2007

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reviewed paper

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1 INTRODUCTION

Enormous quantities of public money are spent on transportation infrastructure (TI). According to the Bureau of Transportation Statistics this infrastructure spend in the U.S. amounted to almost $90 billion in 2001 [1]. In most political spheres, when public money is spent, the public demands a measure of accountability. The dimensions of this accountability depend on the character of the political system that funds TI. In most participatory democracies, ultimate accountability is exercised through a balloting system that ensures elected officials represent, to some degree, stakeholder views and preferences. However, despite enormous expenditure of public monies on TI, this type of accountability is clearly lacking. In particular, the quality of public involvement in TI planning and design is acknowledged to be deficient by the public and by many professionals. Since the public's money is being spent, it behooves professionals to improve this situation.

Our programmatic aim is to improve public satisfaction with both TI design process and product [2]. In this article we characterize the deficiencies of public involvement in the U.S. using the Arnstein Gap as a metric. We propose a theoretical framework for public involvement based on justice. Three principles of justice originally developed by John Rawls [3] are evaluated in terms of their contribution to the observed Arnstein Gap. We explain how this analysis informs the Structured Public Involvement, or SPI, protocol developed and deployed by the authors. The performance of SPI is evaluated using anonymous, real-time evaluations from open public meetings dealing with contentious projects. We conclude by calling for consideration on the part of professionals in non-U.S. contexts to develop and articulate theoretical models for public involvement and, similarly, to evaluate the performance of these protocols using stakeholder data.

2 THE ARNSTEIN GAP

At CORP2006 we proposed the Arnstein Gap as a heuristic for quantifying the extent of the deficit in public involvement in TI [4, p.339]. For six years we have been collecting data from public and professionals during our work on actual TI projects. The Arnstein Ladder [5] is shown to the audience and an anonymous electronic real-time polling system is used by each respondent to quantify first, where the individual feels TI planning is currently located on the Arnstein Ladder, and second, where it should ideally be located. Integer numbers are used corresponding to named steps on Arnstein's Ladder. So far this database contains more than 500 responses from public attendees at actual public meetings in Kentucky, Indiana, Ohio and Arizona (public). It also contains 113 responses from transportation officials with public involvement experience across the U.S. and local land use planners in Kentucky (professionals). Figure 1 shows the results.

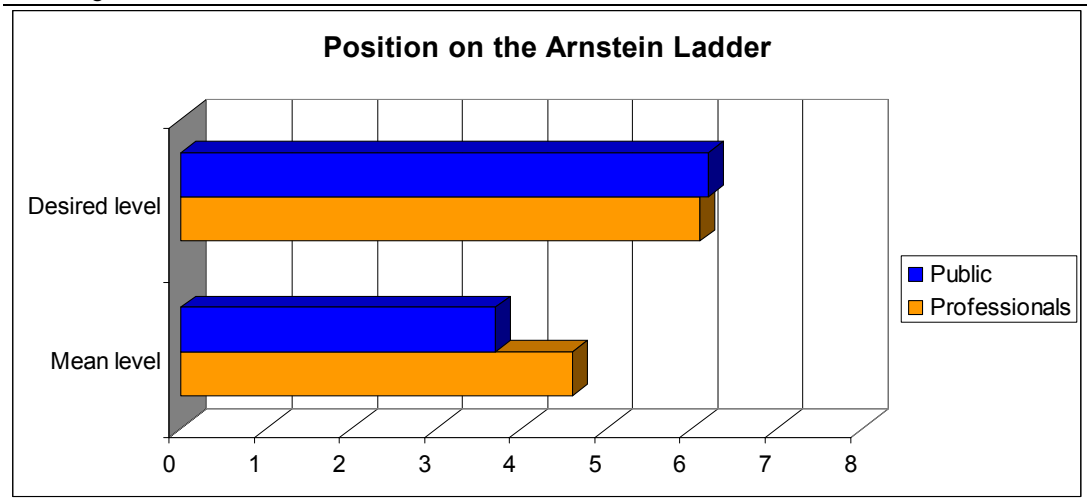

Figure 1. The Arnstein Gap

These findings are significant in several ways. These data indicate a strong agreement on the part of citizens and professionals that the ideal level is just above 6, which Arnstein termed "partnership." This should be heartening, because it demonstrates that when a metric is used directly for this evaluation and meaningful anonymous public polling is undertaken, the public and the professionals are in strong agreement about the desired quality of public involvement. We also note that, contrary to the fears expressed by professionals who are often reluctant to undertake open public polling of this type, it is clear that citizens do not desire "citizen control" of TI planning and design. This means that citizens recognize and desire a degree of expert domain on the part of engineers and planners.

However, there is a statistically significant difference between the public's "desired" and "mean" ratings. We call this difference the Arnstein Gap. The Arnstein Gap indicates that citizens desire a planning and design system that is more directly responsive to public needs. Another salient aspect of the Arnstein data is that professionals are neither doing as well as the public would like nor as well as they think they are. The data show that professionals consider their public participation processes more effective than the public does (4.5 vs. 3.5). The significance of the difference in views between professionals and the public was evaluated using an unpaired two-sample t-test assuming unequal variance. This yielded a p-value of 0.023. We call this self-overestimation of performance the "Professionals' Conceit." These findings may not be surprising, but we have noted that quantifying this data helps to persuade professionals and officials of the both the truth and significance of the public involvement quality deficit.

It is clear that improvement is needed. According to Barnes and Langworthy [6, 8-9] "..there has been little attempt to develop [more general] theories within the context of transportation projects, possibly because systematic public involvement is a relatively recent development in this field." Defining a sound theoretical framework that can be used to develop higher quality public involvement, i.e. to close the Arnstein Gap, is a pressing necessity. We proceed by examining briefly the political context of public involvement and we define an appropriate framework for public involvement based on Rawls' notion of justice.

3 A POLITICAL CONTEXT FOR PUBLIC INVOLVEMENT

Public involvement in TI is carried out within existing political and regulatory structures, such as the National Environmental Policy Act or NEPA [7]. The extent of direct specification of public involvement is highly variable, but a plethora of environmental, planning, and other public good regulations can also affect public involvement in TI e.g. Environmental Justice regulations [8]. These differ considerably between countries and in many cases they differ between sub-national and local political divisions. Adding further complexity is the reality that, although the regulatory framework is relatively fixed, regulations can be interpreted and obeyed in a range of ways by individual design coalitions and partnerships.

Moreover, these political and regulatory frameworks exist within civil societies that see public expenditures as responsive to the needs and wants of the population at large. The political frameworks are not immutable, but in most democracies they are designed to reflect, in different ways and through various mechanisms,

voter preferences. Locally-specific cultural preferences are therefore connected to public expenditure through a complex, tiered political system that possesses considerable hysteresis.

At first blush, then, it seems unlikely, or even fruitless, to search for uniformly effective cross-cultural principles for public involvement. This is not our intent with this analysis. Instead, we propose and evaluate a theoretical solution to the problems associated with classic, or unstructured, public involvement in TI planning and design in the U.S. case.

4 SOME PROBLEMS WITH PUBLIC INVOLVEMENT

Advocating better public involvement in planning and design questions can easily become an empty recitation: easy to favor, difficult to deliver and impossible to measure.

The problems are manifold [9]. Even in cases where public input is solicited, participants often regard the efforts as box-checking proformas that have no influence on design properties i.e. public involvement is performed at a low level on the Arnstein Ladder. This leads to poor attendance at public meetings and a sense of resignation among communities. Often simultaneously, fearful of protracted or supposedly problematic engagements with local stakeholders, professionals and other officials find ways to limit and control the extent of public involvement. Officials claim that "people don't come anyway" to the public meetings, which makes it hard for them, in good faith, to justify increasing the scope of public involvement and incurring additional expense if existing channels are not being used. The awkward dynamic of low expectations and suspicion on the part of the public reinforces the professionals' reluctance to engage proactively with citizens, and a persistent positive feedback loop is established [10].

Many of the public involvement problems with planning and design processes and outcomes can be characterized as injustices of one sort or another.

5 DIMENSIONS OF JUSTICE

In "A Theory of Justice" philosopher John Rawls proposed three foundational dimensions of justice: Distributional Justice (who gets how much); Procedural Justice (how do we decide who gets how much) and Access to Justice (who should be included in the deliberations) [11, p.74-77]. His work has spawned much subsequent analysis, including reformulations of the principles e.g. [12,13].

Frequently, however, only distributional justice is highlighted, with questions of access and procedural justice left unaddressed or somewhat murky [14,15]. Researchers have focused their attention on the deployment of various concepts of scale in struggles over equity and justice, especially in the context of environmental justice [16,17]. They have worked on ways to more finely measure the spatial and social extent of distributive impacts [18,19], combined with alternative methods of analyzing the impacts, such as cost-benefit processes [20].

Distributional justice analyses allow a more straightforward technical and quantitative analysis involving reproducible processes and thus results for researchers. Conversely, "measuring" the justice or fairness of a decision process is much more problematic [21,22]. In some cases, the issues and definitions of procedural justice are forefronted [23]. Even this work, however, typically focuses more on defining principles than on measuring outcomes.

Some experimental research into this specific question suggests that individuals' judgments about equity and fairness are associated with procedural issues than with distributional outcomes, calling into question the wisdom of continued emphasis on distributional analyses [24]. Consequently, we believe it is important for the planning and design professional to consider all three facets of Rawls' justice argument in analyzing various strategies for public involvement.

5.1 Access to Justice

Large public meetings ironically pose serious access questions for the majority who attend. An open microphone arrangement allows accomplished public speakers to dominate the meeting, effectively excluding others. Conversely, a series of smaller meetings consumes so much of participants' free time that they exclude many with jobs and/or children. Sometimes an advisory panel is appointed, limiting participation by fiat. To meet basic access requirements, public meeting input processes need to be scrupulously democratic, straightforward, easily understandable, and time-efficient. However, access to the

decision process involves more than just the ability to participate in public meetings. The very formulation of the "problem" can limit who is eligible to participate. Professionals often make determinations about the initial nature and scale of a problem that leaves the definition of solutions and participants constrained.

5.2 Distributional Justice

Distributional justice is often the implied rationale for many transportation projects. For example, roadways are widened to relieve traffic congestion, the most congested first [25]. That is, those undergoing the most traffic congestion are claimed to be unfairly impacted. Similar arguments can be invoked regarding high crash rates, high noise levels, high air pollution levels, etc. Environmental justice literature is replete with examples of maldistributions of impacts. Furthermore, the studies conducted by professionals that "justify" the need for a project may be very far off the mark as well, and not always by accident [26].

5.3 Procedural Justice

Finally, leaving aside the prior problems, the method of arriving at solutions is also frequently severely circumscribed. A relatively few alternatives are offered by professionals, often arrayed so that their preferred solution appears to be the best technical solution. The general public may suspect that the range of possible solutions is being limited, but cannot confirm it. As a result the tenor of the professional/public engagement conforms to a hostile and adversarial "DAD" protocol, that is: "Decide, Announce, Defend" [27, 3]. Constructing the solution process as a process of adversarial bargaining over constrained alternatives instead of joint problem solving fosters mistrust and lower satisfaction with the outcome [24]. In the end, the entire problem-solution continuum can become formulaic, maximizing the consolidation of decision-making power and minimizing the possibility of justice [28].

Typical public planning processes include justice problems of all three types: for example, access is discouraged either formally by the use of advisory panels or informally by dysfunctional meeting strategies; distributional justice is compromised by professionals' control of the measurement and thus definition of the problem, and procedural justice is limited by restricting public choices to narrow ranges of options.

However, the Arnstein Ladder data suggest that it is not necessary for this situation to arise. Citizens share similar expectations with professionals and elected officials about the level of their involvement. Especially where local cultural landscape aesthetics are concerned, there is no technical "best" solution, and the professional or the elected official is no more qualified than any other individual participant. And even where the nature of the problem is highly technical, it is seldom exclusively so.

6 FRAMEWORK FOR PUBLIC INVOLVEMENT

To design a just public involvement process, then, it is necessary to translate abstract dimensions of justice into principles for process design. The Arnstein data above indicate that a certain level of technical expertise and control is both useful and desirable. Civil engineers, planners, architects and other qualified professionals must establish design parameters around which a problem can be solved, for example they must define minimum levels of safety and service. The legally and financially feasible option range, or public design envelope, must be shown and explained to the public so that they can participate meaningfully. Finally, within the agreed decision domain, public input must be acquired in a form or language that the designers can understand and apply. Equally, within this domain, professionals must refrain from enforcing unnecessarily their personal visual, cultural and locational preferences on participants.

Subject to ethical considerations, such as those proposed by Voogd and Woltjer [29], public involvement should recognize the following principles:

1. Solicit participation from as many representative stakeholder groups and public as practical.
2. Facilitate participation of disadvantaged groups through distributed outreach and reproducible, portable process.
3. Establish the design envelope. This requires an explanation of the legal and financial bounds to the problem (i.e., the domain beyond over which the participants do not exercise direct control).
4. Establish an agreed-upon decision-making process among all participants.

5. Identify and include all criteria of significance to all parties.
6. Provide transparency in method and data collection.
7. Respect participants' time and input.

7 TECHNOLOGIC DIALOGIES/DIALOGIC TECHNOLOGIES

The advantages of visualization as a means of presenting design and larger-scale planning options have been documented in transit design options [30] and in transportation more broadly [31,32]. These advantages include easier comprehension and higher information density and accessibility compared with written specifications and codes [33]. As GIS and visualization technologies converge, in such forms as ArcGIS with 3D extensions, scenario planning tools including CommunityViz, and alternatives analysis softwares such as WhatIf? are increasingly widely used in urban and TI planning and design [34]. Visualization has become an article of faith among planners and officials.

But their use does not by itself improve the quality of public involvement nor the designs and plans. Over thirty years ago, the Transportation Research Board (TRB) published a group of papers exploring the potential for computer visualization to improve the quality of public involvement in transportation planning. In that issue, Arnstein and Winder [35, p.44-48] presciently discussed a series of problems with citizen participation that were likely not substantially improved by visualization tools. These problems included, among others: 1) Which citizens participate; 2) Accountability of transportation officials; 3) Equity of benefits and disbenefits; and 4) Citizen distrust.

Reflexivity is defined as a capacity to negotiate between stakeholder and expert opinions in a participatory decision system. On the one hand, a non-reflexive process is one in which the technologies are used, perhaps unwittingly, or perhaps intentionally, to cipher expert opinion. In these cases GISci technologies become a channel for what Arnstein calls "manipulation" or coercion and lead to what Sheppard [36] finds as suspicion of processes apparently overendowed with such technologies. To the degree that experts are using the technologies to "sell," "convince" or otherwise influence public opinion in a nontransparent way, their use is not reflexive. On the other hand, for example, a participatory visualization process could invite participants to deliver feedback on designs that can be converted into design guidance in architectural terms, for example, density, massing or typology [37]. Reflexive use of geovisual and geospatial technologies is critical in moving stakeholders up the Arnstein Ladder towards "partnership."

8 STRUCTURED PUBLIC INVOLVEMENT

We use the term Structured Public Involvement or SPI [38] to describe a protocol combining dialogic tools, a range of visualization technologies into a participatory decision support system to support, encourage, and make best use of, citizen participation. The aim of SPI is to increase public satisfaction with infrastructure design process and product. SPI assumes that engineers, planners and designers are the technical experts but that citizens best know their own cultural, spatial, and social preferences, and those should be incorporated effectively into the design process.

SPI is a reflexive, iterative and distributed protocol integrating large group input into complex built environment questions. It is a set of linked dialogic processes featuring strongly reflexive use of visualization, spatial analytic and decision-support tools that allow the professional to understand more clearly public planning and/or design preferences. SPI is not a single process applied to all design problem types; rather, it is the set of guidelines for selecting specific dialogic processes and decision support tools for a given problem. It relies on active participation by professionals to help select the specific processes, tools, and techniques to best respond to the question at hand [2].

An example of SPI at work is the recently completed, year-long public involvement stage of the Ohio River Bridges design, in and near Louisville, Kentucky [39]. Working collaboratively with the engineering and design firms, the authors designed and executed a year-long iterative process of gathering and modeling citizen's aesthetic preferences for bridge designs in a complex urban environment. The authors deployed SPI using Casewise Visual Evaluation (CAVE), performing a fuzzy set-based analysis of the aesthetic preference data gathered in public meetings, to help the design team move from a possible range of over 200 designs, to 30 designs, to 12, to 6, and then to 3 finalists [x]. At each stage, the newer designs were improved with the input from the prior round of public meetings. The input process helped designers

understand which specific combinations of design properties contributed to either higher, or lower, aesthetic preference. This information was integrated with other considerations of cost, maintenance, and constructability to arrive at the current three finalists. The public's satisfaction with the overall process was also solicited: consistent with prior work by the authors, the mean public satisfaction rating of the bridge design process was 8 on a scale of 1 to 10.

9 RESULTS OF SPI PROTOCOLS

One of the most fundamental tenets of democracy is accountability. In the case of TI investment, almost no effort is made to determine the extent to which the public are satisfied. Existing claims regarding the performance of public involvement rest on normative assumptions. Where it exists, evaluation is often performed by expert evaluation groups comprised of peers of design and engineering teams or even members of the design team. There are many reasons why this is not compatible with the principles or the practice of participatory democracy. Moreover, this type of evaluation masks the problems with public involvement and is one of the reasons for the existence of the Arnstein Gap.

Over the last ten years we have worked on a wide range of transportation infrastructure (TI) projects in collaboration with design, planning and engineering partners. These projects range from multi-billion dollar interstate bridge design involving thousands of stakeholders [39] to integrated transportation/land use modeling for local municipalities involving a few dozen participants [40]. During these projects, public satisfaction with SPI processes has been gauged by holding an anonymous real-time poll at the same open public meetings where design feedback was gathered. Participants are asked to evaluate their satisfaction on an integer scale of 1 through 10, where 1 is lowest and 10 is highest. This database contains over 500 respondents. Figure 2 shows these results:

These results are indicative. However, they represent the only direct attempt in the literature to gauge stakeholder satisfaction with the public involvement process under live conditions. These findings are important because high public approval ratings of public infrastructure design processes are strong evidence of a fair and equitable process. They also demonstrate the significance of procedural justice in that: "In exchange for participation in a fair and open process, citizens often are willing to support the outcome of the process even if their preferred alternative is not selected." [41, p.2]

10 CONCLUSION

Creating an environment where citizens are, and perceive they are, treated justly in the context of large complex planning and design problems is a very challenging task. It demands a methodical examination of the principles that should be met, and a careful, even meticulous, approach to the specific processes that will negotiate an array of conflicting objectives. We hope this article has helped explicate those goals more clearly and has demonstrated one approach to realizing them. In the same vein, we urge professionals to move past classic myths of public involvement that perpetuate the Arnstein Gap. These myths include claims that the "uninformed" public do not possess adequate understanding of the issues to evaluate them (claims that are sometimes used by professionals to legitimate the public's exclusion [42, p.1465]; the "excessive time" required for meaningful engagement; the argument that "the public won't come anyway, no matter what we do"; the resignation of "we can't give them what they want so why bother"; the notion that failure to achieve consensus is equivalent to process failure; and a number of others [43]

Our work challenges these assumptions. It demonstrates how, in US TI, public involvement can achieve high satisfaction and a strong sense of inclusion with limited engagement time. This success is driven by a clear theoretical structure around which public involvement is organized. SPI features the reflexive use of geovisual and geospatial decision support systems. The public can only be encouraged to participate meaningfully, and to treat professionals with less suspicion, if they see that their values are being taken into account by designers. Longer-term engagement with SPI results in snowball effect, with more people coming to each meeting. Written and verbal comments attest to the public's confidence in the process [44]. In these ways, SPI builds what Docherty et. al [45, p.2225] call "civic capacity."

It is too facile to claim that what works in one place will work in another. It is equally facile to claim, without stakeholder data, that a protocol that shows high performance in one cultural environment will

necessarily perform poorly in another. The success, or otherwise, of public involvement using geovisual and geospatial technologies is strongly dependent on the ways in which the associated group processes conform to prevailing normative democratic ideologies among stakeholders. This success, or otherwise, shows rather less association with what is often viewed as the "outcome" of a design or planning process, i.e. the specific characteristics of the design or plan, than is popularly supposed.

In light of these considerations, we ask that professionals and practitioners in different cultures open a dialog about the kinds of democratic institutions and the theoretical frameworks of justice that could increase public satisfaction with planning and design processes [46]. We seek data, investigation and analysis that connect geovisual/geospatial methods with participatory, or communicative, planning in democratic societies. We seek protocols that assess their performance using open stakeholder evaluations. As a first step, we move for an analysis of the Arnstein Gap in different contexts and an evaluation of appropriate theories of justice, democracy and participation and associated methods for handling Arnstein Gaps, if they exist elsewhere.

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