregation (there is some mechanism for turning private judgements into a collective decision) (10).

Surowiecki applies the wisdom of crowds to three types of problems: *cognition*, *coordination* and *cooperation* (xvii–xviii). Cognition problems have definitive solutions or address problems where there may not be a single right answer, but where some answers are clearly better than others. Coordination problems require members of a group to figure out how to coordinate their behaviour when everyone else is doing the same activity. Cooperation problems involve getting self-interested, distrustful people to work together. Surowiecki writes that crowds are best when there's a right answer to a factual problem or a question (i.e., 'cognition' problem) but that crowds can be surprisingly good at problems involving coordination and cooperation. Groups can even perform well on cognitive problems when the decision environment is characterised by complexity and uncertainty. Groups are least suitable for problems of skill such as asking a group to perform surgery or fly an airplane.

The scope of contemporary planning practice, as identified by Friedmann (1987), is quite broad, ranging from national security planning to regional development planning (see Table 1). These planning domains include both spatial and non-spatial planning problems, some of which may be suitable for using the wisdom of crowds. Although the nature of the planning problems illustrated in the table are complex, multiscale and multisectoral, it appears

possible to factor some planning problems, especially spatial planning problems, for crowd resolution. Although highly simplified, spatial planning questions ('where?') tend to fall within the *cognitive* domain of problems while process questions ('how?') tend to fall within the *coordination* and *cooperation* domains of planning problems. Although most planning domains are informed by planning 'experts', cognitive planning problems involving location and appropriate land use may benefit from the infusion of crowd wisdom that can discover creative solutions that work in a specific planning context (Brabham 2009). For example, what is the best use for an undeveloped parcel of land? Where should a new community centre be located? What areas are best suited for high-density, residential housing? What areas are best suited for future development or conservation?

For land use planning to use the potential of crowd wisdom, planning activity would need to refocus around the development and implementation of public participation methods that structure and facilitate processes to more fully exploit crowd potential. Factors that restrict or cause crowd intelligence to fail include:

- *Lack of independence.* If the crowd is too conscious of the opinions of others, it can lead to emulation and conformity. Crowd imitation can occur through 'information cascades' where people observe the actions of others and make the same choice without using or pursuing private information signals. Noteworthy examples include bubbles in real estate or financial markets. In planning public participation, small group processes such as working groups are vulnerable because individuals become too conscious of the opinions of others in the group, limiting the infusion of new or different information.
- *Lack of crowd diversity.* Crowd diversity refers to cognitive diversity, not sociological diversity. Crowd homogeneity limits the potential of crowd intelligence. The crowd should contain a diversity of individuals across multiple attributes. In public participation, achieving crowd diversity may require seeking out individuals that do not voluntarily attend planning meetings or what may be termed the 'silent majority'.
- *Structural characteristics of the crowd.* Centralisation or compartmentalisation within a crowd can reduce information flow and information sharing. Citizen advisory committees (CACs) in planning are vulnerable because they create a hierarchy or compartmentalised

Table 1. Scope of planning in the public domain (Friedmann 1987) and some key problems that may be amenable to the wisdom of crowds.

Planning domain	National security planning	Economic planning	Social planning	Environmental planning	City planning	Regional development planning
Key problem(s)	How do we best provide for the safety of citizens?	How much and where do we invest for economic growth? How do we achieve employment targets? How should income and wealth be distributed? How do we control money supply to control inflation?	How do we meet the collective needs of citizens for income, housing, health, education and other social goals?	How do we manage the externalities from production and consumption? Where do we maintain vital ecosystem services? What are appropriate levels of development and conservation? How and where do we produce the energy needed in society?	What is the best mix of housing, employment opportunities and services to residents? Where is the best location to site a new public facility? Where do we allocate and zone different types of land uses? How do we best facilitate the movement of people and goods within the city?	Where are the best areas to engage in resource extraction, development (residential, commercial, industrial) or conservation? Where are the best areas to locate housing, transportation and other regional services?

structure that filters information entering into the public participation process.

- *Emotionality*. Emotional factors such as a feeling of belonging can lead to peer pressure, herd instinct and, in extreme cases, collective hysteria. Public hearings in planning are particularly vulnerable to the emotionality factor.
- *Crowd size*. In general, the larger the crowd, the better. Small groups may be especially vulnerable to poor group decision-making driven by the desire for harmony or conformity, a psychological phenomenon called ‘group-think’ by Janis (1972).

For individuals familiar with, or who have observed dysfunctional public participation processes, the above list of factors reads more like a post-mortem. From the emotional outrage of public hearings involving contentious land use changes to closed meetings attended by a small number of insiders highly vested in the planning outcome, the wisdom of crowds is noticeably absent. What is needed is a public participation *structure* that exploits the benefit

of crowd wisdom while avoiding the excesses of crowd behaviour. And yet, a participatory process that achieves sufficient crowd size, independence, and diversity is a necessary, but insufficient condition for effective planning outcomes. One must also ensure that the type of information collected from the crowd is the right type of information. The information should contain public judgement, not mass opinion.

Public judgement and planning

Planning decisions often have long-term consequences. In his seminal book, Yankelovich (1991) makes a crucial distinction between what he terms mass opinion and public judgement. Mass opinion is often what people observe reported in the media – top-of-the-mind, offhand views about a particular subject or topic. These opinions are often solicited using convenience sampling with leading or biased questions. Even public opinions derived using more carefully designed survey methods may still reflect mass opinion. The distinction between mass opinion

and public judgement is the *quality* of the opinion. Yankelovich believes that we have learned a great deal about how to measure public opinion, and how to manipulate it, but almost nothing about how to improve it. He cites three factors that determine the quality of public opinion: (1) whether the individual takes responsibility for the consequences of holding the opinion; (2) the firmness with which the individual holds the opinion; and (3) the consistency of the opinion. Most public opinion polls are misleading because they fail to distinguish between mass opinion and the public's thoughtful considered judgements which are consequential, firm and consistent. As the most advanced form of public opinion, public judgement is 'a genuine form of knowledge that on certain aspects of issues, deserves to carry more weight than that of scientific experts' (Yankelovich 1991, xii).

What would public judgement look like for planning? In planning for future land use, public judgement would embody thoughtful consideration about the current importance of the land as well as future options for the land. This judgement would reflect the collective values the public has for the places under consideration as well as their preferences for future use. This type of information is collected using PPGIS methods, described below. As a psychological construct, values reflect the importance, worth or usefulness that humans assign to objects; public judgement should reflect collective values associated with places. Brown and Reed (2000) developed a typology of place-based values to provide an operational bridge to connect the geography of place (location) with the underlying psychology of place (importance). The typology of place values was originally developed for environmental and natural resource management planning applications and included 13 values such as scenic, economic, recreational and biological values. The typology of values has been adapted to a variety of planning contexts, including urban areas. For a review of empirical applications, see Brown and Kyttä (2014). For example, the typology has been used to identify the spatial distribution of urban park and green space values (Brown 2008), to identify areas of potential conflict in regional land use planning (Brown and Raymond 2014) and to determine whether land use zones are consistent with public values for the areas (Brown 2006).

Spatial preferences reflect more direct and specific beliefs about potential future land uses such as residential development, tourism development or allocation to conservation. Land use preferences provide options for future land use that may be the same or different from current land use. Normatively, land use decisions should reflect a good fit between the long-term values

of place and the more specific uses of place. Dissonance between place values and land use preferences reflect current or future land use conflict (Brown and Raymond 2014).

The combination of place-based values (why is the place important to the crowd?) and land use preferences (what future land use appears most desirable to the crowd?) provides a powerful, operational type of public judgement about place for the purposes of planning. But what is the evidence that crowd identification of place values and preferences reflect public judgement rather than mass opinion? In two separate longitudinal studies spanning 6 and 14 years, respectively, crowd mapping of place-based values showed remarkable consistency in two regional planning studies in Alaska and Australia (Brown and Weber 2012; Brown and Donovan 2014) indicating a type of public judgement about the qualities of place. In the process of mapping values and preferences, the crowd engages in cognitive processes that are more complex than simple measurement of mass opinion. PPGIS provides the means to operationalise and translate the *wisdom of crowds* and *public judgement* into spatially explicit information for land use decisions.

PPGIS and planning

The term 'public participation geographic information systems' was conceived in 1996 at the meetings of the National Center for Geographic Information and Analysis (NCGIA) in the USA to describe how GIS technology could support public participation for a variety of applications (NCGIA 1996a, 1996b; Sieber 2006). The use of the term 'PPGIS' originated in the USA while the term 'participatory GIS' or 'PGIS' emerged from participatory approaches in rural areas of developing countries, the result of a spontaneous merger of Participatory Learning and Action (PLA) methods with geographic information technologies (Rambaldi *et al.* 2006). The term 'Bottom-Up GIS' also refers to public participation methods that use GIS (Talen 2000). Both PPGIS and PGIS promote the inclusion and empowerment of marginalised or under-represented populations in the development and use of spatial information. The distinction between PPGIS and PGIS largely reflects the situational context (developing vs. developed country) in which the practices have emerged. The academic interest in PPGIS has increased significantly over the last decade with significant growth in the number of urban and environmental planning publications (Brown and Kyttä 2014).

There are many design options for the implementation of PPGIS including the spatial attributes

(what is mapped?), sampling (who does the mapping?), purpose (reason for mapping?), technology (how is mapping done?) and location (where is mapping done?). Spatial attributes can be mapped by means of self-administered surveys, key informant or stakeholder interviews, or completed in a group setting such as community workshops. Early PPGIS data collection used simple technology such as hard-copy maps and markers (e.g., pencils, stickers). Digital mapping using the Internet has become more common in recent applications. The general categories of spatial attributes include place values, development preferences, place qualities and participant experiences. Mapping participants often include the 'public', but as Schlossberg and Shuford (2005) caution, the 'public' in PPGIS depends on the definition and may include 'decision makers', 'affected individuals' or the 'random public', among other groups.

Designing PPGIS for crowd wisdom

PPGIS design and implementation determine whether the process will tap into the wisdom of crowds and public judgement. Table 2 provides the wisdom of crowds criteria and how they should be operationalised in PPGIS. To achieve diversity of opinion, PPGIS should include a random sampling component. The logic of collection action (Olson 1971) ensures that stakeholders (individuals and organisations) with vested interests in planning outcomes will be present in the planning process and will be advocating for self-interested outcomes. These participants are

often not diverse and represent a more narrow set of social interests. Even planning processes that are polarised between advocates supporting and opposing particular outcomes do not provide the diversity of opinion necessary to tap into the wisdom of crowds. In planning, the crowd consists of the 'silent majority' that does not attend, and is often not engaged in the public participation process. To engage the crowd, it is necessary to recruit potentially affected publics through random sampling. Convenience, purposive and volunteer sampling, the most common methods used in public participation may contain ideological bias when implemented in PPGIS (Brown *et al.* 2014), but importantly, may also contain less diversity of opinion.

To maintain independence in the PPGIS process, individuals should not be unduly influenced by the opinions of others. This suggests that participant mapping should be done individually and without the assistance or advice from other mappers. When mapping is done in a group setting, the independence criterion may not be satisfied because of the tendency for individuals with stronger personalities to influence the mapping process. For example, when participatory mapping was done in a group setting in rural villages in Suriname, Ramirez-Gomez *et al.* (2013) reported that men, in particular, attempted to influence the locations mapped by women. To maintain independence, women were spatially separated from the men for the mapping activity. In general, the use of small groups for participatory mapping such as focus groups (see Lowery and Morse 2013) is less likely to

Table 2. List of criteria to achieve the *wisdom of crowds* and how they are operationalised in PPGIS.

Criteria	Description	Operationalised in PPGIS	PPGIS methods
Diversity of opinion (cognitive diversity)	Each person should have private information even if it's just an eccentric interpretation of the known facts.	Ensure diverse sub-populations (through sampling and recruitment) are included in mapping activity.	Should include a random sample of population, although convenience, purpose and volunteer sampling can augment the random sample.
Independence	People's opinions aren't determined by the opinions of those around them.	Mapping is done individually, independent of other people mapping.	Spatial mapping is done individually to avoid potential influence by others.
Decentralisation	People are able to specialise and draw on local knowledge.	Distributed participation by regions, communities or neighbourhoods; people map local places, knowledge and experience.	Sampling approach should ensure geographic diversity as well as participant diversity.
Aggregation	Some mechanism exists for turning private judgements into a collective decision.	Spatial aggregation methods such as hotspots (Alessa <i>et al.</i> 2008) and social landscape metrics (Brown and Reed 2012a).	Spatial decision support tools such as values compatibility mapping (Brown and Reed 2012b) and conflict mapping (Brown and Raymond 2014).

allow private information and judgement to occur in the mapping process. Further, empirical evidence indicates that small group mapping processes generate spatially different results from individual mapping processes (Brown *et al.* 2014).

For individuals in the crowd to be able to specialise and draw upon private information, they must be given the opportunity to map their local knowledge and experiences. This information can be obtained in PPGIS by requesting that the participant spatially locate attributes such as positive or negative experiences, place values and land use preferences or the location of special places. These mapped attributes are usually related to physical features in the mapped location. Because PPGIS mapping is influenced by the participant's familiarity and knowledge of place and their place of residence, the crowd should be geographically dispersed within the planning area. The propensity for individuals to map locations based on distance from home is called geographic or spatial discounting (Hannon 1994; Norton and Hannon 1997) and has been shown to influence PPGIS-mapped locations. For example, in two regional studies, participants identified more locations near their communities (Brown *et al.* 2002; Pocewicz and Nielsen-Pincus 2013), while in urban studies, more positive experiences were mapped closer to home than negative ones (Kytta *et al.* 2011). Thus, for PPGIS to achieve participant diversity, sampling methods should ensure geographic diversity of the crowd.

The criterion of aggregation is the most challenging when using PPGIS for planning decision support because it requires making decisions about the relative importance of information provided by different participants in the process. Whose judgement is to be aggregated regarding future land use? Should the potential spatial impact of the plan determine the crowd? Some land use decisions appear truly global (for example, development of major energy sources) while other decisions are more local in character (for example, the development of a shopping mall). The principle of spatial impact is often applied to the scope of consultation for a proposed change in property use (e.g., a new addition on a home), but is less frequently applied at larger planning scales.

Place knowledge and crowd wisdom

What about crowd knowledge and familiarity with the planning area? Is some knowledge of the spatial context of the plan essential to achieving planning wisdom? In the wisdom of crowds, group members need not be exceptionally well informed about the planning decision context. In the extreme, could

an independent, diverse and decentralised crowd of Los Angeles residents make informed judgements regarding the next New York city plan? The extent to which crowd ignorance about the planning context can be pushed and still reach wise planning decisions is a provocative question, but one that need not be fully answered to make effective use of PPGIS. As a practical matter, it appears reasonable to target and aggregate an independent, diverse, and decentralised crowd using random sampling within the planning jurisdiction while allowing volunteer participation to address the wider spatial impact of the plan. This would work for city and regional planning with defined political jurisdictions. For national public lands, one can create a pseudo-jurisdiction that includes a spatially proximate population. For example, residents living within a certain radius of public lands such as 100 km have been operationalised for public lands in the USA (Brown and Reed 2009).

Place familiarity need not result from actually living in or visiting the planning area as information about place derives from multiple sources. For example, the crowd will be familiar with some iconic planning areas such as the Arctic National Wildlife Refuge (Alaska) and will have reached judgement about its value and preferred land use (i.e., protection over oil/gas development) based on information from various sources. Empirical evidence indicates that place familiarity is related to the amount of spatial information PPGIS participants provide (Brown and Kytta 2014), but non-response analyses in previous PPGIS studies have not fully assessed the influence of place familiarity on PPGIS participation. However, it seems logical that some level of non-participation would be related to familiarity with the planning area, under the supposition that individuals more familiar with the planning area would be more likely to participate in the process. This potential bias towards participation based on place familiarity could be beneficial (e.g., more accurate mapping of locations), provided the independence and cognitive diversity of the crowd are sustained in the process.

Using crowd wisdom for planning decisions

The use of crowd wisdom can be applied to three common types of land-related decisions: (1) *site or location selection* (e.g., what site or location is best for a particular type of land use or activity?), (2) *land use selection* (e.g., what alternative land uses can be applied to the land?) and (3) *land use allocation* (e.g., where and how much land should be allocated to different types of uses such as residential, commercial or industrial in urban areas, or resource development versus conservation in rural areas). Of the three

decision types, the spatial aggregation of crowd information for regional land-use allocation is the most fully developed in the literature. For example, Raymond and Brown (2006) describe the use of PPGIS to allocate lands for national parks while Brown (2006) describes the use of PPGIS to identify areas appropriate for tourism development. Land use allocation can be evaluated by: (1) creating density maps of crowd-supplied spatial data, or (2) enumerating crowd data located within pre-defined spatial units of analysis (e.g., existing land use zones). Brown and Reed (2012a) refer to these two approaches as *inductive* and *boundary* social landscape metrics for planning decision support. Inductive methods identify spatial 'hotspots' and reflect the frequency or spatial intensity of mapped attributes, while boundary metrics aggregate spatial attributes within polygon areas providing for cross-unit comparisons. Land use allocation decisions are indicated by the application of spatial decision thresholds to the mapped data.

Examples of operationalising PPGIS for planning decision support

Value compatibility analysis (Brown and Reed 2012b) applies the principle of 'consistency' of land use with crowd-sourced place values as the substantive basis for land use decisions. Value compatibility analysis is a type of general land suitability analysis that uses the distribution of mapped PPGIS data rather than physical land features to determine the suitability of potential land uses. A premise of the method is that the selected land use should be socially acceptable, and the key question is whether the current or proposed allocation of the land is consistent with public values for the land. The distribution of mapped spatial attributes (e.g., values and preferences) falling within the current or prospective land use zones is examined for consistency with the proposed land use. The zones may be revised based on the results or alternatively different activities or uses within the zones may be prohibited or regulated to be consistent with public values. For example, Brown (2006) found that residents of Kangaroo Island (KI), South Australia, mapped place values and land use preferences that were generally consistent with the zoning identified in the development plan for the region. When a new tourism resort was proposed in a coastal conservation zone that appeared inconsistent with resident values for the area, conflict ensued (Brown and Weber 2012). This was not a classic case of NIMBYism (few KI residents live in proximity to the development), but rather a judgement that the proposed development was incompatible with the place values for the area. State planning authorities granted

approval, favouring the interests of the developer over the public judgement of KI residents obtained through PPGIS.

A second example used PPGIS data to identify 'hotspots' of place values to designate special management areas on public lands (Brown and Weber 2013). The New Zealand Department of Conservation was one of the first land management agencies to adopt a place-based approach to conservation management. The premise is that public lands in NZ should be managed for the values identified in the enabling legislation (natural and historic resources, recreation and tourism). To designate the special management areas, the agency used a deductive, expert-driven, top-down approach to identify the significant places at a regional scale. The agency's expert-driven place allocations deviated significantly from the place values identified by the NZ public using PPGIS suggesting that the identification and designation of management areas could be significantly improved by using the wisdom of crowds. In general, planning contexts that involve conflicting or subjective planning goals appear especially suitable for crowd wisdom because the allocative results are likely to be consistently better than those provided by a single or relatively few planners.

Another example of using crowd data for planning decision support is to identify areas with high potential for land use conflict. As a general principle, land use planning seeks to harmonise different land uses, either through separation (zoning) or integration (mixed use). The crowd is ideally suited to determine where future conflict is likely to occur based on the spatial location of similarities and differences in land use preferences (e.g., the location of future residential development) and the type and intensity of public values. Several methods for identifying land use conflict areas with PPGIS data are presented by Brown and Raymond (2014) in a case study of the Hunter Valley region in New South Wales, Australia. Planning decision support takes the form of diagnostic, land use conflict maps where planning or policy interventions can be targeted. In the case study, the conflict maps generated using PPGIS mapped values and preferences were benchmarked against reference sites where future development projects were proposed in the region. The crowd of study participants performed well in correctly identifying the potential conflict areas.

Other planning contexts where the wisdom of crowds and public judgement can be used include the identification of new national scenic byways (Brown 2003), the selection of lands to be included in expanded national parks (Raymond and Brown 2006) and the selection of the best architectural design for an urban

area (Eräranta *et al.* 2015). The *potentiality* of crowd wisdom for planning decision support is emphasised here because as yet, there are no examples where planning decisions have been actually based on the wisdom of crowds using PPGIS. In the case of the KI and New Zealand examples, crowd wisdom obtained through PPGIS would have resulted in different, and arguably, better planning decisions than resulted from the ‘expert’ process. As discussed in the next section, the challenges for adopting crowd wisdom and public judgement for planning decision support are formidable.

The challenges of engaging crowd wisdom for planning

In 2009, Brabham identified multiple challenges for using crowd sourcing for public participation in planning including: (1) the digital divide (i.e., unequal crowd access to technology and the Internet), (2) accessible website design and the recruitment of an online community and (3) potential crowd resistance to participation. While these challenges remain today, significant progress has been made in closing the digital divide and the development of effective Internet technology for large-scale crowd participation. For example, Brown and Kyttä (2014) identify over 40 empirical PPGIS studies for environmental and urban planning applications implemented since 2006, many of these making effective use of Internet technology and crowd-sourcing methods. This figure is likely to significantly under-report the actual number of crowd-sourcing projects for planning, given that many are unpublished in the academic literature.

The idea of crowd-sourcing public participation using PPGIS is tracking towards mainstream. In the first such act of its kind, the Finland government commissioned the development of national PPGIS software for use by local governments and public agencies throughout the country. Further, in 2013, Helsinki became the first world city to implement PPGIS in the development of its new city plan (Helsinki 2050), collecting more than 32,000 citizen observations (<https://helsinki.asiatkartalle.fi/>). While the endorsement of *wisdom of crowds* for public participation in Finland, and Scandinavian countries in general, is not surprising given the cultural level of trust in government and the propensity to embrace new technology, this early adoption may be a bell-wether for adoption in other countries. The desire to use technology, in particular, is a compelling social force. Of the multiple challenges for engaging crowd wisdom in PPGIS, technology is among the least significant barriers, and where technology barriers still exist such as rural areas, non-Internet PPGIS

methods have been quite effective (Pocewicz *et al.* 2012).

The strongest resistance to crowd sourcing comes from politicians, the professional planning community, NGOs and other segments of society imbued with the belief that expert knowledge is superior to crowd wisdom. Why is the wisdom of crowds not trusted for decisions? Surowiecki (2004, 35–36) offers several reasons: (1) people believe experts are better because they assume that true intelligence can only reside in individuals and therefore, the crowd is blind to its own wisdom, (2) citing research by Soll and Larrick (2009), humans believe that averaging multiple responses is dumbing down or compromising when averaging decisions actually produces better results and (3) humans get fooled by the randomness of prediction success which is not the result of skill, nor predictive of future success. Thus, resistance to crowd sourcing is deeply rooted in the beliefs and assumptions about the origin of intelligence and will be difficult to overcome. Even a well-conceived PPGIS process for a land use plan that engages the crowd and produces ‘wise’ results may not be trusted by planning authorities.

So what is a potential path forward for crowd sourcing using PPGIS for land use planning? Contrary to the thesis of this article, extolling the virtues of crowd wisdom and public judgement using PPGIS is unlikely to gain much traction among the majority of planning professionals or politicians. Metaphorically, acceptance of crowd wisdom and public judgement is unlikely to come through the front door, with the possible exception of progressive political societies such as those found in Scandinavian countries. A more plausible strategy is a back-door approach (early adopter strategy) that provides greater opportunity for crowd wisdom and public judgement to demonstrate its utility through empirical evidence. The concept of crowd wisdom would be downplayed, but PPGIS would nonetheless be used to capture crowd wisdom. The principle that the public should be informed and consulted on important land use planning decisions is generally accepted within democratic societies. This natural support can be leveraged by finding planning professionals and political sponsors willing to engage in innovative public participation practices using PPGIS (i.e., early adopters). The planning process would use PPGIS to gather crowd-supported alternatives for land use. One strategy would be to present the crowd-sourced planning alternatives or scenarios, along with expert alternatives, for a crowd vote without disclosing the origin of the alternatives. If Surowiecki is correct that the crowd is ignorant of its own wisdom, it would be instructive to learn if the crowd can discover its own

wisdom located in the list of plan alternatives through a type of crowd voting. This two-step process of using the crowd to generate alternative planning solutions (engaging crowd creativity) and then allowing the crowd to identify the preferred solution (engaging crowd judgement) would take full advantage of the putative benefits of crowd wisdom and public judgement.

This idea is not far-fetched. In the late 1990s, the US Forest Service used PPGIS to allow the public to generate 33 spatially explicit national forest plan alternatives for the Chugach National Forest (see Farnum and Reed 2008). Unfortunately, this is where the crowd-sourcing process ended. The forest planning experts seized control of the process, analysed the crowd alternatives and from these developed its own preferred alternative for the forest plan that was not acceptable to multiple stakeholders and subsequently legally challenged. The use of crowd wisdom to generate plan alternatives was progressive and laudable, but the planning experts did not go the next logical step – to use the crowd to find the ‘wisest’ alternative.

Some empirical PPGIS studies that assess the spatial data quality of crowd wisdom are encouraging. For example, using PPGIS, the public has been able to accurately identify the location of physical land qualities such as the presence of native vegetation (Brown 2012b), suitable habitat for threatened species conservation (Cox *et al.* 2014) and the location of various ecosystem services (Brown *et al.* 2012). These are not the types of spatial attributes that would be mapped for the most common land use planning applications, but they do demonstrate that land features traditionally identified by experts can be accurately identified by the crowd – an affirmative test of crowd intelligence.

Conclusion

The thesis of this article – that the substantive quality of land use decisions can be improved by engaging crowd and public judgement through PPGIS – may appear antithetical to planning practice dominated by specialised or ‘expert’ knowledge obtained through formal education and training. And yet, these ideas are not new to planning theory. Over four decades ago, Friedmann (1973) argued for greater acceptance of lay knowledge in planning through a *theory of transactive planning* that emphasises participatory, decentralised planning wherein the planner’s role is more a facilitator, and less a technician or expert. This view of the planning professional as a facilitator of public discourse rather than expert continued in the *communicative turn in planning theory* (Healey

1992), where Habermasian inter-subjective reasoning offered an alternative to scientific rationalism. Today, geospatial and communication technology has created more opportunity to expand the scope of public participation to evaluate the potential of crowd wisdom for planning decision support.

In many complex areas of society, including land use planning, there is an assumption that making good decisions is about finding the right person or persons with the answer, or what Soll and Larrick (2009) call ‘chasing the expert’. Accordingly, effective land use planning would involve getting the right experts together to make decisions about best land use. This is standard practice today. And yet, Surowiecki (2004) provocatively challenges this dominant paradigm stating that ‘the value of expertise, in many contexts, is overrated’ (32).

There are certainly aspects of land use planning that are highly technical in nature, for example, the siting of hazardous waste, the delineation of wetlands or the identification of flood zones. These tasks are not well suited to crowd wisdom. The wisdom of crowds and public judgement should complement technical expertise, not substitute for it. The reality, however, is that many land use decisions involve social value decisions that are framed as technical decisions where experts offer no special insight into social values beyond the capacity of the crowd itself. PPGIS methods excel in the identification and mapping of place-based social values and land use preferences.

Given the prevailing deference to expert opinion within important segments of society (i.e., the lay/expert divide), there are substantive barriers to building trust for using crowd wisdom in land use planning. This includes trust within the crowd itself where the crowd may be more inclined to accept, or at least defer to, the role of experts in planning. For its part, the planning profession embodies the lay/expert divide and is one of the key reasons why planners have been reluctant to embrace PPGIS methods (Brown 2012a).

Herein lies the challenge for future land use planning. The oft-cited call for greater collaboration as an antidote to ineffective public participation, while well-intentioned, may be misdirected. Collaborative processes are inherently constrained by the number of people that can participate, limiting the diversity, independence and decentralisation of the group, thus resulting in suboptimal planning solutions. If there is a better path to more effective public participation, it will come from expanding, not narrowing the field of participants. Crowd wisdom has become an increasingly important source of knowledge to function in today’s society, influencing

decisions about products (e.g., Amazon[®] reviews), travel (Tripadvisor[®]), entertainment (IMDb[®]) and most important, the underlying principle by which we identify the most relevant information on the Internet (Google[®] search). Given the increased use and acceptance of crowd wisdom in other social domains, and with advances in geospatial and communication technology, the time appears right for innovative planners to engage the *wisdom of crowds* and *public judgement* for land use planning.

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References

- Alessa, L., A. Kliskey, and G. Brown. 2008. "Social-ecological Hotspots Mapping: A Spatial Approach for Identifying Coupled Social-ecological Space." *Landscape and Urban Planning* 85 (1): 27–39. doi:10.1016/j.landurbplan.2007.09.007.
- Arnstein, S. R. 1969. "A Ladder of Citizen Participation." *Journal of the American Institute of Planners* 35 (4): 216–224. doi:10.1080/01944366908977225.
- Brabham, D. C. 2009. "Crowdsourcing the Public Participation Process for Planning Projects." *Planning Theory* 8 (3): 242–262. doi:10.1177/1473095209104824.
- Brown, G. 2003. "A Method for Assessing Highway Qualities to Integrate Values in Highway Planning." *Journal of Transport Geography* 11 (4): 271–283. doi:10.1016/S0966-6923(03)00004-8.
- Brown, G. 2006. "Mapping Landscape Values and Development Preferences: A Method for Tourism and Residential Development Planning." *International Journal of Tourism Research* 8 (2): 101–113. doi:10.1002/jtr.562.
- Brown, G. 2008. "A Theory of Urban Park Geography." *Journal of Leisure Research* 40 (4): 589–607.
- Brown, G. 2012a. "Public Participation GIS (PPGIS) for Regional and Environmental Planning: Reflections on a Decade of Empirical Research." *URISA Journal* 25 (2): 5–16.
- Brown, G. 2012b. "An Empirical Evaluation of the Spatial Accuracy of Public Participation GIS (PPGIS) Data." *Applied Geography* 34: 289–294. doi:10.1016/j.apgeog.2011.12.004.
- Brown, G., and S. Donovan. 2014. "Measuring Change in Place Values for Environmental and Natural Resource Planning using Public Participation GIS (PPGIS): Results and Challenges for Longitudinal Research." *Society & Natural Resources* 27 (1): 36–54. doi:10.1080/08941920.2013.840023.
- Brown, G., S. Donovan, D. Pullar, A. Pocewicz, R. Toohey, and R. Ballesteros-Lopez. 2014. "An Empirical Evaluation of Workshop versus Survey PPGIS Methods." *Applied Geography* 48: 42–51. doi:10.1016/j.apgeog.2014.01.008.
- Brown, G., M. Kelly, and D. Whittall. 2014. "Which 'Public'? Sampling Effects in Public Participation GIS (PPGIS) and Volunteered Geographic Information (VGI) Systems for Public Lands Management." *Journal of Environmental Planning and Management* 57 (2): 190–214. doi:10.1080/09640568.2012.741045.
- Brown, G., and M. Kyttä. 2014. "Key Issues and Research Priorities for Public Participation GIS (PPGIS): A Synthesis Based on Empirical Research." *Applied Geography* 46: 122–136. doi:10.1016/j.apgeog.2013.11.004.
- Brown, G., J. M. Montag, and K. Lyon. 2012. "Public Participation GIS: A Method for Identifying Ecosystem Services." *Society & Natural Resources* 25 (7): 633–651. doi:10.1080/08941920.2011.621511.
- Brown, G., and C. M. Raymond. 2014. "Methods for Identifying Land Use Conflict Potential using Participatory Mapping." *Landscape and Urban Planning* 122: 196–208. doi:10.1016/j.landurbplan.2013.11.007.
- Brown, G., and P. Reed. 2000. "Validation of a Forest Values Typology for Use in National Forest Planning." *Forest Science* 46 (2): 240–247.
- Brown, G. G., and P. Reed. 2009. "Public Participation GIS: A New Method for Use in National Forest Planning." *Forest Science* 55 (2): 166–182.
- Brown, G. G., and P. Reed. 2012a. "Social Landscape Metrics: Measures for Understanding Place Values from Public Participation Geographic Information Systems (PPGIS)." *Landscape Research* 37 (1): 73–90. doi:10.1080/01426397.2011.591487.
- Brown, G., and P. Reed. 2012b. "Values Compatibility Analysis: Integrating Public Values in a Forest Planning Decision Support System." *Applied Spatial Analysis and Policy* 5 (4): 317–332.
- Brown, G. G., P. Reed, and C. C. Harris. 2002. "Testing a Place-based Theory for Environmental Evaluation: An Alaska Case Study." *Applied Geography* 22 (1): 49–76. doi:10.1016/S0143-6228(01)00019-4.
- Brown, G., and D. Weber. 2012. "Measuring Change in Place Values using Public Participation GIS (PPGIS)." *Applied Geography* 34: 316–324. doi:10.1016/j.apgeog.2011.12.007.
- Brown, G., and D. Weber. 2013. "A Place-based Approach to Conservation Management using Public Participation GIS (PPGIS)." *Journal of Environmental Planning and Management* 56 (4): 455–473. doi:10.1080/09640568.2012.685628.
- Cox, C., W. Morse, C. Anderson, and L. Marzen. 2014. "Applying Public Participation Geographic Information Systems to Wildlife Management." *Human Dimensions of Wildlife* 19 (2): 200–214. doi:10.1080/10871209.2014.871663.
- Daniels, S., and G. Walker. 2001. *Working through Environmental Conflict: The Collaborative Learning Approach*. Westport, CT: Praeger.
- Eräranta, S., M. Kahila, and P. Nurmi. 2015. "Web-based Public Participation in Urban Planning Competitions." *International Journal of E-Planning Research* 4 (1): 1–18.

- Farnum, J. O., and P. Reed. 2008. *The Chugach National Forest*. Portland, OR: General Technical Report-Pacific Northwest Research Station, USDA Forest Service, (PNW-GTR-741), 23–31.
- Friedmann, J. 1987. *Planning in the Public Domain: From Knowledge to Action*. Princeton, NJ: Princeton University Press.
- Friedmann, J. 1973. *Retracking America: A Theory of Transactive Planning*. New York: Anchor.
- Hannon, B. 1994. "Sense of Place: Geographic Discounting by People, Animals and Plants." *Ecological Economics* 10 (2): 157–174. doi:10.1016/0921-8009(94)90006-X.
- Healey, P. 1992. "Planning through Debate: The Communicative Turn in Planning Theory." *Town Planning Review* 63 (2): 143.
- Innes, J. E., and D. E. Booher. 2004. "Reframing Public Participation: Strategies for the 21st Century." *Planning Theory & Practice* 5 (4): 419–436.
- Janis, I. L. 1972. *Victims of Groupthink: A Psychological Study of Foreign-policy Decisions and Fiascoes*. Boston, MA: Houghton, Mifflin.
- Kyttä, M., M. Kahila, and A. Broberg. 2011. "Urban Infill Policy and the Perceived Quality of the Environment." *Urban Design International* 16 (1): 19–35.
- Lowery, D., and W. Morse. 2013. "A Qualitative Method for Collecting Spatial Data on Important Places for Recreation, Livelihoods and Ecological Meanings: Integrating Focus Groups with Public Participation Geographic Information Systems." *Society and Natural Resources* 26 (2): 1422–1437.
- National Center for Geographic Information and Analysis (NCGIA). 1996a. "Summary Report: GIS and Society Work-shop." South Haven, MN, March 2–5.
- National Center for Geographic Information and Analysis (NCGIA). 1996b. "Summary Report: Public Participation GIS Workshop." Orono, ME, July 10–13.
- Norton, B. G., and B. Hannon. 1997. "Environmental Values: A Place-based Theory." *Environmental Ethics* 19 (3): 227–245. doi:10.5840/enviroethics199719313.
- Olson, M. 1971. *The Logic of Collective Action: Public Goods and the Theory of Groups*. Cambridge, MA: Harvard University Press.
- Pocewicz, A., and M. Nielsen-Pincus. 2013. "Preferences of Wyoming Residents for Siting of Energy and Residential Development." *Applied Geography* 43: 45–55. doi:10.1016/j.apgeog.2013.06.006.
- Pocewicz, A., M. Nielsen-Pincus, G. Brown, and R. Schnitzer. 2012. "An Evaluation of Internet versus Paper-based Methods for Public Participation Geographic Information Systems (PPGIS)." *Transactions in GIS* 16 (1): 39–53.
- Rambaldi, G., A. P. Kyem Kwaku, P. Mbile, M. McCall, and D. Weiner. 2006. "Participatory Spatial Information Management and Communication in Developing Countries." *The Electronic Journal of Information Systems in Developing Countries* 25: 1. Accessed April 13, 2015. <http://www.ejisdc.org/ojs2/index.php/ejisdc/article/view/237>.
- Ramirez-Gomez, S. O. I., G. Brown, and Tjon Sie Fat. 2013. "Participatory Mapping with Indigenous Communities for Conservation: Challenges and Lessons from Suriname." *The Electronic Journal of Information Systems in Developing Countries* 58 (2): 1–22.
- Raymond, C., and G. Brown. 2006. "A Method for Assessing Protected Area Allocations using a Typology of Landscape Values." *Journal of Environmental Planning and Management* 49 (6): 797–812. doi:10.1080/09640560600945331.
- Schlossberg, M., and E. Shuford. 2005. "Delineating 'Public' and 'Participation' in PPGIS." *URISA Journal* 16: 15–26.
- Sieber, R. 2006. "Public Participation Geographic Information Systems: A Literature Review and Framework." *Annals of the Association of American Geographers* 96 (3): 491–507. doi:10.1111/j.1467-8306.2006.00702.x.
- Soll, J. B., and R. P. Larrick. 2009. "Strategies for Revising Judgment: How (and How Well) People Use Others' Opinions." *Journal of Experimental Psychology: Learning, Memory, and Cognition* 35 (3): 780–805. doi:10.1037/a0015145.
- Surowiecki, J. 2004. *The Wisdom of Crowds: Why the Many are Smarter than the Few*. London: Little, Brown.
- Talen, E. 2000. "Bottom-up GIS: A New Tool for Individual and Group Expression in Participatory Planning." *Journal of the American Planning Association* 66 (3): 279–294. doi:10.1080/01944360008976107.
- Yankelovich, D. 1991. *Coming to Public Judgment: Making Democracy Work in a Complex World*. Syracuse, NY: Syracuse University Press.